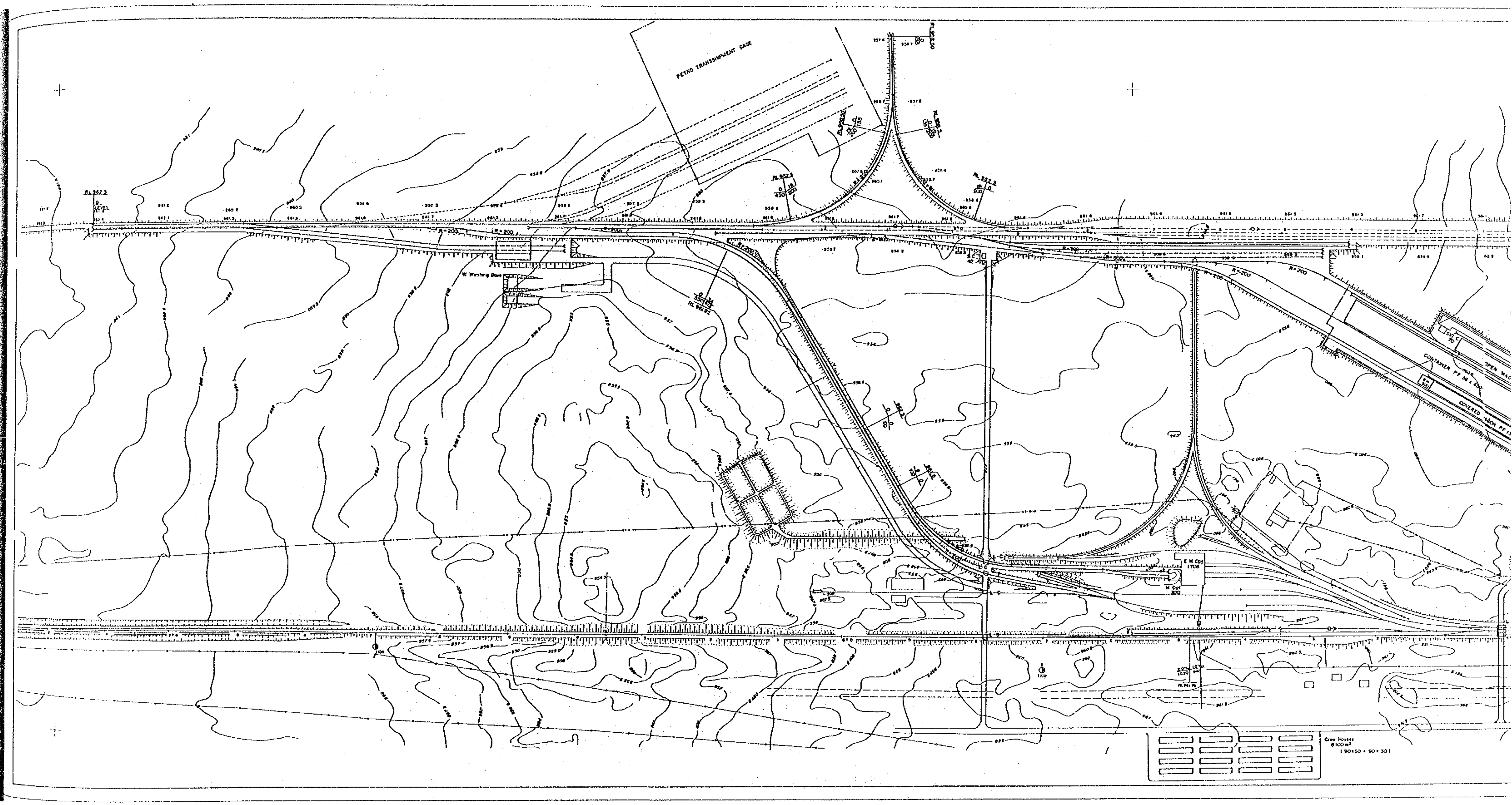


PETRO TRANSSHIPMENT BASE
W Washing Base
CONTAINER PF 38 x 450
E M Dpt
1700
M Dpt
300
Crew Houses
8100m²
(90x60 + 90 x 30)

2000 Year Plan
Track to be adjusted, 1520 to 1435mm (Urgent
Existing Facility
Petro Track Line to be done by others

S.C : Signal Cabin (42m²)
M.Dept: Locomotive Maintenance Depot (300m² or 1708m²)
M.O : Main Administration Office (150m²×2F)
S.H : Storage House (300m²)
P.F : Platform

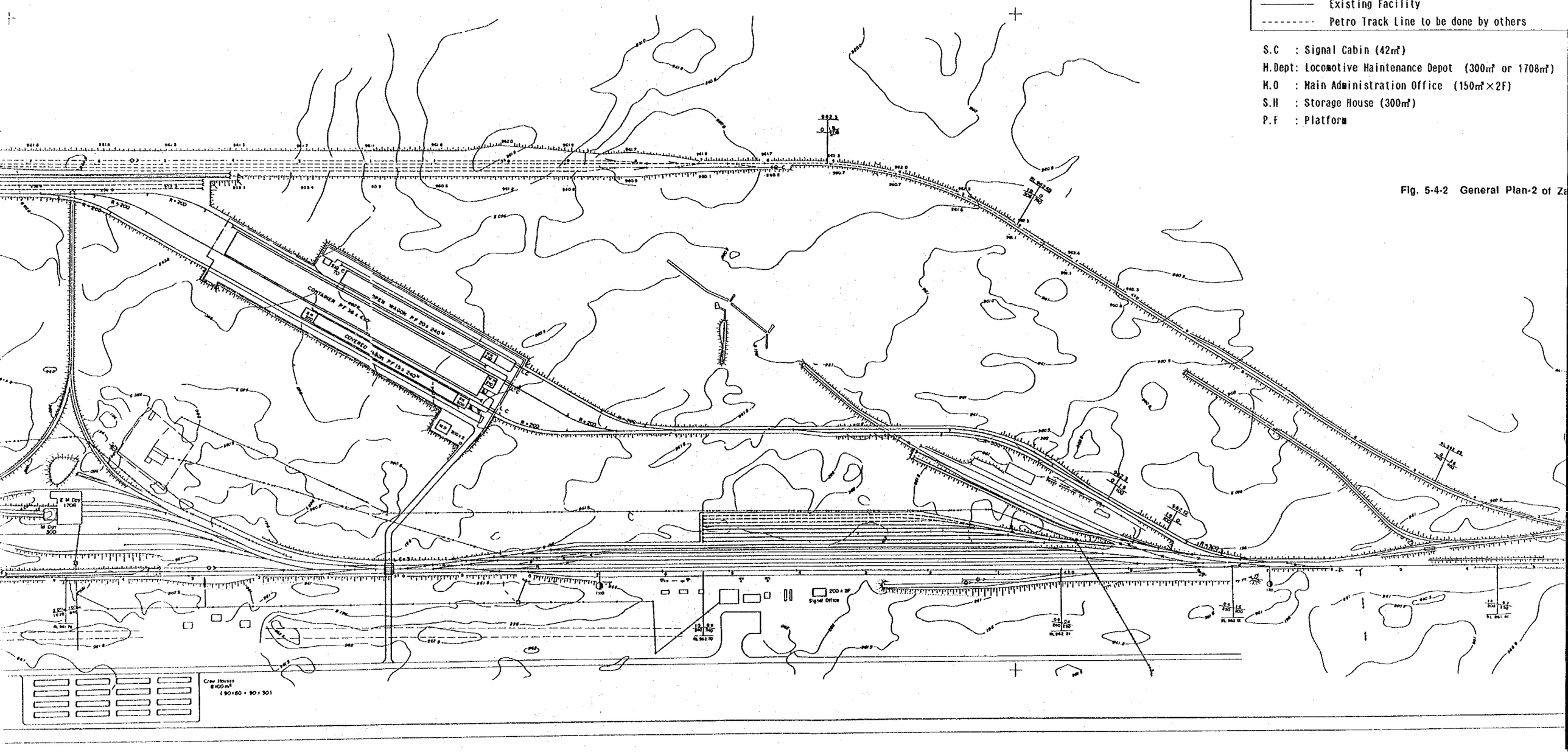
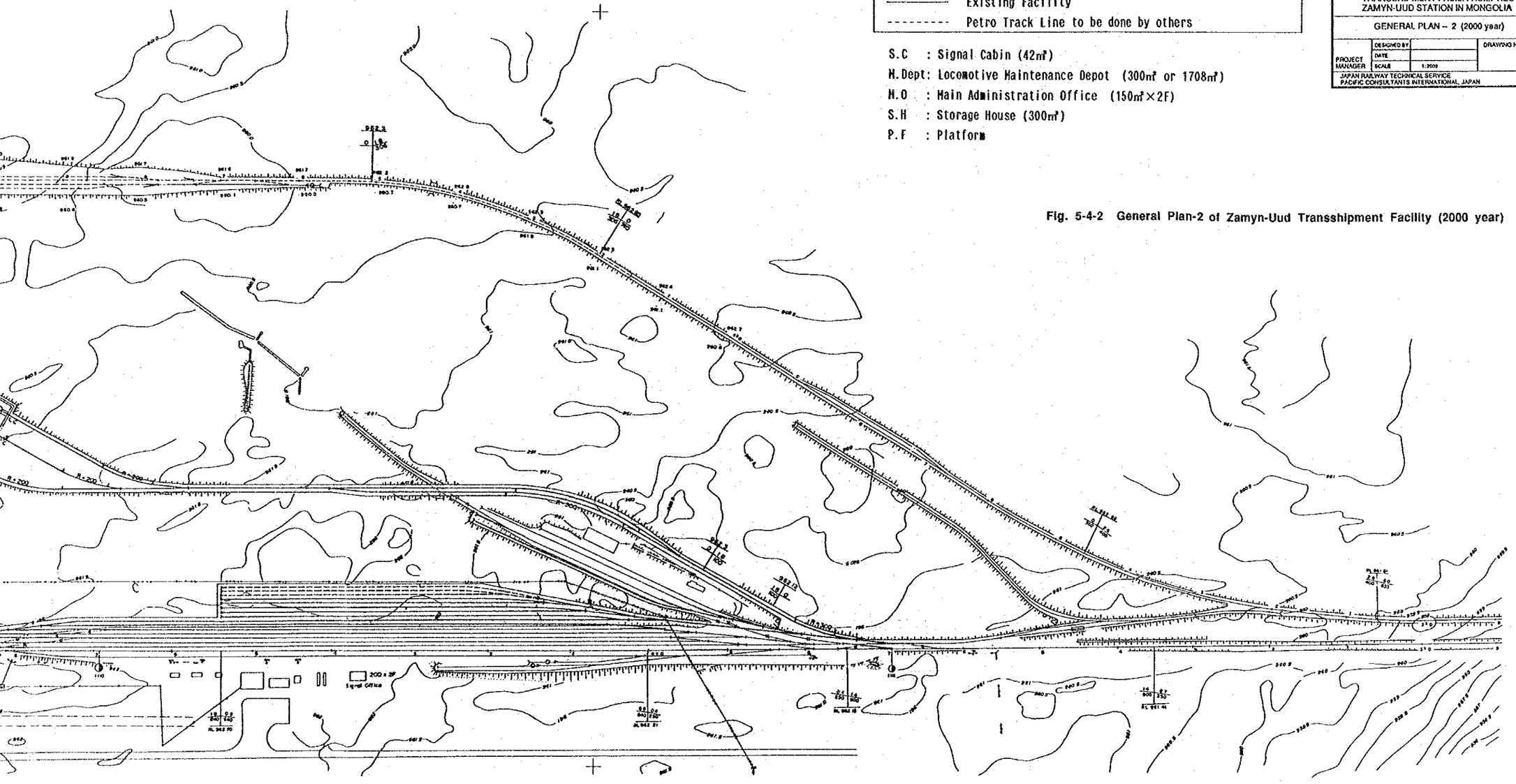


Fig. 5-4-2 General Plan-2 of Za



2000 Year Plan
Track to be adjusted, 1520 to 1435㎜ (Urgent Project)
Existing Facility
Petro Track Line to be done by others

S.C : Signal Cabin (42㎡)
H.Dept: Locomotive Maintenance Depot (300㎡ or 1708㎡)
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S.H : Storage House (300㎡)
P.F : Platform

MINISTRY OF TRADE AND INDUSTRY
AND
MONGOLIAN RAILWAY, MONGOLIA

THE IMPROVEMENT PLAN FOR TRANSSHIPMENT FACILI FACILI TIES AT ZAMYN-UUD STATION IN MONGOLIA

GENERAL PLAN -- 2 (2000 year)

PROJECT MANAGER	DESIGNED BY	DRAWING NO.
	DATE	
	SCALE 1:2000	

JAPAN RAILWAY TECHNICAL SERVICE
PACIFIC CONSULTANTS INTERNATIONAL JAPAN

Fig. 5-4-2 General Plan-2 of Zamyn-Uud Transshipment Facility (2000 year)

Chapter 6

CHAPTER 6 PRELIMINARY DESIGN

6-1 Track, Civil Structure, and Building

6-1-1 Design Principles

For the Preliminary Design, rational planning shall be carried out on the basis of matters confirmed with local government organs at the time of the surveys, of the design of former Soviet facilities, and of the actual performance of road construction work currently in progress in the area. This shall be an append to the chapter on Preliminary Design Drawings.

6-1-2 Design Outline

(1) Track Layout Design

As a basic principle of layout design, effective use shall be made as far as possible of readily installable facilities. In addition, the layout shall be such that operations for train departure/arrival, engine run-round, and shunting shall not effect, conflict with, or cause inconvenience to the others.

1) Departure and arrival tracks

a) Track for departure and arrival of Chinese freight trains (1,435mm gauge)

Departure and arrival operations

Chinese freight trains will arrive at the arrival track hauled by Chinese locomotives. On arrival, only the locomotive will run-round. To avoid conflict between this locomotive and other yard shunting work, it will draw onto the petro base passage track, and after passing the departure and arrival tracks will wait on the Engine Waiting Track until it is due to depart for China.

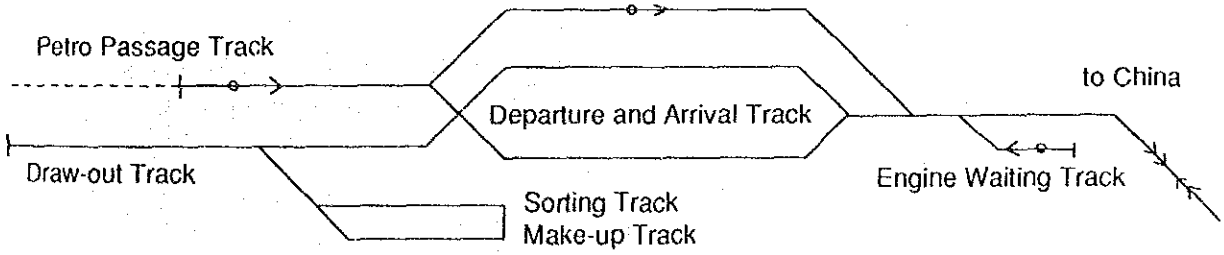


Fig. 6-1-1 Departure and Arrival Tracks (1,435mm)

When the train of empties to be returned to China has been made up on a Departure track, the Chinese locomotive that has been waiting on the Engine Waiting Track will set back and be couple up. The train will then return to China via the China Department track.

Layout of the departure and arrival tracks

The existing departure and arrival tracks (4 tracks) will be retained. The Draw-out Track and the Petro Base Link Track will be separated. The effective lengths of departure and arrival tracks for these cases will be as follows.

The departure and arrival tracks shall be numbered 1, 2, and 3 from the north.

Table 6-1-1 Effective Length of Dept/Arr Tracks (1,435mm)

	Existing (m)	Planned (m)
Main Track	840	840
No. 1 Track	840	840
No. 2 Track	830	830
No. 3 Track	700	770
East engine waiting track	–	50

b) Departure and arrival tracks for Mongolian freight trains

Departure and arrival operations

Mongolian loaded cars with export cargoes will arrive from locations within Mongolia at the Zamyn-Uud border town station. Here the trains will undergo train load adjustment from 2,600tons to 2,000tons. Trains depart for China pulled by Mongolian locomotives. Mongolian freight wagons which have been emptied at the Chinese transshipment stations will arrive hauled by Mongolian locomotives.

Empty Mongolian wagons from China as well as empty cars and tank cars returned from locations within Mongolia will be remarshalled, and these wagons which have been selected for transshipment will be shunted to the transshipment facility to which this plan relates. After loading, they will be made up into trains together with the remaining empty cars, and will depart for Mongolian destinations.

In other words, the main operations of the departure and arrival tracks will be engine run-round for Chinese trains to and from China, adjusting the train load of Mongolian trains bound for China, remarshalling Mongolian empty wagons from China, and from Mongolia, and making up trains departing for Mongolia.

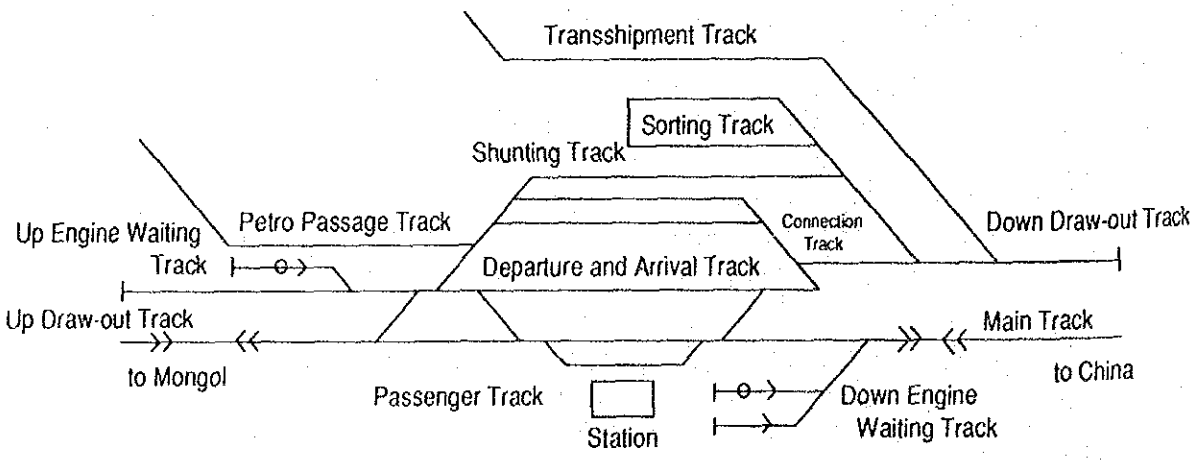


Fig. 6-1-2 Departure and Arrival Track (1,520mm)

Layout of departure and arrival tracks

Since most of the existing departure and arrival tracks have an effective length of 850m or less, the effective length will be extended by altering the track layout. The extension will take the form of improvements to the western part of the existing departure and arrival tracks. Since the Down Draw-out Track is extremely busy, an Up Draw-out Track will be laid out for auxiliary support. To this end, a Shunting Track (Make-up and Break-down) will be laid such that make-up and break-down of freight cars for up-trains can be carried out on the Up Draw-out Track. Train load adjustments to down trains and shunting of tank wagons (petroleum tank wagons) will as far as possible be carried out on the Up Draw-out Track. The Make-up and Break-down Track mentioned above can also be used effectively for tank wagons going in and out of the petroleum base.

Engine run-round for locomotives hauling trains arriving from China will in principle take place on departure and arrival track No. 1, and 'conflict' will be avoided between operations on up/down draw-out tracks and make-up/break-down tracks, and on the down draw-out track and sorting/connecting track.

The effective lengths of the departure and arrival tracks are as follows. Departure and arrival tracks are numbered 1, 2, 3, etc. from the south.

Table 6-1-2 Effective Length of Dept/Arr Tracks (1,520mm)

	Existing (m)	Planned (m)
Main Track	761	761
No. 1 Track	891	891
No. 2 Track	868	900
No. 3 Track	769	890
No. 4 Track	767	870
No. 5 Track	714	845
No. 6 Track	714	714
Up engine waiting track	2 × 120	1 × 120
Down engine waiting track	2 × 120	2 × 120
Make-up/break-down track 1	–	650
Make-up/break-down track 2	–	620

2) Draw-out Track/Make-up Tracks/Sorting Tracks

a) Chinese freight trains

A new draw-out track will be laid and will be divided from the engine run-round and petro-base passage tracks. Although 4 sorting tracks and 2 ~ 3 make-up tracks will be needed, the total for both will be set at 5 since the sorting and make-up tracks can partly be used in combination. The effective lengths of each are as below.

Table 6-1-3 Effective Length of Shunting Yard Track (1,435mm)

Draw-out Track	460m
Sorting Track No. 1	440m
Sorting Track No. 2	440m
Sorting Track No. 3	360m
Sorting Track No. 4	360m (Future)
Sorting Track No. 5	360m (Future)

b) Mongolian freight trains

Mongolian freight trains returning from China will be completely remarshalled, those wagons which are suitable for transshipment will be spotted for loading. Fairly lengthy sorting tracks will be needed so that both these loaded wagons and the remaining empty wagons can be sorted according to destination. The number of sorting tracks and their respective effective lengths are as follows.

Table 6-1-4 Effective Length of Shunting Yard Track (1,520mm)

Down Draw-out Track	500m
Up Draw-out Track	450m
Sorting Track No. 1	480m
Sorting Track No. 2	430m
Sorting Track No. 3	430m
Sorting Track No. 4	380m
Sorting Track No. 5	380m
Sorting Track No. 6	330m (Future)
Sorting Track No. 7	330m (Future)
Sorting Track No. 8	330m (Future)

c) Layout of transshipment facility

Chinese freight wagons arriving from China will be brought up alongside platforms sorted according to Covered Wagons, Container Wagons, or Open Wagons (Covered Wagon Platform, Container Wagons Platform, and Open Wagon Platform), and their cargoes will be transshipped to Mongolian freight wagons. If Mongolian freight wagons are already waiting on the platform at the time, transshipment will be performed directly, otherwise the cargo will be temporarily off-loaded onto the platform. For loading and unloading, a Gantry Crane may be used, or else a conveyance vehicle such as a forklift truck. The track layout as well as the platform width will depend on the method adopted. The difference in layout according to whether a crane is used or not will be as follows. Layout plans for both cases have been made (Plan 1, Plan 2) and a comparative study has been made.

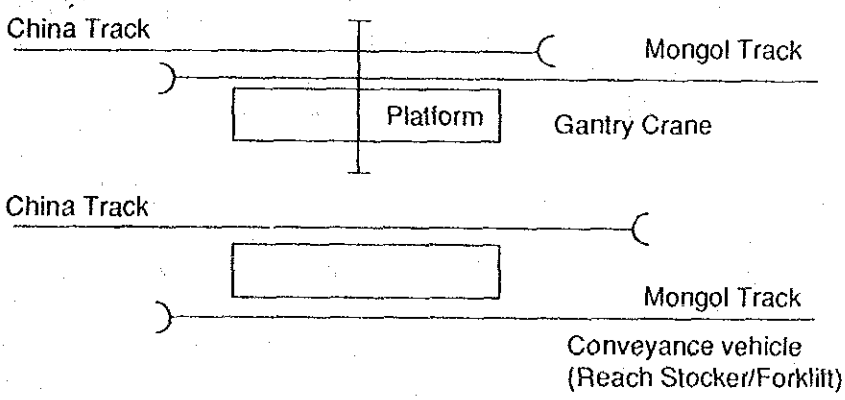


Fig. 6-1-3 Track Layout by Different Transshipment Equipment

d) Other facilities

Wagon repair track

Wagon repairs are carried out when the wagons are empty. Since the present location is the most suitable one there is no need to relocate, so it will be used in its present location with track layout alterations.

Wagon washing track

Freight wagons should also be washed when they are empty.

Chinese freight trains : 12 (Wagons) + 13 (Gondolas) = 25 cars
Mongolian freight trains: 68 (Wagons) + 55 (Gondolas) = 123 cars

Thus, if freight trains are washed once a month, Chinese wagons will be cleaned at a rate of 1 per day, and Mongolian wagons 4 per day. Thus four times wagon length is needed for the effective length of the washing track.

(2) Design of Structures

1) Conditions for banking support ground foundations

The Zamyn-Uud construction site is on an alluvial foundation composed of a light viscous soil layer (0.5 ~ 2m thick) sandwiched between dominant layers of fine sand mixed with gravel. Though no measurement of the N-value has been made, since the void ratio is 0.6 ~ 0.7 (measured value), we estimate that the N-value could be about 10. Therefore, we can assume a support strength of 10t/m^2 in the banking ground foundation after compaction. The foundations of the transshipment facility can be formed adequately with a direct foundation, and there is expected to be no major residual subsidence even if the banking construction is executed quickly.

2) Conditions for design of structures

We have taken the design standards adopted by Japanese Institute of Civil Engineers and the Railway Facilities Bureau/Construction Bureau as a base, but we have also decided on the form, materials, and dimensions for structures so as to conform with local conditions in Mongolia (the strength of wooden materials, the availability and usability of materials) as far as possible, with reference to design diagrams obtained in Mongolia.

3) Design of structures

a) Banking and track structures

The form, dimensions, materials, and other elements for banking and track structures have been adopted as stated in the plan in Chapter 4. For slope protection we have considered turfing.

b) Maintenance road

In view of the small amount of rainfall throughout the year, the small amount of through traffic, and the need to reduce construction costs, we have considered a crusher-run surface with regulated grain size.

c) Platforms

There is no concrete manufacturing or asphalt factory in the Zamyn-Uud region. Indeed, asphalt relies on imports of raw materials from overseas, and even then it cannot be procured in sufficient quantity. But materials for concrete do exist in Mongolia, and there is a manufacturing factory in the vicinity of Ulan Bator. In view of these facts, we have considered using concrete surfacing for platforms. In view of the workability, finished condition, maintenance, and durability we are considering concrete cast on-site.

d) Retaining walls and foundations

In view of the fact that imports are also relied upon for steel reinforced products, we are considering structures in which the volume of steel reinforcement is small (Gravity-type).

e) Crane foundations

Assuming a container foundation of 4 units with a weight of 25 ~ 30 tons each, designs have been based on a foundation support strength of 8 ~ 10t/m^2.

f) Platform roofing

Though platform roofing is planned only for the wagon transshipment platforms, we have considered a steel-reinforced structure with a lateral width which allows half of the freight wagons to be exposed so that work can be done even in rainy conditions. Please refer to the design diagrams.

g) Building

We have decided on structures which use bricks or pre-cast sheets (available locally) as far as possible for wall materials for management offices, staff rooms, accommodation, and other buildings.

(3) Design Diagrams

Outline design diagrams are given below and in the appendix.

