6-3 Premises and Outline of the Plan

6-3-1 Function of the Plant

The function of the carriage and wagon manufacturing plant is to manufacture and assemble carriages and wagons. To achieve this purpose, the following major facilities will be incorporated into the plant:

(1) Administration office

(2) Carriage and wagon manufacturing workshop

(3) Jig and tool manufacturing shop and maintenance shop for mechanical and electrical facilities

(4) Education and training centre

(5) Material warehouse

6-3-2 Scope of Carriage and Wagon Manufacturing Work

Refer to 5-3.

6-3-3 Scope of Auxiliary Work

The scope of auxiliary work at the factory includes:

(1) Maintenance of mechanical and electrical facilities for the factory and buildings.

(2) Manufacturing and repair of jigs, tools, and fixtures used in the manufacture of carriages and wagons.

(3) Receiving and distributing electric power.

(4) Generation of acetylene gas, steam, and compressed air.

(5) Treatment and distribution of water supply.

(6) Refuse incineration.

6-3-4 Scale of the Factory

The carriage and wagon manufacturing plant will have a capacity of manufacturing 120 cars and 900 units per year on a single-shift work system, as described in CHAPTER 4. The final assembly and furnishing shops for carriages and wagons in the factory will have sufficient space to handle the increasing number of carriages and wagons to be produced in the future.

6-3-5 Material Storage Capacity

The warehouse and outdoor stockyard for material storage will have the capacity to handle the number of carriages and wagons produced in one year.

Brake equipment, electrical equipment, auxiliary equipment, electric wire, pipes, thin steel plates, and interior furnishings will be stored indoors.

Thick steel plates and shaped steel will be stored in the outdoor stockyard, which is to be equipped with a 15-ton yard crane.

6-4 Carriage and Wagon Manufacturing Plant Plan

6-4-1 Plant Layout

The plant layout will be planned considering the following points:

- The steel materials cutting shop and machining shop will be planned as common shops for manufacturing carriages and wagons. Separate shops for the block assembly of car body frames and bogie frames, the final assembly of the car bodies and furnishings and their final adjustment and inspection will be planned for carriages and wagons.
- In the car body painting shop and car body furnishing shop, tracks which require fixed scaffolding for side plate work of the car body will be separately planned for broad gauge cars and meter gauge cars.
- Dummy bogies (for broad gauge) will be used for transportation of car bodies in the factory.

The incoming track to the factory will be planned so as to branch from the siding of BR.

Access of factory employees and material transport vehicles is planned so that they can reach the centre of the factory directly from the existing road, which links to the national road. The administration office building, employees' canteen, rest shelter, etc. are planned to be adjacent to the main workshop building to decrease walking distances as much as possible.

(1) Work flow of carriage and wagon manufacturing

The work flow of carriage and wagon manufacturing will be planned so as to minimize parts handling frequency and transport distance in the main workshop building, as well as to ensure uninterrupted work flow.

The production flow chart for carriages is shown in Fig. 6-4-1, and that for wagons, in Fig. 6-4-2; the work flow in manufacturing carriage and wagon in the plant is shown in Fig. 6-4-3.

(2) Premises for determining the scale of facilities

1) Main building for manufacturing carriages and wagons

As described in 6-3-4, the main workshop building is planned to be capable of manufacturing 120 of carriages and 900 wagons per year on a single-shift work system. The jigs/tools manufacturing shop and machine and electric maintenance shop are planned to be in the same building.

2) Administration office

The production department and supporting department will be housed in the administration building. This office will be adjacent to the main workshop building for the convenience of visitors from outside to both buildings and for communication between offices and workshops.

3) Training facility

The Education and Training Centre will be planned inside the plant to teach the special technologies required for manufacturing carriages and wagons as described in 7-5.

4) Others

In addition to the above, the scale of the employees' duty time control facility, personnel facilities like canteen, rest shelter, shower room, garage, and warehouse will be determined according to the number of employees and the number of carriages and wagons manufactured.

(3) Scale of facilities

Based on the layout plan in Fig. 6-4-4, the areas of facilities are outlined below.