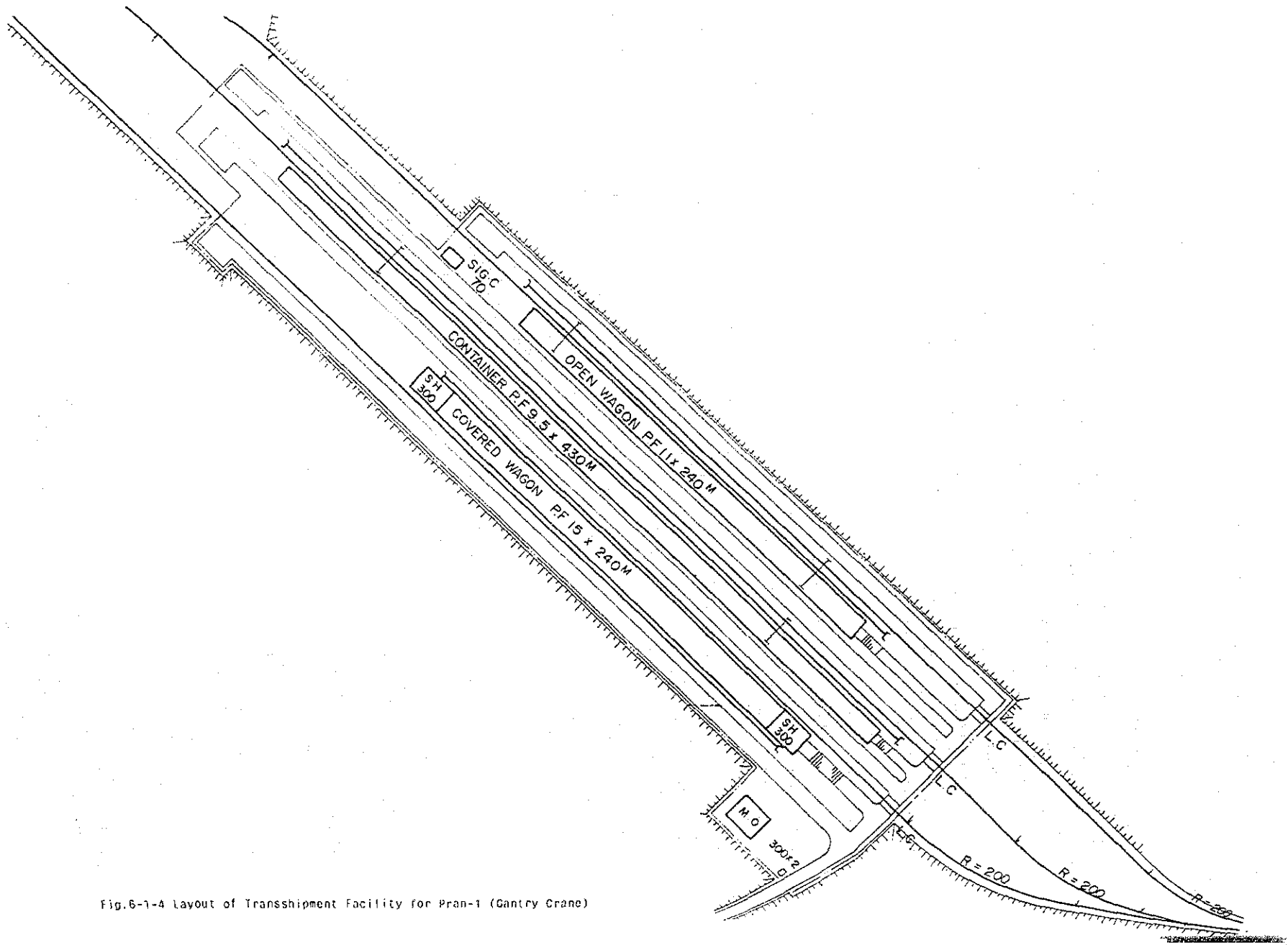


Fig.6-1-4 Layout of Transshipment Facility for Pran-1 (Gantry Crane)

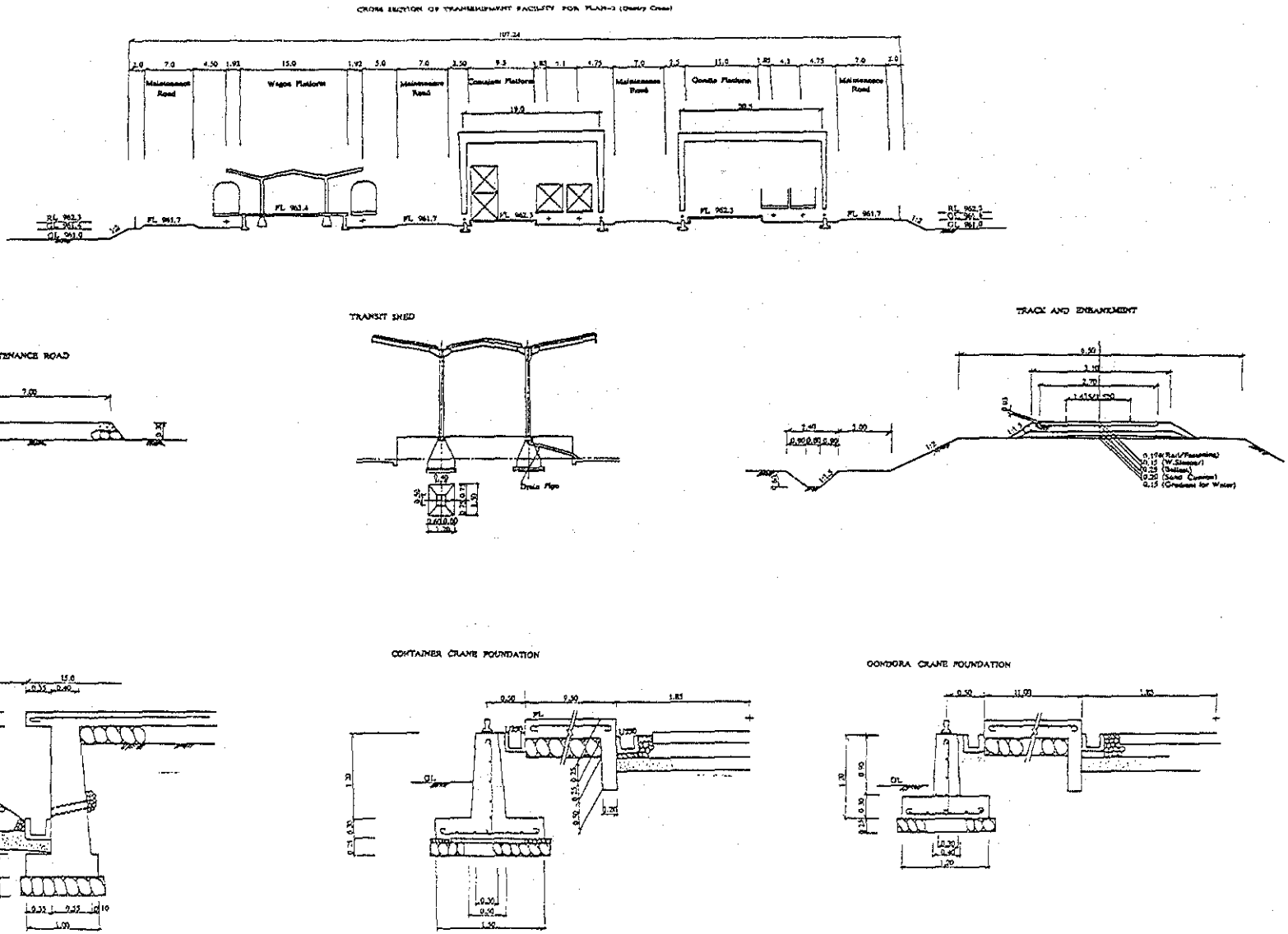


Fig. 6-1-5 Preliminary Design Drawings of Civil Structure for Plan-1 (Gantry Crane)

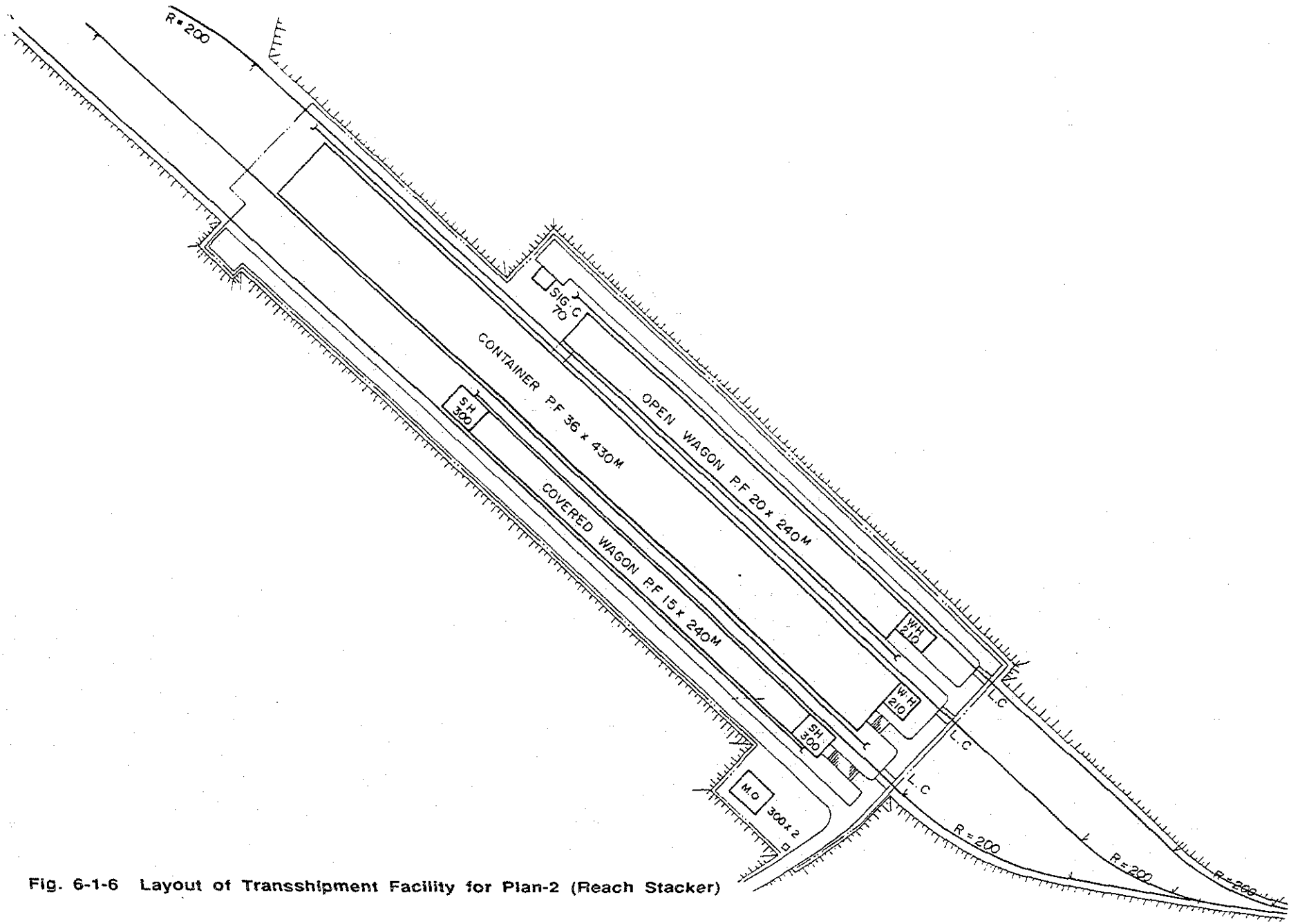
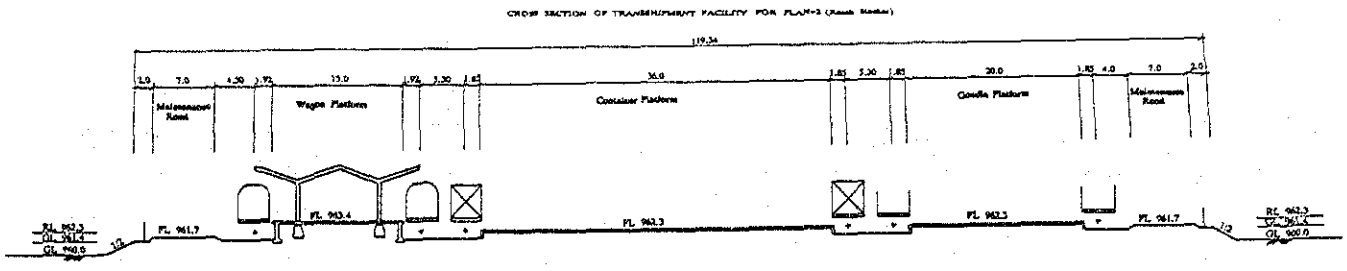
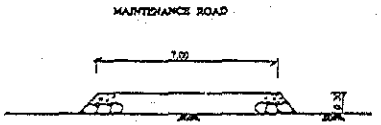
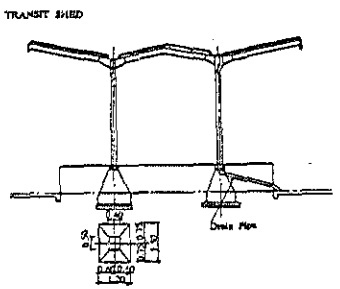
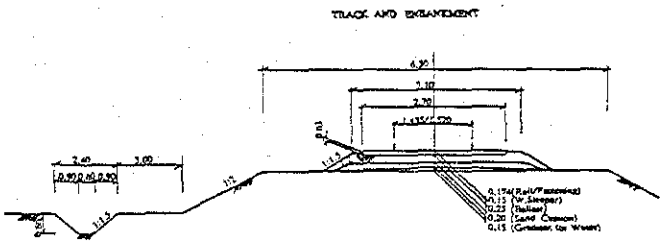


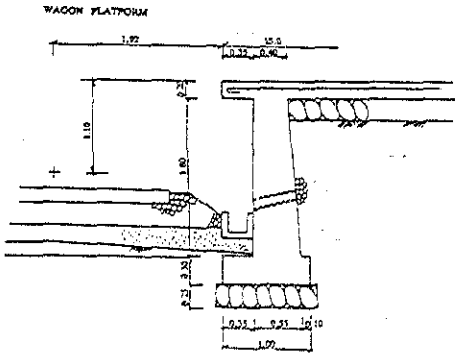
Fig. 6-1-6 Layout of Transshipment Facility for Plan-2 (Reach Stacker)











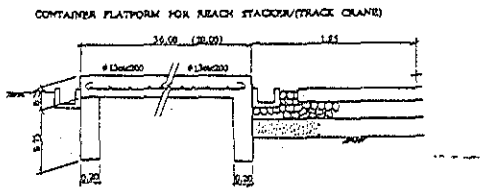


Fig. 6-1-7 Preliminary Design Drawings of Civil Structure for Plan-2 (Reach Stacker)

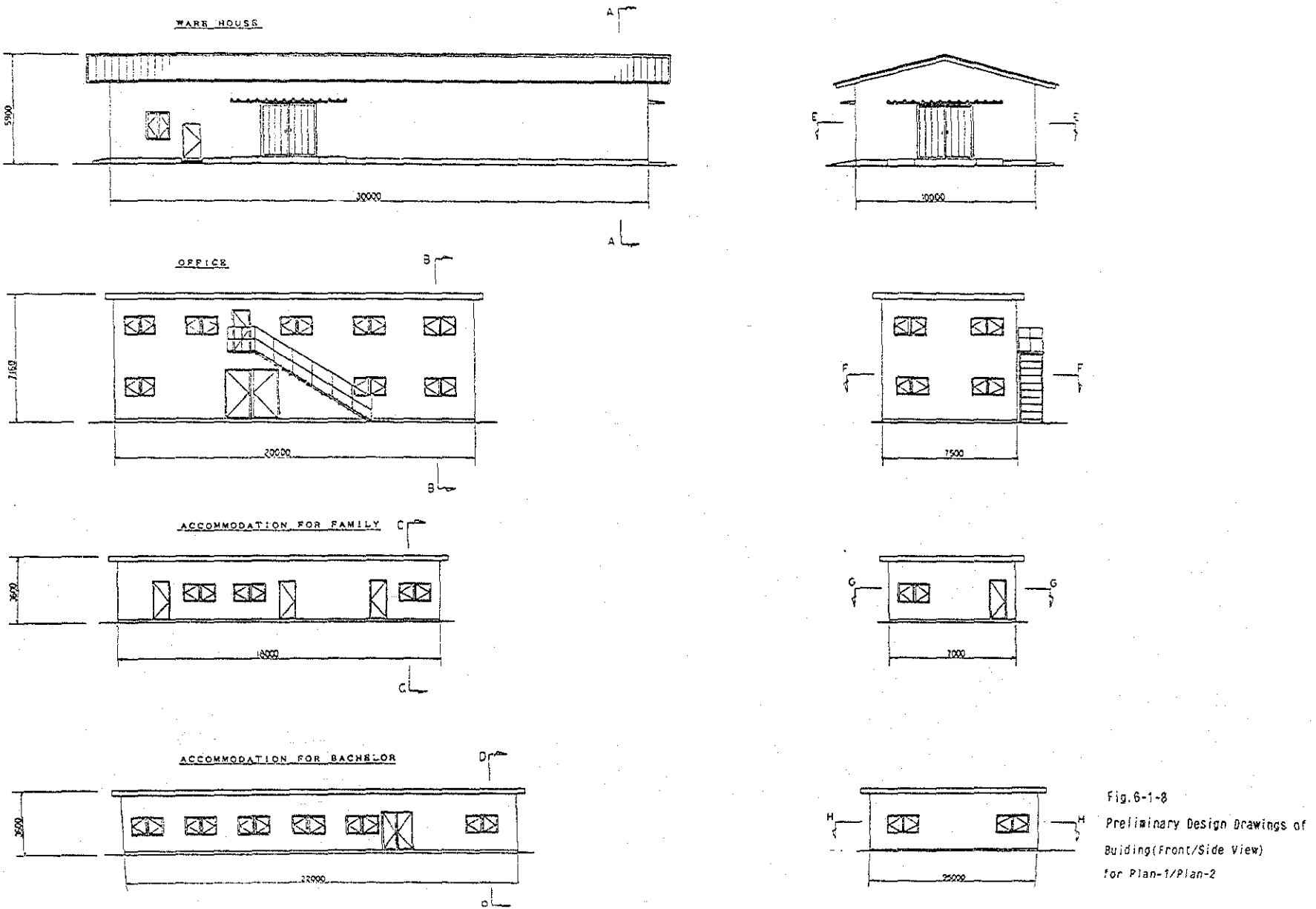
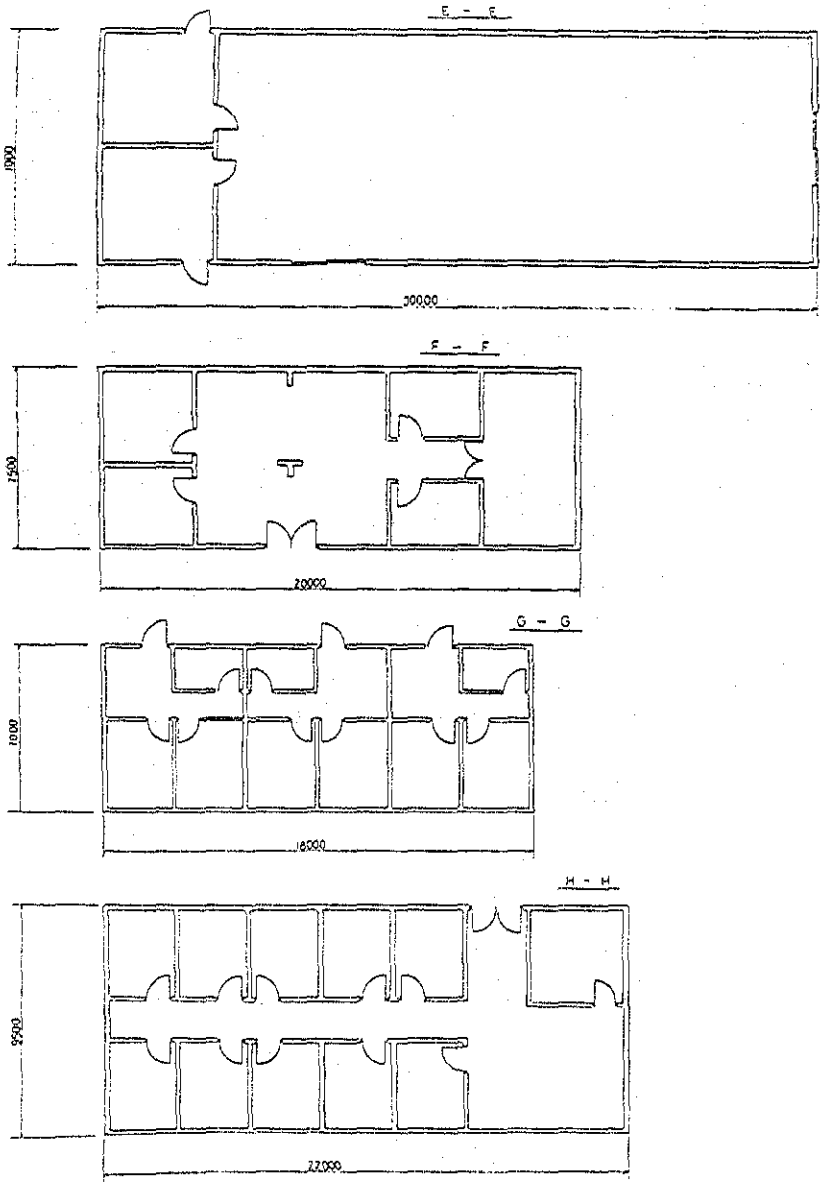


Fig.6-1-8
Preliminary Design Drawings of Buiding(Front/Side View) for Plan-1/Plan-2



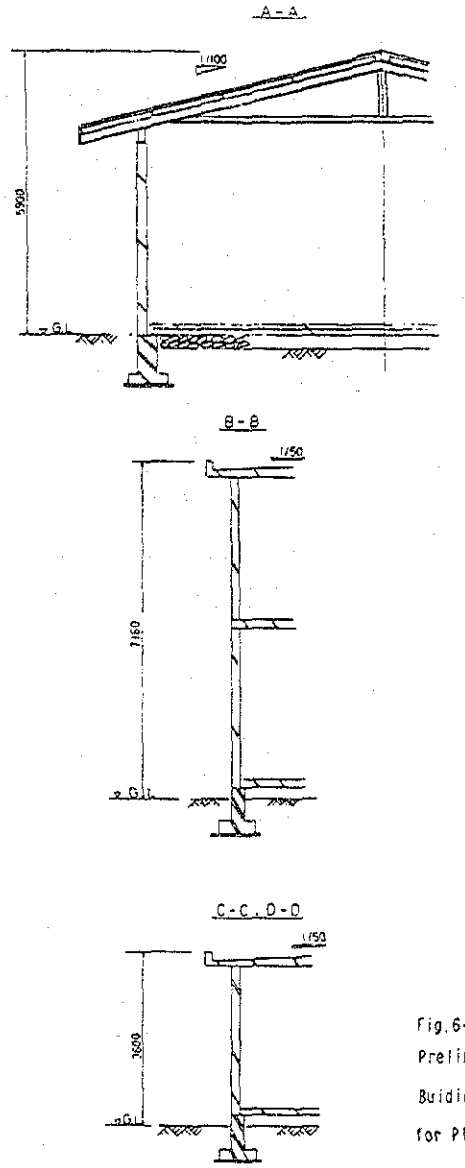
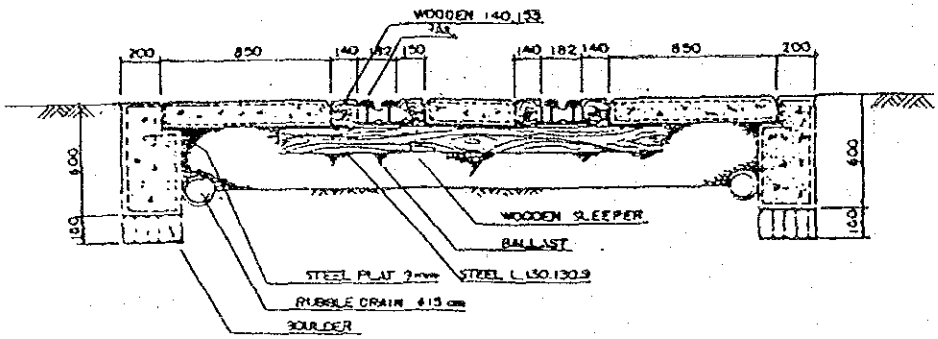


Fig.6-1-9
Preliminary Design Drawings of Building (Layout/Cross Section) for Plan-1/Plan-2

RAILWAY SURFACE ROAD

STANDARD CROSS SECTION



DETAIL OF GUARD RAIL STRUCTURE

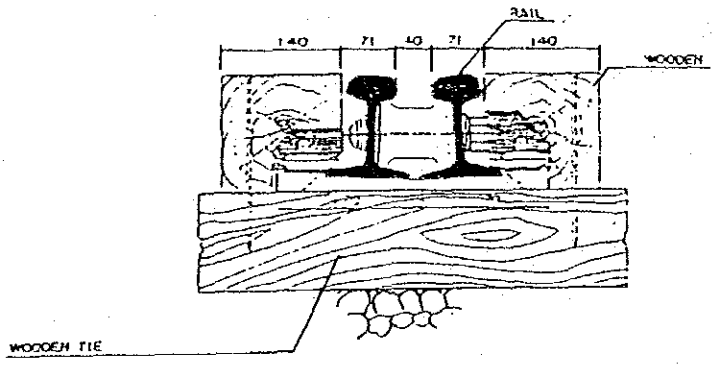


Fig.6-1-10 Level Crossing

ENTRANCE GATE

FRONT ELEVATION

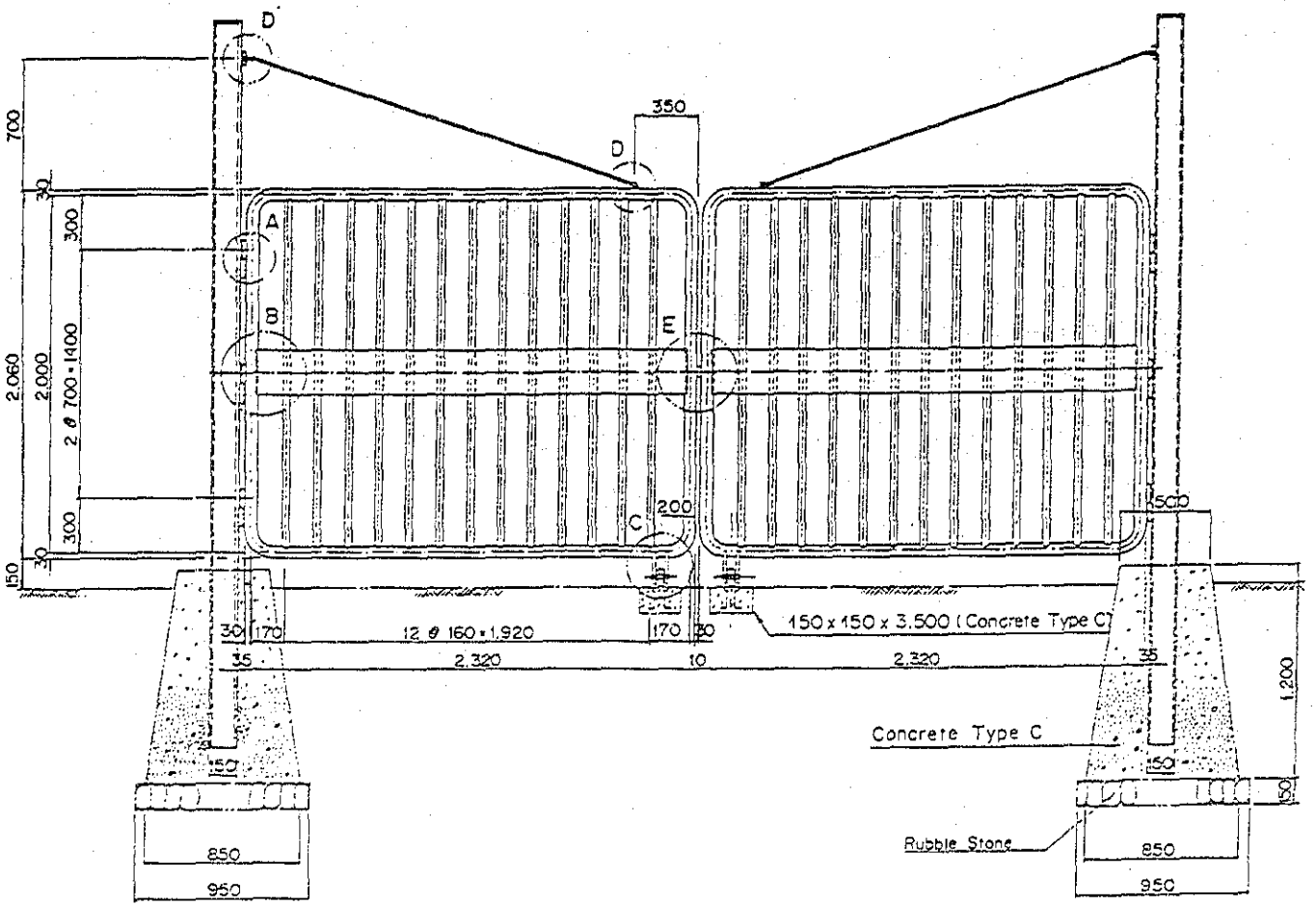


Fig.6-1-11 Entrance Gate

PLUMBING SYSTEM

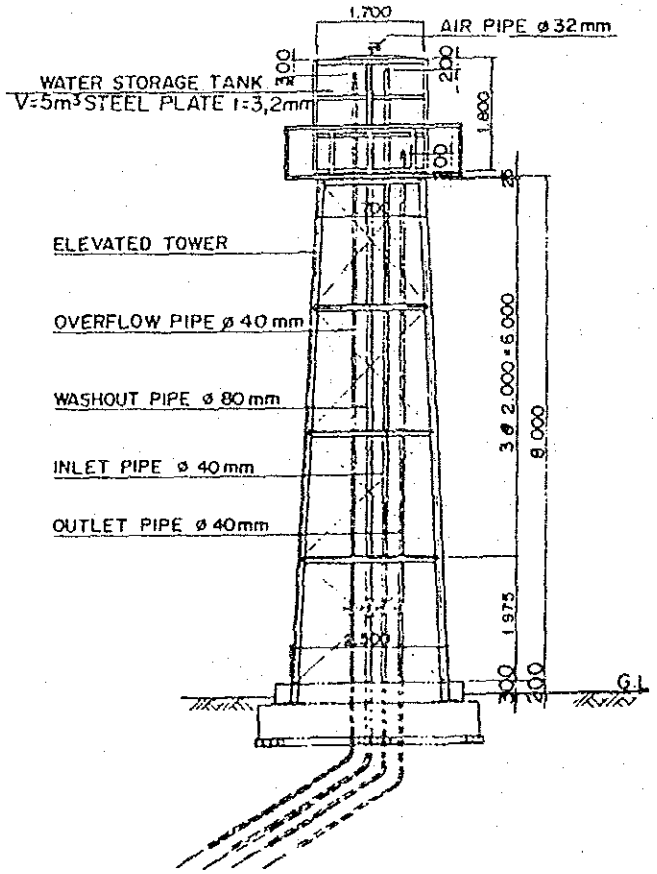


Fig. 6-1-12 Plumbing System

INSPECTION SHED

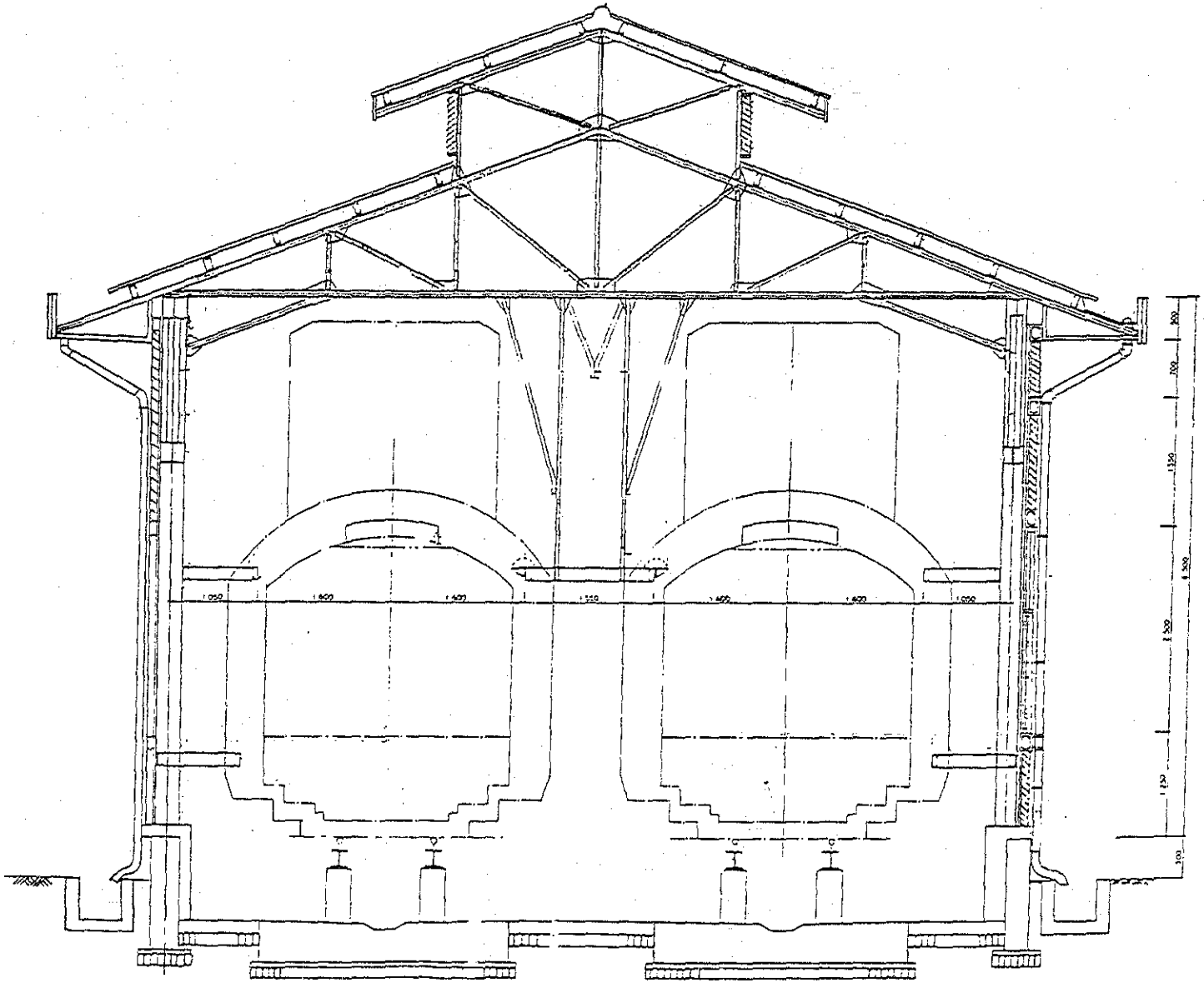
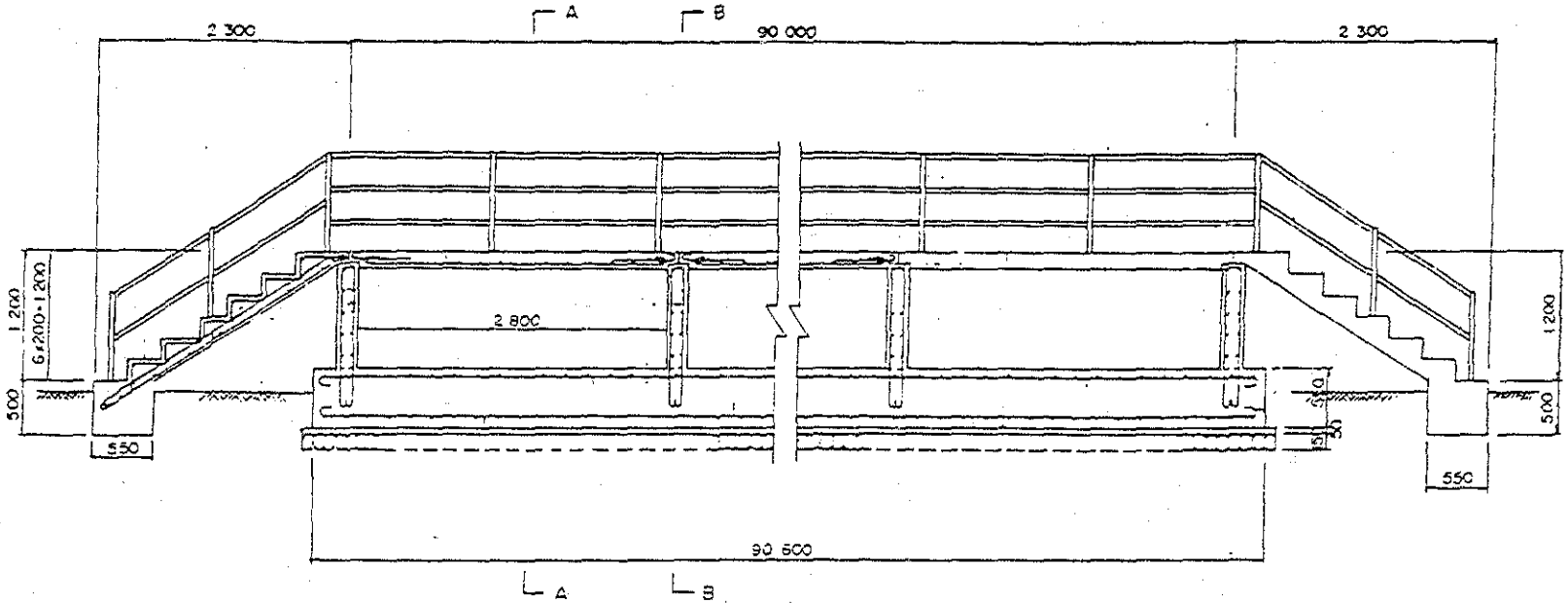


Fig.6-1-13 Inspection Shed

CAR WASHING STAND

SECTION C-C



SECTION A-A

SECTION B-B

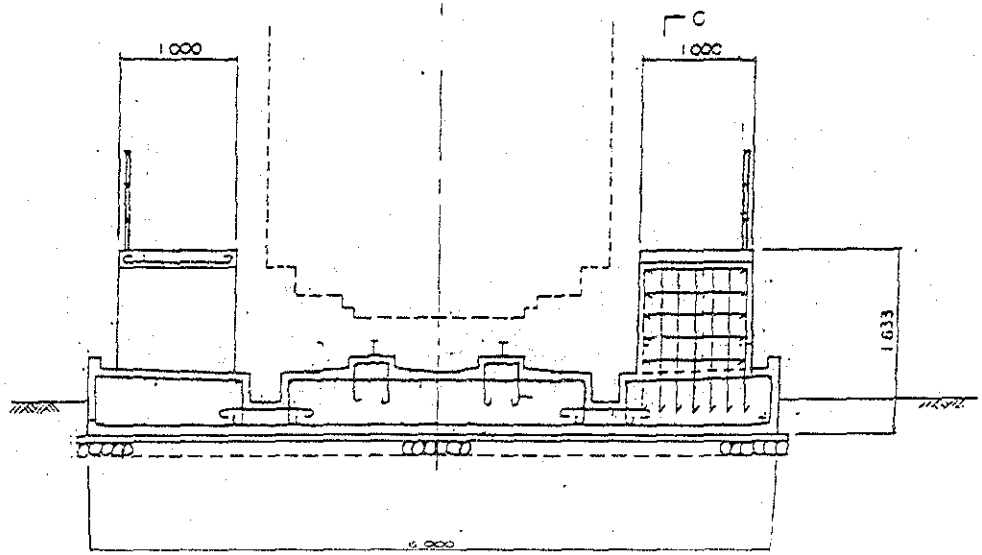
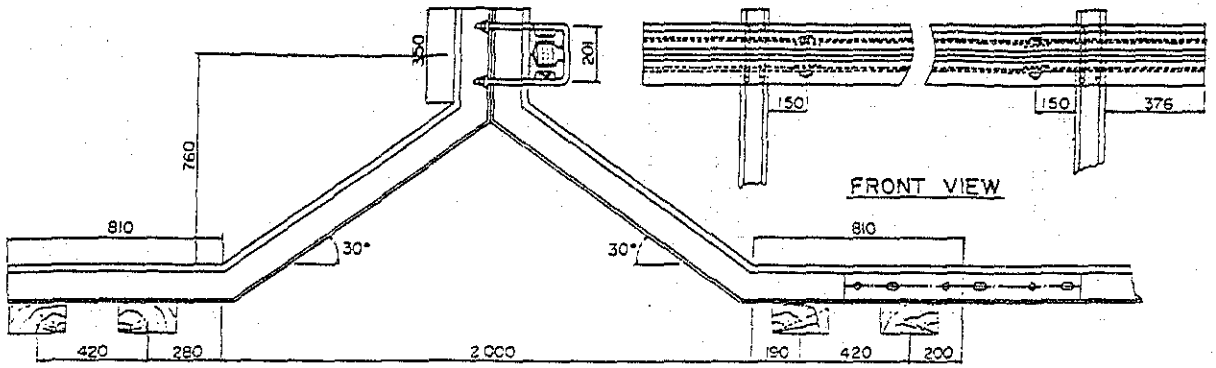


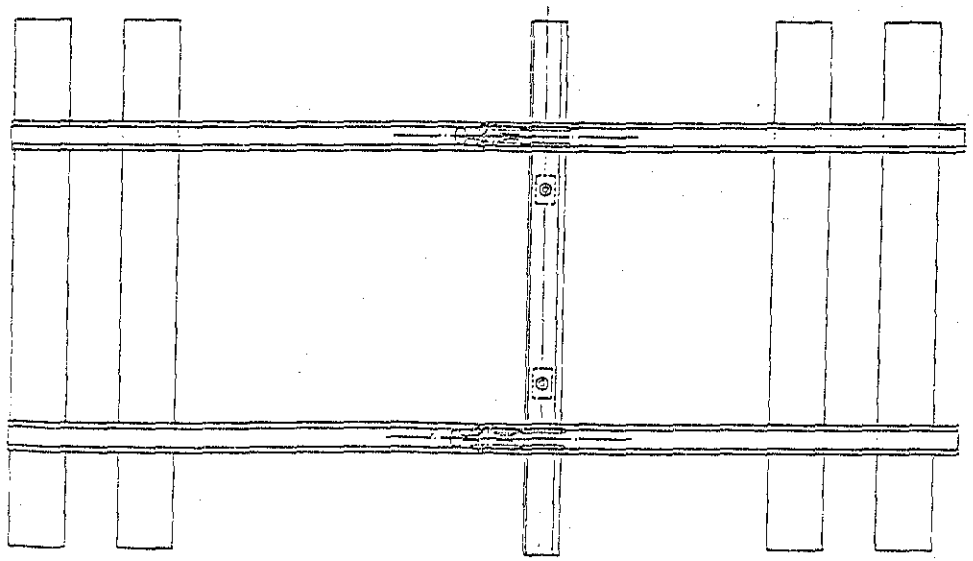
Fig.6-1-14 Car Washing Stand

BUFFER STOP



SIDE VIEW

NOTE :
IN FABRICATING BUFFER STOPS
OLD RAILS SHALL BE UTILIZED



PLAN

Fig.6-1-15 Buffer Stop

6-2 Transshipment Equipment

6-2-1 Introduction

According to section 4-4-6, cargo handling equipment selected for Plan I and Plan II are summarized as Table 6-2-1.

Table 6-2-1

Wagon Type	Selected Equipment	
	Plan I	Plan II
Box Type Car	Forklift × 4 Nos. Portable Conveyor × 4 Nos.	
Container Car	Container Handling Gantry crane × 2 Nos.	Reach stacker × 2 Nos.
Gondola Type Car	Gantry crane × 1 No.	Truck Crane × 1 No.

In this section, individual equipment for Plan I and Plan II are preliminarily designed corresponding to the cargo handling operation for the respective wagon types.

6-2-2 Basic Design Conditions

(1) Natural Conditions

a. *Ambient temperature*

Maximum temperature : 40.7°C
Minimum temperature : –37.2°C
Annual average temperature : 3.4°C

b. Precipitation

Average annual precipitation : 120 ~ 160mm
Distribution of precipitation
in Summer : *More than 85% of precipitation*
in Autumn : Short period heavy rains
in Winter : 1 ~ 3%
Average Snowfall : Over ten days (2 ~ 4cm)

c. Wind

Maximum annual wind velocity : 26 ~ 34m/sec.
In spring (April, May) and in Autumn (September)
Annual average wind velocity : *4.9m/sec.*
Sandstorm and Snowstorm occur in spring
Wind direction : W, NW

d. Humidity

Maximum relative humidity	:	60 ~ 72% in Winter
	:	40 ~ 60% in Summer
Minimum relative humidity	:	28 ~ 40% in April/May
Average annual relative humidity	:	43 ~ 56%

e. Earthquake

Magnitude of earthquake	:	6 bar.

(2) Design Standards and Codes

Basically, Japanese Industrial Standards (JIS) or the equivalent internationally recognized standards are applied for the design of equipment.

6-2-3 General Cargo Handling Equipment for Box Wagons

(1) General Cargo Handling System

Cargo handling from Chinese box type wagons to Mongolian box type wagons will be done in such manner as shown in Figure 6-2-1 General Cargo Handling Flow Chart.

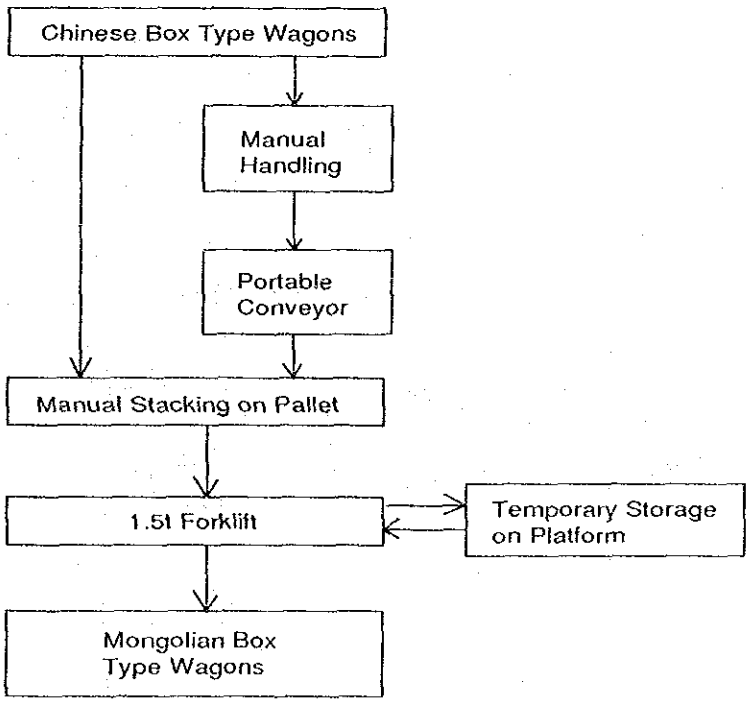
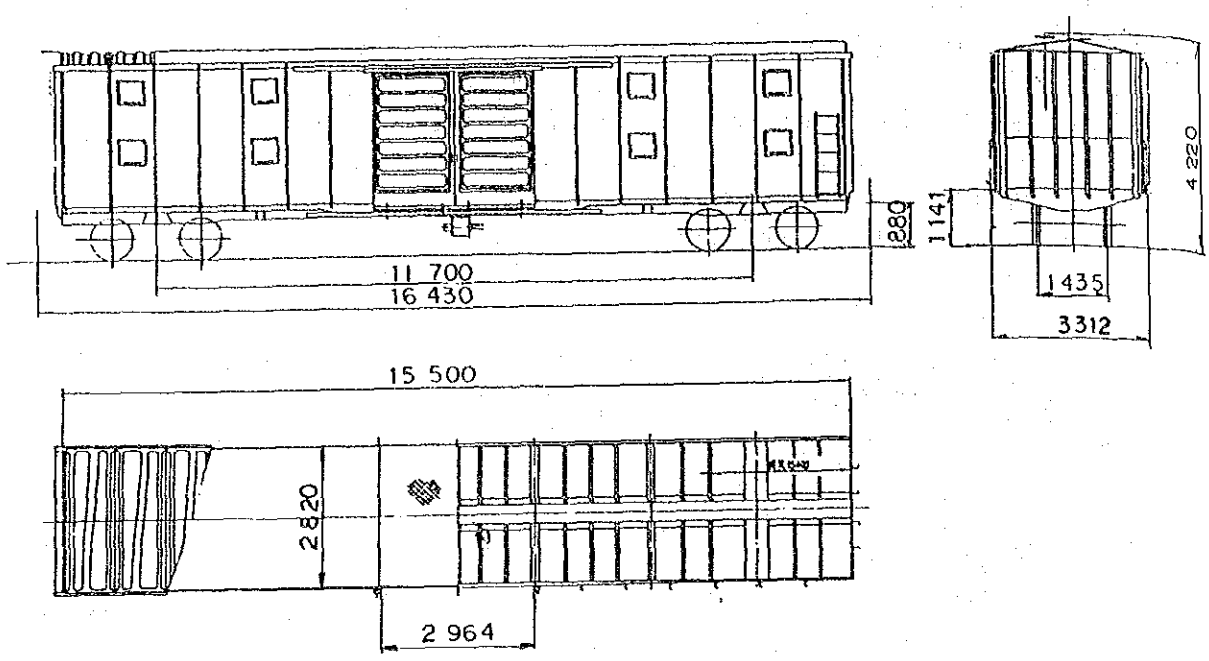
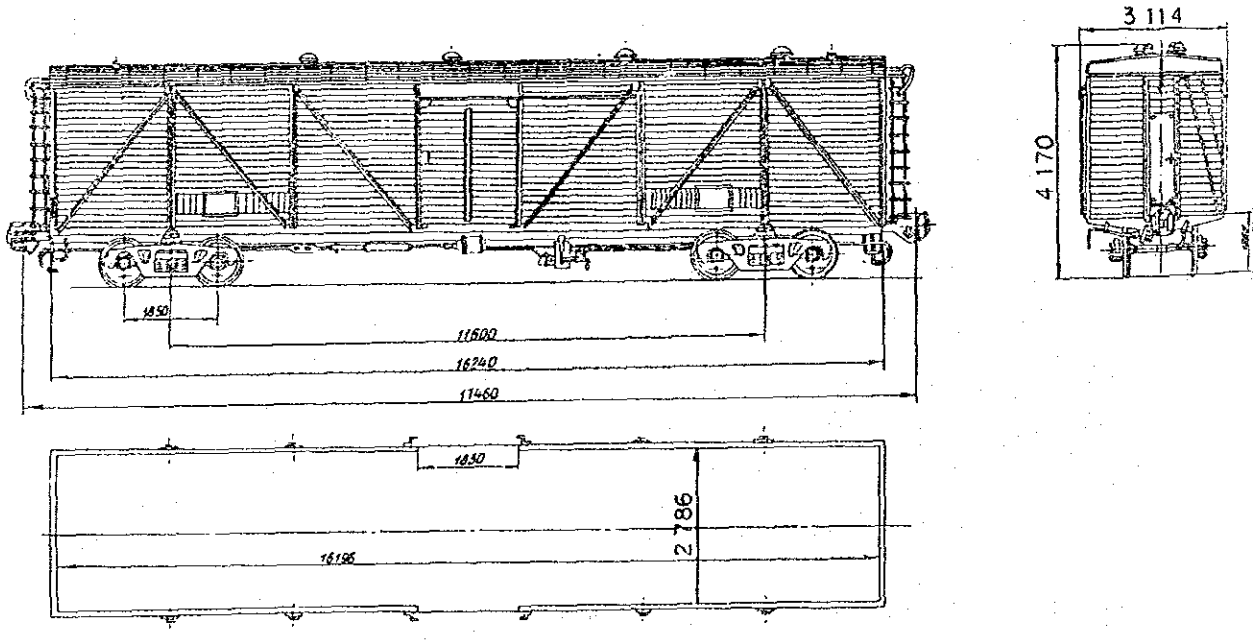


Fig. 6-2-1 General Cargo Handling Flow Chart

Ordinary cargoes in bags or boxes will be manually taken out from Chinese box type wagons and loaded on the portable belt conveyor. At the discharge point in the middle of high platform, cargo will be received and stacked on the pallet manually. After stacking on pallet is completed, then 1.5 ton capacity forklift will pick up loaded pallet and bring into the Mongolian box type wagons. In case Mongolian wagons are not ready, loaded pallet will be moved out from the cargo discharge point of the conveyor to the suitable temporary storage area on the platform.



(a) Typical Chinese Box Type Wagon



(b) Typical Mongolian Box Type Wagon

Fig. 6-2-2 Typical Box Type Wagons

Figure 6-2-2 shows typical box type wagons both from China and Mongol. Door clear opening of box type wagon is minimum of 1,830mm, which limits the size selection of forklift to be the maximum of 1.5ton capacity.

(2) 1.5ton Forklift

1) Outline configuration

Typical 1.5ton Capacity Forklift is shown in Figure 6-2-3.

Ordinary type rubber typed forklift with standard fork can handle cargo on pallet and move into the box type wagon.

2) Preliminary technical requirements

a) Performance requirement

- Load capacity : 1,500kg
- Lifting height : Max. abt. 3m
- Lifting speed (with load) : Abt. 30mm/sec.
- Traveling speed (No load) : abt.18km/h
- Turning Radius : abt. 2m

b) Dimensions

- Overall height : abt.3,100mm
- Fork length : abt.920mm
- Overall width : abt.1,100mm
- Wheel base : abt.1,350mm

c) Drive power

- Rated flywheel horsepower : Not less than 45Hp
- Fuel : Diesel oil

d) Special requirement

- Plug-in cord backup shall be provided at least for heaters and main engine start up.
- Oil pan heater and oil tank heater shall be provided.

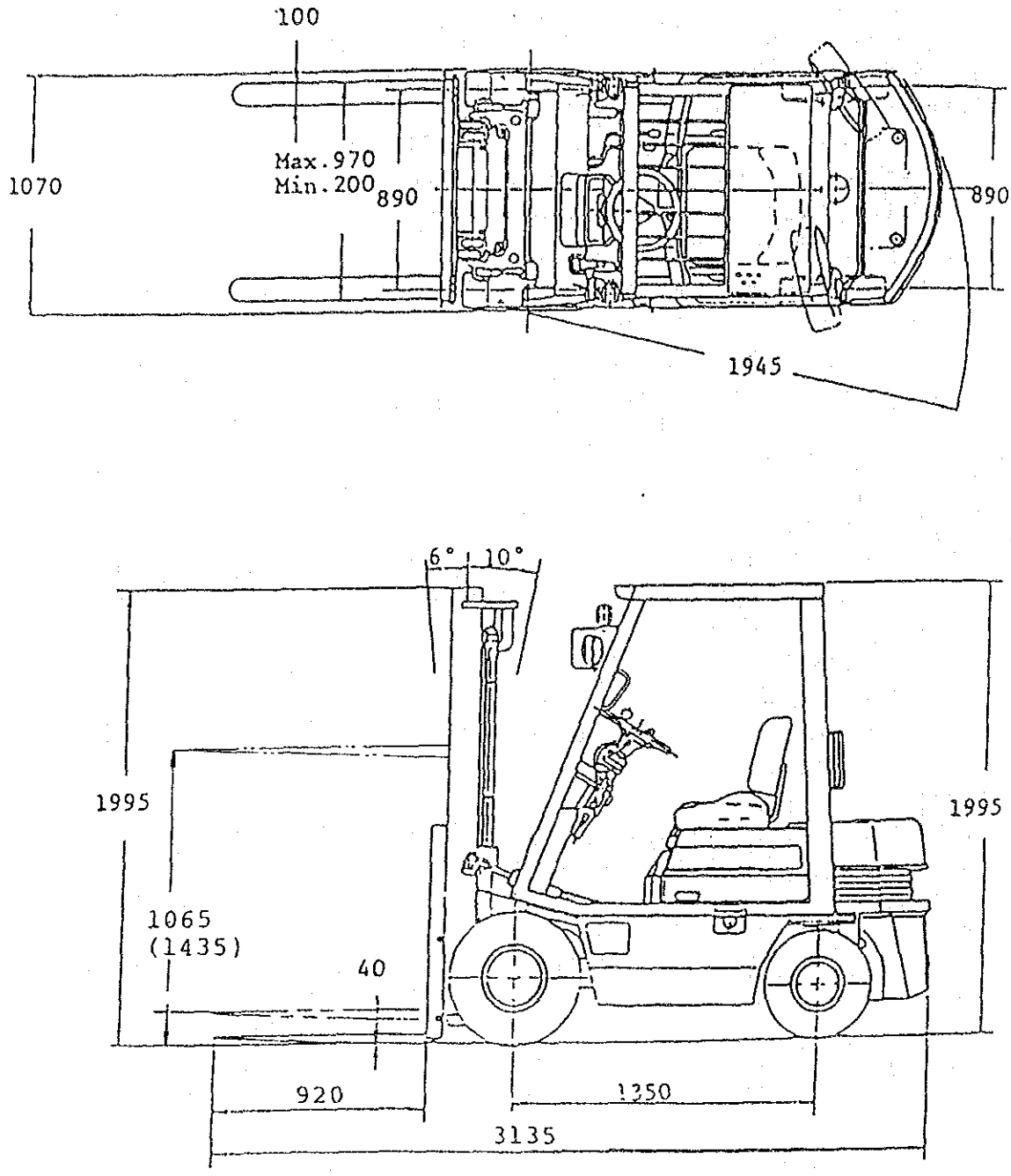


Fig. 6-2-3 Typical 1.5ton Forklift

(3) Portable Conveyor

1) Outline configuration

For bags and boxes handling, portable type conveyor will be used to support manual handling of the cargo.

Figure 6-2-4 shows typical arrangement of Portable Conveyor.

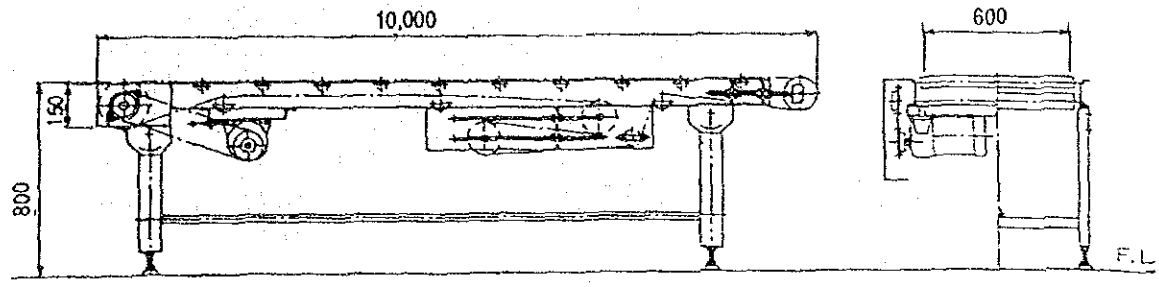


Fig. 6-2-4 Portable Conveyor

2) Preliminary technical requirements

- Type : Horizontal conveyor
- Conveyor length : abt.10m
- Conveyor width : abt. 600mm
- Conveyor speed : abt.20m/min.
- Drive motor : abt.1.5kW
- Power supply : 50Hz, 400V

6-2-4 Container Handling Equipment for Flat Wagons

(1) Container Handling System

Container will be handled in two ways, namely direct transfer from Chinese wagon to Mongolian wagon or temporarily storaged on the platform during transshipment. Cargo flow is as shown in Figure 6-2-5 Container Handling Flow Chart.