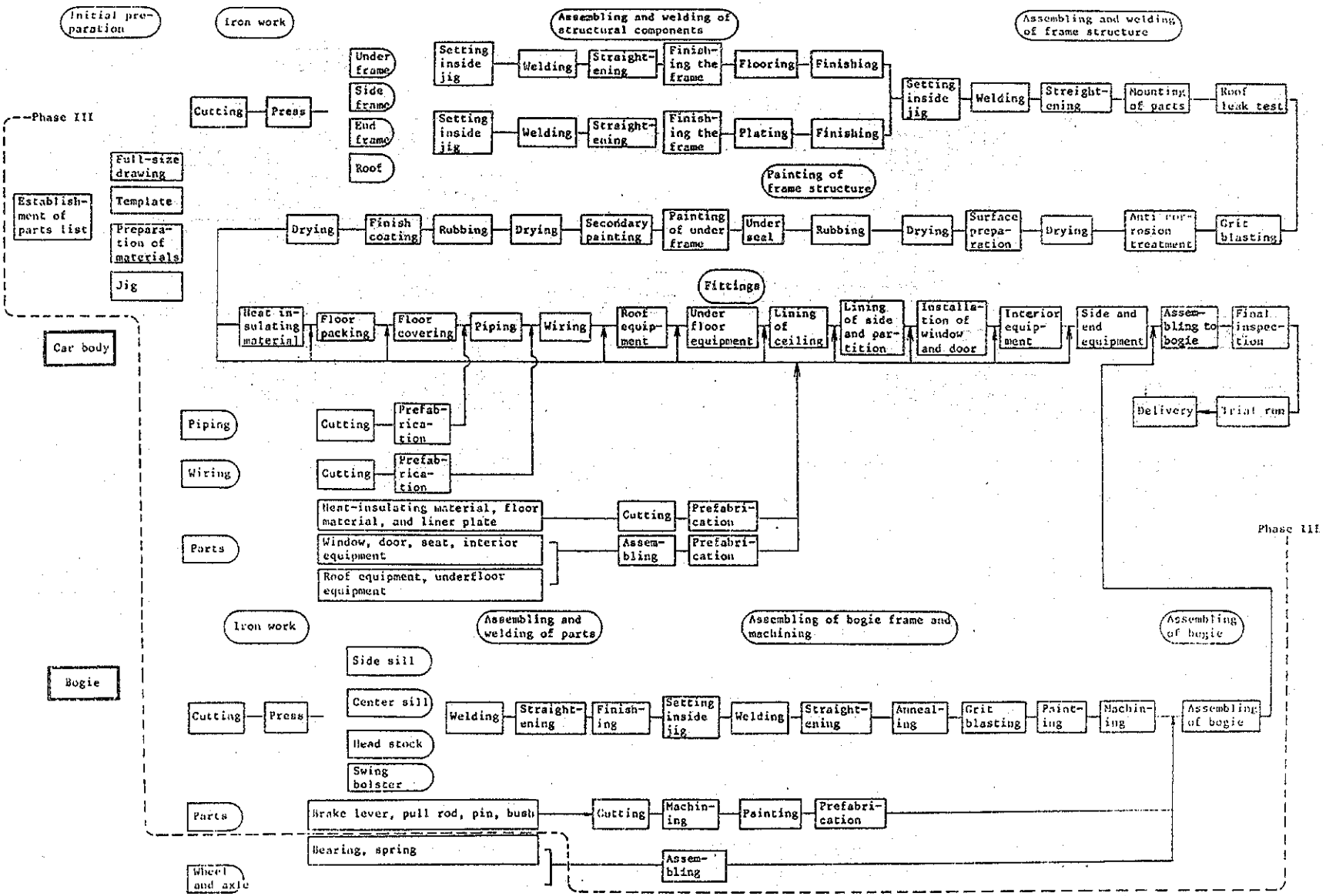


Fig. 6-4-1 Carriage Production Flow Chart

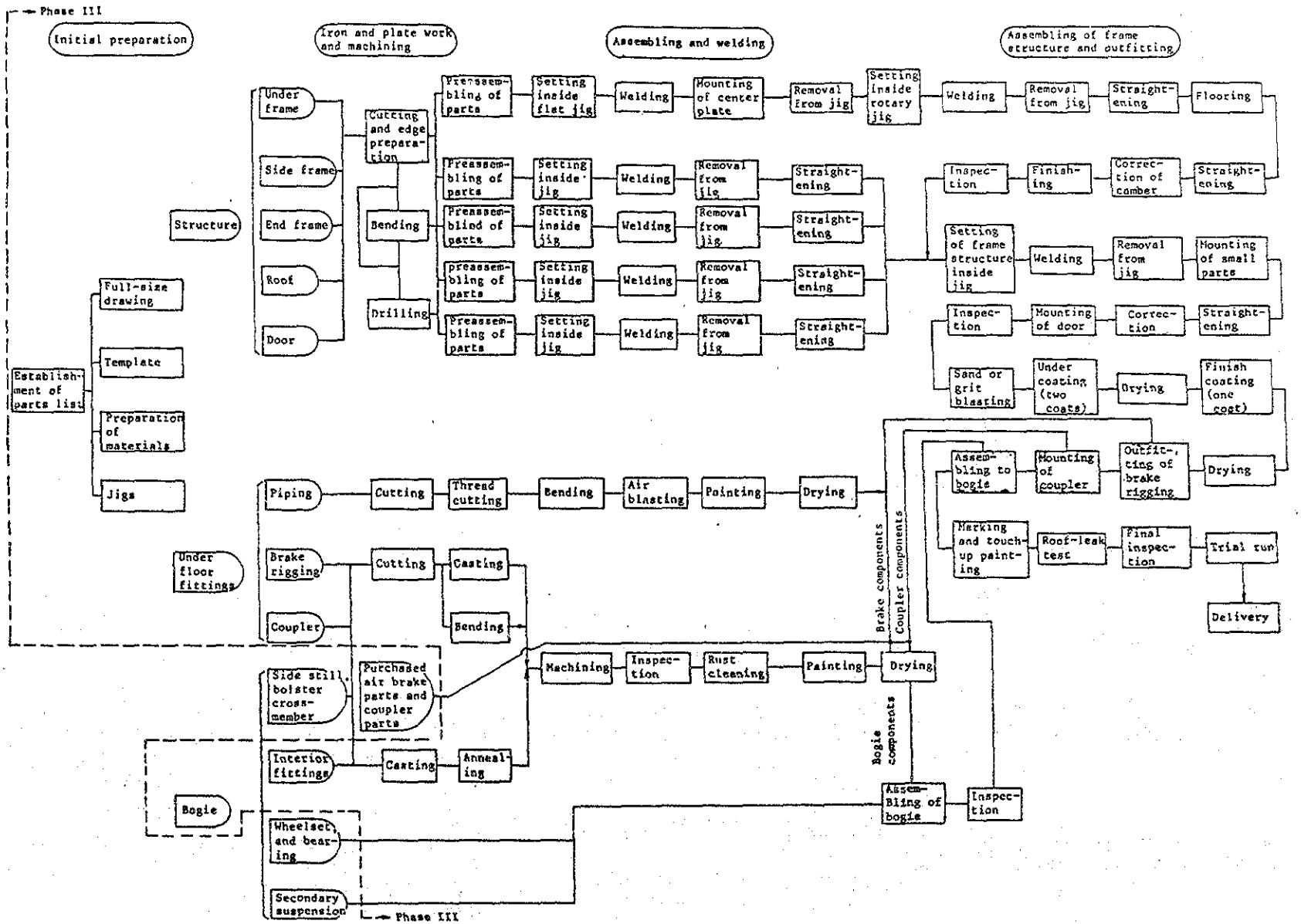


Fig. 6-4-2 Wagon Production Flow Chart

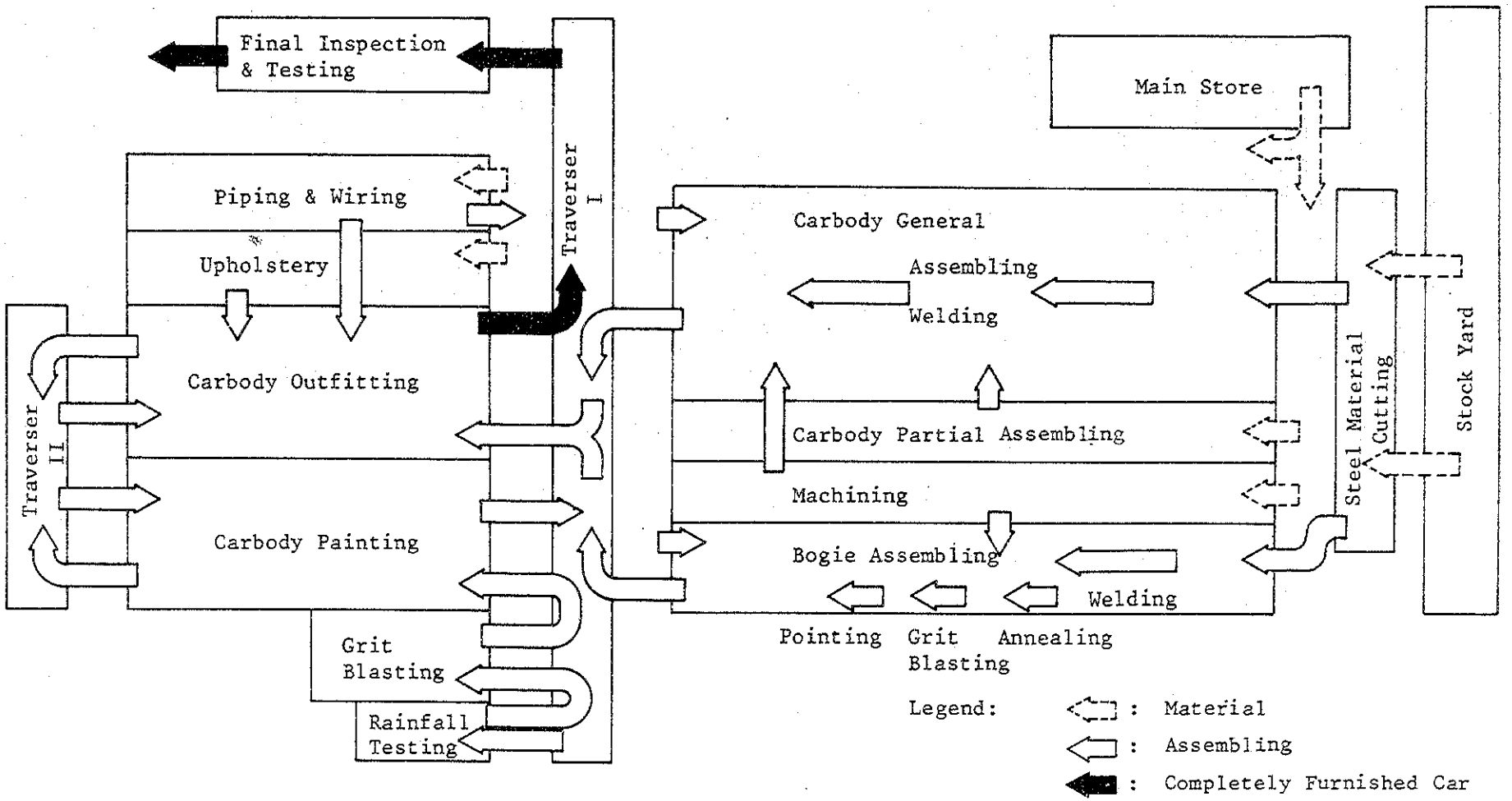


Fig. 6-4-3 Work Flow in Manufacturing Carriage and Wagon in the Factory

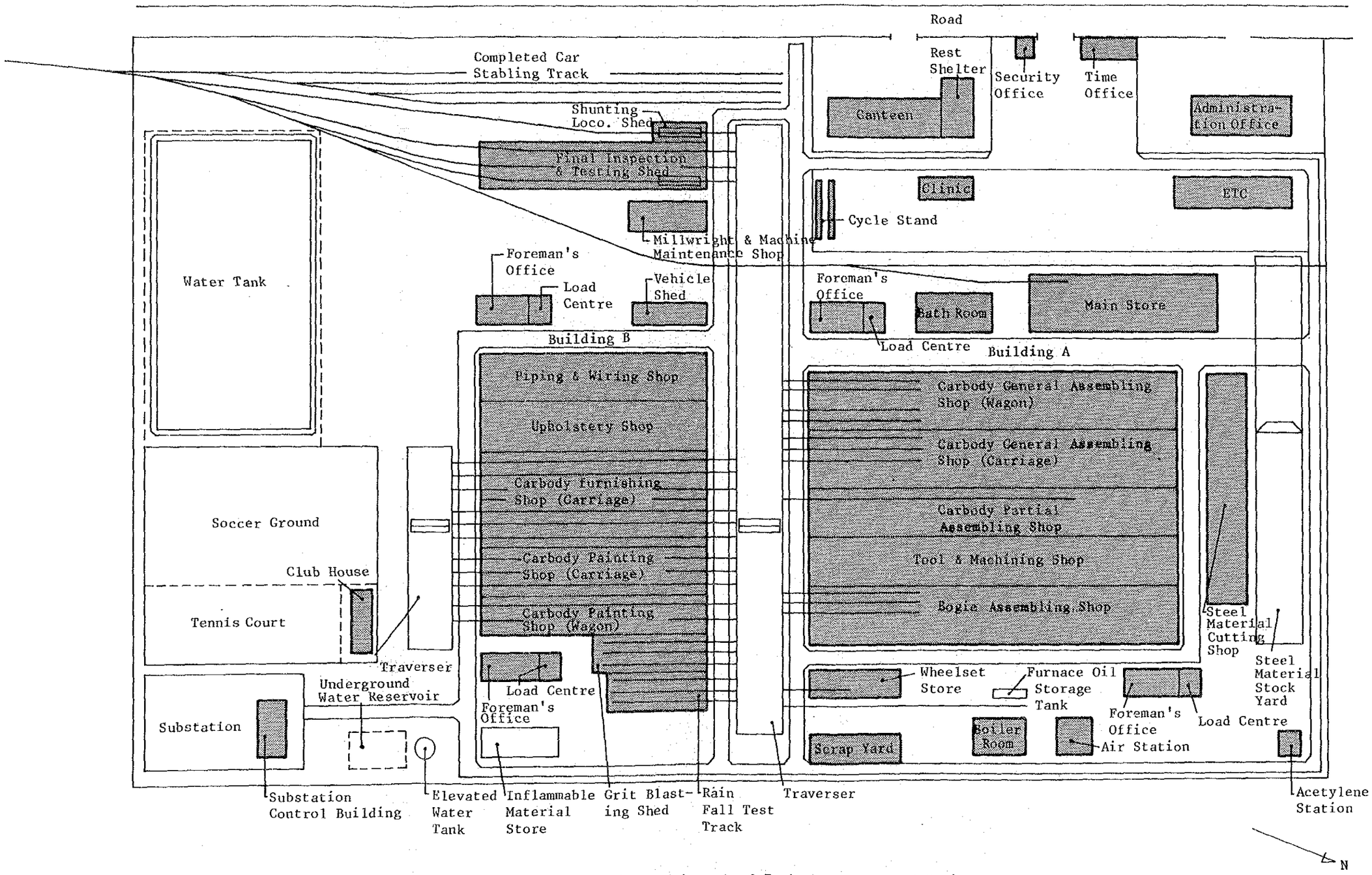


Fig. 6-4-4 Overall Layout of Factory (Cf. Fig. 6-2-1)

1) Working area by use

	For phase I	For phase III
Main workshop	37,000 m^2	12,000 m^2
Auxiliary workshop	2,000 m^2	
Storehouse	5,000 m^2	
Education and training centre	2,000 m^2	
Administration building and other offices	8,000 m^2	
Power room	1,500 m^2	
Welfare facilities	3,000 m^2	
Others	1,000 m^2	

2) Track

Indoor track	3,300 m	200 m
Outdoor track	2,000 m	
Traverser	1,400 m	
Turnout	9	

6-4-2 Plan of Main Facilities

Major machines and equipment are shown in Table 6-4-1.

(1) Machinery and equipment

1) Machinery and equipment for carriage and wagon manufacturing

Machinery and equipment for carriage and wagon manufacturing are listed below.

(a) Machines for cutting, forming, and machining steel plates and shaped steel

(b) Welding jig for block assembly of car body frame and underframe

(c) Machining facilities for bogie frame

(d) Steel plate surface treatment facilities (phosphating treatment, grit blasting, painting, and drying)

(e) Inspection and test facilities (magnetic flaw detection, ultrasonic flaw detection, electric test, and brake test)

(f) Overhead travelling crane, traverser, transport machines, dummy bogies

Table 6-4-1 Major Machines and Equipment

(1) Plant machinery

Name of machine	Nos	Specification
Gap shear	3	45, 6, 13t × 3,000 mm
Band saw	2	400, 500 mm
Lathe	6	1.5, 2, 2.8 m
Threading machine	2	
Drilling machine	7	40, 540, 2,000, 2,500 mm
Vertical milling machine	4	
Boring machine	2	
Universal tool grinder	3	
Press	9	20, 50, 100, 200, 300t
Double-head grinder	8	
Arc welder	25	
Manual hydraulic press	30	
Heating furnace	1	
Grit blasting equipment	3	
Pipe cutter	2	3/8" ~ 2-1/2"
Pipe threading machine	2	do.
Pipe bender	2	
Universal circular sawing machine	3	For wood
Other machines		

(2) Inspection and testing facility

Micrometer	5	
Ultrasonic flaw detector	2	
Magnetic flaw detector	2	
Insulation resistance tester	3	
Portable brake tester	3	
Rainfall testing equipment	3	
Weight measuring unit	1	
Other equipment		

(3) Transport facility

Name of machine	Nos	Specification
Yard crane	1	15t
Overhead travelling crane	21	2, 5, 7.5, 10, 15, 25t
Car lifter	4	15t
Traverser	2	50t
Forklift	10	2, 4t
Freight car	2	Diesel system 10t
Micro bus	2	25 persons
Other facility		

(4) Maintenance machine

Working machine for maintenance 1 set

(5) Utility service facility

Boiler	2	5t
Air compressor	2	
Acetylene gas station	1	

2) Auxiliary machinery

Machines and equipment indirectly related to daily carriage and wagon manufacturing of the factory are listed below:

(a) Machinery for maintaining mechanical and electrical facilities as well as for manufacturing and repairing tools and jigs.

(b) Machinery for transportation within workshop and for materials handling.

3) Utility service facilities

(a) Furnance oil storage facility and pipeline

Furnance oil storage facility and pipeline for heat treatment of welded steel block assemblies.

(b) Acetylene gas station and pipeline

Acetylene gas pipeline for gas cutting of steel plate and steel materials will be laid from the gas station to each shop.

(c) Oxygen and carbon dioxide supply system

Oxygen and carbon dioxide supply system for welding and gas cutting of steel materials will be supplied using cylinders.

(d) Air compressor and air pipeline

The air compressor and air pipeline will be provided to supply compressed air for work.

(e) Steam boiler and steam pipeline

Steam boiler and steam pipeline will be provided to supply steam for drying car bodies and parts after painting, and to supply steam for heating the phosphating treatment tanks.

(2) Track and turnout

1) Track

(a) Rolling stock gauge and construction gauge

The rolling stock gauge and construction gauge to be applied in planning various facilities is shown in Fig. 6-4-5.

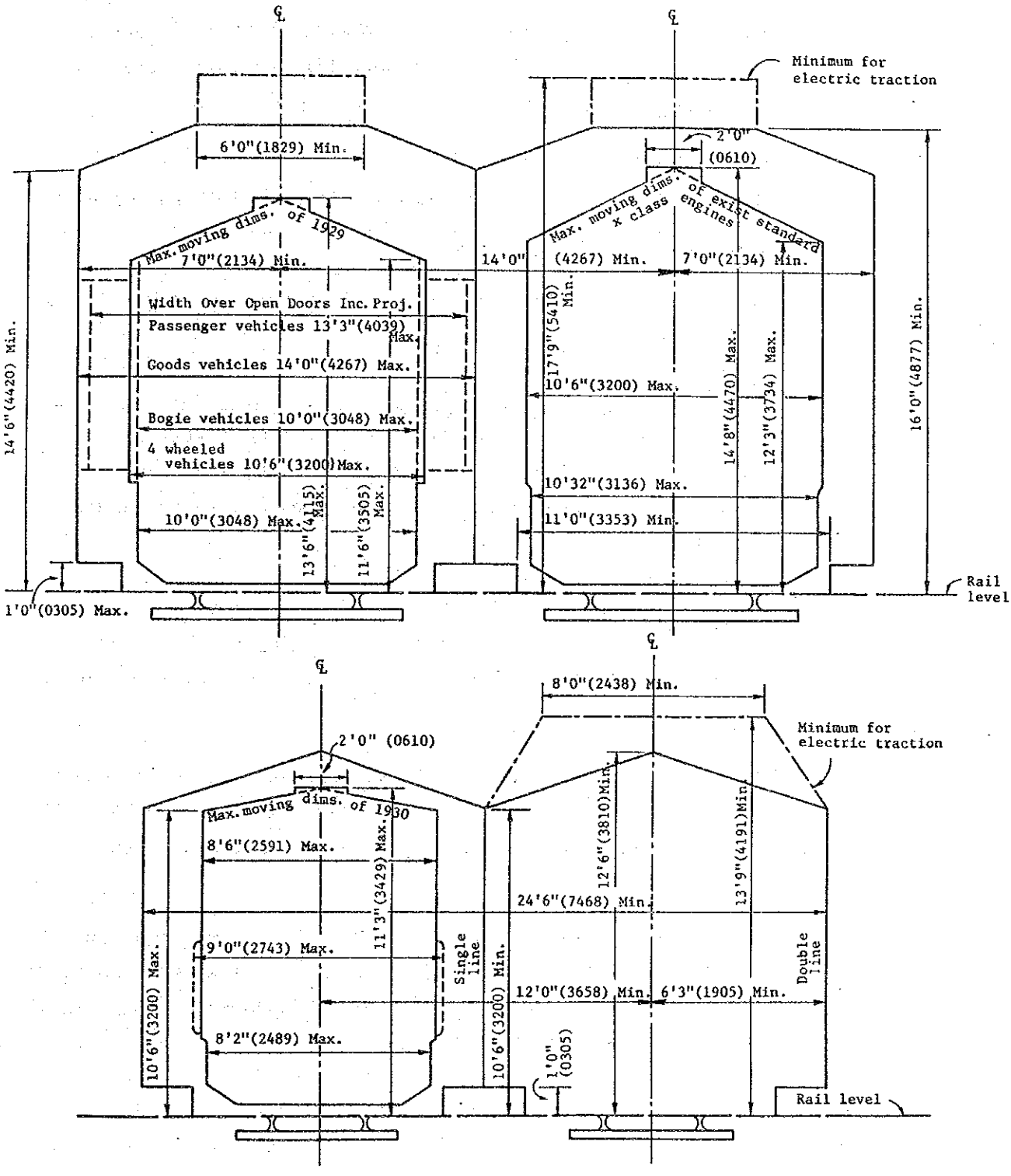


Fig. 6-4-5 Loading and Structure Design Diagrams for BR

(b) Kind of track

Incoming track, outgoing track, track inside the testing and inspection shed, and track on the centre traverser of the plant will be of dual-gauge for common use by metre gauge and broad gauge cars. The car body lifting jack track will be a four-rail system.