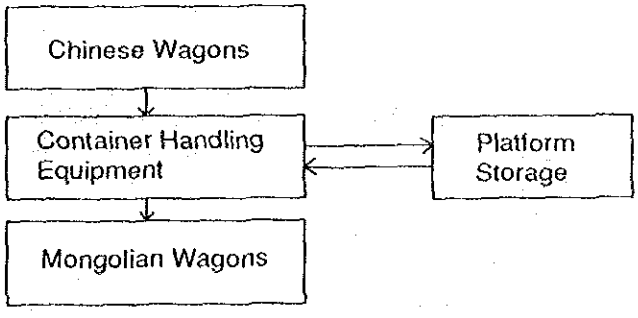
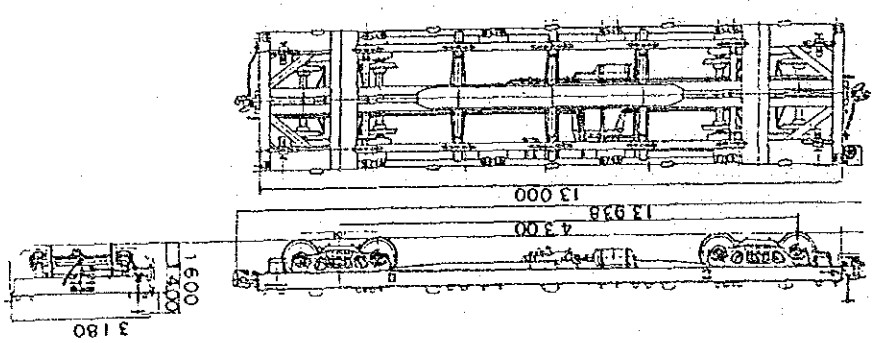
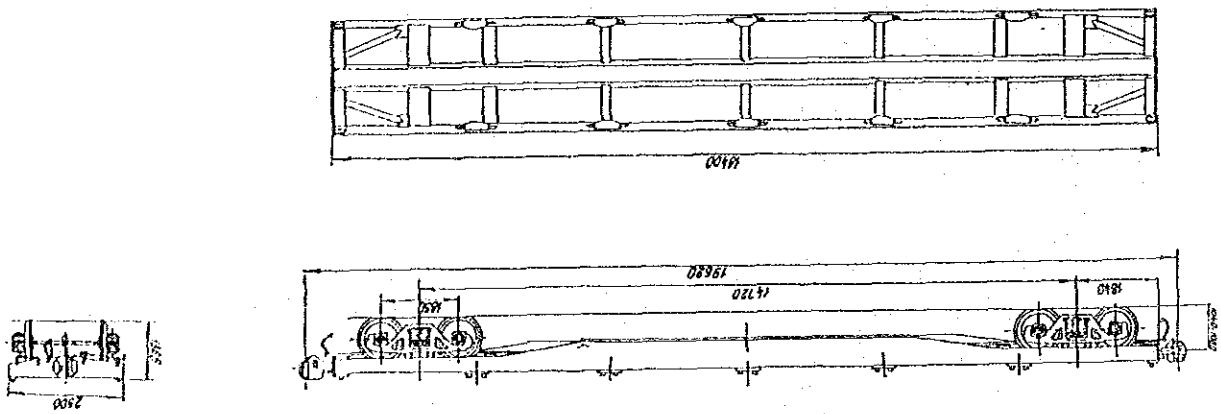


Fig. 6-2-5 Container Handling Flow Chart

Container handling equipment are preliminarily selected for case study; Plan-I with container transfer crane and Plan-II with reach stacker.



(a) Typical Chinese Flat Wagon



(b) Typical Mongolian Flat Wagon

Fig. 6-2-6 Container Flat Wagons

(2) Container Transfer Crane (Plan-I)

1) Outline configurations

In the case of container transfer crane application, parallel track arrangement of Chinese and Mongolian rails will be most preferable. Thus the direct transfer mode will become most efficient. On the other hand, temporary stacking area will be allocated at the opposite side of railway tracks as shown in Figure 6-2-7 Preliminary Arrangement of Container Transfer Crane.

Container transfer crane will be of rail mounted type with the 20 FT/40 FT telescopic spreader.

Spreader is suspended at four corners by wire rope from trolley, which travels along the main girder of the container transfer crane.

Spreader control wire rope system, namely the hoisting equipment will be installed on the trolley frame. Since wire rope system including the hoisting drum system is the vital equipment, it is preferable to be contained inside of the machinery house in order to protect greasy equipment and parts from adhesion of fine sand dust. However even though those are contained in the enclosed housing, still housing cannot be made entirely dust proof construction since the wire rope system penetrates the housing wall. Also the space on the ordinary trolley is extremely narrow, therefore, in case housing is applied, much more bigger trolley is required, which leads to enlarge size of Container Transfer Crane more bigger, to keep open access for maintenance.

Therefore, in this stage ordinary construction is applied for the financial comparison purpose.

2) Preliminary technical requirements

- Type : Rail mounted gantry crane
- Rated load : 30.5ton
- Main dimensions
  - Lift (under spreader) : Min. 9.5m
  - Span : 19m
  - Clear width inside legs : Min. 28m
  - Trolley travel range : Min. 15m
  - Wheel base : Min. 6.4m
- Operating speed
  - Hoisting/Lowering : Min. 15m/min.
  - Traverse : abt.50m/min.
  - Travel : Max. 60m/min.
- Type of spreader : 20 FT/40 FT telescopic spreader with corner guide
- Spreader position control
  - Skew : ±5 degrees at 4m about ground
  - Tilt : ±3 degrees
- Speed control method : DC Ward Leonard Control or Invertor Control
- Power supply : Diesel general set
  - AC generator : 1 set AC 400V 50Hz
  - DC generator : 2 set DC 400V

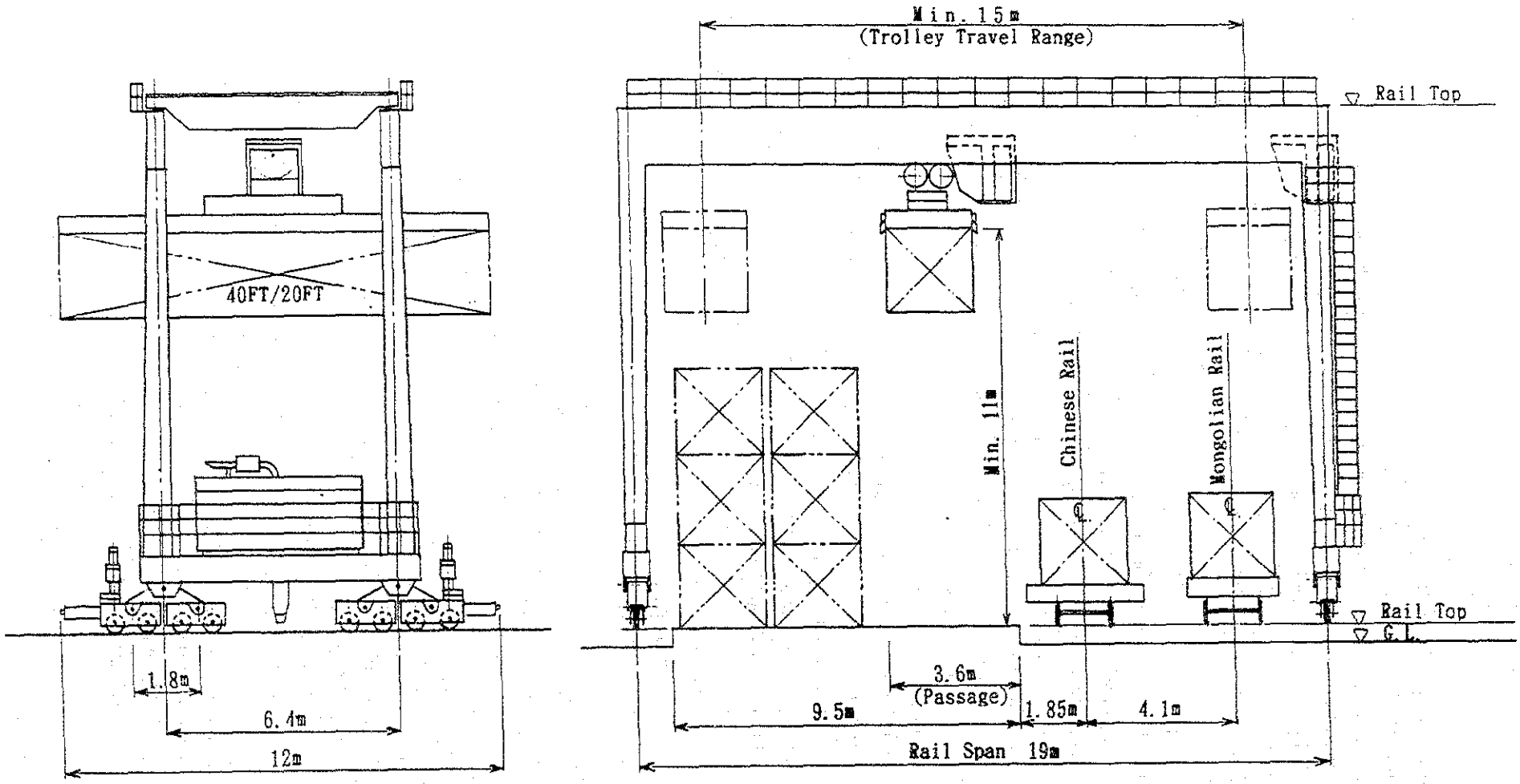


Fig. 6-2-7 General Arrangement of Container Crane

- Main drive motors
  - Hoisting : Min. 120kW × 1 set
  - Traversing : Min. 18.5kW × 1 set
  - Traveling : Min. 15kW × 4 sets
- Number of wheels
  - Total number of wheel : 16
  - No. of driven wheels : 8 (2 wheels × 4 corners)
  - No. of idle wheels : 8 (2 wheels × 4 corners)
- Wheel pressure
  - Under operating condition : abt.18t/W
  - Under storm condition : abt. 25t/W
- Special provisions
  - Electric heaters shall be provided at least for main engine oil pan, main motors and main gear reducers.
  - Plug-in cord back up shall be provided for heaters and main engine start up.
  - For parking position, storm anchor holders and jack-up plates shall be provided.

(3) Reach Stacker (Plan-II)

1) Outline configurations

In the case of Reach Stacker application, intermediate platform arrangement between Chinese and Mongolian lines is considered suitable from the maintenance aspect of civil works. Thus the containers will be temporarily be stacked in the middle part of the platform. Figure 6-2-8 shows the typical example of operating capability of Reach Stacker.

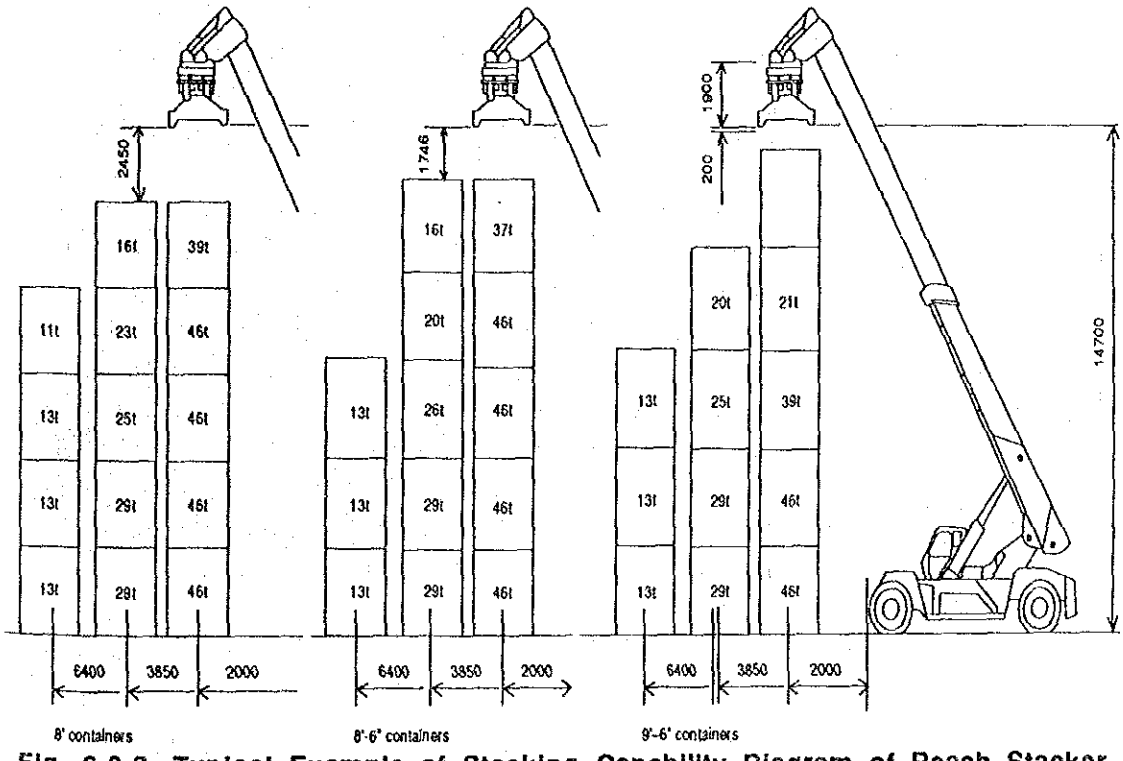


Fig. 6-2-8 Typical Example of Stacking Capability Diagram of Reach Stacker

Reach Stacker is similar to truck crane, but more specialized for container handling work at the limited space area in a simplified and the most easy manner. Also Reach Stacker can handle various cargoes by use of lifting lugs as shown in Figure 6-2-9.

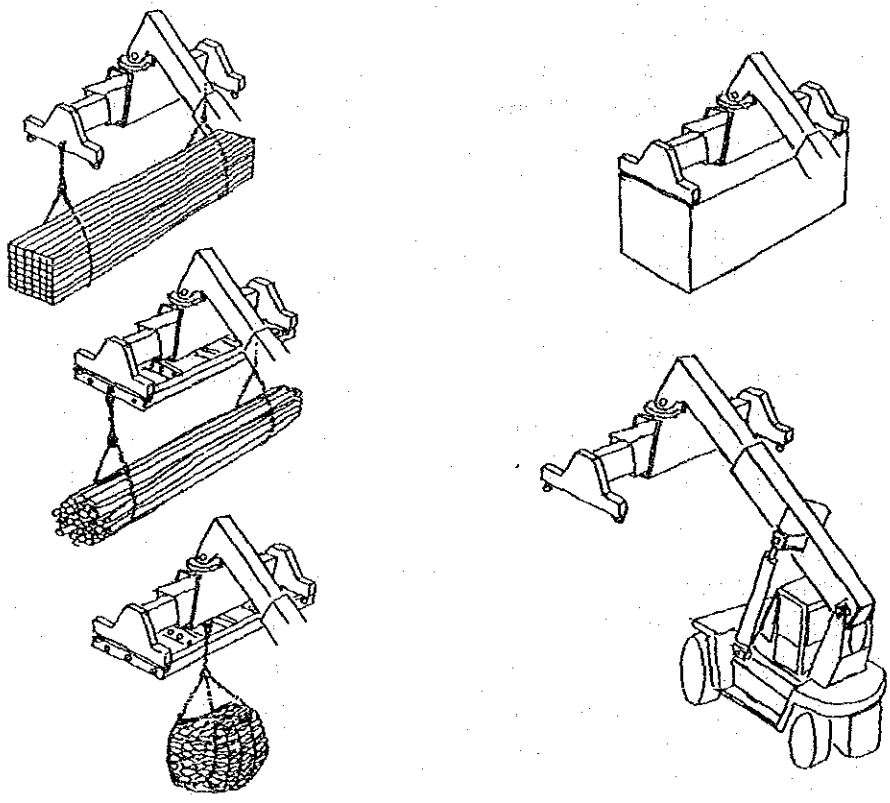


Fig. 6-2-9 Lifting Capability of Reach Stacker for Various Cargoes

Reach Stacker was developed to resolve the difficulties of both the Container Transfer Crane and Toplifter.

The container transfer crane controls spreader by use of wire rope system. Therefore control of spreader positioning is difficult even at no wind and calm condition since spreader swings by the inertia of spreader itself. To resolve this problems, spreader is mechanically attached to the boom on the Reack Stacker. Although Toplifter has a similar arrangement, Toplifter must access to the very close position and exactly perpendicular to the container position. With this regard Reach Stacker may keep apart from the container position and may not be positioned perpendicular to the container, since Reach Stacker has a extendable boom and 180 degrees slewable spreader. Furtherly Reach Stacker has an advanced control and maneuvering system, so that operator can drive and control the Reach Stacker in a extremely easy manner.

Figure 6-2-10 shows the typical arrangement of Reach Stacker.

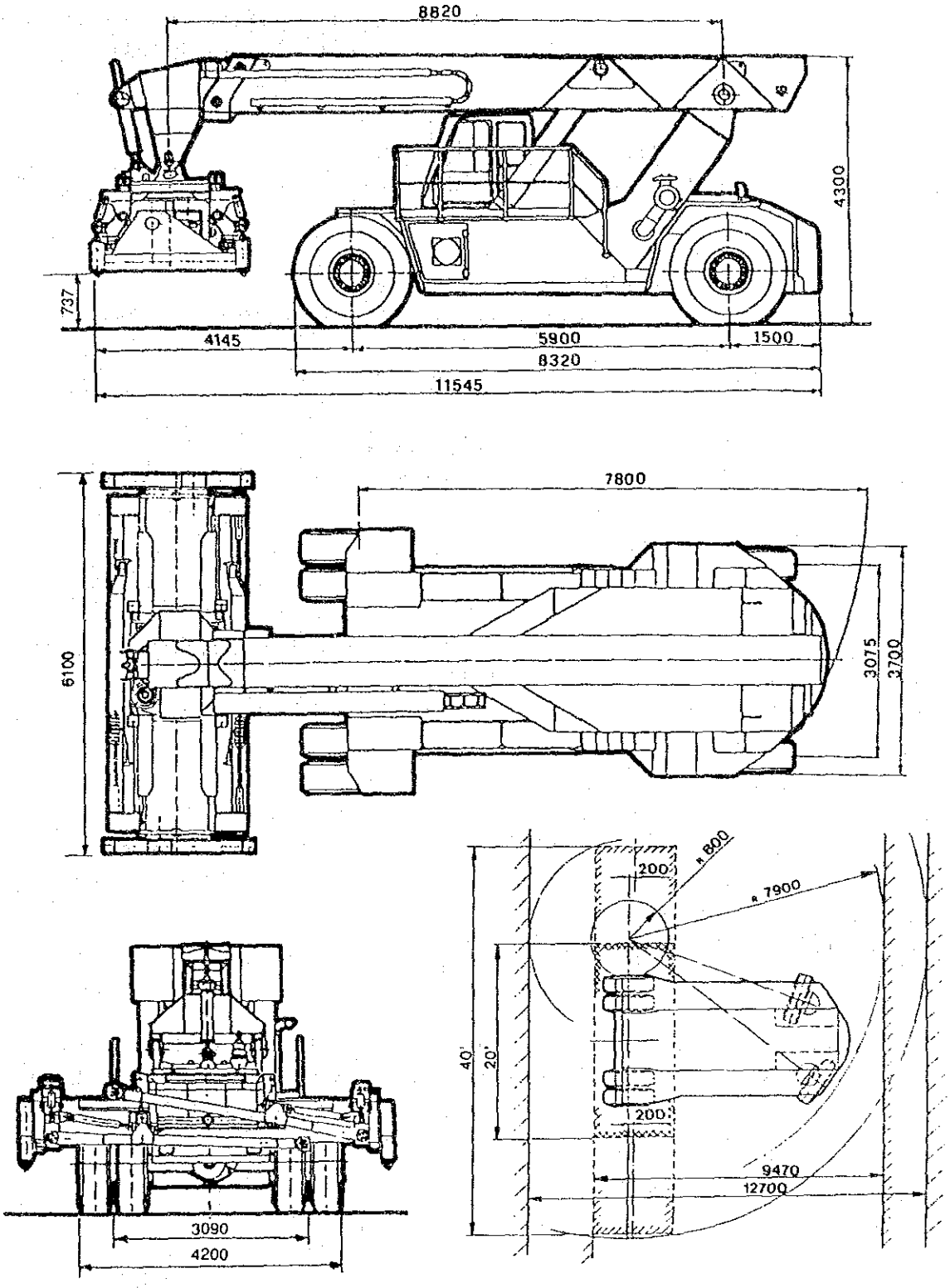


Fig. 6-2-10 Typical Arrangement of Reach Stacker

2) Preliminary technical requirements

- Lifting capacity : Min. of 30.5 Ton at 2m front from end of the wheel
- Container Stacking Capacity : Min. of two rows and three high stack
- Performance
  - Boom hoisting speed : Min. 0.14m/s
  - Boom lowering speed : Min. 0.20m/s
  - Travel speed : Min. 20km/h
  - Gradability : Min. 15%
- Spreader control
  - Spreader sideshift : abt. ±800mm
  - Spreader slewing angle : Min. ±90 degrees (at least 185 deg. for one way)
  - Spreader tilt angle : ±5 degrees
  - Boom angle : Up to abt. 50 deg. or over
- Engine
  - Type : Diesel engine
  - Fuel : Diesel oil
  - Rated horsepower : Min. 220HP
- Type arrangement
  - Front wheel : 4 wheels (2 wheels × 2 sets)
  - Rear wheel : 2 wheels (1 wheel × 1 set)
- Brake system : Hydraulic brake or Hyddro-Pneumatic brake system with air dryer
- Minimum turning radius : Not more than 12m
- Maximum axle load : Not more than 115ton
- Maximum wheel pressure : Not more than 28t/w
- Special provisions
  - Electric heaters shall be provided for main engine oil pan and hydraulic tank.
  - Plug-in cord back up shall be provided for heaters and main engine start up.

6-2-5 Cargo Handling Equipment Gondola Wagons

(1) Cargo Handling System

Bagged cargo or other cargos suitable for lifting on the gondola type wagon will be handled by use of Gantry Crane or Truck Crane. Also the Reach Stacker can be used for this purpose. Cargo handling procedure is similar to the container handling. Figure 6-2-11 shows the flow chart of cargo handling system for Gondola type wagons.

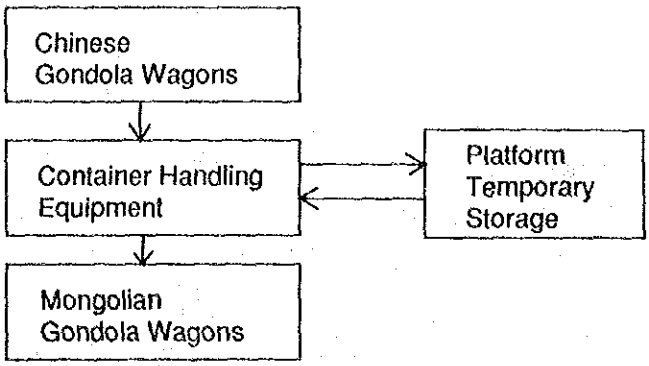
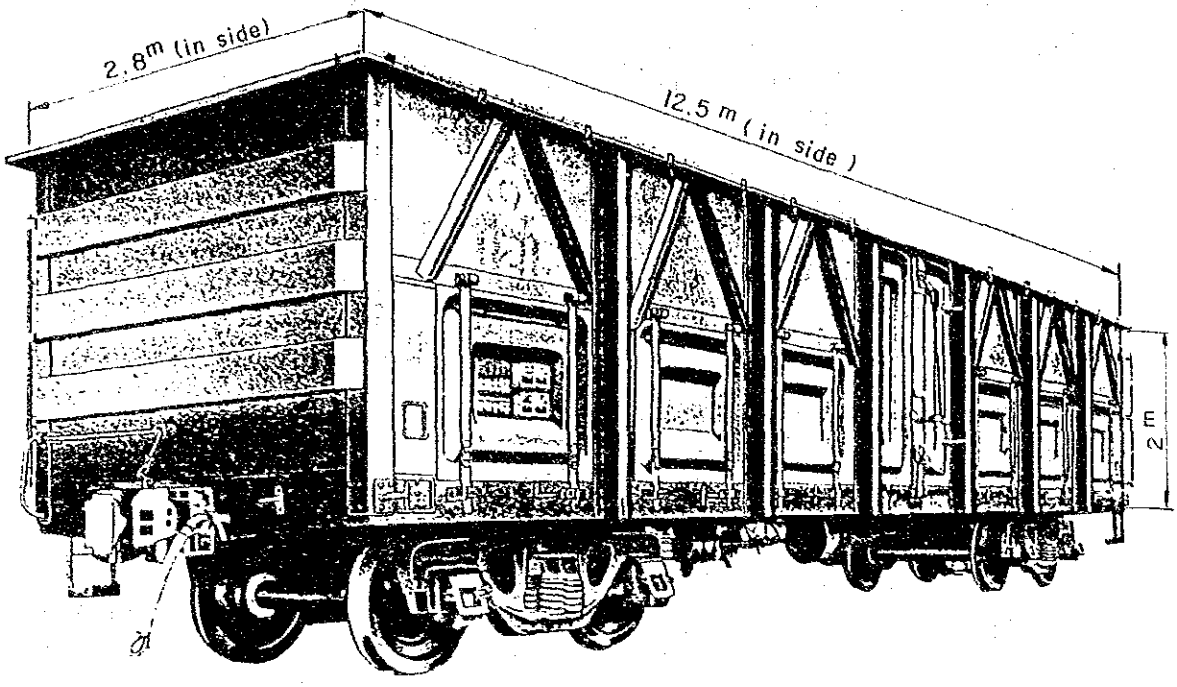
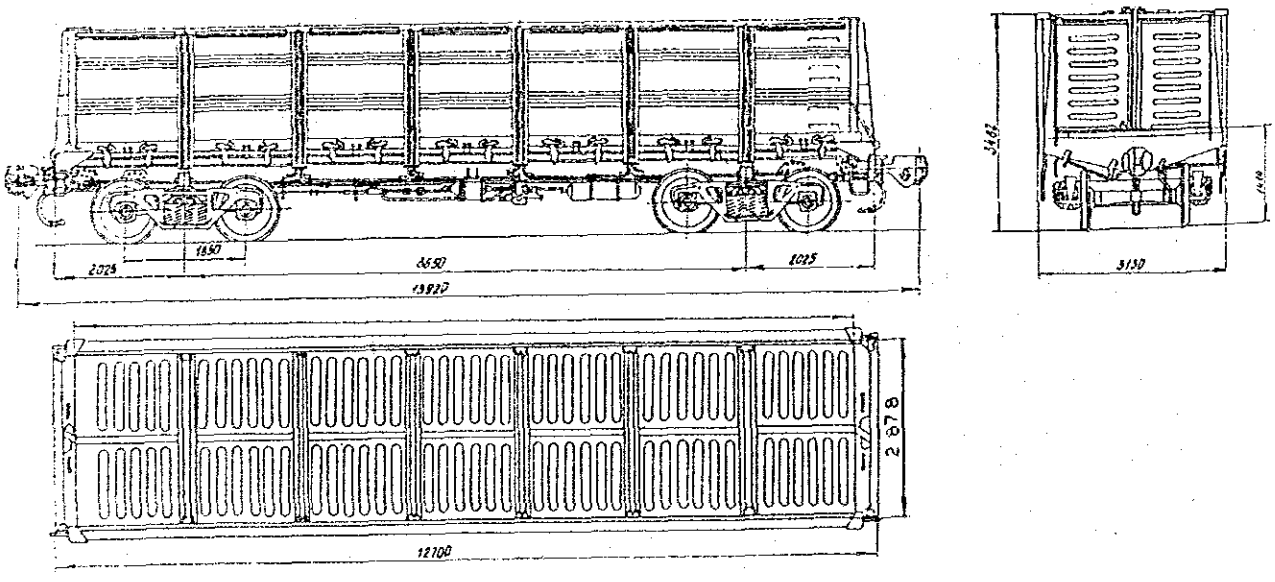


Fig. 6-2-11 Cargo Handling Flow Chart

In this section, Gantry crane for Plan-I and Truck Crane for Plan-II are subject to the preliminary comparison for case study.



(a) Typical Chinese Gondola Wagons



(b) Typical Mongolian Gondola Wagons

Fig. 6-2-12 Gondola Wagons

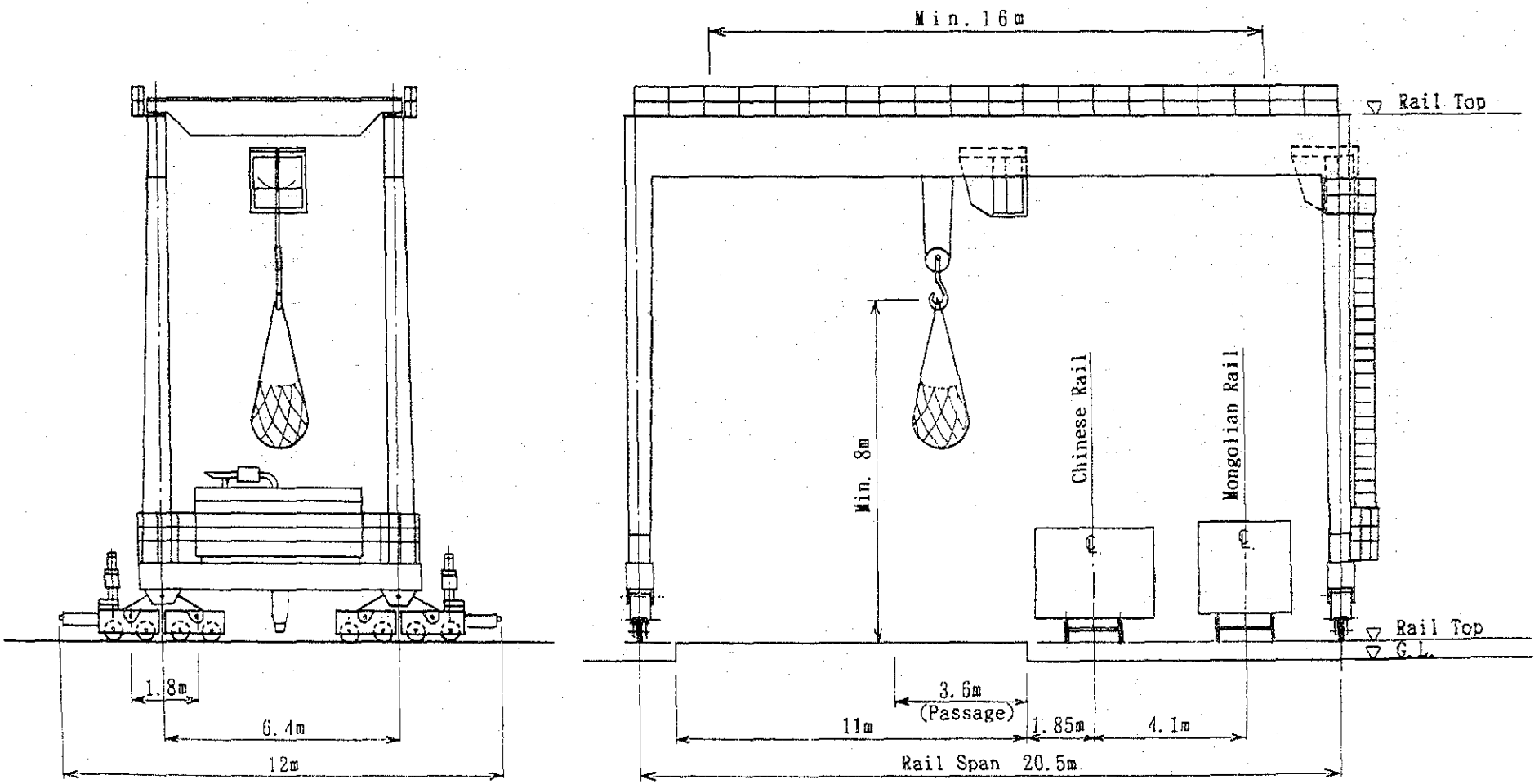


Fig. 6-2-13 20 ton Gantry Crane General Arrangement

(2) 20ton Gantry Crane (Plan-I)

1) Outline configurations

Parallel track arrangement of Chinese and Mongolian railway will be preferable for gantry crane operation. Thus the similar overall arrangement of passage way and temporary cargo storage area planned for Container Crane is considered. Since the break bulk cargo cannot be stacked so high as containers a little wider storage space is provided. Those arrangement is shown in Figure 6-2-13 General Arrangement of 20ton Gantry Crane. As shown on this drawing, Gantry Crane will be self-propelled rail mounted type with engine-generator set.

Since the Gantry Crane is designed operable by use of engine-generator set, similar structural arrangement with Container Crane is applied for preliminary design.

2) Preliminary technical requirements

- Type : Rail mounted gantry crane
- Rated load : 20ton
- Main dimensions
  - Lift : Min. 8m
  - Span : 20.5m
  - Clear width inside legs : Min. 14.8m
  - Trolley travel range : Min. 16m
  - Wheel base : Max. 6.4m
- Operating speed
  - Hoisting/Lowering : Min. 15m/min.
  - Traverse : abt. 25m/min.
  - Travel : Max. 60m/min.
- Speed control method : DC Ward Leonard or Inverter Control
- Power supply : Diesel generator set
  - AC Generator : 1 set AC 400V, 50Hz
- Main drive motors
  - Hoisting : Min. 60kW × 1 set
  - Traversing : Min. 12.5kW × 1 set
  - Traveling : Min. 8.5kW ×4 sets
- Wheel pressure
  - Under operating condition : abt. 16t/W
  - Under storm condition : abt. 24t/W
- Special provisions
  - Electric heaters shall be provided at least for main engine oil pan, main motors, and main gear reducers.
  - Plug-in cord back up shall be provided for heaters and main engine start up.
  - For parking position, storm anchor holders and jack-up plates shall be provided.

(3) 35ton Truck Crane (Plan-II)

1) Outline configuration

For Truck Crane application, similar track arrangement as for Reach Staker platform design will be required. Namely low platform with 20m width will be arranged between Chinese line and Mongolian line.

At normal operating mode, Truck Crane should extend and set the outrigger to stabilize the Truck Crane under operation. However for the purpose of light weight cargo transportation, Truck Crane can bring the cargo at the low speed with the outrigger extended. For this purpose Truck Crane should be operable from one both for traveling and crane operation.

For heavy cargo handling, Truck Crane will unload the cargo, then Reach Stacker will bring the cargo to the designated loading position, and load the cargo onto the wagon.

2) Preliminary technical requirements

- Lifting capacity : Max. 35ton at 3m Radius
- Boom length : aabt. 9m up to abt. 34m (extendable)
- Maximum working radius : abt. 34m
- Maximum lifting height : abt. 30m
- Performance
  - Hoisting rope speed : Max. about 125m/min.
  - Hook speed : abt. 6m/min ~ abt. 12m/min.
  - Boom lifting angle : 0° ~ abt. 80 deg.
  - Slewing range : 360 deg.
  - Slewing speed : abt. 3 rpm
  - Traveling speed : Max. 45km/h (no load)
    abt. 1.5km/h (with load)
  - Steering radius
    - By two wheel steering : Max. 9m
    - By four wheel steering : Max. 6m
- Type arrangement
  - Front wheel : 2 wheels
  - Rear wheel : 2 wheels
- Engine
  - Type : Diesel engine
  - Fuel : Diesel oil
  - Rated horsepower : Min. 210Hp
- Brake system : Hydraulic or Hydro-Pneumatic Brake System

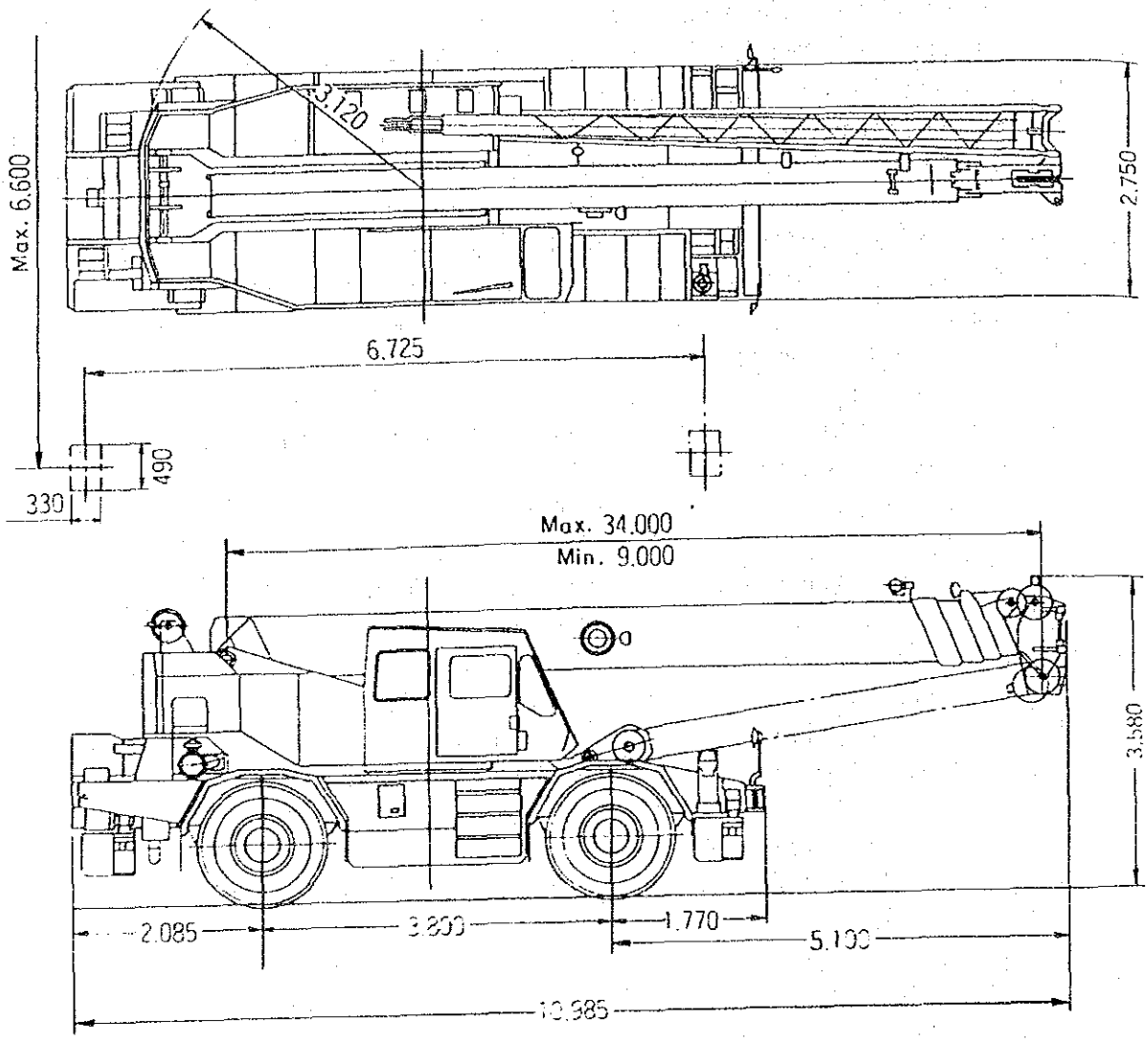


Fig. 6-2-14 Typical Arrangement of 35 Ton Truck Crane

6-3 Signal, Communication and Power Supply

6-3-1 Signal Equipment

(1) Signal Equipment

We plan installation of the following signal equipment. Quantities are given in Table 6-3-1.

- Departure signal, home signal, calling-on signal and shunting signal.
- Route indicator for home signal.
- Track indicator for shunting signal (for three and multiple routes) and track indicator lamp where a large number of shunting signals are installed.
- Inspection stand for signal equipment where necessary.

Table 6-3-1

Signal/indicator	Q'ty	Signal/indicator	Q'ty
Departure signal	18	Stop track signal	52
Home signal	8	Route indicator	5
Calling-on signal	3	Track indicator (for three tracks)	23
Shunting signal	93	Track indicator (for multiple tracks)	4
Track indicator	17		

Note: Three existing home signals are reused.

Figure 6-3-1 shows the arrangement of signals.

(2) Block Equipment

- We will plan introduction of special automatic block system in the section between Zamyn-Uud and P52 signal station using the existing lines of tablet block system. Figure 6-3-2 shows the system composition.
- We will plan to use the existing type 64 relay semi-automatic block system for the 1,435mm gauge track between Zamyn-Uud and Erenhot. The operating panel will be incorporated in the control desk in the signal operation cabin to be newly built. The 1,520mm gauge track will be equipped with the most appropriate system based on the negotiations with China. These equipment will be operated from a common operating panel.
- The automatic block system will be introduced in the section between Zamyn-Uud and P52 station. According the P52 station will be equipped with the equipment given in Table 6-3-2.

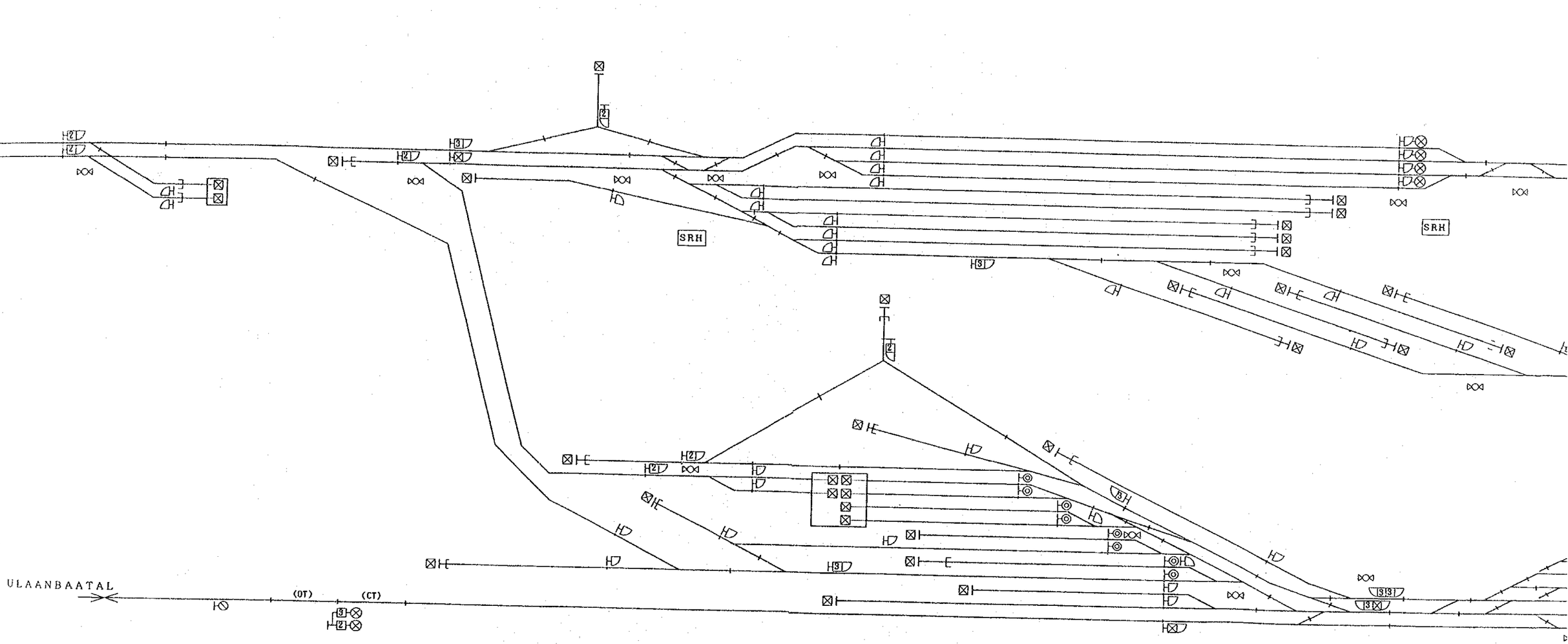
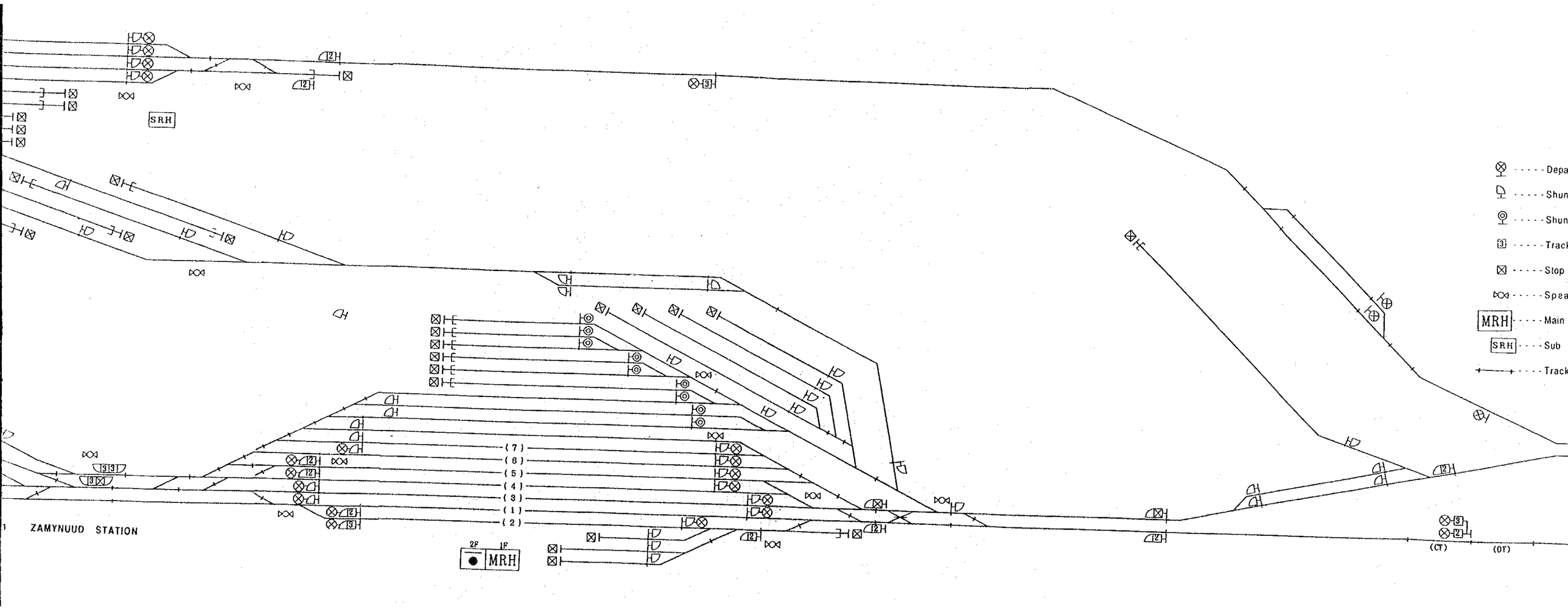
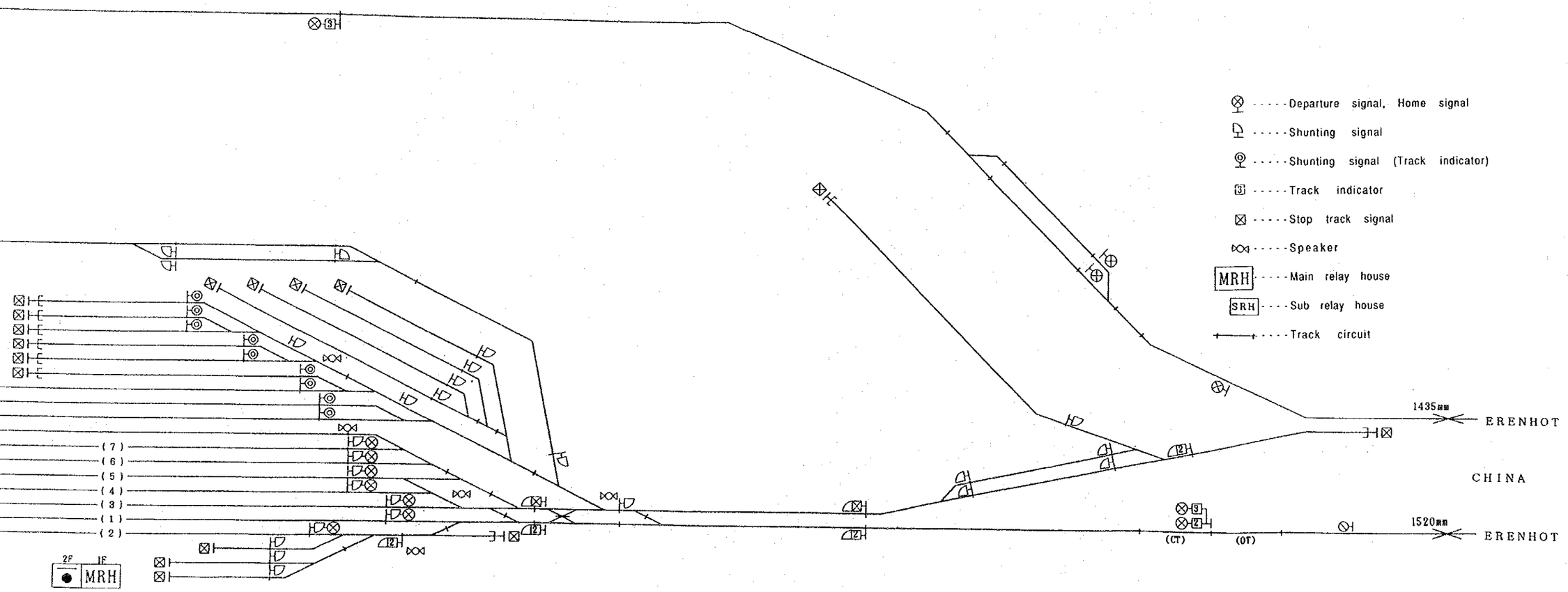


Fig. 6-3-1 ZAMYNUUD STATION



1 ZAMYNUUD STATION



- ·····Departure signal, Home signal
- ·····Shunting signal
- ·····Shunting signal (Track indicator)
- ·····Track indicator
- ·····Stop track signal
- ·····Speaker
- MRH ····Main relay house
- SRH ····Sub relay house
- ····Track circuit

Table 6-3-2

Equipment	Q'ty	Equipment	Q'ty
Departure signal	3	Track circuit	6
Home signal	1	Operating panel	1
Power-operated point	2	Signal box	3

(3) Interlock Equipment

- We will plan installation of a relay interlock system. A separated type operation panel will be installed in the signal operation cabin. The operation panel will incorporate the talk back system, radio equipment and a voice call telephone.
- An air-cooling type air cooling system will be introduced in the main relay and auxiliary relay rooms, and an air-cooling type air conditioning equipment in the signal operating cabin.
- We will plan to adopt a signal switchboard, capacity 300 A, and a rectifier, capacity 100 A.

(4) Points

We will adopt AC NS-A type points for the main line and AC YS type points for side tracks. Table 6-3-3 gives the quantities of these points.

Table 6-3-3

Point	Q'ty
Power-operated point (AC NS type)	55
Power-operated point (AC YS type)	45
Total	100

(5) Track Circuit

We will adopt a frequency of 50Hz for the track circuit current. The welding copper wires, size 15mm^2, will be the duplicated type. Insulation of rail will be reinforced to extend the life and facilitate maintenance work. Cables, 10mm^2 × 2c, will be used at current supply and arrival points. The quantity of the track circuit is given in Table 6-3-4.

Table 6-3-4

Track circuit	Q'ty
Switching track circuit	79
Straight track circuit	62
Total	141

(6) Cables

Cables are accommodated in throughs, 10cm below the ground surface.

6-3-2 Telecommunication Equipment

(1) Radio Communications Equipment

We propose to introduce radio communications equipment, frequency 150 to 156MHz, for the communications between the station and the signal operating cabin and between shunting locomotive drivers, yard men, lever operators and other crew in the yard. The antenna for this system will be installed on the roof of the main office. The equipment on the locomotive is the fixed type, and others are the portable type. Table 6-3-5 gives the quantities of the radio communications equipment.

Table 6-3-5

Purpose	Output	Q'ty
In the station	20W	1
On locomotives	10W	7
Portable	1W	20

(2) Talk Back Equipment

We will plan to install talk back equipment near major shunting signals and points for the convenience of shunting and maintenance work. The operation panel will be placed in the signal operating cabin of the station. The speakers, 20 sets, are the type to be installed on a pole with a calling button. Cables will be shielded.

(3) Telephone Exchange

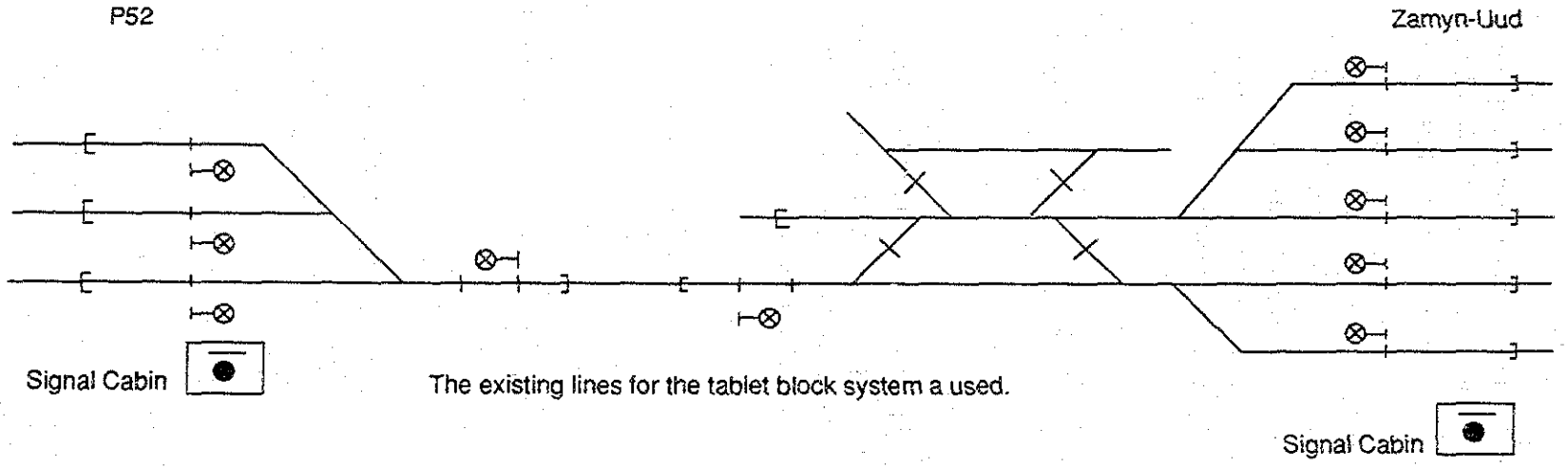
We will plan to introduce a digital exchange to accommodate 500 subscriber lines and replace the existing step-by-step exchange, capacity 200 lines, which is superannuated and prone to errors. As the auxiliary equipment, we will introduce an exchange stand, a switchboard, a rectifier and batteries. We will also introduce push-button telephones and allocate a number to each of the telephones distributed in the station compound and the residential area.

(4) Voice Call Telephone

We will introduce voice call telephones in the offices engaged in train operation. The quantities of the equipment is given in Table 6-3-6.

Table 6-3-6

Item	Q'ty
Telephone	20 sets
Cable (20P U-6020)	6km
Terminal box	20 sets



P52

Equipments		Q'ty
Starting Signal		3
Home Signal		1
Track Circuit		6
Motor Point		2
Interlock System		1
Items	Controller	
	Relay	
	Power Supply	

Zamyn-Uud

Equipments		Q'ty
Starting Signal		5
Home Signal		1
Track Circuit		9
Motor Point		9
Interlock System		1
Items	Controller	
	Relay	
	Power Supply	

Fig. 6-3-2 Special Automatic Block System

6-3-3 Electric Power Facilities

(1) Generating Equipment

New generators shall use medium-speed diesel engines with heavy oil fuel, generating voltage at 6,000V. Starting devices, starting panels, generator panels and transformers shall be newly provided when generators are replaced. The new generators shall be placed where the existing ones, Nos. 1 and 2 (each, 630kW), are removed.

Each breaker provided for 10kV common bus shall be replaced for the automation of power source change-over and the enhancement of power source reliability. The emergency transmission of power from Sainshand generating plant may be made impossible because of load increase in station yard. However, the existing generation No. 3 (800kW) shall be used as a reserve to enhance the reliability. Therefore, no power supply suspension is considered to take place. See Figure 4-5-1.

(2) Transformer

Power distribution lines shall be provided for signal stations, field offices, freight car washing points and residences where loads are heavy, and transformers for power distribution near major loading points. Transformers shall be installed at poles.

(3) Illumination for Transshipping Facilities

Illumination shall be provided at platforms for open freight cars and containers, and covered freight cars. For open freight car and container tracks, lighting poles shall be planted around both platform, with mercury lamp projectors. The sheltered platform for covered freight cars shall be illuminated from the ceiling with mercury lamp projectors. See Figure 6-3-3 and Table 6-3-7.

(4) Yard Illumination

Figure 6-3-4 shows the layout of yard illumination for storage tracks and engine run around tracks. Table 6-3-8 and 6-3-9 also shows illumination.

(5) Electric Power Facilities for Various Buildings

Various buildings in station yard and residences shall be illuminated with fluorescent lamps, and the engine shed with high ceiling also illuminated with indoor mercury lamps.

(6) Others

Distribution panels and outlets shall be provided, indoor and outdoor, where considered necessary.