(c) Track centre distance

The minimum track centre distance will be 5 m in the plant.

(d) Minimum radius of curvature

Minimum radius of curvature of the track will be 200 m in the plant.

(e) Inspection pit

A single inspection pit of one carriage length will be provided in the final inspection and testing shed, and the inspection pit with side pit will be provided in the shunting locomotive shed.

2) Turnout

Turnout No. 8 1/2 will be used for plant siding track. These are simple turnouts operated by a switch box with weighted lever.

(3) Site electrical system

Electrical power (50 Hz, 3-phase, 230 kV) will be received through a dual feeder system from the power transmission lines of the PDB. This will provide stability and reliability of power services to the plant facilities.

A substation will be provided to interface with transmission lines of the PDB and to step down received 230 kV power to 11 kV for distribution in the factory. Load centres will also be provided in the local electric rooms and the main workshop building.

where distributed 11 kV power will be stepped down to low voltage (3-phase, 230-Y/400-V).

1) Substation facilities

(a) Dual banks of 3-phase, 230 kV equipment will be provided to supply power from one circuit if the other fails or shuts down.

(b) Power receiving equipment and power transformers will be installated outdoors. Relay panels, distribution panels, and operation panels will be installed in the substation building.

(c) Operator(s) will be assigned to the substation to monitor and operate power systems and switchgear.

2) Load centres

The 11 kV power will be stepped down to 230-Y/400-V at each load centre.

3) Standby generator

If commercial power fails, a diesel engine driven generator will be provided to supply power to heavy duty equipment for administration, safety, and security, as well as for exterior security lights and plant fire fighting and alarm equipment. The electric systems will be 230-Y/400-V, 50 Hz, 3-phase, 4-wire.

4) Site lighting systems

Site lighting will be provided by pole-mounted lights for traffic of vehicles and workers, outdoor work, and security of the factory site at night.

(4) Telecommunications Facilities

Telecommunications facilities will be provided for efficient administration and communication in the factory. They will consist of a telephone system, public address system, master clock system, and fire alarm system. The national telephone network will soon be completed. When completed the factory telephone system will become more effective for information exchange.

6-5 Building Construction Plan

6-5-1 Applicable Laws and Regulations

Structural calculation in the detailed design will be done in accordance with Japanese laws and regulations, while general architectural design should be done in accordance with local conditions and customs.

6-5-2 Construction Material Procurement

Construction materials will be procured locally as far as possible, while imported materials will be used where advantageous.

Major construction materials which are banned from import are as follows:

List of banned items from import into Bangladesh under the 1984-83 import policy.

(Construction materials)

Building

. MS Bars/Rods Rounds 2" diameter or less
. Cast iron plates
. GI sheets above 26 BWG
. Prefabricated structures
. Window/door (i.e., unworked or unfabricated)

Sanitary

. GI pipes (1/2" to 4" diameter)
. Earthenware and vitreous China (wash basins, sinks, closets, long pan, syphon, and footrest pipes and fittings, etc.)

Extinguishers

. Carbon dioxide fire fighting equipment (fire extinguishers up to 2 gallon capacity)

Lighting fixtures

- Electric bulbs of 15 watt to 100 watt and fluorescent tube lights
- Electric ceiling fans
- Electrical accessories (except tumbler switches)

Construction materials will be procured as follows:

· Sand, gravel, brick, backfill material	Local	(100%)
· Cement, reinforcement	Local	(70%)
	Import	(30%)
· Paint, wood	Local	(10%)
	Import	(90%)
· Steel members and fixtures	Import	(100%)
· Gas pipes (less than 100 mmϕ), wash basins, toilets	Local	(100%)
· CO_2 fire extinguishers (up to 2 gallons)	Local	(100%)
· Incandescent and fluorescent lamps (15 - 100 W)	Local	(100%)
· Ceiling fans	Local	(100%)
· Air conditioners and ventilators	Import	(100%)

6-5-3 Building Plans

(1) Facilities layout

The layout of the main plant and other related facilities is shown in Figs. 6-4-4 and 6-5-1 (bird's-eye-view).
Car body assembling shops are accommodated in Building A, furnishing shops in Building B.

(2) General plan

General plans for buildings are as follows:

1) Main work building

(a) Floor plan and section

- Column/beam spacing will be determined considering production work and crane arrangement.

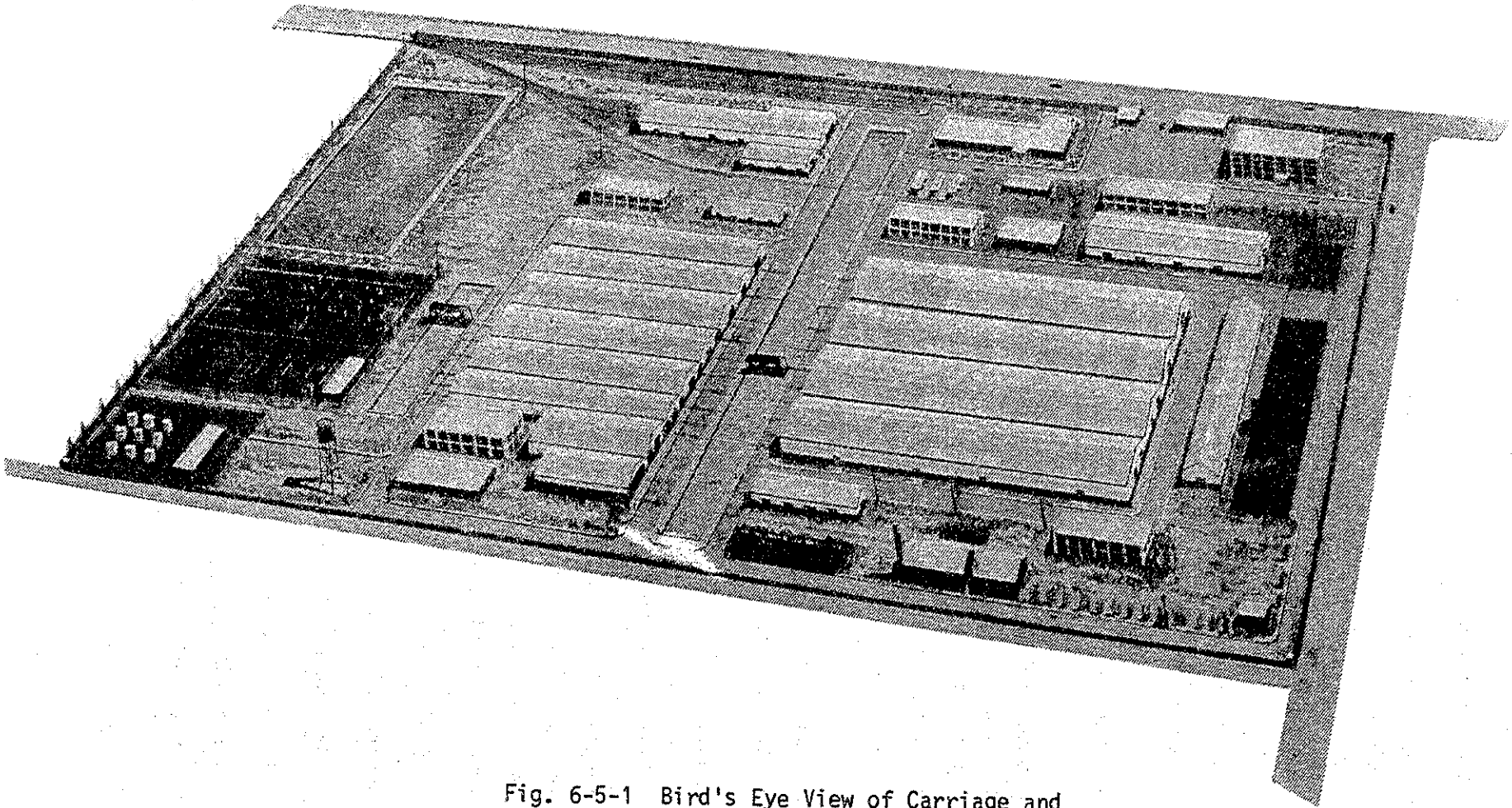


Fig. 6-5-1 Bird's Eye View of Carriage and Wagon Manufacturing Plant

- The eaves height of Building A will be 11 m since 25 t cranes will be operated inside, while the eaves height of Building B will be 9 m since 2 t cranes will be operated. A mezzanine level will be constructed for each building.

  Plan and elevation of Building A are shown in Fig. 6-5-2.

(b) Structure

The buildings will be of steel structure because of the large span to be used. They will have pile foundations.

(c) Ventilation

Mechanical and natural ventilation will be provided by ventilators on the roof and louvers on the lower part of walls.

(d) Lighting

Skylights and ceiling lights will also be used to ensure 150 lux as standard.

2) Administration building

(a) Floor plan

The building will accommodate administration offices, meeting rooms, storage areas, locker rooms, lavatories and a canteen for management personnel.

Storey height: 4 m

The standard floor plan and elevation are shown in Fig. 6-5-3.

(b) Structure

The building will be a four-storey reinforced concrete structure with a rigid frame of 7 m span for both beams and cross beams.

(c) Lighting

Standard luminous intensity in the room will be 300 lux.

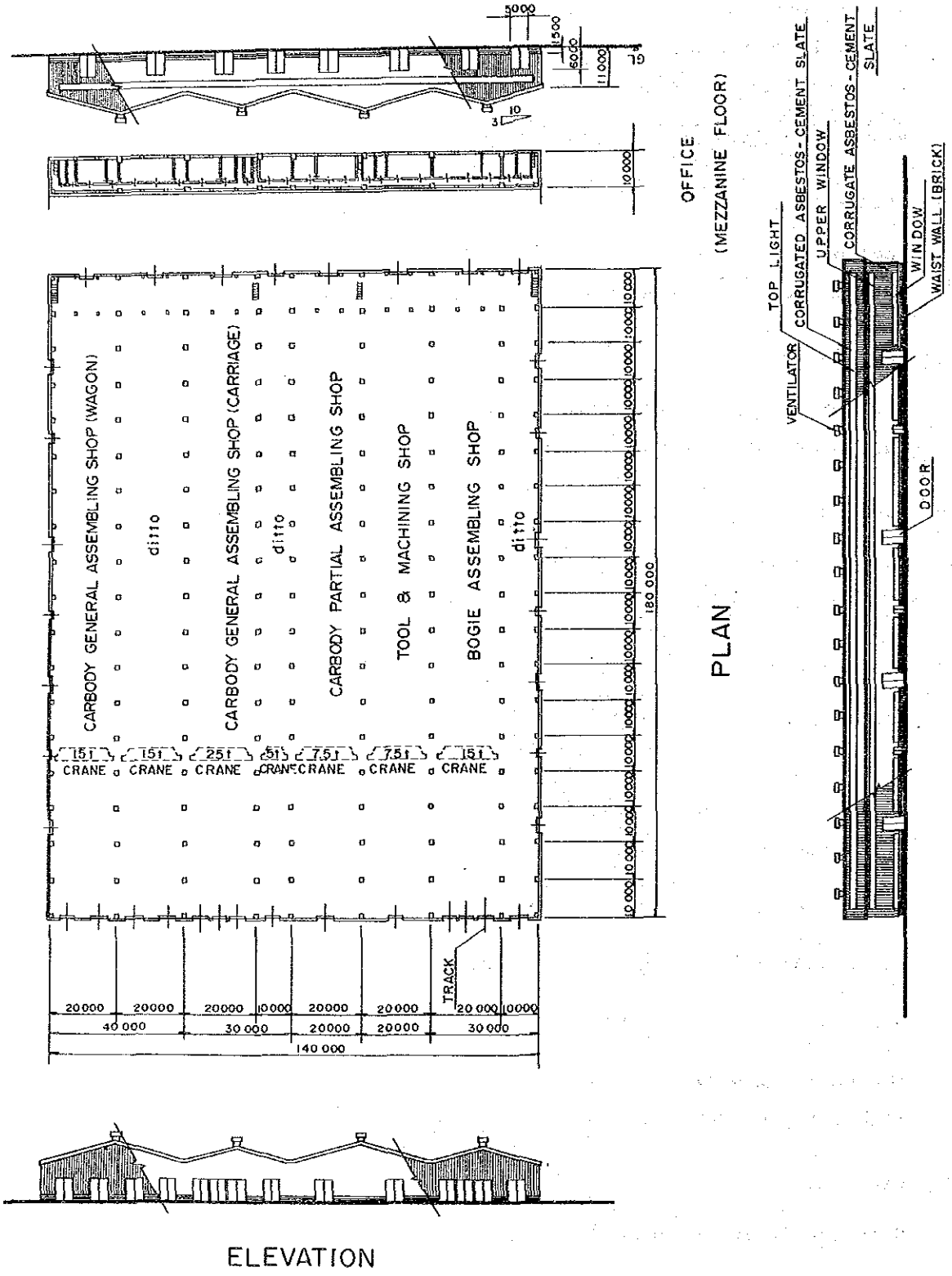
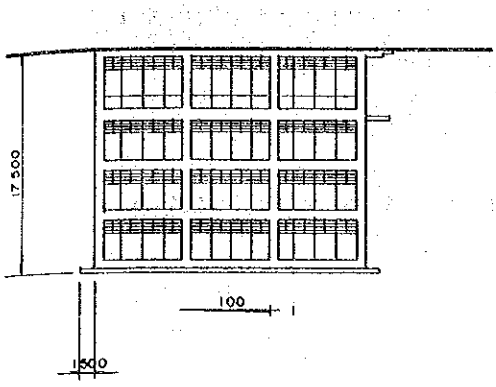
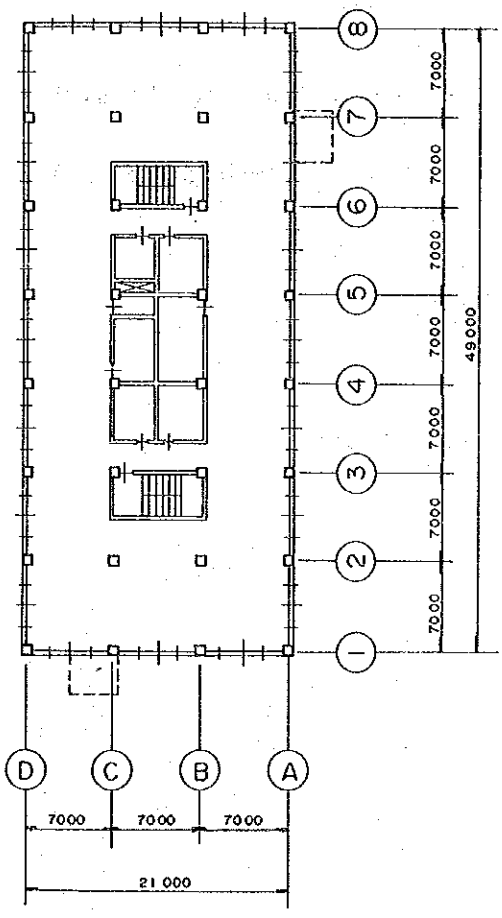


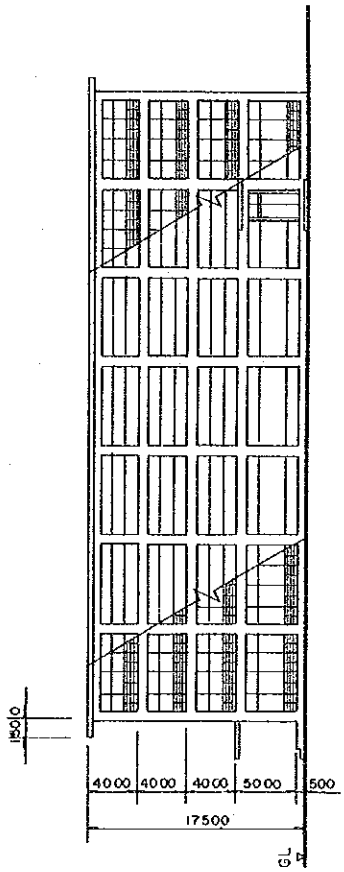
Fig. 6-5-2 Building A



ELEVATION



TYPICAL PLAN



ELEVATION

Fig. 6-5-3 Administration Building

3) Foreman's offices

There will be four two-storey reinforced concrete structures with storey height of 3.5 m and one load center each.

4) Substation building

(a) The building will be a reinforced structure with brick walls.

(b) Storey height: 5 m

5) Canteen

(a) The canteen will be a one-storey reinforced concrete structure with a eaves height of 5.0 m.

(b) The canteen will be installed adjacent to a rest shelter.

6) Open space and fencing

(a) Landscaping and planting will be provided within the site.

(b) The boundary fencing will be of brick (2.0 m-high) with 1.0 m-high barbed wire.

(c) Roads will be paved with concrete.

7) Airconditioning system

Substation building will be airconditioned.

8) Other facilities

(a) Football field, and tennis court

(b) The club house will be a one-storey reinforced concrete structure.

(3) Building sizes

Building sizes will be planned in accordance with the production stages.

Table 6-5-1 Building Construction Plan (1)

Assort	Name of Buildings	Areas (m^2) Total	for Phase I	for Phase II	for Phase III	Stories
Main Building (45,950 m^2)	A Wing (Steel)	25,200	16,200		9,000	1
	Carbody Partial Assembling Shop	3,600	3,600			
	Carbody General Assembling Shop (Car.)	5,400	5,400			
	" (Wag.)	7,200	7,200			
	Tool & Machining Shop	3,600			3,600	
	Bogie Assembling Shop	5,400			5,400	
	B Wing (Steel)	18,350	15,600		2,750	1
	Piping & Wiring Shop	2,750			2,750	
	Upholstery Shop	2,750	2,750			
	Carbody Outfitting Shop (Car.)	5,500	5,500			
	Carbody Painting Shop (Car.)	2,750	2,750			
	" (Wag.)	2,200	2,200			
	Grit Blasting Shed (Car.)	750	750			
	" (Wag.)	750	750			
	Rain Fall Test Track Shed	900	900			
	Steel Material Cutting Shop (Steel)	2,400	2,400			1
Auxiliary Workshop (3,650 m^2)	C Wing (Steel)	3,050	3,050			1
	Final Inspection & Testing Shed	2,750	2,750			
	Shunting Locomotive Shed	300	300			
	Millwright & Machine Maintenance Shop (Steel)	600	600			1

Table 6-5-1 Building Construction Plan (2)

Assort	Name of Buildings	Areas (m^2)				Stories
		Total	for Phase I	for Phase II	for Phase III	
Store House (4,830 m^2)	Main Store (Steel)	3,000	3,000			1
	Inflammable Material Store (RC)	600	600			1
	Wheelset Store (Steel)	750	750			1
	Vehicle Shed (Steel)	480	480			1
Educational Training Centre (RC)		2,000	2,000			2
Administration Building & Other Offices (9,340 m^2)	Administration Office (RC)	4,000	4,000			4
	Time Office (BM)	360	360			1
	Security Office (BM)	180	180			1
	Cycle Stand (Steel)	120	120			1
	Clinic (BM)	360	360			1
	D Wing (RC)	4,320	4,320			1
	Foreman's Office	3,600	3,600			2
	Load Centre	720	720			1
Power Room (1,600 m^2)	Boiler Room (Steel)	600	600			1
	Acetylene Station (Steel)	150	150			1
	Substation Control Building (RC)	450	450			1
	Air Station (Steel)	400	400			1
Welfare Facilities (2,600 m^2)	E Wing (RC)	1,800	1,800			1
	Rest Shelter	600	600			
	Canteen	1,200	1,200			
	Bath Room (RC)	800	800			1
Others (RC)		1,000	1,000			1
Club House, Lavatory, etc.		1,000	1,000			
Grand Total		70,970	59,220		11,750	

(4) Housing

Employees' housing will be planned in accordance with new design standards by personnel rank. (See Figs. 6-5-4, 6-5-5.)

1) Types of quarters

Table 6-5-2 New Types of Quarters

Type	Plinth Area (m^2)(ft^2)	Structural Type	
		Roof, Floor	Wall
P-I	167.2 (1800)	Concrete slab	Brick
P-II	139.4 (1500)	ditto	ditto
P-III	116.1 (1250)	ditto	ditto
P-IV	92.9 (1000)	ditto	ditto
P-V	55.7 (600)	ditto	ditto
P-VI	46.5 (500)	ditto	ditto

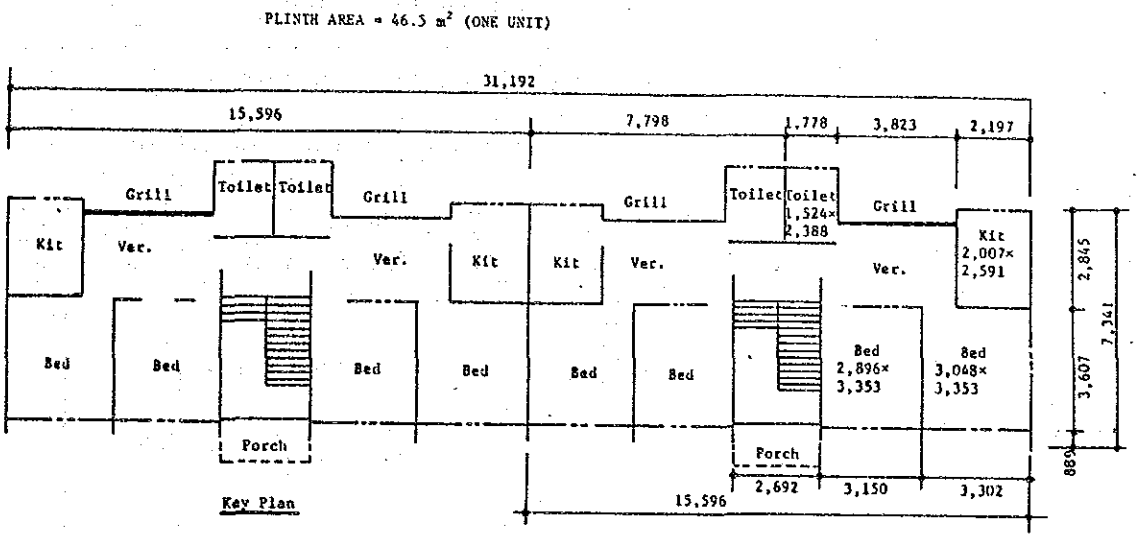


Fig. 6-5-4 P-VI Type (for Ordinary Employees)

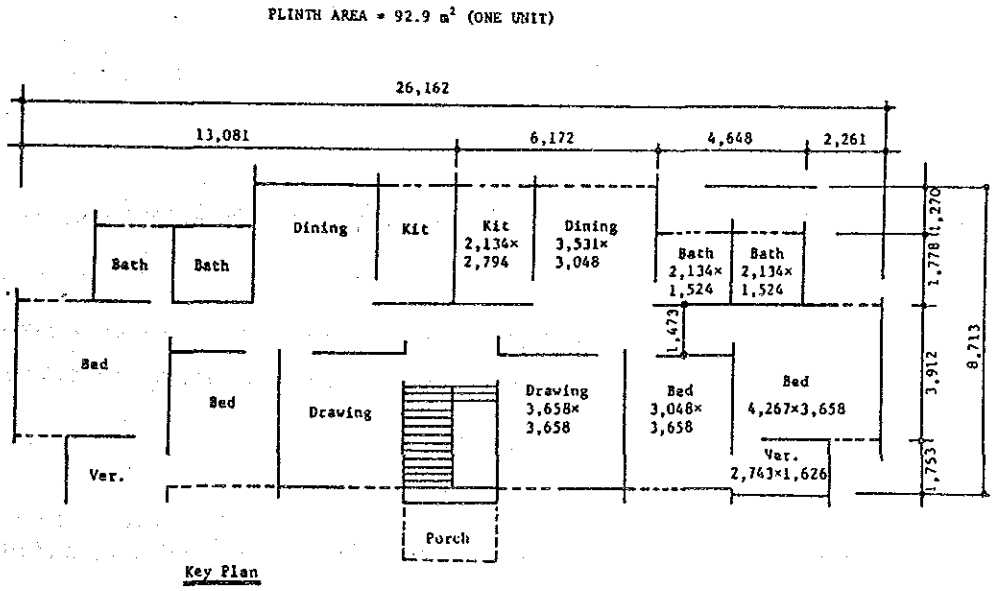


Fig. 6-5-5 P-IV Type (for Senior Personnel)

2) Housing Construction Plan

Table 6-5-3 Housing Construction Plan

Personnel Class		Type	Numbers of Houses, Areas (m^2)							
			Total		for Phase I		for Phase II		for Phase III	
			Houses	Area (m^2)	Houses	Area (m^2)	Houses	Area (m^2)	Houses	Area (m^2)
for Senior Personnel	S	P-II	168	16,440	82	8,130	66	6,360	20	1,950
	A	P-III								
	B	P-IV								
for Ordinary Employees	C	P-V	1,152	59,900	528	27,500	480	24,970	144	7,430
	D,P									
	E,Q	P-VI								
	F,R									
Grand Total			1,320	76,340	610	35,630	546	31,330	164	9,380

Note: For definitions of classes S, A - F, P-R, see Table 7-3-2.

6-5-4 Utilities

(1) Water supply system

Two deep wells will be provided for supplying water to the plant and adjacent quarters.

Water pumped from the deep wells will be stored in an underground reservoir and treated before being pumped to an elevated tank.

(2) Drainage system

1) Rainwater drainage

Rainwater will be led through side ditches around the buildings and near the roads to a tank in the site.

2) Waste water

Waste water will be treated at each building and will be discharged into the rainwater drainage system.

6-6 Scope of Work

6-6-1 Project Schedule

The project schedule is summarized as follows:

· October 1985	Submission of Final Report by JICA
· January 1986	Consulting Service Contract (Directly Appointed Contract) Commencement of Detailed Design
· September 1987	Tender Notice
· December 1987	Completion of Prequalification
· March 1988	Tender Close
· July 1988	Site Preparation (Power Distribution, Site Levelling, Removal of Obstacles, and Embankment)
· September 1988	Selection of Contractor
· January 1989	Commencement of Construction (for Phase I)
· July 1992	Commencement of Production Operation

6-6-2 Construction Stage

(1) General

Construction will be divided into Phases I, II and III.

1) Phase I

Building A, except for the bogie assembling shop (5,400 m^2) and the tool and machining shop (3,600 m^2), and Building B, except for the piping and wiring shop (2,750 m^2), will be completed by the end of 1991. Mechanical equipment for these buildings will be constructed in accordance with the schedules in 6-3 and 6-4.

Approximately 600 quarters units will be completed by the end of 1990.

2) Phase II

Approximately 550 quarters units will be added by the end of 1993.

3) Phase III

The bogie assembling shop and the tool and machining shop for Building A and the piping and wiring shop for Building B will be completed by the end of 1996. Approximately 150 quarters units will be added by the end of 1996.

At this stage, the plant will be completed to be able to start full-scale production in the final year of the construction period (2000).

(2) Construction sequence

To start commercial operation in July 1992, all preparation work (including construction approval, detailed design, selection of contractor, electrical power connection and site preparation (removal of obstacles, land levelling and embankment)) must be completed before construction work begins. Also, an educational training centre for basic training and housing for plant employees must be completed a year and a half before commencement of operation (January 1991), and a warehouse for storing production materials must be completed one year before (July 1991).

Building A and B should be completed as early as possible since installation work, utility work and inspection will take a relatively long time.

The detailed construction schedule is shown in Table 6-6-1.