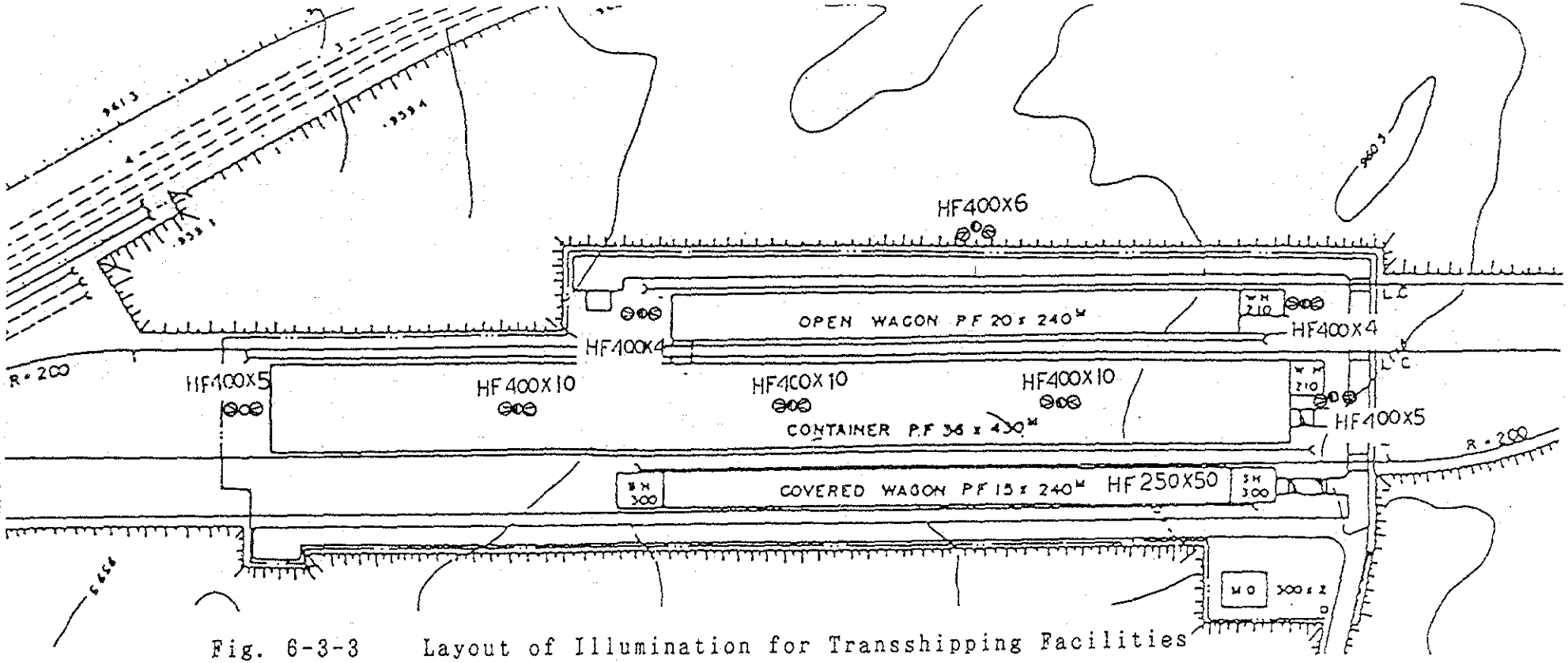


Fig. 6-3-3 Layout of Illumination for Transshipping Facilities

Table 6-3-7 Illumination for Transshipping Facilities

Platform	Lighting area (sq.m)	Kind	Lux	Lighting pole	Illuminator
Container	6,700	Mercury, outdoor	10	15m x 5	HF400x40
Covered car	3,600	Mercury, indoor	100		HF250Wx50
Open car	5,300	Mercury	10	15m x 3	HF400x14

Table 6-3-8 Illumination (gauge, 1435mm)

Lighting area (sq.m)	Kind	Lux	Illuminator
a. 43,000	Projector, outdoor	1.0	HF400Wx10

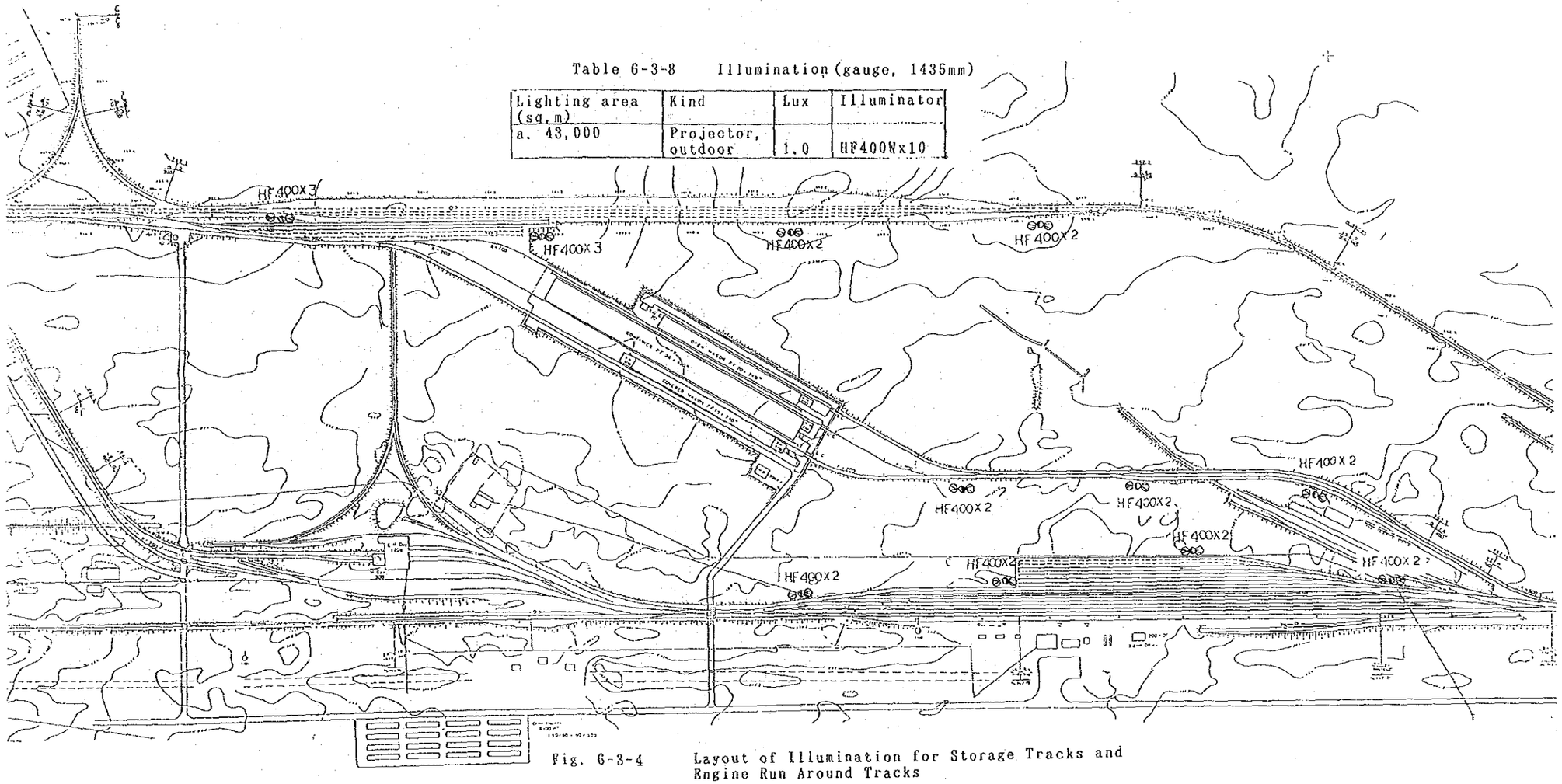


Fig. 6-3-4 Layout of Illumination for Storage Tracks and Engine Run Around Tracks

Table 6-3-9 Illumination (gauge, 1520)

Lighting area (sq.m)	Kind	Lux	Illuminator
a. 78,000	Projector, outdoor	1.0	HF400Wx14

Chapter 7

CHAPTER 7 COST ESTIMATE

7-1 Calculation Method

Mongolia has only recently converted from a planned economy to a market economy, and its economic mechanism has now fallen into total disarray. The economy that was created under the socialist regime mixed up with the newly introduced capitalist economic mechanism. For example, while he official exchange rate is 40 Tuglik to the US dollar, the unofficial rate is constantly fluctuating under the effects of inflation and other factors (August 1992, 270Tg=1US$; September 1992, 300Tg=1US$). Market commodity prices are also subject to fierce inflation, such that the cost calculations for government-ordered road construction works have to undergo major revisions every year. While the cost of asphalt paving work three years ago was 500,000Tg/km, this has now reached 3,000,000Tg/km (according to the Mongolian Road Department).

Although calculation data does exist in Mongolia (1990 edition), in practice calculations are made by multiplying this by the rate of inflation (which is difficult to estimate). Labour and material costs in Mongolian are not easy to establish. Apart from basic materials such as sand, ballast, cement, timber, and bricks, other materials are imported from neighboring countries (Russia, China). But now that these too are converting to market economies, difficulties are anticipated (no market trends for other countries have been surveyed in this research).

Therefore, in this study the project costs have been calculated under the following preconditions.

1) It is assumed that locally available construction machinery can be utilized to the full and that none will be brought in from Japan for the project. However, Japanese calculation standards shall be applied to rental and other charges for construction machinery (rental charges for machinery, fuel costs, repair and parts costs, and so on).
2) The same applies to construction materials; thus while materials which can be produced inside Mongolia will all be procured locally, it shall be assumed that imported materials such as steel reinforcements, rails, steel frames, and hardware shall be imported from Japan, since market trends in Russia and China are unknown. Unit prices for locally procured materials shall be based on the latest 1992 prices obtained during the local surveys. Unit prices for imported materials shall be based on Japanese calculation standards, and material transportation costs from Japan to Mongolia shall also be taken into account.
3) For labour, in principle it is assumed that labour available in Mongolia will be utilized to the full. Skilled workers will be trained on-site in the form of on-the-job training, with technical guidance from Japan. Therefore, the costs of sending technicians from abroad will also be taken into account.
4) Of the project costs, the following costs will be added to the civil engineering/building costs, apart from the direct construction costs (A).

    a) Shared temporary construction costs (temporary roads, temporary on-site supervision offices, temporary warehousing, temporary accommodation quarters, temporary enclosures, safety measures, electricity/gas/waterworks etc. for construction purposes) ..... A×9%

b) On-site expenses (technicians sent from Japan by works contractors, direct personnel costs for locally appointed typists, security personnel, engineers etc., their direct expenses, office expenses, etc.)

..... A × 12%

c) General management costs A × 10%

d) Transportation costs (Japan to Mongolia)

..... ¥50,000/ton or cu. metre

5) For design and works management costs, 10% of the above costs shall be estimated.

6) The exchange rate has been set as follows:
40Tg/1US$, ¥125/1US$

7-2 Works Quantities for Outline Calculations

The works quantities for outline calculations according to alternative proposals A-1 and A-2 are shown in Table 7-2-1.

Table 7-2-1 Total Works Quantities

		Proposal A-1	Proposal A-2
Civil Engineering Works			
Embankment work		200,900m^3	209,100m^3
Track extension	(1520)	8,600m	8,500m
	(1435)	14,700m	14,600m
Concrete ducts		3,600m^3	6,300m^3
Building Works			
Station office/Staff room		1,100m^2	1,100m^2
Platform roofing		3,600m^2	3,600m^2
Repair workshop/store		4,300m^2	4,300m^2
Staff accommodation		8,100m^2	8,100m^2
Machinery			
Container cranes		2	–
Gantry crane (20t)		1	–
Fork lifts (1.5t)		4	4
Portable conveyors		4	4
Reach stackers		–	2
Track crane (35t)		–	1
Signals & Communication Works			
Signals		29	29
Shunting signals		93	93
Specially-made auto blockers		1 set	1 set
Interlocking		"	"
Switchers		"	"
Track circuits		141	141
Wireless radios		28	28
Talk-back equipment		1 set	1 set
Switchboard		"	"
Telephones		20	20
Electricity Works			
Generators (750kW)		2	2
Lighting/cables		1 set	1 set

7-3 Total Construction Costs

The total construction costs according to alternative proposals A-1 and A-2 are shown in Table 7-3-1.

Table 7-3-1 Table of Total Construction Costs

(Unit: 1,000 Tugrik)

Type of Work	A-1		A-2	
	Foreign currency	Domestic currency	Foreign currency	Domestic currency
Civil Engineering/Building Costs				
Transshipment facility (civ.eng.)	59,104	43,143	51,057	55,028
Transshipment facility (bldg.)	56,665	1,186	56,522	1,182
Track works	292,242	97,281	288,363	95,977
Embankment works	47,869	29,202	49,383	29,424
Building works	123,560	127,902	123,322	127,647
Despatch of technicians	27,502	0	27,447	0
Subtotal	606,942	278,714	596,094	309,258
Transshipment Machinery & Equipment Costs				
Container cranes (2)	162,560	0	0	0
Gantry crane (1)	55,040	0	0	0
Fork lifts (1.5t) (4)	7,862	0	7,862	0
Conveyors (4)	1,664	0	1,664	0
Incidental equipment	58,554	0	17,351	0
Reach stackers (2)	0	0	78,080	0
35t Track crane	0	0	18,880	0
Subtotal	285,680	0	123,837	0

Type of Work	A-1		A-2	
	Foreign currency	Domestic currency	Foreign currency	Domestic currency
Signaling & Communication Equipment				
Blockers	17,669	55	17,669	55
Signals	13,913	97	13,913	97
Interlocking	112,696	237	112,696	237
Switches	30,245	129	30,245	129
Track circuits	35,844	311	35,844	311
Electric cable channels	32,929	823	32,929	823
Exchanger equipment	24,842	0	24,842	0
Power/Air-conditioning/Wireless etc.	26,298	64	26,298	64
Subtotal	294,436	1,716	294,436	1,716
Electricity Equipment				
750kW Generators (2)	119,970	82	119,970	82
High-tension board	30,110	16	30,110	16
Transformer	6,942	16	6,942	16
Roof lighting	7,587	152	7,587	152
Telegraph poles etc.	12,674	231	12,674	231
Subtotal	177,283	497	177,283	497
TOTAL	1,364,341	300,927	1,191,650	311,471
	1,665,268		1,503,121	

Chapter 8

CHAPTER 8 IMPLEMENTATION PLAN

8-1 Effectuating Authorities

The effectuating authorities for this project shall be the Mongolian Ministry of Trade and Industry and the Mongolian Railways.

8-2 Construction Implementation Objectives

As stated in 2-10, Mongolian construction companies are as yet technologically underdeveloped, thus dependence is placed on foreign (including Russian) companies for implementing construction work. Thus we have no choice but to give guidance to Mongolian construction companies in executing the work with financial and technical support from overseas. In other words, the work should be carried out jointly by construction companies from technically advanced countries and their Mongolian counterparts. Mongolian manufactured products and labour should be utilized to the full in order to contribute even in a small way to the development of the Mongolian economy.

As stated in 2-6, the natural environmental conditions at Zamyn-Uud are by no means favorable for construction purposes, since it is in a desert region, while its geographical location is inconvenient. Apart from embankment materials there are many not materials available locally. Besides imported materials (such as rails and steel-framed products), the basic materials (such as cement, gravel, timber, and bricks) as well as construction materials have to be brought in from places 700km away. This means that the Mongolian Railways will be required to transport construction materials, it will be imperative to enlist the cooperation. In winter, temperatures fall to -10 or -20°C, so in this period difficulties are anticipated in work such as concrete casting and embankment compaction. The construction processes will have to be planned with all due consideration to the timing of implementation.

In the construction of concrete structures, large amounts of concrete will be used for vital structures such as platforms and crane foundations. Thus concrete should be mixed and cast on site, in view of workability and durability. It will be advantageous if precast concrete is used wherever durability is not of vital importance (namely, walls of buildings), since this work can be implemented even in the winter period.

For implementation procedures, materials could be ordered and brought in and banking materials could be transported in the winter period, while the embankment constructed and concrete cast in the summer. The buildings could be erected and machinery and rails could be brought in and stored on-side in the following winter.

8-3 Implementation Schedule

Although the two proposals (A-1 and A-2) that have been presented for the project do differ somewhat in their finer details, there is no major difference in the timing, as of their implementation schedules are the same. However, we have decided to divide operations into two phases: Phase 1 for those that are urgent, and Phase 2 for those that are not. The Implementation Time Schedule is shown in Figure 8-3-1.

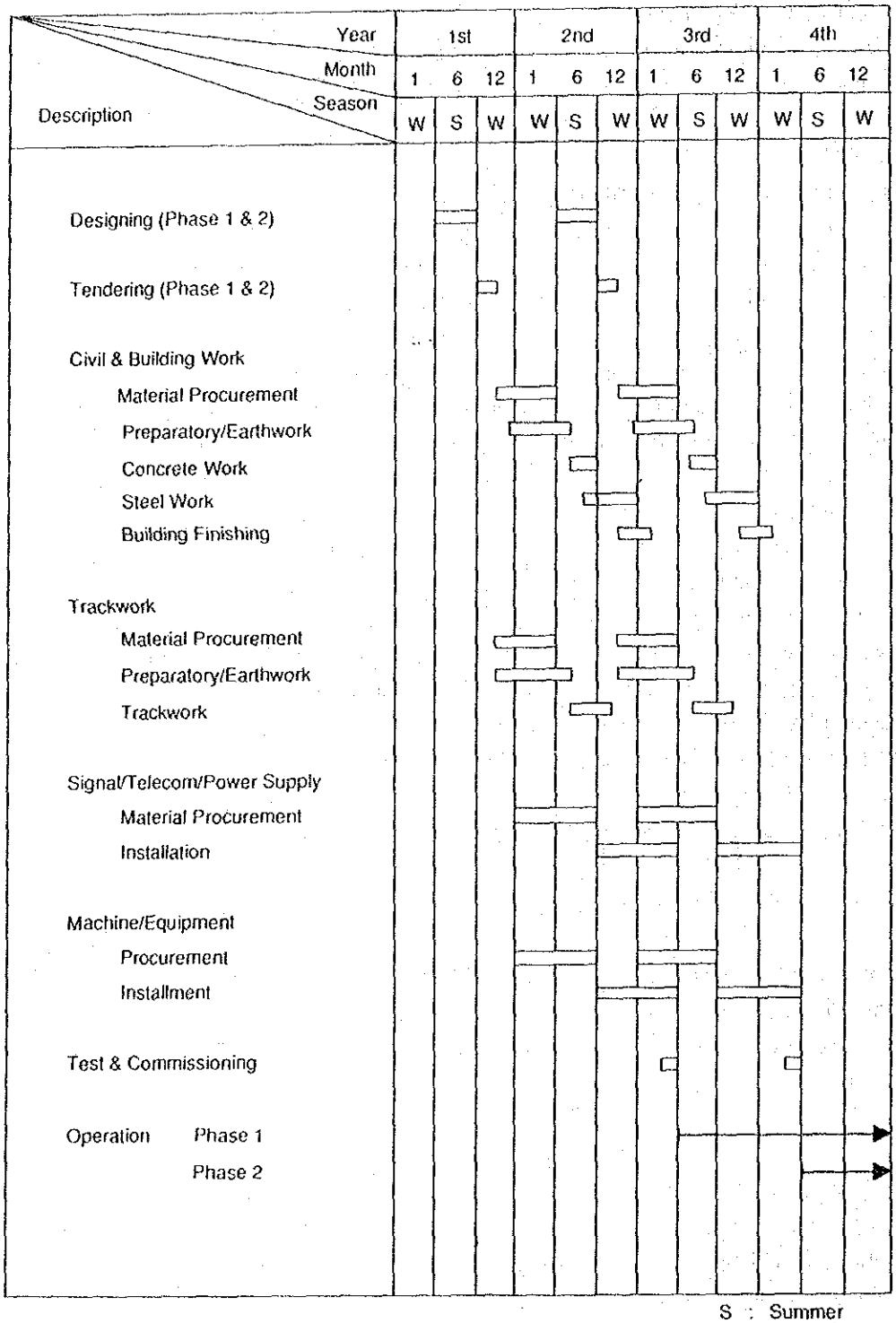


Fig. 8-3-1 Implementation Time Schedule for Zamyn-Uud Transshipment Facility Project

Chapter 9

CHAPTER 9 OPERATION AND MANAGEMENT

To efficiently operate freight trains between Mongolia and China, the team discussed the appropriate organization of Zamyn-Uud station. At the same time, the team estimated the costs of the transshipment work and the maintenance of the facilities of the station.

9-1 Operation

International freight transport between two countries of different track gauges requires transshipment of cargo at the border stations. According to the international practice, it is a rule that the recipient country transships the arriving cargos.

In the case of Mongolia and China, however, the transshipment is being carried out at Erenhot in China despite this international rule, since Mongolia does not have transshipment facilities at its border station.

After the completion of the transshipment facilities now planned for Zamyn-Uud station, it must be operated efficiently to facilitate smooth cargo transport between Mongolia and China. For this purpose, it is indispensable to exchange information on the cargo movements including packing styles, car types and destinations between the two countries.

9-2 Organization

Zamyn-Uud station is engaged in a wide range of activities including train operation, rolling stock maintenance, power generation, track maintenance, signaling, operation of hospital and school, and fire prevention, with 357 employees in total.

Since the station is located near the border with China, a remote place from large towns, the increase of employees must be limited to a minimum level, by utilizing the present work force as much as possible. For this reason, it is necessary to:

(1) Operate the station with the present organizational structure without organizing new divisions.
(2) Introduce efficient work procedures for the cargo transshipment work, and
(3) Cope with the increased workloads by improving the efficiency of the present work force.

9-3 Number of Employees

To efficiently implement the international freight transport, the team determined the number of employees taking into consideration transport demand, freight train operation plan, yard work plan and scales of various cargo handling equipment, in addition to the employment situation of Mongolian Railway as a whole. Table 9-3-1 shows the number of employees thus determined.

(1) Operation of Station

As explained in 4-2, the employees to be newly adopted include cargo transshipment workers, inspectors of cargo transshipment work, interpreters for Chinese inspectors, yard men for shunting, signal men to handle signals and the relay interlock system, point men and guards for

prevention of thefts. In case the workload increases in the future, train dispatchers, errand workers and customs document officers will be newly recruited.

(2) Shunting Locomotive Drivers

Zamyn-Uud station will be assigned with two types of shunting locomotives, one each for the 1,435mm gauge track and the 1,520mm gauge track. With the aid of radio communication means, a locomotive can be operated by one driver. When the frequency of train operation between Zamyn-Uud station and Erenhot increases in the future, drivers and assistant drivers will additionally be employed accordingly.

Table 9-3-1 Number of Employees for Station Business and Shunting Locomotives

Assignment	Sep. 1992		2000		Increase
	No. of daily report/1 shift	Total	No. of daily report/1 shift	Total	
1. Station master	1	1	1	1	0
2. Deputy station master	3	3	3	3	0
3. Operation clerk	1	5	2	8	3
4. Document transmission clerk	1	1	2	8	7
5. Senior yardman	1	4	3	12	8
6. Yardman	1	4	3	12	8
7. Switchman	3	12	0	0	-12
8. Freight inspector	1	4	10	40	36
9. – do – (Erenhot)	9	36	9	36	0
10. Customs handling clerk	1	4	2	8	4
11. Interpreter	2	8	2	8	0
12. Information clerk	1	1	2	8	7
13. Equip. administrator	1	1	1	1	0
14. Traffic clerk	1	1	1	1	0
15. Cleaner	1	1	1	1	0
16. Fare collector	1	1	1	1	0
17. Driver	1	1	1	1	0
18. Wagon arrangement clerk	1	4	2	8	4
19. Signalman			2	8	8
20. signalman (assistant)			2	8	8

Table 9-3-1 Number of Employees for Station Business and Shunting Locomotives (continued)

Assignment	Sep. 1992		2000		Increase
	No. of daily report/1 shift	Total	No. of daily report/1 shift	Total	
21. Freight handling service man			3	12	12
22. Forklift operator			3	12	12
23. Crane operator			2	8	8
24. Crane operator (assistant)			3	12	12
25. Interpreter			2	8	8
26. Guardman			2	8	8
27. Fare collector (freight)			1	1	1
Total		92		234	142
1. Driver			2	8	8
2. Driver (to/from Erenhot)	2	6	2	10	4
Total		6		18	12

(3) Rolling Stock Maintenance

The rolling stock maintenance is being carried out by 47 workers at present as explained in 2-9-4. Their major assignments are inspection of locomotives and freight and passenger trains, mainly visually made without dismounting components from the cars. In case a locomotive or a car fails, however, they will do necessary repair work.

At present two freight trains and three passenger trains are inspected at Zamyn-Uud station. In the year 2000, the numbers of trains and locomotives to be dealt with will increase to six freight trains and two locomotives besides the three passenger trains which are the same as at present.

Even though the workload is nine trains, the present work force seems to be able to cope with, since it takes only one hour or so to complete inspection of a train. In view of the new assignment of two types of shunting locomotives and the possibility of increase of rolling stock maintenance as a result of the increase of cars to be handled, it is appropriate to add one worker to each shift, i.e., four workers in total in the four-shift working system.

(4) Maintenance of Cargo Handling Equipment

The cargo handling equipment require an appropriate number of operating and maintenance staff. The cargo transshipment work consists of three categories, transshipment of containers, transshipment of cargos in gondolas and transshipment of cargo in wagons. (See 4-4-6 for the time lengths necessary for the transshipment work.)

In this situation, the work force must be composed of:

a. A crane operator and an assistant for container,
b. A crane operator and two assistants for cargo in wagons, and
c. A forklift operator and six cargo carrying workers for cargos in gondola.

Cargos in gondola are wound with wires when to be lifted. This requires an assistant for unloading from the Chinese car and another for loading on the Mongolian car. Three to four forklifts and conveyors will be used in handling the cargos transported by wagon.
From the above, a team should have 11 workers. It is necessary therefore to employ 44 workers for the cargo transshipping in the four-shift working system.
The workload differs depending on the packing styles and volume of cargos transported by a train, so that the number of the workers in one shift should not be fixed. Adjustments should be made between different shifts flexibly by confirming the composition and contents of the arriving train.

(5) Track and Building

1) Track

The length of track to be maintained is 20km in total, i.e., 10km in the yard and 10km to the border. The present work force consists of

A head of the team,
A foreman and
Eight track men, for the yard,

and for the track to the border,

A foreman,
Five track men and
A driver.

In the year 2000, the tracks in the yard have been extended to 33km, to make the total length to be maintained 43km. The passing tonnage is given in Table 9-3-2.
In estimating the necessary number of track maintenance staff in the year 2000, the team considered the present status of track maintenance work, severe natural conditions at the site, possibility of improvement of maintenance work and modernization of the facilities, in addition to the similar situation of the private freight transport railway companies in Japan for a reference. The number thus determined is

A head of the team,
Two foremen and
Thirteen track men, for the yard

and for the track to the border,

A foreman,
Five track men and
A driver.

The calculation is:

33km × 0.6 person/km × 0.6 (reduction rate for a yard) × 1.3 (multiplication rate for the environmental conditions) = 16 persons.

The number of workers per km is the standard of private railway companies in Japan.

Table 9-3-2 Passing Tonnage

Track Gauge (mm)	Section	Passing Tonnage (ton/day)	Remarks
1,435	E to Z	4,663.6	Pay load + tare
		360	Locomotive
	Z to E	1,810	Pay load + tare
		360	Locomotive
	Total	7,193.6	
	Total per year	2.63×10^6	
1,520	Z to E	11,106	Pay load + tare
		720	Locomotive
	E to Z	3,667	Pay load + tare
		720	Locomotive
	Total	16,213	
	Total per year	5.92×10^6	
	U to Z	11,631	Pay load + tare
		1,200	Locomotive
		7,087.6	Pay load + tare
	Z to U	1,200	Locomotive
	Total	21,118.6	
	Total per year	7.71×10^6	

Note : Z : Zamyn-Uud E : Erenhot U : Ullaanbaatar

Table 9-3-3 Freight Transport of Private Railway Companies in Japan

Company	Route Length (km)	Passing Tonnage (10^3 t)	Passing Tonnage × Kilometer (10^6 t•km)	No. of Track Men (Person)	Unit No. of Track Men (person/km)
Hachinohe	8.5	179	1.52	1	0.12
Iwate	11.5	3,311	38.08	14	1.21
Akita	7.9	194	5.50	2	0.25
Sendai	9.5	932	5.15	2	0.21
Hiroshima	19.2	252	3.31	6	0.31
Keiyou	26.3	2,000	24.61	5	0.19
Chichibu	79.3	6,182	181.2	50	0.6

Source: 1985 statistics of private railway company in Japan

2) Building

The present building maintenance team consists of a foreman, two painter and a carpenter, which will be strengthened in the year 2000 to a formation of a foreman, a plasterer, a carpenter and a painter.

(6) Signal and Telecommunication

Twenty-one members including the head of the team and a senior engineer are employed at present to operate and maintain the following signal and telecommunication equipment.

Signal	7 sets
Hand-operated point	42 sets
Tablet block system	2 sets
Semi-automatic block system	1 set
Point and route setting lever	4 sets
Step-by-step exchange	1 set
Exchange stand	1 set
Transmission equipment	2 sets
Bare wire equipment	1 set

The number of the staff to operate and maintain the signal and telecommunication equipment must be determined to cope with the quantities of the equipment, fixed workload and fluctuation of workload.

In the year 2000, the quantities of equipment will have been increased to the following quantities.

Signal and point signal	119 sets
Indicator	49 sets
300-route relay interlock equipment	1 set
Power-operated point	100 sets
Track circuits	141 sets

Digital exchange	1 set
Exchange stand	1 set
Talk-back equipment	20 sets
Voice call telephone	20 sets
Transmission equipment	2 sets
Telephone	300 sets

Table 9-3-4 Gives the man-hours require for the maintenance of signal equipment.

Table 9-3-4

Equipment	Quantity	Quantity of daily inspection	Frequency per month	No. of maintenance staff	Man-hours per month
Power operated point (inspection)	100	20	2	5	500
– do – (replacing)	100	2 (per month)	1	10	200
Signal/indicator	168	30	1	3	170
Track circuit	141	50	1	2	60
Interlock	1			2	400
P52 station	1		2	5	100
Transmission line	207 km	4	1	4	170
Contingency					300
Total					1,900

When the man-hours per month per person is assumed as 200, the number of the workers necessary for the signal equipment is 1900/200 ≃ 10. When an engineer is included, the number of the team becomes 11.

Table 9-3-5 shows the man-hours necessary for the maintenance of telecommunication equipment.

Table 9-3-5

Equipment	Quantity	Man-hours per month	Remarks
Digital exchange	1	300	30 days × 1 = 30
Transmission equipment	2	300	30 days × 1 = 30
Bare wire equipment	100 (km)	300	Daily inspection : 10km, frequency once a month, (100/10) × 100 = 30
Others		300	Including talk-back and telephone

Four members are required for the telephone exchange in 24 hours. One member is fixed as the postal service man. The number of maintenance staff is calculated as 1000/200=5.
Thus, the number of the staff for the telecommunication equipment is 10.
When the numbers of the staff required for signal and telecommunication equipment are totalled, the necessary number becomes 21, which is the same as the number of the present staff.