Table 6-6-1 Construction Schedule Details

Item		Year: 1988	1989	1990	1991	1992	1993	1994	1995	1996
		7~12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12
Overall construction work		Site preparation	Start of construction Construction of housing facilities Construction of education and training centre and warehouse	Partial admission in the housing facilities	Installation of machines OJT	Start of plant operation	Housing			Bogie Assembling Shop Tool & Machining Shop Housing
Preparatory works	Land grading & removal of obstacles									
	High-voltage power lines									
	Embankment									
Plant	Temporary work	Electricity running water and office								
	Rails		Siding		Internal					
	Roads		For access to the site		Finishing					
	Backfilling									
	Main wing of plant		Design, manufacture and purchase of imported equipment and materials						Bogie Assembling shop Tool & Machining shop	
	Administrative wing and others									
	Auxiliary workplaces			Manufacture of imported equipment						
	Warehouse									
	Training Center									
	Fences, outdoor structures, guard house				Gardens					
	Paving									
	Mechanical equipment			Design, manufacture and purchase of imported materials	Installation	Test			Manufacture	Installation Test
	Electric equipment			Manufacture and purchase of imported equipment and materials	Installation	Test				
	Utilities	Well digging & construction of elevated water tank		Manufacture of imported equipment						
Housing	Housing for senior personnel									
	Housing for ordinary employees									
	Paving									
	Fences		Border walls	Construction of roads and gardens						
	Utilities									
	Electric facilities		Purchase of imported quipment and materials							
Phase			for Phase I				for Phase II			for Phase III

6-6-3 Construction Cost

(1) General

Construction cost for each item was estimated based on labour, material, equipment and indirect costs.

1) Cost estimates are based on prices as of the end of December 1984.

2) Local prices will be applied to equipment and materials which will be procured locally.
Unit price of labour and material cost are shown in Table 6-6-2.

3) Foreign currency and domestic currency portion

(a) Foreign currency portion

- Imported equipment and material costs
  Including FOB, ocean freight and insurance.
- Salaries for professionals from abroad
- Labour and administration costs for foreign consultants and contractors

(b) Domestic currency portion

- Locally procured material costs
- Transportation cost for imported equipment and material (local handling)
  Including unloading costs at port
- Labour and administration costs for local companies
- Import duty and sales tax

Table 6-6-2 Unit Prices for Major Equipment, Material and Labour

Wage rates

Item	Skill	Unskill
Earthworker	35	28
Carpenter	68	54
Reinforcing bar placer	68	54
Scaffolding man	68	-
Welder	95	68
Electrician	95	68
Operator (heavy equipment)	110	-
Driver	95	-
Machinist	95	68
Foreman (construction)	125	-

Average wage rate: 68 TK/8H

Unit prices for major materials

Cement (Type I)	2,733 TK/ton
Filling material	137 TK/m^3
Sand	298 TK/m^3
Gravel	621 TK/m^3
Reinforcing bar	19,008 TK/ton
Steel member	10,710 TK/ton
37 kg rail	813 TK/m
Form	161 TK/m^2
Brick	560 TK/m^3
Asbestos cement slate	81 TK/m^2

4) Quantities of each work item are calculated based on the basic plan proposals (Fig. 6-4-4 "Overall Layout of Factory", Fig. 6-5-1 "Bird's-Eye View", Fig. 6-5-2 "Building A", Fig. 6-5-3 "Administration Building", Table 6-5-1 "Building Construction Plan", Table 6-5-3 "Housing Construction Plan", Fig. 6-5-4 "P-VI Type" and Fig. 6-5-5 "P-IV Type").

(2) Unit price analysis

The unit price for each work item was calculated from labour and material costs considering local conditions. The foreign currency portion was converted to domestic currency at the rate of $1 = TK26.0 = ¥251.40, TK1.0 = ¥9.6692.

(3) Work included in construction cost

1) Plant construction including site preparation

2) Design and construction supervision

3) Transportation of construction equipment and material to the construction site

(4) Work not included in construction cost (to be borne by GOB)

1) Land clearing and levelling required for constructing plant and colonies

2) Provision of power distribution, water supply, drainage and auxiliary facilities

3) Furniture and fixtures

(5) Breakdown of construction cost

1) Site preparation
Embankment (Plant and quarters sites)

2) Plant direct cost (Civil engineering)
- Structure
- Track
- Building
- Utility system (Water supply/drainage system)

3) Plant direct cost (Machine)

4) Plant direct cost (Electric)

5) Plant direct cost (Utility)

6) Housing

- . Building
- . Utility system

7) Indirect field expenses

- . Field office
- . Medical facility (for construction personnel)
- . Electrical installation and waterworks
- . Fixtures and expendables at field office

8) Consultancy service

- . Design fees
- . Engineering (supervision) fee
- . Geological survey and surveying costs

9) Construction equipment

Construction equipment will be procured from foreign sources and will be transferred to the owner without charge for use in maintenance.

CHAPTER 7 STAFFING AND PLANT ORGANIZATION

7-1 Staffing Scheme

The staffing scheme not only depends on such directly related factors as scale of the plant, types of rolling stock produced, and parts procurement method, but also varies considerably depending on such other aspects as available technology and skill level, efficiency, plant location, and related laws, regulations, and customs. In this study the staffing scheme is drawn up by assuming the construction of standard carriages and wagons.

7-1-1 Calculation of the Required Personnel

(1) Premises

Quantity of rolling stock to be produced (as shown in Chapter 5)

- Carriages 120
- Wagons 900

Duty conditions

- Same as those of the existing rolling stock repair workshop

(2) Number of directly involved personnel

The number of directly involved personnel is calculated by multiplying the quantity of rolling stock by the number of man-hours required to produce each rolling stock, then dividing by the number of annual working hours of each worker.

These man-hours are estimated by considering in Chapter 5 such factors as the man-hour staff assignment scheme obtained from the BR and the results of studies regarding working groups of the BR, in addition to the improvement of the equipment, upgrading of the technical level, and mass production effect of the new plant.

(3) Administrative staff

The administrative sector is organized according to the accountable work execution system, using the duty analysis technique. The staff regarded as necessary within the relevant organization is assigned accordingly.

(4) The reference year for the sake of calculating the number of personnel is the last year of the Production Plan Phase II.

7-2 Organization Scheme

7-2-1 Basic Scheme

Orders for new rolling stock will be placed according to the ordering schemes of the government and the railway. Therefore, the situation is quite different from that of ordinary commodities, where the volume of orders is conspicuously influenced by the marketplace of supply and demand.

The organization of the plant must be rational and simple to cope with production. Furthermore, the order and command system must be well defined and must strictly conform with various pertinent laws and regulations.

(1) Plant organiation scheme

The head of the plant is assumed to have all the authority and to bear all the responsibility regarding its operation. The plant is operated by dividing it into the required sections, each having its own head and staff.

(2) Workplace

The workplace organization significantly influences the operation of the plant, specifically in connection with work efficiency and product quality. Therefore, it is necessary to define the workplace organization by examining with utmost care aspects such as the actual state of the occupational groups, the customs in the area where the plant is located, and other relevant problems.

It must be acknowledged that this report of F/S does not delve sufficiently into the particulars of these aspects, and therefore the matter presented here should be regarded merely as a tentative approach.

7-2-2 Basic Duties in Each Section

The basic duties to be handled by each section of the plant organization are listed below.

(1) Marketing section

- Demand forecast
- Order acceptance and delivery
- Complaints and claims handling
- Demand expansion and public relations

(2) Administrative section

- Business planning, annual planning
- Budgeting
- Finance and account
- Cost control
- General affairs

(3) Materials and warehousing section

- Procurement of materials (imported materials, domestic materials)
- Import procedures
- Purchasing
- Outside manufacture duties (inspection personnel should be dispatched from the quality control section for technical checks)
- Warehousing (including receiving and delivery of commodities)
- Distribution

(4) Technical section

- Technical data collection and management
- Management of industrial properties
- Technical development and standardization
- Laboratory

(5) Design section

- Basic design of rolling stock to be manufactured
- Detailed design of carriages and wagons
- Drawing management
- Preparation of working drawings

(6) Engineering services section

- Equipment and layout planning
- Equipment administration, maintenance, and conservation
- Transportation inside and outside the plant
- Delivery of products and rolling stock

(7) Manufacturing techniques

- Planning and management of production process
- Planning and coordination of technical training
- Administration of production techniques
- Determination of scope of outside manufacture, purchasing, etc.
- Safety control
- Management of tools, jigs, and instruments
- Management of energy and power in the plant

(8) Manufacturing section

- Workplace composition by type of rolling stock and by duty, for manufacture of carriages and wagons
- Labour management of floor workers
- Implementation of OJT and technical guidance of floor workers
- Process control

The manufacturing section consists of the following:

Car body general assembly, partial assembly, upholstering, furnishing, machining, casting and forging, wiring and piping, painting and pretreatment thereof, and forming and wood working.

(9) Quality control, inspection and test section

- Quality control
- Technical inspection and testing of outside manufactured commodities and purchased commodities (provided with inspection and test equipment for this purpose)
- Intermediate inspection and final testing of carriages and wagons
- Completion test
- Servicing
- Official procedures for approval

(10) Education and training section

- Education regarding general plant operation
- Education of design engineers
- Education of production engineers
- Education of highly qualified technicians and trainers
- Education and training for skilled workers
- Education and training for newly admitted employees

(11) Labour and personnel affairs section

- Labour and personnel control
- Planning and implementation of education and training programmes
- Planning and implementation of safety and sanitation programmes
- Wage and overtime affairs
- Promotion, job rotation, transfers, retirement, etc.
- Social insurance, pension, mutual insurance
- Welfare, lodgings, etc.
- Medical affairs

7-3 Organization and Personnel Assignment

7-3-1 Organization

The organization based on the policy for Phase II is shown in Fig. 7-3-1.

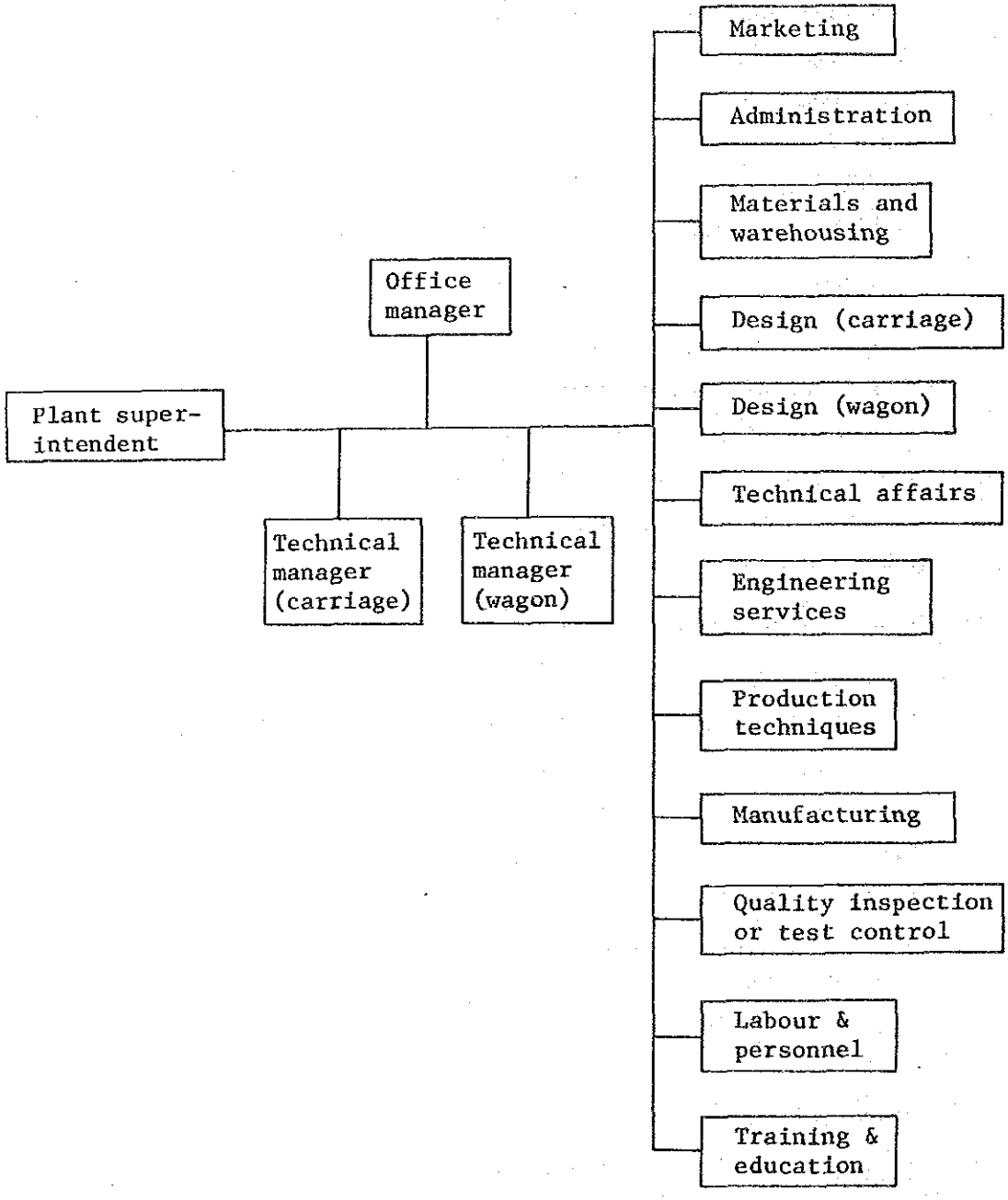


Fig. 7-3-1 Organization and Duties

7-3-2 Staffing

(1) Calculating staff requirements

1) Direct workers

The number of workers required for work described in Chapter 5 is estimated considering required production based on expected productivity and the number of working days.