(7) Power Supply Equipment

At present, 25 workers are assigned to the power generating plant of Zamyn-Uud staton, including four maintenance staff and engine operators, assistant operators and electricians who are working in two shifts.
In the year 2000, the operation of power generators and the auxiliary distribution board will have been automated so that the number of staff need not be increased for the operation of the system. However, one more member will be necessary as the maintenance staff to cope with the increase of the number of power generators and the length of transmission lines.

(8) Increase of the Number of Staff

Table 9-3-6 summarizes the increase of the number of the station staff as of the year 2000.

Table 9-3-6

Assignment	Increase	Remarks
Train operation	98	Increases of trains and cargos
Locomotive	12	Introduction of shunting locomotives and increase of shunting
Car maintenance	4	Introduction of shunting locomotives and increase of maintenance
Cargo handling equipment	44	Installation of cargo transshipment equipment
Track and building	6	Extension of tracks
Signal and Telecom. eq.	0	The present staff can cope with the increased equipment
Power supply eq.	1	Increase of maintenance work
Total	165	

Increase of train operation frequency and emergence of cargo transshipment work will accompany miscellaneous auxiliary work, which shall be dealt with, however, by effectively utilizing the present and increased work force.

9-4 Training

For the operation of the cargo transshipment facilities, the following training is necessary.

(1) Before the Commissioning

1) Contents of training

a) Operation of cargo handling equipment
Structure, function and operation

b) Maintenance of cargo handling equipment
Structure, function and maintenance

c) Operation of signal, switching and relay interlock equipment
Security system for train operation, equipment, operation and trouble shooting

d) Signal and point and their maintenance
Structure and maintenance

e) Radio communication equipment, digital exchange, communication equipment in the yard
Function and operation

f) Maintenance of radio communication equipment

Function and maintenance

g) Power supply equipment
Operation of generator and maintenance

2) Instructor
Prior to the training of the workers, instructors must be trained. Training of instructors are to be made abroad or in Mongolia depending on the situation. As for the training on the cargo handling equipment, however, the equipment can be brought into the construction site in advance, then the engineers from the manufacturers will be able to train the instructors and transfer the technologies using the equipment. Similar approaches can be adopted for the training of signal, interlock and radio communication equipment, generator and digital exchange.

(2) After the Commissioning
It may take nearly one year after commissioning the cargo transshipment facilities for the staff to be sufficiently experienced and acquire necessary skills in the operation. The training schedules must be well prepared considering the severe natural conditions, the maximum temperature of 40°C in summer, the minimum temperature of –40°C in winter and the climate of the desert area.

9-5 Operating and Managing Costs

According to the above operating and managing policy, the team calculated the operating and managing costs in the year 2000 as follows.

(1) Personnel Cost
The team calculated only the personnel cost of the employees increased for the reason of commissioning the cargo transshipment facilities assuming that the monthly salary or wage of an employee is 3,000Tg.

(2) Energy Cost

1) Power (for signal and lighting)
The yearly watt-hour of power consumption was multiplied by the unit cost.

Yearly power consumption
Signal : 328,500KWH
Lighting : 1,029,000KWH

To decide the unit cost, the team devided the total costs for power generation including the personnel costs for maintenance and the heavy oil cost by the total amount of power generation per year.

Total costs for power generation per year	:	10,046,000Tg.
Total watt-hour of power generation	:	7,884,000KWH
Unit cost	:	1.3Tg.

2) Light oil (for cargo handling equipment)
The price of the equipment is multiplied by the following factor.

Container/gantry crane	:	0.020
Forklift/conveyor	:	0.023
Reach stacker	:	0.027
Truck crane	:	0.035

3) Operation and maintenance

The price of the equipment was multiplied by the following factor mainly based on the standard of former Japanese National Railways.

a) Signal and telecommunication equipment 0.0025

b) Civil structure (including 10% as the personnel cost of maintenance staff)

Track bed	0.0004 × 0.6 (reduction rate for yard)
Track	0.0005 × 0.6 (– do –)
Building	0.00057
Platfromn	0.00041

c) Cargo handling equipment 0.05 (including personnel cost of 44 workers)

Chapter 10

CHAPTER 10 ECONOMIC AND FINANCIAL EVALUATION

10-1 Economic Evaluation

10-1-1 Method of Evaluation

(1) General Statement

In this section, an economic evaluation of the project will be conducted based on the plans discussed in the previous chapters. The project entails building facilities for transshipping freight, and the evaluation will be conducted by comparing the social cost and benefit that will be generated by the construction of the facilities.

The project assumes a construction period of three years, from 1993 through 1995. Some of the facilities are expected to begin operating in 1994. Our economic analysis will cover a period lasting 30 years from the start of construction.

During the course of the evaluation, calculation will be carried out on three indices: the net present value (NPV); the ratio of benefit to cost (B/C); and the internal rate of return (IRR).

The net present value (NPV) indicates economic profitability on the basis of the difference between the net present value of benefit and the net present value of cost. When the discount rate is i, the difference can be indicated by the following equation:

$$NPV = (\sum Bt/(1 + i)^t)/(\sum Ct/(1 - i)^t)$$

The ratio of benefit to cost is represented by the equation given below used to calculate the ratio of the present net value of benefit to the present net value of cost. As such, it indicates the economic profitability by the size of the benefit of the present value per cost of the present value.

$$B/C = (\sum Bt/(1 + i)^t/(\sum Ct/(1 + i)^t)$$

The internal revenue rate (IRR) corresponds to the maximum interest rate commensurate to the revenue when it is time to repay the benefits generated by the supply of capital obtained by investing in the project. This is defined as the discount rate at which the net present value (NPV) is zero. In other words, the internal revenue rate is defined when the discount rate i is

$$\sum(Bt - Ct)/(1 + i)^t = 0$$

An 8% discount will be used in calculating NPV and B/C. This rate is based on the estimates of capital case cost which Japan's international assistance agency adopts in many underdeveloped areas. The unit of money used in the analysis is the fiscal 1992 tugrik unit.

(2) Benefit

There are no measurable benefits, direct or indirect, generated by the project. Generally speaking, one would think that construction of facilities, such as those proposed, would generate various benefits including: increased circulation velocity of goods, reduced damage to load, and effective operation of transport vehicles. But this project calls for only one thing: the transfer of facilities for transshipping freight. No other improvements on the transport environment are being considered. Thus it will be impossible to measure the direct benefits of this project.

The only thing that will change as a result of the construction stipulated in the project is that Mongolia will no longer have to pay the fee for transshipping freight that it used to pay to the Chinese side, Since the money saved as a result will not leave the country, it can be counted as a benefit for the Mongolian economy.

Also, there is no guarantee that it will be possible in the future to continue relying on the transshipping facilities on the Chinese side to transship freight. In certain cases, it may become necessary to take charge of the freight on the Chinese side and transship it to the railroad on the Mongolian side. In such cases, an additional investment will be needed to transport the freight by truck and transship it to the Mongolian side. It will be possible to avoid the cost of such additional investment if the proposed project is implemented. Thus this can be regarded as a form of benefit.

From the foregoing, it was decided that benefit calculations should be made by taking into consideration the additional investment of truck transport and related fees.

(3) Cost

The cost of conducting an economic evaluation will be determined by converting the cost of the project mentioned in the previous section (financial cost) into economic cost. In this conversion, it will be necessary on the one hand to remove the cost of transfer included in the economic cost and on the other hand to introduce Mongolia's potential labor rate. However, being a socialist state, there are many uncertainties regarding, for example Mongolia's unemployment rate. Consequently, it was decided that actual wages, without alteration, should be used, and that income tax should be removed from the wages. But no other measures were considered.

Moreover, since the evaluation period for the project is 30 years, the scrap value of items with useful life of more than 30 years was calculated and added as negative cost to the cost account of the final fiscal year of the evaluation period.

10-1-2 Calculation of Benefits

(1) Transshipping Fee

Fees to be added to the evaluation as benefits are those charged by the Chinese side on goods imported to Mongolia.

(a) Fees that Mongolia will pay to China.
(b) Fees that the former Soviet Union will pay to China.

(a) is what Mongolia will pay if the project is not implemented. (b) is what Russia will pay to China if the project is not implemented. Hence (b) will become a revenue for Mongolia after the project is completed.

Since transshipping fees are proportional to the amount of freight handled, these fees were sought by using an existing method of calculation based on a freight traffic demand forecast. Transshipping fees for each fiscal year are shown in Table 10-1-1. It is assumed that there will be no increase in the transshipping fees (the amount of freight handled) after the year 2000.

Table 10-1-1 Transshipping Fees for Each Fiscal Year

(Thous. tugrik)

Fiscal year	Fee
1994	19,482
1995	38,668
1996	50,862
1997	52,684
1998	54,406
1999	56,130
2000	57,754
2001	57,754

(2) Addition Investment in Truck Transport

In case a system is adopted where freight is transshipped by truck, the additional investment will be regarded as a benefit.

1) The cost of constructing the transshipping facilities on the Mongolian side

The cost of constructing the transshipping facilities is obtained by subtracting from the construction cost of the project the cost of constructing the trackage on the Chinese side. This difference should correspond to (a) the cost of constructing transshipping facilities on the same scale as those planned in the present project, (b) the cost of constructing the facilities laid only on the trackage on the Mongolian side. As for the cost of constructing transshipping facilities in the case of truck transport, the calculation was made assuming a case where no crane — which entails a relatively low construction cost and after-scale cost — was used. Construction cost, maintenance cost and other calculated costs are shown in Table 10-1-2.

Table 10-1-2 Construction Cost of Transshipment Facilities

(Thous. tugrik)

Commodity	Survival year	Construction Cost			Maintenance Cost		
		Foreign	Local		Foreign	Local	P. expend
			P. expend.	Others			
Civil architect		300,598	19,571	162,897	1,299	1,221	2,785
Concrete work	35	37,757	5,176	43,088			
Platform work	20	41,798	110	927			
Rail track work	30	127,946	5,417	45,090			
Earth work	100	21,911	1,661	13,823			
Building work	20	53,718	7,206	59,968			
Construction specialist	--	16,468	0	0			
Mechanical		91,577	0	0	9,658	0	1,517
Reach stacker	7	57,740	0	0			
Track crane (35t)	7	13,962	0	0			
Forklift (1.5t)	6	5,814	0	0			
Port. comveyor	5	1,231	0	0			
Aux. facility	8	12,831	0	0			
Signal & telecom.		217,735	1,615	0	859	0	724
Transmission line	30	24,351	774	0			
Air equp.	17	6,462	16	0			
Radio commu.	19	2,555	0	0			
Talk-Back	19	3,232	30	0			
Tel. exchange	10	18,371	0	0			
Voice commu.	19	5,343	12	0			
Block	30	13,066	52	0			
Signal	30	10,289	91	0			
Interlock	30	83,339	223	0			
Power supply	30	1,855	2	0			
Switching equp.	30	22,366	121	0			
Track cir.	30	26,507	293	0			
Power equp.		131,587	433	0	988	0	2
Generator	10	68,034	188	0			
Lighting	20	3,283	56	0			
Power supply lines	30	60,269	188	0			
Total		741,497	21,619	162,897	12,804	1,221	5,029

Note: Civil architect to personal expenditure of maintenance cost contains 71's drive maintenance persons.

2) Transport vehicles

Cost is calculated for vehicles used in transporting goods by truck between Erenhot Station on the China side and Zamyn-Uud Station on the Mongolia side. The number of trucks that will be required is sought for each type of freight by using the results of freight traffic demand forecast for the year 2000. According to these results and the schedule of transport, it is estimated that if two freight trains arrived from China every day, the breakdown of that freight would be 12 boxcars (447 tons), 13 open freight cars (612 tons), and 65 containers (20 ft). The average time for transshipment of cargo is estimated to be 40 minutes per boxcar, 10 minutes per open freight car, and 10 minutes per container. The calculation is made on the assumption that it will take 20 minutes to cover the 10-kilometer route between the two stations going at 30km/h. The number of hours available for operating each train was set at six hours. Also, 10 percent of the trains were assumed to be suspended for maintenance. The train drivers worked under a four-shift system. The fuel cost was calculated by setting fuel cost at 30Tg/lit at a fuel efficiency of 30km/lit. Furthermore, 5 percent of the train cost was appropriated for annual repair expenses. The required number of transport vehicles, purchase cost (economic cost) and operating expenses are show in Table 10-1-3.

Table 10-1-3 Required Transport Vehicles

Type		Boxcar	Open Freight	Container
Volume	(number)	6.0	6.5	34
Volume	(ton)	223.5	306.0	–
Transshipping hours	(min.)	80	160	20
Required hours	(min.)	40	40	40
Type of car		10t boxcar	10t flat body	20 feets
Economic prices	(Thous. togrog)	400	269	4,672
Survival year		4	4	5
Number of required car		8	18	6
Number of reserved car		1	2	1
Number of total		9	20	7
Purchase cost	(Thous. togrog)	3,600	5,380	32,704
Personal expense of driver	(Thous. togrog)	1,104	2,483	828
Fuel efficiency	(Thous. togrog)	868	1,172	1,302
Repair expenses	(Thous. togrog)	157	234	1,423
Operating expenses	(Thous. togrog)	2,128	3,889	3,552

3) Rent for facilities located on the Chinese side

As the cost of transshipping freight from freight trains to trucks on the Chinese side, Mongolia will pay China one-half of the fee indicated in Table 10-1-1. This fee will be added to the rent Mongolia will pay China for the use of its facilities.

4) Cost of constructing transport roads

The road currently in use will basically be used as a transport road for truck transport. The cost will be calculated by regarding only the distance of some 450 meters from this road to the transshipping facilities as the road to be constructed anew.

10-1-3 Calculation of Economic Cost

(1) Construction Cost

The cost of the project (financial expense) was divided into foreign currency cost and domestic currency cost on the basis of where the necessary materials were procured from. Domestic currency was converted into economic cost by dividing it further into personnel expenses and other material costs. Properly speaking, in converting domestic currency into economic cost, prices which are not determined through a valid market mechanism are put into force only after they have been revised. The principal revisions include removal of transfer cost, revision of foreign exchange rates, and consideration of potential labor wage rates. In this project, economic cost was calculated by removing from the calculation only one of these revisions whose content can be clearly grasped, that is to say, removal of transfer cost.

1) Foreign currency cost

With regard to foreign currency, import tax and surtax were removed. Import tax differs depending on the asset. But its division is not clear, and in this project, since special equipment was not available, an average import tax of 15% was applied to all foreign currencies before they were removed from the calculation. Surtax was set at 13%. With regard to the cost of dispatching experts to the construction site, it will not be taxed, this cost was judged to be the same as the financial cost.

2) Personnel expenses in Domestic currency

Due to the lack of data for calculating potential labor wage rates, the influence of personnel expenses is difficult to calculate. Thus it was decided that labor wages should be used without altering them. But it was decided that income tax should be removed from the calculation. Since a progressive taxation system has been introduced, properly speaking, income tax should be calculated in terms of type of occupation. But since data on income tax are not available, the calculation of personnel expenses was simplified by removing a tax rate of 5.9% from the calculation, which corresponds to 3,375Tg/month, the wage of an average construction worker.

3) Other personnel expenses in Domestic currency

With regard to other personnel expenses in domestic currency, economic cost was determined by removing a 13% surtax from the calculation.

(2) Maintenance and Working Expenses

Maintenance and working expenses can be divided into maintenance and administrative expenses on the one hand and running cost on the other. The former is an investment made to prevent the function of transshipping facilities from declining; the latter is the cost incurred to operate the facilities. These expenses and cost are incurred every year, so no distinction was made between them in this project.

Maintenance and working expenses of the relevant facilities were calculated by dividing them into cost of materials, such as spare parts, and personnel expenses. With regard to materials, since most of the materials are imported, this cost was added to the foreign currency cost.

Maintenance and working expenses related to transshipping expenses were calculated by dividing them into those added to the foreign exchange cost of materials and those added to the domestic currency cost of the same.

Personnel expenses other than those for paying the workers who will maintain and administer the facilities and those for paying the personnel who will be running them were calculated as follows: The total number of workers in the year 2000 is estimated to be 230. Of these, the 92 who are currently on loan in China will be needed regardless of the project. Hence, the cost of maintaining these workers were removed from the calculation. The personnel expenses of the 72 (44 engaged in work related to facilities, and 22 engaged in work related to signals) of the remaining 138 workers were calculated separately.

(3) Residual Value

Since the period of evaluation is 30 years, the residual value of items with useful life exceeding 30 years was calculated and added as negative cost to the cost account of the final fiscal year of the evaluation period.

With regard to machinery, in case they are replaced, it was decided that the scrap value of old machines should be estimated as having a 10% residual value. With regard to assets other than machinery, since they cannot be diverted to other use once they have passed their useful life, they were deemed to have no residual value.

Table 10-1-4 Economic Cost (Plan 1)

(Thous. tugrik)

Commodity	Survival year	Construction Cost			Maintenance Cost		
		Foreign	Local		Foreign	Local	P. expend
			P. expend.	Others			
Civil architect		455,998	28,114	233,888	1,299	1,221	2,785
Concrete work	35	43,707	4,059	33,782			
Platform work	20	41,904	111	929			
Rail track work	30	216,113	9,154	76,171			
Earth work	100	35,399	2,748	22,865			
Building work	20	91,373	12,043	100,140			
Construction specialist	–	27,502	0	0			
Container cranes		211,260	0	0	16,027	0	1,517
Gantry crane	8	120,213	0	0			
Track crane (35t)	8	40,702	0	0			
Forklift (1.5t)	6	5,814	0	0			
Port. comveyor	5	1,231	0	0			
Aux. facility	8	43,301	0	0			
Signal & telecom.		217,735	1,615	0	859	0	724
Transmission line	30	24,351	774	0			
Air equp.	17	6,462	16	0			
Radio commu.	19	2,555	0	0			
Talk-Back	19	3,232	30	0			
Tel. exchange	10	18,371	0	0			
Voice commu.	19	5,343	12	0			
Block	30	13,066	52	0			
Signal	30	10,289	91	0			
Interlock	30	83,339	223	0			
Power supply	30	1,855	2	0			
Switching equp.	30	22,366	121	0			
Track cir.	30	26,507	293	0			
Power equp.		131,158	414	0	988	0	2
Generator	10	68,034	188	0			
Lighting	20	3,143	47	0			
Power supply lines	30	59,981	179	0			
Total		1,016,151	30,143	233,888	19,172	1,221	5,029

Note: Civil architect to personal expenditure of maintenance cost contains 71's drive maintenance persons.

Table 10-1-5 Economic Cost (Plan 2)

(Thous. tugrik)

Commodity	Survival year	Construction Cost			Maintenance Cost		
		Foreign	Local		Foreign	Local	P. expend
			P. expend.	Others			
Civil architect		447,961	29,096	242,154	1,299	1,221	2,785
Concrete work	35	37,757	5,176	43,088			
Platform work	20	41,798	110	927			
Rail track work	30	213,244	9,030	75,151			
Earth work	100	36,519	2,768	23,039			
Building work	20	91,197	12,011	99,948			
Construction specialist	–	27,447	0	0			
Mechanical		91,577	0	0	9,658	0	1,517
Reach stacker	7	57,740	0	0			
Track crane (35t)	7	13,962	0	0			
Forklift (1.5t)	6	5,814	0	0			
Port. comveyor	5	1,231	0	0			
Aux. facility	8	12,831	0	0			
Signal & telecom.		217,735	1,615	0	859	0	724
Transmission line	30	24,351	774	0			
Air equp.	17	6,462	16	0			
Radio commu.	19	2,555	0	0			
Talk-Back	19	3,232	30	0			
Tel. exchange	10	18,371	0	0			
Voice commu.	19	5,343	12	0			
Block	30	13,066	52	0			
Signal	30	10,289	91	0			
Interlock	30	83,339	223	0			
Power supply	30	1,855	2	0			
Switching equp.	30	22,366	121	0			
Track cir.	30	26,507	293	0			
Power equp.		131,587	433	0	988	0	2
Generator	10	68,034	188	0			
Lighting	20	3,283	56	0			
Power supply lines	30	60,269	188	0			
Total		888,861	31,143	242,154	12,410	1,221	5,029

Note: Civil architect to personal expenditure of maintenance cost contains 71's drive maintenance persons.

10-1-4 Evaluation Results

(1) Evaluation Results

Where a crane is installed in the transshipping facility (Plan 1) and where a crane is not installed (Plan 2), if a cash flow and an evaluation index are indicated from the two cases, that is, the case where the additional cost of truck transport is treated as a benefit, and the case where only the fee is treated as a benefit, the results are shown in Appendix 10-1-1 and Appendix 10-1-2.

If the rate of discount is set at 8%, it can be shown that only Plan 2 is feasible.

Figure 10-1-1 illustrates the relationship between the net present value and the rate of discount when truck transport is treated as a benefit.

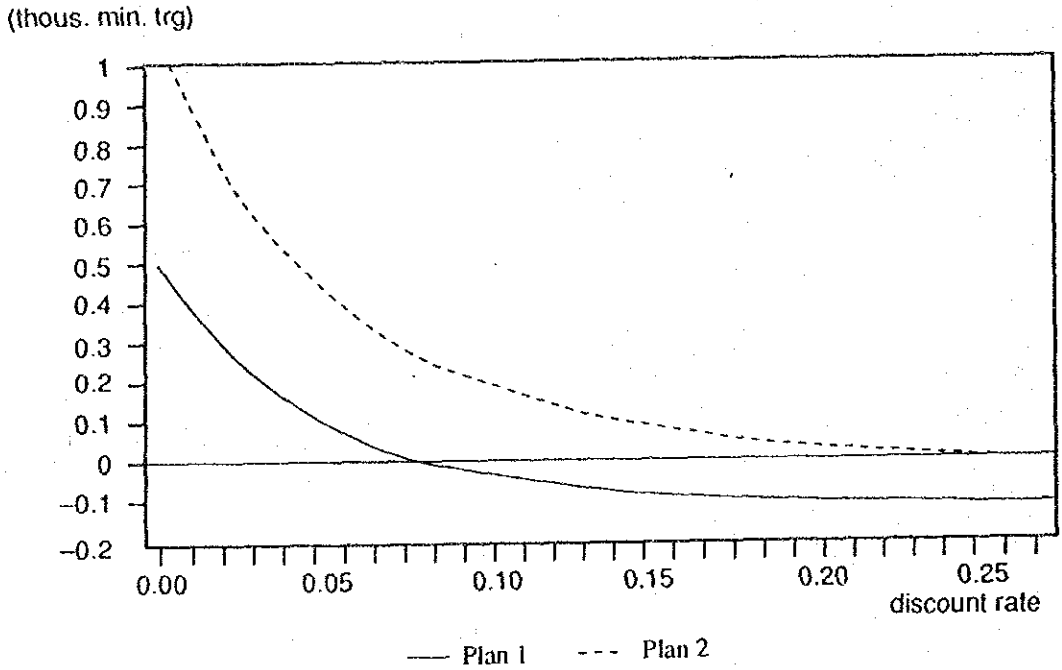


Fig. 10-1-1 Relationship of the Net Present Value and the Discount Rate

(2) Sensitivity Analysis

With regard to the case where truck transport is treated as a benefit, a sensitivity analysis was conducted on the amount of freight handled and the construction cost. In the sensitivity analysis, an IRR calculation was conducted for a case where the amount of freight handled was reduced by 5% and for a case where the construction cost rose by 5%. The results are shown in Table 10-1-4. From these results, it can be said that, despite some fluctuations, the sensitivity analysis for Plan 2 is fully feasible. The results also indicate that the impact of demand fluctuations is greater than that of cost fluctuations.

Table 10-1-6 Sensitivity Analysis

IRR (%)

Case	Plan 1	Plan 2
Basic case	8.88	26.28
Reduced by 5% of demand	5.46	18.12
Increase by 5% of cost	5.61	18.42

Appendix 10-1-1 Economic Estimate (Plan 1 Thous. Tugrik)

Year	Const. Cost	Main. Cost	Total	Benefits	Differences
1993	520,365	0	520,365	425,245	-95,121
1994	411,629	8,474	420,103	317,526	-102,577
1995	348,000	16,948	364,948	300,946	-64,002
1996	0	25,422	25,422	53,582	28,160
1997	0	25,422	25,422	62,575	37,153
1998	554	25,422	25,975	85,340	59,365
1999	3,170	25,422	28,592	59,386	30,794
2000	2,616	25,422	28,038	98,193	70,155
2001	103,718	25,422	129,140	94,942	-34,198
2002	67,086	25,422	92,508	60,877	-31,631
2003	80,286	25,422	105,707	157,605	51,898
2004	6,065	25,422	31,487	63,093	31,606
2005	8,127	25,422	33,549	73,237	39,688
2006	2,616	25,422	28,038	59,644	31,606
2007	0	25,422	25,422	95,576	70,155
2008	554	25,422	25,975	112,997	87,022
2009	104,272	25,422	129,693	69,513	-60,181
2010	69,029	25,422	94,451	62,820	-31,631
2011	17,550	25,422	42,971	65,437	22,465
2012	7,911	25,422	33,333	64,939	31,606
2013	153,771	25,422	179,193	221,101	41,909
2014	92,540	25,422	117,962	160,904	42,942
2015	88,635	25,422	114,056	144,433	30,376
2016	0	25,422	25,422	57,028	31,606
2017	106,334	25,422	131,756	71,575	-60,181
2018	70,256	25,422	95,678	93,480	-2,198
2019	13,544	25,422	38,966	61,431	22,465
2020	0	25,422	25,422	57,028	31,606
2021	0	25,422	25,422	103,658	78,237
2022	0	25,422	-227,630	-119,262	108,368
Total	2,278,629	711,805	2,737,382	3,234,846	497,464

Residual Value	253,052	
NPV	19,107	(1,000 Tg)
IRR	8.88	(%)
B/C	1.08	

Appendix 10-1-2 Economic Estimate (Plan 2 Thous. Tugrik)

Year	Const. Cost	Main. Cost	Total	Benefits	Differences
1993	452,785	0	452,785	425,245	-27,540
1994	370,789	6,220	377,009	312,655	-64,354
1995	338,397	12,440	350,836	291,279	-59,557
1996	0	18,660	18,660	40,866	22,207
1997	0	18,660	18,660	49,404	30,744
1998	554	18,660	19,213	71,739	52,526
1999	3,170	18,660	21,830	45,353	23,524
2000	41,165	18,660	59,825	83,754	23,930
2001	29,832	18,660	48,492	80,504	32,012
2002	3,849	18,660	22,509	46,438	23,930
2003	71,145	18,660	89,804	143,167	53,363
2004	6,065	18,660	24,725	48,654	23,030
2005	8,127	18,660	26,787	58,799	32,012
2006	2,616	18,660	21,276	45,205	23,930
2007	38,549	18,660	57,208	81,138	23,929
2008	26,537	18,660	45,196	98,559	53,363
2009	4,403	18,660	23,063	55,074	32,012
2010	5,793	18,660	24,452	48,382	23,930
2011	8,409	18,660	27,069	50,998	23,930
2012	7,911	18,660	26,571	50,500	23,930
2013	153,646	18,660	172,306	206,663	34,357
2014	130,964	18,660	149,624	146,465	-3,158
2015	114,493	18,660	133,153	129,994	-3,158
2016	0	18,660	18,660	42,589	23,930
2017	6,466	18,660	25,125	57,137	32,012
2018	7,019	18,660	24,679	79,041	53,363
2019	4,403	18,660	23,063	46,992	23,930
2020	0	18,660	18,660	42,589	23,930
2021	38,549	18,660	57,208	89,200	32,011
2022	25,983	18,660	-215,287	-133,701	81,586
Total	1,901,618	522,469	2,164,158	2,834,703	670,545

Residual Value 259,929

NPV 269,866 (1,000 Tugrik)

IRR 26.28%

B/C 1.33

10-2 Financial Analysis

10-2-1 Purpose of Analysis and the Index of Evaluation

The purpose of financial analysis is to evaluate profitability of the project, i.e. the possibility of sound management of the organization or enterprise operating the project. This purpose is entirely different from that of economic analysis. As main index of evaluation for financial analysis, Financial Internal Rate of Return (FIRR) is usually used. FIRR is calculated by making Cash Flow from the revenue of the project based upon the demand forecast, the investment cost and the operating expense of the project.

10-2-2 Main Prerequisites

Main prerequisites for this analysis are set as follows taking the discussions with Mongolian counterparts into consideration.

(1) Project Life

Project life to be analyzed is from 1993 (the starting year of construction) to 2025 (30 years from the completion of construction work).

(2) Inflation

Inflation is not considered in this analysis. It is very difficult to forecast future rate of inflation because it is influenced by political factors. Inflation also has the same effects on both sides of revenue and expense and thus it is to some extent neutral to the analysis.

(3) Exchange Rate

Now it is said that the real value of Mongolian currency, Tugrik is far below its official exchange rate, but according to Mongolian Railway the official exchange rate is applied for al their external payments and receipts. Therefore in this analysis the exchange rate of Mongolian Currency is fixed at 40 Tugrik to US Dollar.

(4) Price

All prices are indicated in market price as of August/September of 1992, the time of our initial study in Mongolia.

(5) Investment and Depreciation

Ten percent contingency is added to the investment cost presented by the study members. Total investment cost is divided equally into three and the same amount is disbursed each year during the construction period. After the durable years of each equipment have elapsed, it must be renewed. So the same amount of reinvestment is included in the analysis. Salvage value is included as negative investment in the last year of the project life. Amount of depreciation for each year is calculated by using the same durable years shown in the previous Section 10-1, Economic Analysis.

Table 10-2-1 is the initial investment for Plan 2 including 10% contingency and Appendix 10-2-1 shows the total investment including reinvestment for each year during the project life.

Table 10-2-1 Initial Investment (Including Contingency)

(Unit: Thousand Tugrik)

Investment	F/C	L/C	Total
Concrete construction	56,163	60,531	116,694
Platform	62,174	1,300	63,474
Rail	317,199	105,575	422,774
Roadbed	54,321	32,366	86,688
Building	135,654	140,412	276,066
Foreign specialists	30,192	0	30,192
Reach stacker	85,888	0	85,888
Truck crane	20,768	0	20,768
Forklift	8,649	0	8,649
Portable conveyor	1,830	0	1,830
Other loading equipment	9,715	0	9,715
Signaling equipment	194,735	572	195,307
Air conditioner	9,612	19	9,631
Rail circuit, etc.	75,650	1,247	76,898
Wireless equipment	16,556	50	16,606
Telephone exchange	27,326	0	27,326
Power generator	101,200	220	101,420
Lighting etc.	94,534	286	94,820
Total	1,302,167	342,577	1,64,745

(6) Transshipment Fee

Transshipment work of the cargo coming into Mongolia at Chinese border is now handled by Chinese side against international rules and practice and Mongolian Railway has to pay transshipment fee for the work. After the construction work of this project is completed, Mongolian Railway will be able to receive transshipment fee from the consignee of cargo according to the same standard.

The rate of transshipment fee at the border is based upon the international agreement with neighboring countries. Payment was made in Ruble upto 1990, but the revised agreement effective from 1991 has fixed the fee rate in Swiss Francs for each package style as follows.

S.Frs. 0.27 per 100kgs. of Package and Piece Cargo
S.Frs. 0.24 per 100kgs. of Bulky Cargo
S.Frs. 2.19 per each Container Gross Weight upto 2.5 Tons
S.Frs. 4.40 per each Container Gross Weight over 2.5 Tons

According to the information received from Mongolian Railway, revision of the above agreement is now under negotiation among the concerned countries and it is almost certain that the fee will be doubled equally for every package style from 1993. But even after this raise, the fee will be still low compared with the international standard and has to be adjusted to the level reflecting the cost of operation. Under such circumstances we presume that transshipment fee will be twice as much as the above rate from 1993 and will be raised further by 25% each in 1996, 1999 and 2002 (every three years).

In this analysis revenue in Swiss Franc is converted into Tugrik using the exchange rate of Swiss Franc prevailing in August 1992 (1.3 Swiss Francs to US Dollar) and the official rate of Mongolian Currency (40 Tugrik to US Dollar).

(7) Interest Rate and Other Conditions of Loans

Foreign currency portion of the initial investment is to be financed by loans from overseas. All other necessary funds (local currency portion of the initial investment, reinvestment and repayment of the foreign loan) are to be financed from the domestic loan if cash in hands is not enough. Borrowing of local loan is to be the minimum required amount and any surplus funds are to be immediately assigned to repayment. In this analysis no limit is set to the maximum amount of local loan.

The conditions of both foreign and local loan are as follows.

1) Foreign funds

International Financing Institutions or Development Aid Organizations may provide the countries at almost the same level of per capita national income as Mongolia with long term loans at the interest rate of 0.75 ~ 1.00%. In this analysis we presume that the most favorable loan is available as follows.

Interest Rate: 0.75% p.a.
Repayment: 40 Years Equal Installment including 10 Years Grace Period

2) Local funds

Mongolia is now in a period of transition to market economy system. In financial sector, various interest rates have been increased remarkably during the past few years. However,

according to Mongolian Railway the funds with low interest rate of 2% p.a. is to be provided for this project because it is very important national investment for Mongolia. This is the same level of interest rate which state enterprises under the old socialistic regime were paying on their borrowing.

10-2-3 The Results of the Analysis

The results of our analysis under the aforementioned prerequisites are shown in Appendix 10-2-2 as Basic Case. The results of the sensitivity analysis for the following three cases are shown in Appendix 10-2-3/5.

Sensitivity Analysis (1): Investment Increased by 10% from Basic Case
Sensitivity Analysis (2): Revenue Decreased by 10% from Basic Case
Sensitivity Analysis (3): Investment Increased by 10% and Revenue Decreased by 10% from Basic Case

The main indices of evaluation are shown in Table 10-2-2.

Table 10-2-2 Indices of Evaluation

(Unit: Thousand Tugrik)

	Basic Case	Sensitivity Analysis		
		(1)	(2)	(3)
Financial Internal Rate of Return (FIRR)	1.91%	1.26%	1.04%	0.43%
Weighted Average Interest Rate of Loans	0.82%	0.86%	0.90%	1.01%
Net Loss Turned into Profit in	1999	2002	2002	2002
Accumulated Net Loss Turned into Profit in	2004	2006	2008	2016
Peak Balance of Local Loan	308,620	343,567	314,474	429,779
Peak Balance of Local Loan Recorded in	1995	1995	1995	2017

Financial Internal Rate of Return (FIRR) indicates ability of the project to pay interest of loan. In other words funds for the project should be raised at the interest rate below FIRR. The results of the analysis show that FIRR of this project is very low. Even in Basic Case it is only 1.91%. The low level of FIRR, however, does not necessarily mean that the project is not feasible, because both foreign and local loans with low interest rates are available to this project. The weighted average interest rate of foreign and local loans throughout the project life is lower than FIRR except in case of Sensitivity Analysis (3). In other three cases the project is able to pay interest. In the case with higher FIRR, accumulated net loss turns into profit earlier and the weighted average interest rate of all borrowed funds is lower because local loan with relatively higher interest rate will take smaller portion of all funds put into the project.

The balance of local loan shows rather downward trend after the completion of construction work except the sensitivity analysis (3) and no balance is recorded in and after 2008 in Basic Case and in and after 2023 in Sensitivity Analysis (1). Sensitivity Analysis (1) shows higher peak balance than Sensitivity Analysis (2), but later in the project life the balance of Analysis (1) is going down at higher pace. We did not set the limit to the maximum amount of local loan as the prerequisite of this analysis. The results of the analysis show that in all cases local funds over 300 Million Tugrik have to be provided at the peak. Even if the project is able to pay interest, whether such a big amount of loan is available to the railway project in Mongolia is another problem. In case of need the funds to which neither interest payment nor repayment is required should be introduced to cover a part of investment.

In conclusion this project is feasible provided that the aforementioned prerequisites (especially future increase of transshipment fee and availability of local loan) are fulfilled. Either increase of investment or decrease of revenue by 10% is permissible. The results show that decrease of revenue gives bigger effects on the project than increase of investment.

(UNIT : THOUSAND TUGRIK)

APPENDIX 10-2-1

TOTAL INVESTMENT WITH CONTINGENCY PLAN 2

		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
INVESTMENT TOTAL		548248	548248	548248	0	0	0	0	0	0	8649	106656	9715
	FOREIGN TOTAL	434056	434056	434056	0	0	0	0	0	0	8649	106656	9715
	LOCAL TOTAL	114192	114192	114192	0	0	0	0	0	0	0	0	0
CIVIL WORKS		331962	331962	331962	0	0	0	0	0	0	0	0	0
	FOREIGN CURRENCY	218568	218568	218568	0	0	0	0	0	0	0	0	0
	LOCAL CURRENCY	113395	113395	113395	0	0	0	0	0	0	0	0	0
LOADING MACHINERY		42283	42283	42283	0	0	0	0	0	0	8649	106656	9715
	FOREIGN CURRENCY	42283	42283	42283	0	0	0	0	0	0	8649	106656	9715
	LOCAL CURRENCY	0	0	0	0	0	0	0	0	0	0	0	0
SIGNAL EQUIPMENT		93945	93945	93945	0	0	0	0	0	0	0	0	0
	FOREIGN CURRENCY	93332	93332	93332	0	0	0	0	0	0	0	0	0
	LOCAL CURRENCY	613	613	613	0	0	0	0	0	0	0	0	0
TELECOMMUNICATION EQUIPMENT		14644	14644	14644	0	0	0	0	0	0	0	0	0
	FOREIGN CURRENCY	14627	14627	14627	0	0	0	0	0	0	0	0	0
	LOCAL CURRENCY	17	17	17	0	0	0	0	0	0	0	0	0
POWER GENERATOR		65413	65413	65413	0	0	0	0	0	0	0	0	0
	FOREIGN CURRENCY	65245	65245	65245	0	0	0	0	0	0	0	0	0
	LOCAL CURRENCY	169	169	169	0	0	0	0	0	0	0	0	0
SALVAGE VALUE (-)		0	0	0	0	0	0	0	0	0	0	0	0

(UNIT : THOUSAND TUGRIK)

APPENDIX 10-2-1

TOTAL INVESTMENT WITH CONTINGENCY PLAN 2

		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
INVESTMENT TOTAL		0	128746	0	8649	0	106656	0	9715	9631	8649	16606	128746
	FOREIGN TOTAL	0	128526	0	8649	0	106656	0	9715	9612	8649	16556	128526
	LOCAL TOTAL	0	220	0	0	0	0	0	0	19	0	50	220
CIVIL WORKS		0	0	0	0	0	0	0	0	0	0	0	0
	FOREIGN CURRENCY	0	0	0	0	0	0	0	0	0	0	0	0
	LOCAL CURRENCY	0	0	0	0	0	0	0	0	0	0	0	0
LOADING MACHINERY		0	0	0	8649	0	106656	0	9715	0	8649	0	0
	FOREIGN CURRENCY	0	0	0	8649	0	106656	0	9715	0	8649	0	0
	LOCAL CURRENCY	0	0	0	0	0	0	0	0	0	0	0	0
SIGNAL EQUIPMENT		0	0	0	0	0	0	0	0	9631	0	0	0
	FOREIGN CURRENCY	0	0	0	0	0	0	0	0	9612	0	0	0
	LOCAL CURRENCY	0	0	0	0	0	0	0	0	19	0	0	0
TELECOMMUNICATION EQUIPMENT		0	27326	0	0	0	0	0	0	0	0	16606	27326
	FOREIGN CURRENCY	0	27326	0	0	0	0	0	0	0	0	16556	27326
	LOCAL CURRENCY	0	0	0	0	0	0	0	0	0	0	50	0
POWER GENERATOR		0	101420	0	0	0	0	0	0	0	0	0	101420
	FOREIGN CURRENCY	0	101200	0	0	0	0	0	0	0	0	0	101200
	LOCAL CURRENCY	0	220	0	0	0	0	0	0	0	0	0	220
SALVAGE VALUE (-)		0	0	0	0	0	0	0	0	0	0	0	0

(UNIT : THOUSAND TUGRIK)

APPENDIX 10-2-1

TOTAL INVESTMENT WITH CONTINGENCY PLAN 2

		2017	2018	2019	2020	2021	2022	2023	2024	2025	TOTAL
INVESTMENT TOTAL		106656	0	0	18364	0	0	0	106656	0	2418837
	FOREIGN TOTAL	106656	0	0	18364	0	0	0	106656	0	2075752
	LOCAL TOTAL	0	0	0	0	0	0	0	0	0	343086
CIVIL WORKS		0	0	0	0	0	0	0	0	0	995887
	FOREIGN CURRENCY	0	0	0	0	0	0	0	0	0	655703
	LOCAL CURRENCY	0	0	0	0	0	0	0	0	0	340184
LOADING MACHINERY		106656	0	0	18364	0	0	0	106656	0	617214
	FOREIGN CURRENCY	106656	0	0	18364	0	0	0	106656	0	617214
	LOCAL CURRENCY	0	0	0	0	0	0	0	0	0	0
SIGNAL EQUIPMENT		0	0	0	0	0	0	0	0	0	291466
	FOREIGN CURRENCY	0	0	0	0	0	0	0	0	0	289609
	LOCAL CURRENCY	0	0	0	0	0	0	0	0	0	1857
TELECOMMUNICATION EQUIPMENT		0	0	0	0	0	0	0	0	0	115190
	FOREIGN CURRENCY	0	0	0	0	0	0	0	0	0	115091
	LOCAL CURRENCY	0	0	0	0	0	0	0	0	0	99
POWER GENERATOR		0	0	0	0	0	0	0	0	0	399080
	FOREIGN CURRENCY	0	0	0	0	0	0	0	0	0	398134
	LOCAL CURRENCY	0	0	0	0	0	0	0	0	0	946
SALVAGE VALUE (-)		0	0	0	0	0	0	0	0	409146	409146

APPENDIX 10-2-2 **** FINANCIAL ANALYSIS FOR THE STUDY ON THE IMPROVEMENT PLAN FOR TRANSSHIPMENT FACILITIES AT ZAMYN-UUD STATION IN MONGOLIA PLAN 2

(UNIT: THOUSAND TUGRIK) BASIC CASE

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
PROFIT & LOSS STATEMENT												
OPERATING REVENUE	0	19482	38668	63577	65855	68009	87704	90242	90242	112802	112802	112802
OPERATING COST	0	5873	11695	16322	16634	16928	17222	17500	17500	17500	17500	17500
PERSONNEL COST	0	1724	3423	4502	4663	4816	4968	5112	5112	5112	5112	5112
ENERGY COST	0	1603	3181	4185	4335	4476	4618	4752	4752	4752	4752	4752
MAINTENANCE COST	0	2545	5091	7636	7636	7636	7636	7636	7636	7636	7636	7636
DEPRECIATION	0	18079	36158	54237	54237	54237	54237	54237	54237	54237	54237	54237
OPERATING PROFIT	0	-4469	-9185	-6982	-5016	-3156	16245	18505	18505	41066	41066	41066
INTEREST	0	2284	4341	16086	15463	14787	14061	12933	11737	10517	9831	9886
NET PROFIT	0	-6753	-13526	-23068	-20478	-17943	2183	5572	6768	30549	31235	31180
ACCUMULATED NET PROFIT	0	-6753	-20279	-43347	-63825	-81769	-79586	-74014	-67245	-36696	-5461	25719
FINANCE PROGRAM												
FINANCE IN FOREIGN CURRENCY												
BORROWING	437311	440591	443895	0	0	0	0	0	0	0	0	0
REPAYMENT	0	0	0	0	0	0	0	0	0	0	44060	44060
LOAN BALANCE	437311	877902	1321798	1321798	1321798	1321798	1321798	1321798	1321798	1321798	1277738	1233678
INTEREST DURING CONSTRUCTION	3255	6535	9840	0	0	0	0	0	0	0	0	0
INTEREST	0	0	0	9913	9913	9913	9913	9913	9913	9913	9831	9500
FINANCE IN LOCAL CURRENCY												
BORROWING	114192	102867	91560	0	0	0	0	0	0	0	19273	0
REPAYMENT	0	0	0	31169	33758	36293	56420	59809	61005	30165	0	19273
LOAN BALANCE	114192	217059	308620	277451	243693	207399	150979	91170	30165	0	19273	0
INTEREST	0	2284	4341	6172	5549	4874	4148	3020	1823	603	0	385
CASH FLOW STATEMENT												
CASH FLOW	-548248	-534639	-521275	47254	49221	51081	70481	72742	72742	86654	-11354	85587
OPERATING PROFIT	0	-4469	-9185	-6982	-5016	-3156	16245	18505	18505	41066	41066	41066
DEPRECIATION	0	18079	36158	54237	54237	54237	54237	54237	54237	54237	54237	54237
INVESTMENT (-)	548248	548248	548248	0	0	0	0	0	0	8649	106656	9715
SALVAGE VALUE	0	0	0	0	0	0	0	0	0	0	0	0
FIRR	1.9108%											

APPENDIX 10-2-2

(UNIT: THOUSAND TUGRIK)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
PROFIT & LOSS STATEMENT												
OPERATING REVENUE	112802	112802	112802	112802	112802	112802	112802	112802	112802	112802	112802	112802
OPERATING COST	17500	17500	17500	17500	17500	17500	17500	17500	17500	17500	17500	17500
PERSONNEL COST	5112	5112	5112	5112	5112	5112	5112	5112	5112	5112	5112	5112
ENERGY COST	4752	4752	4752	4752	4752	4752	4752	4752	4752	4752	4752	4752
MAINTENANCE COST	7636	7636	7636	7636	7636	7636	7636	7636	7636	7636	7636	7636
DEPRECIATION	54237	54237	54237	54237	54237	54237	54237	54237	54237	54237	54237	54237
OPERATING PROFIT	41066	41066	41066	41066	41066	41066	41066	41066	41066	41066	41066	41066
INTEREST	9170	8840	9147	8179	7848	7518	7187	6857	6526	6196	5865	5535
NET PROFIT	31896	32226	31919	32887	33218	33548	33878	34209	34539	34870	35200	35531
ACCUMULATED NET PROFIT	57614	89841	121759	154646	187864	221412	255291	289499	324039	358909	394109	429640
FINANCE PROGRAM												
FINANCE IN FOREIGN CURRENCY												
BORROWING	0	0	0	0	0	0	0	0	0	0	0	0
REPAYMENT	44060	44060	44060	44060	44060	44060	44060	44060	44060	44060	44060	44060
LOAN BALANCE	1189618	1145558	1101498	1057438	1013378	969318	925258	881198	837138	793079	749019	704959
INTEREST DURING CONSTRUCTION	0	0	0	0	0	0	0	0	0	0	0	0
INTEREST	9170	8840	8509	8179	7848	7518	7187	6857	6526	6196	5865	5535
FINANCE IN LOCAL CURRENCY												
BORROWING	0	31902	0	0	0	0	0	0	0	0	0	0
REPAYMENT	0	0	31902	0	0	0	0	0	0	0	0	0
LOAN BALANCE	0	31902	0	0	0	0	0	0	0	0	0	0
INTEREST	0	0	638	0	0	0	0	0	0	0	0	0
CASH FLOW STATEMENT												
CASH FLOW	95302	-33444	95302	86654	95302	-11354	95302	85587	85672	86654	78697	-33444
OPERATING PROFIT	41066	41066	41066	41066	41066	41066	41066	41066	41066	41066	41066	41066
DEPRECIATION	54237	54237	54237	54237	54237	54237	54237	54237	54237	54237	54237	54237
INVESTMENT (-)	0	128746	0	8649	0	106656	0	9715	9631	8649	16606	128746
SALVAGE VALUE	0	0	0	0	0	0	0	0	0	0	0	0
FIRR												

APPENDIX 10-2-2

(UNIT: THOUSAND TUGRIK)

	2017	2018	2019	2020	2021	2022	2023	2024	2025	TOTAL
PROFIT & LOSS STATEMENT										
OPERATING REVENUE	112802	112802	112802	112802	112802	112802	112802	112802	112802	3231031
OPERATING COST	17500	17500	17500	17500	17500	17500	17500	17500	17500	539667
PERSONNEL COST	5112	5112	5112	5112	5112	5112	5112	5112	5112	157008
ENERGY COST	4752	4752	4752	4752	4752	4752	4752	4752	4752	145947
MAINTENANCE COST	7636	7636	7636	7636	7636	7636	7636	7636	7636	236712
DEPRECIATION	54237	54237	54237	54237	54237	54237	54237	54237	54237	1681339
OPERATING PROFIT	41066	41066	41066	41066	41066	41066	41066	41066	41066	1010025
INTEREST	5205	4874	4544	4213	3883	3552	3222	2891	2561	245739
NET PROFIT	35861	36192	36522	36853	37183	37513	37844	38174	38505	764287
ACCUMULATED NET PROFIT	465501	501693	538215	575067	612250	649764	687607	725782	764287	
FINANCE PROGRAM										
FINANCE IN FOREIGN CURRENCY										
BORROWING	0	0	0	0	0	0	0	0	0	1321798
REPAYMENT	44060	44060	44060	44060	44060	44060	44060	44060	44060	1013378
LOAN BALANCE	660899	616839	572779	528719	484659	440599	396539	352479	308419	30130401
INTEREST DURING CONSTRUCTION	0	0	0	0	0	0	0	0	0	19630
INTEREST	5205	4874	4544	4213	3883	3552	3222	2891	2561	211901
FINANCE IN LOCAL CURRENCY										
BORROWING	0	0	0	0	0	0	0	0	0	359794
REPAYMENT	0	0	0	0	0	0	0	0	0	359794
LOAN BALANCE	0	0	0	0	0	0	0	0	0	1691904
INTEREST	0	0	0	0	0	0	0	0	0	33838
							WEIGHTED	AVERAGE	INTERES	0.8165%
CASH FLOW STATEMENT										
CASH FLOW	-11354	95302	95302	76939	95302	95302	95302	-11354	504448	681673
OPERATING PROFIT	41066	41066	41066	41066	41066	41066	41066	41066	41066	1010025
DEPRECIATION	54237	54237	54237	54237	54237	54237	54237	54237	54237	1681339
INVESTMENT (-)	106656	0	0	18364	0	0	0	106656	0	2418837
SALVAGE VALUE	0	0	0	0	0	0	0	0	409146	409146
FIRR										

APPENDIX 10-2-3 **** FINANCIAL ANALYSIS FOR THE STUDY ON THE IMPROVEMENT PLAN FOR TRANSSHIPMENT FACILITIES AT ZAMYN-UUD STATION IN MONGOLIA PLAN 2

(UNIT: THOUSAND TUGRIK) SENSITIVITY ANALYSIS (1) INVESTMENT 10% UP
REVENUE 0% DOWN

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
PROFIT & LOSS STATEMENT												
OPERATING REVENUE	0	19482	38668	63577	65855	68009	87704	90242	90242	112802	112802	112802
OPERATING COST	0	5873	11695	16322	16634	16928	17222	17500	17500	17500	17500	17500
PERSONNEL COST	0	1724	3423	4502	4663	4816	4968	5112	5112	5112	5112	5112
ENERGY COST	0	1603	3181	4185	4335	4476	4618	4752	4752	4752	4752	4752
MAINTENANCE COST	0	2545	5091	7636	7636	7636	7636	7636	7636	7636	7636	7636
DEPRECIATION	0	19887	39774	59660	59660	59660	59660	59660	59660	59660	59660	59660
OPERATING PROFIT	0	-6277	-12800	-12406	-10439	-8580	10821	13082	13082	35642	35642	35642
INTEREST	0	2512	4803	17776	17187	16546	15855	14763	13603	12420	10862	12126
NET PROFIT	0	-8789	-17603	-30182	-27626	-25126	-5034	-1681	-521	23222	24780	23517
ACCUMULATED NET PROFIT	0	-8789	-26392	-56574	-84201	-109326	-114361	-116042	-116563	-93341	-68561	-45045
FINANCE PROGRAM												
FINANCE IN FOREIGN CURRENCY												
BORROWING	481042	484650	488285	0	0	0	0	0	0	0	0	0
REPAYMENT	0	0	0	0	0	0	0	0	0	0	48466	48466
LOAN BALANCE	481042	965692	1453977	1453977	1453977	1453977	1453977	1453977	1453977	1453977	1405511	1357046
INTEREST DURING CONSTRUCTION	3581	7189	10824	0	0	0	0	0	0	0	0	0
INTEREST	0	0	0	10905	10905	10905	10905	10905	10905	10905	10814	10450
FINANCE IN LOCAL CURRENCY												
BORROWING	125612	114514	103441	0	0	0	0	0	0	0	81347	0
REPAYMENT	0	0	0	29478	32034	34535	54626	57979	59139	73369	0	24024
LOAN BALANCE	125612	240126	343567	314089	282054	247520	192894	134914	75775	2407	83754	59730
INTEREST	0	2512	4803	6871	6282	5641	4950	3858	2698	1516	48	1675
CASH FLOW STATEMENT												
CASH FLOW	-603073	-589463	-576100	47254	49221	51081	70481	72742	72742	85789	-22019	84616
OPERATING PROFIT	0	-6277	-12800	-12406	-10439	-8580	10821	13082	13082	35642	35642	35642
DEPRECIATION	0	19887	39774	59660	59660	59660	59660	59660	59660	59660	59660	59660
INVESTMENT (-)	603073	603073	603073	0	0	0	0	0	0	9514	117322	10687
SALVAGE VALUE	0	0	0	0	0	0	0	0	0	0	0	0
FIRR	1.2581%											

APPENDIX 10-2-3

(UNIT: THOUSAND TUGRIK)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
PROFIT & LOSS STATEMENT												
OPERATING REVENUE	112802	112802	112802	112802	112802	112802	112802	112802	112802	112802	112802	112802
OPERATING COST	17500	17500	17500	17500	17500	17500	17500	17500	17500	17500	17500	17500
PERSONNEL COST	5112	5112	5112	5112	5112	5112	5112	5112	5112	5112	5112	5112
ENERGY COST	4752	4752	4752	4752	4752	4752	4752	4752	4752	4752	4752	4752
MAINTENANCE COST	7636	7636	7636	7636	7636	7636	7636	7636	7636	7636	7636	7636
DEPRECIATION	59660	59660	59660	59660	59660	59660	59660	59660	59660	59660	59660	59660
OPERATING PROFIT	35642	35642	35642	35642	35642	35642	35642	35642	35642	35642	35642	35642
INTEREST	11282	10207	11943	10882	9990	8889	10113	9015	8109	7183	6452	6089
NET PROFIT	24361	25435	23699	24760	25652	26753	25529	26627	27533	28459	29190	29554
ACCUMULATED NET PROFIT	-20684	4751	28450	53210	78862	105615	131144	157771	185304	213763	242953	272507
FINANCE PROGRAM												
FINANCE IN FOREIGN CURRENCY												
BORROWING	0	0	0	0	0	0	0	0	0	0	0	0
REPAYMENT	48466	48466	48466	48466	48466	48466	48466	48466	48466	48466	48466	48466
LOAN BALANCE	1308580	1260114	1211648	1163182	1114716	1066250	1017784	969318	920852	872386	823921	775455
INTEREST DURING CONSTRUCTION	0	0	0	0	0	0	0	0	0	0	0	0
INTEREST	10087	9723	9360	8996	8633	8269	7906	7543	7179	6816	6452	6089
FINANCE IN LOCAL CURRENCY												
BORROWING	0	104991	0	0	0	79374	0	0	0	0	0	66981
REPAYMENT	35555	0	34893	26441	36847	0	36723	27135	28134	18366	0	0
LOAN BALANCE	24174	129166	94272	67831	30984	110358	73635	46500	18366	0	0	66981
INTEREST	1195	483	2583	1885	1357	620	2207	1473	930	367	0	0
CASH FLOW STATEMENT												
CASH FLOW	95302	-46318	95302	85789	95302	-22019	95302	84616	84709	85789	77036	-46318
OPERATING PROFIT	35642	35642	35642	35642	35642	35642	35642	35642	35642	35642	35642	35642
DEPRECIATION	59660	59660	59660	59660	59660	59660	59660	59660	59660	59660	59660	59660
INVESTMENT (-)	0	141621	0	9514	0	117322	0	10687	10594	9514	18266	141621
SALVAGE VALUE	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX 10-2-3

(UNIT: THOUSAND TUGRIK)

	2017	2018	2019	2020	2021	2022	2023	2024	2025	TOTAL
PROFIT & LOSS STATEMENT										
OPERATING REVENUE	112802	112802	112802	112802	112802	112802	112802	112802	112802	3231031
OPERATING COST	17500	17500	17500	17500	17500	17500	17500	17500	17500	539667
PERSONNEL COST	5112	5112	5112	5112	5112	5112	5112	5112	5112	157008
ENERGY COST	4752	4752	4752	4752	4752	4752	4752	4752	4752	145947
MAINTENANCE COST	7636	7636	7636	7636	7636	7636	7636	7636	7636	236712
DEPRECIATION	59660	59660	59660	59660	59660	59660	59660	59660	59660	1849473
OPERATING PROFIT	35642	35642	35642	35642	35642	35642	35642	35642	35642	841891
INTEREST	7065	8252	7117	5959	5182	3985	3544	3181	2817	295708
NET PROFIT	28577	27390	28525	29683	30460	31657	32098	32462	32825	546184
ACCUMULATED NET PROFIT	301084	328474	356999	386682	417142	448799	480897	513359	546184	
FINANCE PROGRAM										
FINANCE IN FOREIGN CURRENCY										
BORROWING	0	0	0	0	0	0	0	0	0	1453977
REPAYMENT	48466	48466	48466	48466	48466	48466	48466	48466	48466	1114716
LOAN BALANCE	726989	678523	630057	581591	533125	484659	436193	387727	339261	33143441
INTEREST DURING CONSTRUCTION	0	0	0	0	0	0	0	0	0	21593
INTEREST	5725	5362	4998	4635	4271	3908	3544	3181	2817	233091
FINANCE IN LOCAL CURRENCY										
BORROWING	77550	0	0	0	0	0	0	0	0	753810
REPAYMENT	0	38584	39720	20677	41655	3894	0	0	0	753810
LOAN BALANCE	144530	105946	66226	45549	3894	0	0	0	0	3130856
INTEREST	1340	2891	2119	1325	911	78	0	0	0	62617
							WEIGHTED	AVERAGE	INTERES	0.8579%
CASH FLOW STATEMENT										
CASH FLOW	-22019	95302	95302	75102	95302	95302	95302	-22019	545363	480703
OPERATING PROFIT	35642	35642	35642	35642	35642	35642	35642	35642	35642	841891
DEPRECIATION	59660	59660	59660	59660	59660	59660	59660	59660	59660	1849473
INVESTMENT (-)	117322	0	0	20200	0	0	0	117322	0	2660721
SALVAGE VALUE	0	0	0	0	0	0	0	0	450060	450060
FIRR										