2) Administrative staff

The staff required to operate and manage the organization will be assigned to the plant.

(2) Job class

The estimated number of workers was divided into nine classes to enable flexible operation.

(3) Yearly staff requirements (by phase)

Table 7-3-1 Yearly Staff Requirements List

Schedule / Production quantity	Year	1	2	3	4	5	6	7	8
	Phase	I		II			III		
	Carriages	80	80	100	110	120	120	120	120
	Wagons	500	600	700	800	900	900	900	900
No. of employees	Direct	1,247	1,528	2,308	2,658	2,942	3,052	3,153	3,368
	Indirect	249	303	458	527	583	601	625	668
	Total	1,496	1,831	2,766	3,185	3,525	3,653	3,778	4,036

(4) Base wage by class (monthly)

Table 7-3-2 Base Wage List by Job Class

Job class	Indirect						Direct		
	S	A	B	C	D	E/F	P	Q	R
Base wage (month)	3,360	2,767	2,065	1,556	1,246	900	926	688	470

(5) Job assignment list

The assignment list (for Phase II-2) is shown in Tables 7-3-3 and 7-3-4 (production section).

Table 7-3-3 Job Assignment List

Job class / Job	Indirect							Direct				Total
	S	A	B	C	D	E/F	Sub-total	P	Q	R	Sub-total	
Senior management	4						4					4
Administration		2	1	5	20	5	33					33
Sales		1		2	8	2	13					13
Procurement		2	1	6	30	15	54					54
Design (carriages)		2		5	20	3	30					30
Design (wagons)		1	1	3	10	2	17					17
Technology		1	1	3	10	5	20					20
Engineering		2	1	6	26	20	55					55
Production technology		1	1	5	25	10	42					42
Manufacturing (including production)		7	6	38	90		141	1,461	798	399	2,658	2,799
Quality control		1	1	7	35	5	49					49
Labour relations/ personnel management		1	1	4	10	5	21					21
Education and training		1	1	16	25	5	48					48
Total	4	22	15	100	309	77	527	1,461	798	399	2,658	3,185

Table 7-3-4 Job Assignment List of Manufacturing Dpt.

Job class / Job	Indirect								Direct				Total
	S	A	B	C	D	E	F	Sub-total	P	Q	R	Sub-total	
Production management		2	2	10	10			24					24
Section No. 1		1		4	10			15	168	92	46	306	321
No. 2		1		4	10			15	168	92	46	306	321
No. 3		1		4	10			15	168	92	46	306	321
No. 4			1	3	8			12	151	82	41	274	286
No. 5		1		3	9			13	168	92	46	306	319
No. 6		1		3	9			13	168	92	46	306	319
No. 7			1	2	8			11	151	82	41	274	285
No. 8			1	2	8			11	151	82	41	274	285
No. 9			1	3	8			12	168	92	46	306	318
Subtotal		7	6	38	90			141	1,461	798	399	2,658	2,799

This plan was made based on information related to local conditions and will be subject to modification by BR.

7-4 Supply and Demand of Manpower

7-4-1 Worker

As much as possible, the required manpower will be recruited from nearby workshops or by relocating staff from other BR organizations.

Posts remaining vacant, in spite of said internal recruiting measures, will be filled through external recruiting.

(1) All employees of the Saidpur Workshop directly involved in constructing carriages, as well as 30% of its remaining personnel, will be transferred to the new plant.

(2) Ten percent of the floor workers of the new plant will be relocated from other BR workshops.

(3) Ten percent of the floor workers of the new plant will be relocated from other BR organization exclusive of workshops.

(4) The number of new workers is obtained by subtracting 90% of the total of (1), (2), and (3) above from the total number of floor workers required by the new plant. (The 10% is assumed to be charged as administrative staffs.)

7-4-2 Administrative Staff, etc.

(1) Ten percent of the relocated personnel will be promoted to be administrative staffs.

(2) Personnel regarded as fit for administrative posts will be selected from all over the country and relocated to the new plant.

7-4-3 Personnel Evaluation, Rotation and Others

(1) Service record evaluation

Employee records should be evaluated impartially and objectively, with appropriate promotions and increases in pay provided. Furthermore, a bonus system should be introduced to improve efficiency and promote work motivation.

(2) Transfer and job rotation

Efforts should be made to minimize gaps in the execution of duties due to transfers and job rotation among employees. In particular, the personnel management system should be modified to extend the length of assignment of university and college graduates from the current two to three years to six to ten years.

(3) Recruitment and education of personnel with high academic backgrounds

Personnel with high academic backgrounds must be assigned to the management and technical fields in order to enable smooth operation of the new plant. Furthermore, continual education and training are required in order to upgrade their level.

(4) Post vacancies

Filling vacant posts due to retirement, prolonged medical treatment, transfers, etc., will be examined separately in the project implementation stage.

7-5 Education and Training Programme

The education and training scheme should be drawn up and implemented from the standpoint of establishing a new industry. In particular, it must be borne in mind that the essential points regarding the implementation of this programme are to recruit personnel with sufficient potential to enable a smooth production of rolling stock and to provide them with education and training until they reach the appropriate levels of technical knowledge and skill. It is thus necessary to implement an effective education and training programme by establishing an exclusive Education and Training Centre (ETC) provided with appropriate teaching materials and qualified instructors, and by making practical use of existing training schools.

7-5-1 Objectives of the Educational and Training Programme (at ETC) and Jobs to be Considered

A wide variety of fields are interrelated in the operation of a plant. The training and education programme should comprehensively encompass all of them, but the fields of management, technical affairs, and manufacturing should be considered slightly more important than the other fields.

(1) Management

The management education and training programme should encompass elements related to the operation of the new rolling stock plant to achieve smooth operation.

Jobs to be considered: Marketing, management, materials control, engineering services, production techniques, quality control, labour, and personnel affairs.

(2) Technical affairs

The purpose of the technical education and training programme is to improve rolling stock design and production technique thereby, increasing production.

Jobs to be considered: Rolling stock design, manufacturing techniques, quality control, inspection and related techniques.

(3) Manufacturing

Acquisition of technical knowledge and skill required to manufacture rolling stock.

Jobs to be considered: Floor workers and foremen in charge of supervision and guidance.

7-5-2 Education and Training Period

Education and training should be started simultaneously with the decision approving the plant construction. In particular, the education and training of instructors must be given top priority. Training and education should be both intensive and efficient, including training in overseas rolling stock plants for some of the instructors.

All workers are expected to receive training, but the training centre alone cannot satisfy such a demand. Thus, basic training for new employees will be temporarily done at training schools in existing workshops. All training will be eventually done at the training centre after the operation is started and the number of entrants decreases.

Table 7-5-1 (Overseas Training/Education)

Table 7-5-2 (Domestic Training/Education)

Table 7-5-1 Overseas Training Schedule and Instructor Dispatching Schedule

Job description			Phase / Number	Plant construction and preparation for operation 1990	1991	1992	1993	Operation	Instructors Man-months
Senior management			3						9
Overseas training/education	Design	Carriages	2						12
		Wagons	2						12
	Engineering	Technology	1						4
		Facilities engineering	1						4
		Production technology	2						8
		Quality control	3						12
	Production	Production control	15						90
		Instruction	28						168
	Administration	Material	2						6
		Labour/personnel management	2						6
	Education/training		2						8
Technicians			27						162
Number of personnel			90						501
Dispatch of foreign instructors			20 10						120 180
Number of personnel			30						300

Table 7-5-2 Education/Training Schedule (Domestic Training)

Item		Schedule		Construction period			Operation			
		Phase		Preparation		↓ I				II
		Number of trainees	Period (month)	1990	1991	1992	1993	1994	1995	1996
	Education of instructors	60	4-6	—						
Design	Carriages	30	6		—	—	—	—	—	—
Design	Wagons	17								
Engineering	Technology	20	6		—	—	—	—	—	—
Engineering	Production technology	38								
Engineering	Engineering	40	6		—	—	—	—	—	—
Engineering	Quality control	49								
Administration	Material	40	6		—	—	—	—	—	—
Administration	Labour/personnel management	20			—	—	—	—	—	
Production	Management: Staff	40	6		—	—	—	—	—	—
Production	Foremen	100			—	—	—	—	—	—
Production	Team leaders	300	6		—	—	—	—	—	—
Production	Skilled workers / Semiskilled workers	1,800	4-6 (36)	—						
Production	New employees	600	12			—	—	—	—	—
	Number of classes (estimate)			5	9	9	9	9	9	9
	Capacity (estimate)			250	380	350	350	350	350	350

( ) include another workshop training.

7-5-3 Training Centre

(1) Establishment policies

The training centre is designed to educate and train personnel required for the plant;

1) Knowledge of administration and operation required for production activities

2) Basic design, technological development and production technology

3) Training on special skills required for production

(2) Training and education courses

Training and education consists of the following courses:

1) Basic education

2) Specialized course

3) Technical training and practice

Detailed curriculum for the education and training courses including on the job training should be prepared considering job type, type of rolling stock manufactured, technical level of workers and other related conditions.

(3) Educational equipment and material

Lecture rooms, library and educational equipment will be provided along with course materials and reference books meeting requirements for each type of job.

7-5-4 Technical Guidance by Foreign Instructors

Temporary instructors for implementation guidance should be recruited (during a fixed period) from related rolling stock manufacturing plants abroad at the time the operation starts.

Only a few rolling stock will be manufactured immediately upon starting plant operation, but intensive On-the-Job Training (OJT) should be carried out in the meantime to improve the technical knowledge and upgrade the skill level.

7-6 Housing and Welfare Facilities

(1) Housing

1) All management staff will be assigned to staff housing.

2) Thirty percent of workers will be assigned to worker housing.

3) Housing will be divided into five classes according to the job class.

4) Instructor and trainee housing will be constructed prior to other housing.

It is assumed that most workers relocated from the Saidpur Workshop can commute from their homes. Workers relocated from other work-places should be provided with housing.

(2) Medical facilities

A clinic should be installed in the plant for employees and their families and supplemented by the existing major hospital nearby.

(3) Supporting facilities

Ancillary facilities such as shower equipment, a club house, athletic field, canteen education facility, and gymnasium (to be used as a movie theatre as well), should be constructed.

CHAPTER 8 PROJECT COST ESTIMATES AND FINANCING PLAN

8-1 Project Cost Estimates

8-1-1 Major Assumptions in Estimating Project Cost

In addition to the relevant conditions provided in the preceding Chapters, major assumptions for estimating the project cost requirements are set as follows:

(1) Project scheme and implementation schedule

1) The implementation schedule is assumed as follows:

- Commencement of consultancy service	Jan. 1, 1986
- Tender close for construction contract	Mar. 31, 1988
- Commencement of site preparation	July 1, 1988
- Start of construction	Jan. 1, 1989
- Commencement of production operation	July 1, 1992

The plant operation according to the schedule above follows the phased production increasing domestic portion of it as indicated in Tables 5-4-1 and 5-4-2.

2) Cost is estimated according to the international calendar year instead of the fiscal year of the Bangladesh Government.

3) A 33-year project life from commencement of construction work to 2020 is assumed for project economic and financial analyses.

(2) Currency and exchange rate

All costs, prices, fees and expenses related to this study are expressed in Bangladesh Taka. Exchange rates to Bangladesh Taka from other currencies applicable in this study are assumed as those at the end of December 1984 as follows:

1) Official rate

$1 U.S. = 26.0 Bangladesh Taka
= 251.4 Japanese Yen

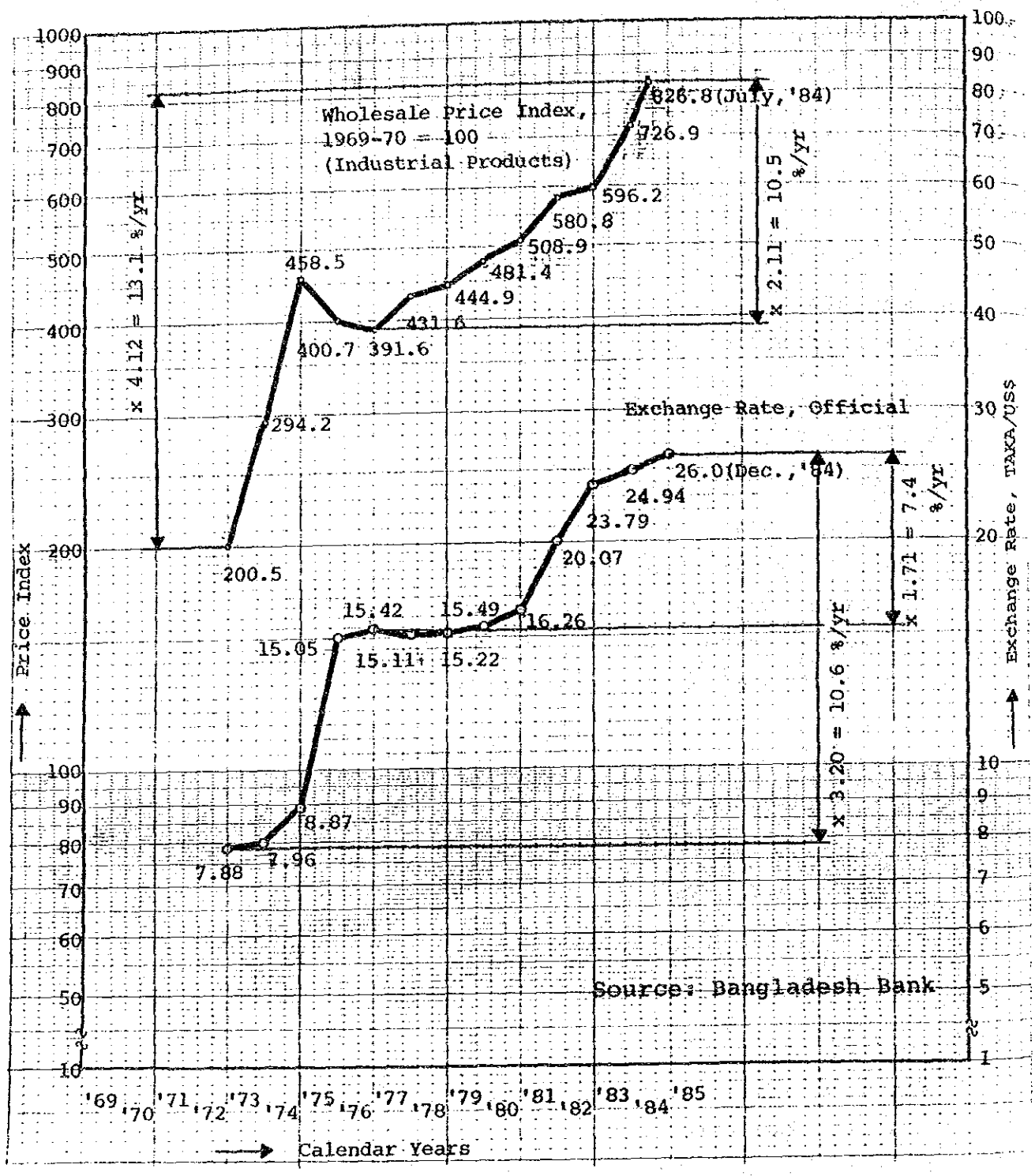


Fig. 8-8-1 Trends of Price and Foreign Exchange Rate

2) Import permit rate (Worker's Earning Scheme)[1/]

$1 U.S. = 29.5 Bangladesh Taka

1/ To be used in the project economic analysis.

(3) Price escalation factors

The following assumptions are applied to the "escalated project cost estimation" for estimating actual project cost considering inflation, as noted in the next clause (4). However, the price escalation is not employed in economic and financial analyses mentioned in Chapters 9 and 10, which are performed on the constant term basis, referring to 9-2 (2) and 10-2.

Figure 8-1-1 shows trend of the wholesale price of industrial products and the foreign exchange rate for 1972/73 to 1984/85. The exchange rate trend has followed the wholesale price trend of the industrial products including devaluation against the sterling pound in 1975. As shown in the figure, the comparison of the price index with the exchange rate indicates that the average annual increase in the wholesale price is higher than that in the foreign exchange rate by 3% whether for 1972/73 to 1984/85 or 1976/77 to 1984/85.

Considering the above trend, the following price escalations are assumed for the period between this study and realization of the project investment:

4 percent per annum in terms of U.S. Dollars
11 percent per annum in terms of Bangladesh Taka

This assumption necessarily implies that the exchange rate of Bangladesh Taka will follow the generally floating trend identical to the last decade. It is also assumed that the exchange rate of Japanese Yen to U.S. Dollars will not change for the aforesaid period.

(4) Base date for project cost estimation

The project costs are estimated on the base date of December 31, 1984. All costs obtained during this study are adjusted to the base date (called "Base Project Costs" referring to Table 8-1-2).

In addition, for reference purpose only, the costs are escalated through each assumed disbursement time using escalation rates specified in paragraph (3) above. The escalated project cost estimation which is obtained in this method refers to Appendix 8-2.

(5) Physical contingency

The physical contingency reflects expected price increases in the Base Project Cost estimates due to changes in quantities and methods of implementation, judged necessary, as being caused by uncertainties related to the site conditions and other design bases, as well as the degree of precision applied in the estimation.

Physical contingency rates considered applicable are indicated in the contingency schedule as follows:

Table 8-1-1 Physical Contingency Schedule (in percent)

	Foreign	Local
Site Preparation	5	10
Plant Direct Cost	7.5	7.5
Housing	5	10
Construction Equipment	5	5
Ocean Freight, Insurance and Local Handling	5	5
Indirect Field Expenses	10	15
Services	5	5
Consultancy and Technology Transfer	7.5	20

(6) Taxes and duties

A 20 percent import duty and 10 percent sales tax, 32 percent in product, are assumed to be levied for all the goods imported for the Bangladesh Railway during construction and operation of the plant in this project, in accordance with the Notification of GOB Ministry of Finance of November 12, 1984.

8-1-2 Project Cost Estimate

Table 8-1-2 shows estimated project cost in which the Base Project Cost comprises the following cost items on the base date (December 31, 1984) basis:

A. Land Acquisition and Site Preparation
B. Plant Direct Cost, Housing and Construction Equipment
C. Services
D. Consultancy and Technology Transfer
E. Pre-operational Expenses

The following two cost items are estimated on the accruing date basis.

F. Initial Working Capital
G. Interest during Construction

(1) Base project cost estimate

1) Land acquisition and site preparation

Land cost is not estimated since the proposed plant is assumed to be constructed on land owned by the Bangladesh Railway.

Site preparation cost is estimated for this item.

2) Plant direct cost

The plant construction cost is estimated in the following items in accordance with the assumed progress of the project in the phased production.

- Civil Engineering and Building
- Mechanical Plant Facilities
- Electric Plant Facilities
- Utility Facilities

The method of estimating major items is described below.

i) Equipment and materials (E & M)

For equipment to be installed, refers to 6-4 and 6-5.

Table 8-1-2 Estimated Capital Requirement

Unit: Taka in Lakh

		Base cost			Physical contengency			Total		
		Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total
A.	Site Preparation	0.0	1019.7	1019.7	0.0	102.0	102.0	0.0	1121.7	1121.7
B.	Plant direct cost	6829.1	3598.5	10427.6	512.2	269.9	782.1	7341.3	3868.4	11209.7
C.	Housing colony	8.4	3398.1	3406.5	0.4	339.8	340.2	8.8	3737.9	3746.7
	Sub total (1)	6837.5	6996.6	13834.1	512.6	609.7	1122.3	7350.1	7606.3	14956.4
D.	Construction equipment	257.0	0.0	257.0	12.9	0.0	12.9	269.9	0.0	269.9
E.	Ocean fr, Insr, Loc. hndlg	425.8	247.6	673.4	21.3	12.4	33.7	447.1	260.0	707.1
F.	Indirect field expenses	399.0	155.3	554.3	39.9	23.3	63.2	438.9	178.6	617.5
G.	Services	527.1	812.7	1339.8	26.4	40.6	67.0	553.5	853.3	1406.8
H.	Consultancy, Tech. transfer	2258.8	61.3	2320.1	169.4	12.3	181.7	2428.2	73.6	2501.8
	Sub total (2)	3867.7	1276.9	5144.6	269.9	88.6	358.5	4137.6	1365.5	5303.1
I.	Import duty	0.0	2580.3	2580.3	0.0	0.0	0.0	0.0	2580.3	2580.3
J.	Pre-operational expenses	0.0	10.0	10.0	0.0	0.0	0.0	0.0	10.0	10.0
	Base Project Cost	10705.2	11883.5	22588.7	782.5	800.3	1582.8	11487.7	12683.8	24171.5
K.	Intial working capital	4121.0	2709.0	6830.0	0.0	0.0	0.0	4121.0	2709.0	6830.0
	Total Project Cost	14826.2	14529.5	29418.7	782.5	800.3	1582.8	15608.7	15392.8	31001.5
L.	Interest drg. construction	709.9	0.0	709.9	0.0	0.0	0.0	709.9	0.0	709.9
	Total Financing Required	15536.1	14592.5	30128.6	782.5	800.3	1582.8	16318.6 (51.5%)	15392.8 (48.5%)	31711.4 (100%)

ii) Spare parts

The cost of spare parts for one year of plant operation, around 3% of E & M costs, is included in the E & M cost estimation.

iii) Civil engineering and erection

The following civil engineering materials are assumed to be supplied from local sources and estimated in the local prices, referring to 6-6-3.

river sand,
brick, and
crushed stone.

Around 70 percent of the cement and reinforced bar is assumed to be locally supplied and is estimated accordingly in the local and international prices.

Most of the civil engineering works will be subcontracted to local contractor(s).

Local contractor(s) will erect the plant under supervision of foreign experts or engineers who are charged with mechanical, electrical, and foundation work and installation of equipment and machinery.

3) Housing

Housing requirements are based on the expected number of employees in the progress of the project, referring to Table 7-3-1, p. 181 and Table 6-5-3, p. 166.

4) Construction equipment

The equipment necessary for the plant construction is assumed to be transported from foreign countries, and to be transferred to the plant owner after construction. The cost difference thereby generated is estimated for this item.

The transportation cost of the construction equipment is estimated and included in the next item.

5) Ocean freight, insurance and local handling

These items refer to the costs of transporting imported equipment and materials for plant construction to the plant site from the country of origin.

Those costs are estimated on the following basis:

Ocean Freight	U.S.D. 178.48/FT.
Marine Insurance	0.95% of C&F price
Local Handling	1% of C&F price
Inland Transportation	Assumed to be transported by BR at its own expense

6) Indirect field expenses

Temporary work, general expenses for construction labour and office expenses for field work during construction are included in this cost item as a local currency requirement.

7) Services

This item is estimated by adding contractor(s)' fee and equipment supplier's serviceman cost for periods of construction and commissioning.

8) Consultancy service and technology transfer

Consultancy service for this project is estimated according to project size and estimated requirements for category of this kind.

Technology transfer, including domestic and overseas training of the BR staff and workers, is assumed as noted in 7-5.

(2) Other cost estimates

1) Interest during construction

Interest for the long-term loan is to be paid during the construction before the production and sales activities commence. The necessary amount is calculated based on an interest rate of 1.25 percent annum and the disbursement schedule of the long-term loan.

2) Initial working capital

Initial working capital has to be provided in advance for the commencement of production and sales. It comprises the following requirements:

i) Operating cash	:	Sum of variable costs and fixed costs for 1 month
ii) Initial inventory	:	Sum of variable costs and fixed costs for 6 months
iii) Product inventory	:	Work in process for 1.5 months
iv) Accounts payable	:	Variable cost for 1 month

8-2 Financing Plan

8-2-1 Debt Equity Ratio

It is assumed that the foreign portion of the total financing required is financed with foreign loans, and the local portion with equity in the local currency. The debt equity ratio is estimated as to be 51.5 percent (foreign portion) and 48.5 percent (local portion), referring to Table 8-1-2.

8-2-2 Financing Terms on Long-Term Loan (Foreign Loan)

The terms assumed in this study are as follows:

Interest rate	1.25 percent per annum
Repayment	20-year repayment in equal installments after 10-year grace period

8-2-3 Financing Terms on Short-Term Loan (Local Loan)

A short-term loan is assumed to be required by this project, to cover the shortage of working capital in the estimated funds flow, with terms as follows:

Interest rate	11 percent per annum
Repayment	One year

8-3 Project Operation Plan

8-3-1 Major Assumptions

(1) Management and organization

The project is presumed to be implemented by the Bangladesh Railway. Therefore, the organization will be embodied as one department of the BR. The envisaged organization refers to 7-3.

(2) Operating system

The operation is planned on the one-shift basis for the working days being practiced in BR.

8-3-2 Production, Inventory and Revenue Schedule

(1) Production schedule

This item refers to 5-4 and 5-5.

(2) Inventories

Inventories are assumed as follows for the manufacturing period:

Products Inventories	0 month
Material Inventories	12 months of variable costs
Accounts Receivable	1 month of sales revenue
Accounts Payable	1 month of variable costs

(3) Selling price of products

It is necessary to assume the average international market price of carriages and wagons of similar types as those to be manufactured by this new project. The price exclusive of import duty and sales tax will be applied to the cost of economic analysis for "without the project" with adjustment with the shadow exchange rate. And the price including import duty and sales tax will be applied in the sales price of financial analysis, since a domestic market price does not exist in Bangladesh at the time of this study.

Despite the many carriages and wagons exported and imported throughout the world, it is difficult to find exactly the same type of carriages and wagons in terms of not only size, structure, material quality, and accommodations but also strength, service life, performance, and reliability. Considering all the given conditions above-mentioned, the following prices are established based on the Study Team's experience and modification of governmental procurement prices in Japan.

1) For the financial analysis:

(Unit: Thousand yen)

	Carriage	Wagon
C&F Chittagon price	49,000	7,600
Unloading cost (1% of C&F)	490	76
Premiums for marine and land insurance (0.95% of C&F)	466	72
Other expenses (PC: 0.75% of C&F)	366	
(FC: 1.50% of C&F)		120
Import duty and sales tax (32% of C&F)	15,680	2,432
Total imported price	66,000 (68.27 Taka in Lakh)	10,300 (10.65 Taka in Lakh)

Note: Exchange rates Taka 26.0/US$, JY 251.4/US$

2) For the economic analysis

The prices noted above are adjusted to the following economic prices in terms of Bangladesh Taka: (Unit: Taka in Lakh)

	Carriage	Wagon
C&F Chittagon price 1/	57.50	8.92
Unloading cost 2/	0.51	0.08
Preminums for marine and labor insurance 1/	0.55	0.08
Other expenses 2/	0.38	0.12
Total economic price	58.93	9.20

Notes: 1/ Exchange rates Taka 29.5/US$, JY 251.4/US$
2/ Exchange rates Taka 26.0/US$, JY 251.4/US$

(4) Operating costs

1) Variable costs

The variable costs are estimated in accordance with the progress of the phased manufacturing, referring to 5-4.

2) Fixed cost

Labour cost is estimated on the assumed manning of employees, referring to 7-3.

Overhead cost is estimated to be 60 percent of the labour cost in accordance with practice of Japanese National Railways.

3) Depreciation

The following fixed asset depreciation terms are assumed:

Buildings: 50 years, straight-line method
Plant facilities: 20 years, straight-line method
1% salvage value for both items above.

(5) Taxation on revenue

Revenue of enterprise by BR is assumed not to be taxed.

CHAPTER 9 ECONOMIC ANALYSIS

9-1 Objective

The objective of this chapter is to analyze and evaluate the project for constructing and operating the railway carriage and wagon manufacturing plant in terms of its economic effects based upon the proposed plan noted in preceding chapters.

9-2 Prerequisites

(1) Project life

An economic life of 33 years from the start of construction is presumed for economic analysis.

(2) Escalation rate

An estimate of price escalation for a period over 30 years will render an amount far different from the present price levels. Furthermore, it will be difficult to ensure a reliable estimate, so economic analysis is performed on a constant price basis.

(3) Foreign exchange rate

The following exchange rate as of the end of December, 1984 is used as the shadow exchange rate in economic analysis:

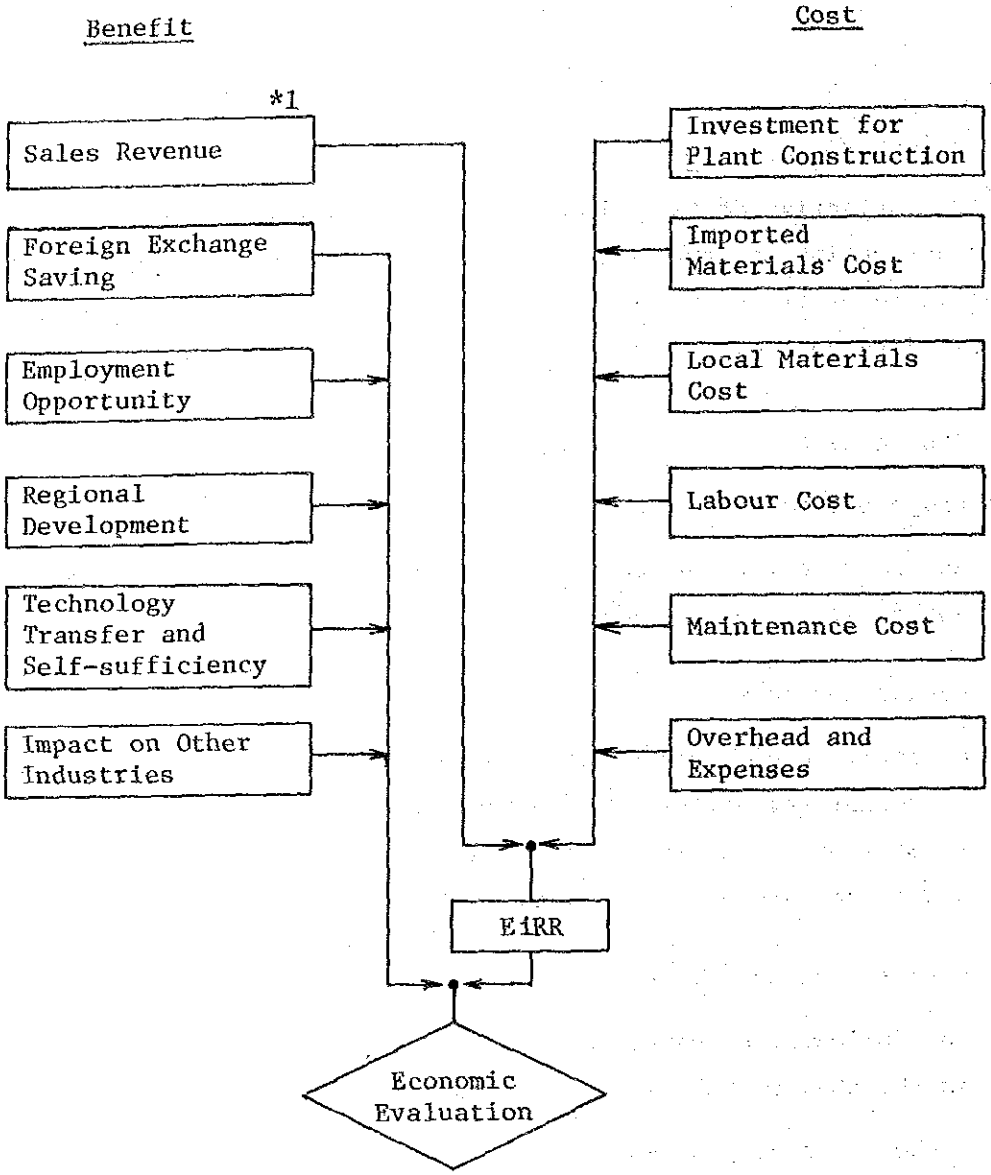
Worker's Earning Scheme (W.E.S.) Rate (I.P.R.):

Bangladesh Taka 29.50/U.S. Dollar

9-3 Methodology of Economic Analysis

9-3-1 With/Without Project

Since there is no railway carriage or wagon manufacturing plant in Bangladesh, the required carriages and wagons are presently imported. In the proposed "with" project case, however, a manufacturing plant for



*1 The value identical to import cost of carriage and wagon in the "Without" project.

Fig. 9-3-1 Cost and Benefit Items of Economic Analysis

supplying the entire requirement is not planned. Therefore, the "without" project case is defined as that in which the carriages and the wagons are imported in quantities identical to those which are projected to be manufactured in the "with" project case.

The project economic benefits are evaluated by comparing the economic costs of the "with" and "without" cases.

9-3-2 Economic Effects

The project, construction of a new plant, is expected to achieve the following economic benefits: create employment-opportunity, contribute to regional development, impact other industries, transfer technology and thereby support technical self-sufficiency, and save foreign exchange.

The economic internal rate of return will be numerically evaluated in 9-4-1. Other economic benefits are discussed in 9-4-3.

9-3-3 Economic Prices

The economic analysis is to be performed using economic values instead of market prices (used for financial analysis) to measure the economic value of the project.

The economic values have been calculated by the following methods:

(1) Tax and duties

All taxes and duties levied on the purchase of project equipment and materials are deemed transfer expenditures and are to be deducted in the economic analysis.

Subsidies, if any, for the project must also be adjusted for the same reason, but are not applicable to this project.

For this project, the adjustment is made by deducting import duty and sales tax from imported materials for plant construction and manufacturing.

Income tax in labour costs for construction and manufacturing is not adjusted since income tax is imposed on few people.

(2) Labour cost

In consideration of scarcity of job opportunity for job seekers, the economic labour cost has been adjusted by deducting 50% of the cost for unskilled labour.

(3) Local materials

The local market price of materials for construction and manufacturing after deduction of sales tax is assumed as the economic cost in terms of the local currency.

(4) Shadow exchange rate

It is necessary in economic analysis to adjust the revenues and costs of foreign currency portion into those reflecting economic value or real value in terms of local currency. The adjustment is to be performed by means of an exchange rate such as the shadow exchange rate. In this study the costs in foreign portion, deducted by tax and duties, are converted into Bangladesh Taka using W.E.S. rate (I.P.R.) as the shadow exchange rate based upon discussion with BR.

(5) Economic prices of carriages and wagons

The economic prices of carriages and wagons are evaluated to border prices (CIF Bangladesh port) based on the same specifications and quality as those projected to be manufactured in the project as noted in 8-3-2 (3) 2).

9-4 Result of Analysis

9-4-1 Economic Internal Rate of Return

The economic internal rate of return obtained by the aforesaid method is 9.42 percent. In addition to this result calculated by means of numerical analysis, this project has such macro-economic benefits as foreign exchange saving, contribution to self-sufficiency and other non-quantifiable benefits.

Endeavours to take proper measures such as deducting imported materials cost, which have majority in the total production cost, and other savings in foreign currency will further enhance the economy of the project.

9-4-2 Sensitivity Analysis

The sensitivity of the economic internal rate of return on major parameters is analyzed, as shown in Table 9-4-1.

Table 9-4-1 Results of Sensitivity Analysis in Terms of Economic Internal Rate of Return

Products Price		Materials and Parts Cost		Investment	
-10%	+10%	-10%	+10%	-10%	+10%
6.25	12.34	11.77	7.13	10.01	8.88

9-4-3 Evaluation of Other Economic Benefits

The benefits to be evaluated in addition to the economic rate of return are as follows.

(1) Foreign exchange savings

The project is envisaged as a major means of import substitution: Replacing the railway carriages and wagons which are currently imported with domestically produced carriages and wagons.

To review the effect of expected foreign currency savings by this project, the total balance of foreign exchange outflow-inflow is analyzed as indicated in Appendixes 9-12 and 9-13.

(2) Creation of employment opportunity

Employment opportunity will be created during plant construction and operation. The permanent employment in BR for this project is expected to be approximately 1,800 in Phase I of the operation, 3,500 in Phase II, and 4,000 in Phase III.

(3) Contribution to regional development

Investment in and operation of this project will cause regional development of north-west Bangladesh including employment of local manpower, various commercial activities, and public investments including transportation, education and so forth.

(4) Industrial technology transfer and contribution to self-sufficiency

The implementation of the proposed project will initiate and advance trasnfer of technologies on design, plant construction and operation of the railway carriages and wagons manufacturing plant. Those technologies comprise plant engineering for the construction period, and manufacturing technology of the carriages and wagons in the operation period.

Especially the carriages and wagons manufacturing technology, inclusive of design and management, forms the essential portion of the technologies to be transferred.

Further those technologies transferred are expected to result advantages in the maintenance of the railway carriages and wagons. Since maintenance technology is primarily based on application of manufacturing technology, the establishment of the up-dated plant manufacturing railway carriages and wagons will be the source of maintenance technology for those products. Another advantage forecasted in the rolling stock maintenance is supply of component parts in the new manufacturing plant which have not been referred in this report. The supply of standardized spare parts is expected to result improvement in rolling stock maintenance by decreasing too many variety of spare parts. The technology transfer in the fields as above-noted will encourage self-sufficiency in technical and consequently economic aspects of Bangladesh.

(5) Impact on other industries

This project investment and operation will impact other local industrial sectors including materials and components manufacturing, maintenance services and supplies, transportation of supplies, industrial construction, etc.

CHAPTER 10 FINANCIAL ANALYSIS

10-1 Objectives

The envisaged railway carriage and wagon manufacturing plant is expected to function as a department of the Bangladesh Railway. This financial analysis is made to evaluate the financial viability of the plant by means of the financial internal rate of return, financial statements and financial indicators, upon the proposed plan noted in preceding chapters.

10-2 Prerequisites

(1) Project life

(2) Escalation rate

The prerequisites for the above two conditions identical to those applied to economic analysis are also employed in the financial analysis.

(3) Foreign exchange rate

The following exchange rates as of the end of December, 1984 are used in financial analysis:

Official rates: Bangladesh Taka 26.00/U.S. Dollar
Japanese Yen 254.10/U.S. Dollar

10-3 Results of Financial Analysis

Based on the prerequisites as above, the following financial papers have been prepared and attached in Appendices 10-1 to 10-53.

a. Production and sales plan
b. Production cost statements
c. Working capital statements
d. Income statements (for year ending December 31)
e. Funds flow statements
f. Balance sheet

g. Long-term debt repayment schedule

h. Profitability and financial indicators

10-3-1 Financial Internal Rate of Return (FIRR)

The financial internal rates of return on investment obtained by the aforesaid method are as follows:

Base Case A — 10.01 percent
(Import duty and sales tax are imposed on the imported materials for plant construction.)

Base Case B — 10.63 percent
(Tax and duty are exempted from the imported materials for plant construction.)

10-3-2 Sensitivity Analysis

The sensitivity of the financial internal rate of return on major parameters is analyzed for Base Cases A and B, as shown in Table 10-3-1.

Table 10-3-1 Results of Sensitivity Analysis in Terms of Financial Internal Rate of Return

	Sales Price		Materials and Parts Cost		Investment	
	-10%	+10%	-10%	+10%	-10%	+10%
Base Case A	6.82	12.98	12.42	7.68	10.60	9.46
Base Case B	7.32	13.73	13.17	8.18	11.21	10.09

10-3-3 Evaluation of Financial Analysis Results

(1) Rates of return

The EIRR (refer to Chapter 9) and FIRR differ. The difference is due to the fact that deduction of combined import duty and sales tax in estimating economic price of products is affecting on EIRR more than the effect of the shadow exchange rate.

(2) Profitability of the project

On the Income Statement, Appendices 10-13 and 10-38, profit due to the project is yielded in the fourth year of the project, and is forecasted to increase by year.

(3) Working capital

Shortfall of working capital takes place for seven years after starting the production for both Base Cases A and B. The shortfall is assumed to be covered by the short term loan (refer to Appendices 10-21/22 and 10-42/43).

(4) Quick ratio (Acid test)

The ratio refers to quick current asset, which is current asset subtracted by inventory, being of nature rapidly cashable, over current liability. Being an indicator for liquid stability, the value over 1.0 is advisable.

It comes under 1.0 for the first seven years and for the first six years in Base Cases A and B respectively. However, it increases soon until around 1.4 showing satisfactory stability of the project. (Refer to Appendices 10-26 and 10-46.)

(5) Debt service coverage ratio

It is calculated as;

$$\frac{\text{Depreciation + Interest expense + Net profit after tax}}{\text{Repayment of long term debt + Interest expense}} .$$

It refers total cash generated in the year over total payment for principal and interest. The project is evaluated as stable considering eventual risks when the ratio exceeds a value of 1.5.

For this project the ratio, both for Cases A and B, keeps value of 4 to 7 indicating financial stability.

(6) Evaluation of project profitability and stability

The financial stability of the project, upon the aforesaid prerequisites and cost estimations, is evaluated as sufficient from it liquidity. It is advisable that the shortfall of operating capital, expected in initial stage of the project, is to be reduced due to endeavour to decrease inventory.

CHAPTER 11 COMPREHENSIVE EVALUATION

Judging from the result of the economic and financial analyses in addition to the technical assessment the envisaged project is concluded to be worthy of implementation.

Thereat it must be noted that the project incorporates so many significant economic benefits such as regional development and self-sufficiency of rolling stock beside that which is presented by quantitative methods.