Government of Southern Sudan
Ministry of Transport and Roads
Central Equatoria State
Ministry of Physical Infrastructure

PREPARATORY SURVEY

ON

THE PROJECT FOR IMPROVEMENT OF JUBA RIVER PORT

IN

THE REPUBLIC OF THE SUDAN

FEBRUARY 2011

JAPAN INTERNATIONAL COOPERATION AGENCY

KATAHIRA & ENGINEERS INTERNATIONAL

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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey on the Project for Improvement of Juba River Port in the Republic of the Sudan and entrusted the survey to Katahira & Engineers International.

The Survey team held a series of discussions with the officials concerned of the Government of Southern Sudan, and conducted a field investigation, and organized a survey team headed by Mr. Kenji ISOMOTO of Katahira & Engineers International between 5 March, 2010 to 30 October, 2010. As a result of further studies in Japan, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of the Sudan for their close cooperation extended to the teams.

February, 2011

Kiyofumi KONISHI
Director General,
Economic Infrastructure Department
Japan International Cooperation Agency

Summary

1. Outline of the Country

The Republic of the Sudan has territory area of 2.5 Million sq.km, or the largest country in Africa. The northern part of the country reaches the Red Sea, also tropical rain forest and the Sahara Desert are situated in south and north respectively. The population is approximately 41.35 Million in 2008, and 43 % of the population lives in rural area. GDP is 55.9 Billion dollars, and GDP per capita is 1.1 thousand dollars. The economic growth rate in 2008 recorded 8.3% and inflation rate is 15.8%

2. Background of the Project

After the Comprehensive Peace Agreement in 2005 which ended the civil war over 50 years, GOSS was established. And as postwar recovery proceeds, the momentum toward the referendum on independence has been rising. With the activation of economy and community in Southern Sudan, the demand for import material for living and infrastructure development from the Northern Sudan and neighboring countries is growing fast. Therefore the stable and efficient logistics is a key to development, which makes the relationship between the Northern and the Southern Sudan strong, and promotes the peace as a result.

On the other hand, since arterial highways have not been paved in Southern Sudan and detour the vast wetland along the River Nile, the capacity and efficiency of inland transport is limited. Therefore inland waterway transport from Kosti River Port in the Northern Sudan to Juba River Port as well as inland corridor from Kenya and Uganda to Southern Sudan is a lifeline to support the reconstruction in Southern Sudan.

Under the above conditions, JICA is providing consistent support of river port facility development and capacity building as an only donor to cooperate with the sector after the peace agreement. Before now, JICA implemented the development of the 35m jetty and the handover of the gantry crane as well as the introduction of mechanization of cargo handling. Moreover initial trainings were carried out to Juba River Port Administration (hereinafter referred to be as “JRPA”) established by the Ministry of Transport and Roads (hereinafter referred to be as “MOTR”) / GOSS and the Ministry of Physical Infrastructure (hereinafter referred to be as “MOPI”) / Central Equatoria State (hereinafter referred to be as “CES”).

On the other hand, as the reconstruction goes ahead, the cargo handling volume has increased drastically. In order to keep up the demand, the jetty and natural river bank are utilized. However the docking to the natural river bank has safety problems and makes the cargo handling activity inefficient. Accordingly it is urgent matter that the expansion of Juba River Port facilities which have suitable functions as a base port in order to support the economic activity in the Southern Sudan.

Under the conditions, the goal and purpose of the Project is to promote the economic development of cities along the River Nile and to advance investments and developments thorough the improvement of access to southern part of the Sudan.

3. Outline design of the study and contents of the project

Based on the field surveys and a series of discussions with concerned authorities, the scope of the Grand Aid was agreed by both sides as follows;

Item	Terms of Agreement
Area of River Port	Approx. 5.4 ha (including Road Reserve & 2nd Phase Expansion Area)
Length of Perimeters	Approx. 620 m (covering above area except river side)
Length of Proposed Quay	Approx. 205 m (including Existing Jetty, 35m), Inclined Quay 28 m, Water Depth : 2.5m
Handling Objects	Container / Pallet / Break Bulk / Vehicle / Passenger
Handling Method	Crane / Slip Way / Pontoon (Roll-On & Roll-Off & Passenger)
Design Code	Technical Standards & Commentaries for Port & Harbor Facilities in Japan (The Overseas Costal Area Development Institute of Japan)
Design Vessel	Standard 500 ton Loading Capacity Barge (Length : 36m x Width : 9.5m x Depth : 2.3m, and Max Draft : 2.0m)
Design Load (Vertical)	Crawler Crane 150 ton (evaluated as 5.0 ton per sq.m against the Super Structure)
Design Load (Horizontal)	25 ton per Mooring Post
Design Seismic Factor	0.10~0.15 (Peak Ground Acceleration of 0.8 to 1.6 m per s^2 based on USGS Africa Seismic Hazard Map)
Design High Water Level	452.86 ASL (As Same Level as that of Existing Jetty Construction)
Design Low Water Level	451.36 ASL (As Same Level as that of Existing Jetty Construction)
Design Datum Level	453.70 ASL (Top of Existing Jetty Deck)

The layout plan is shown as follows;

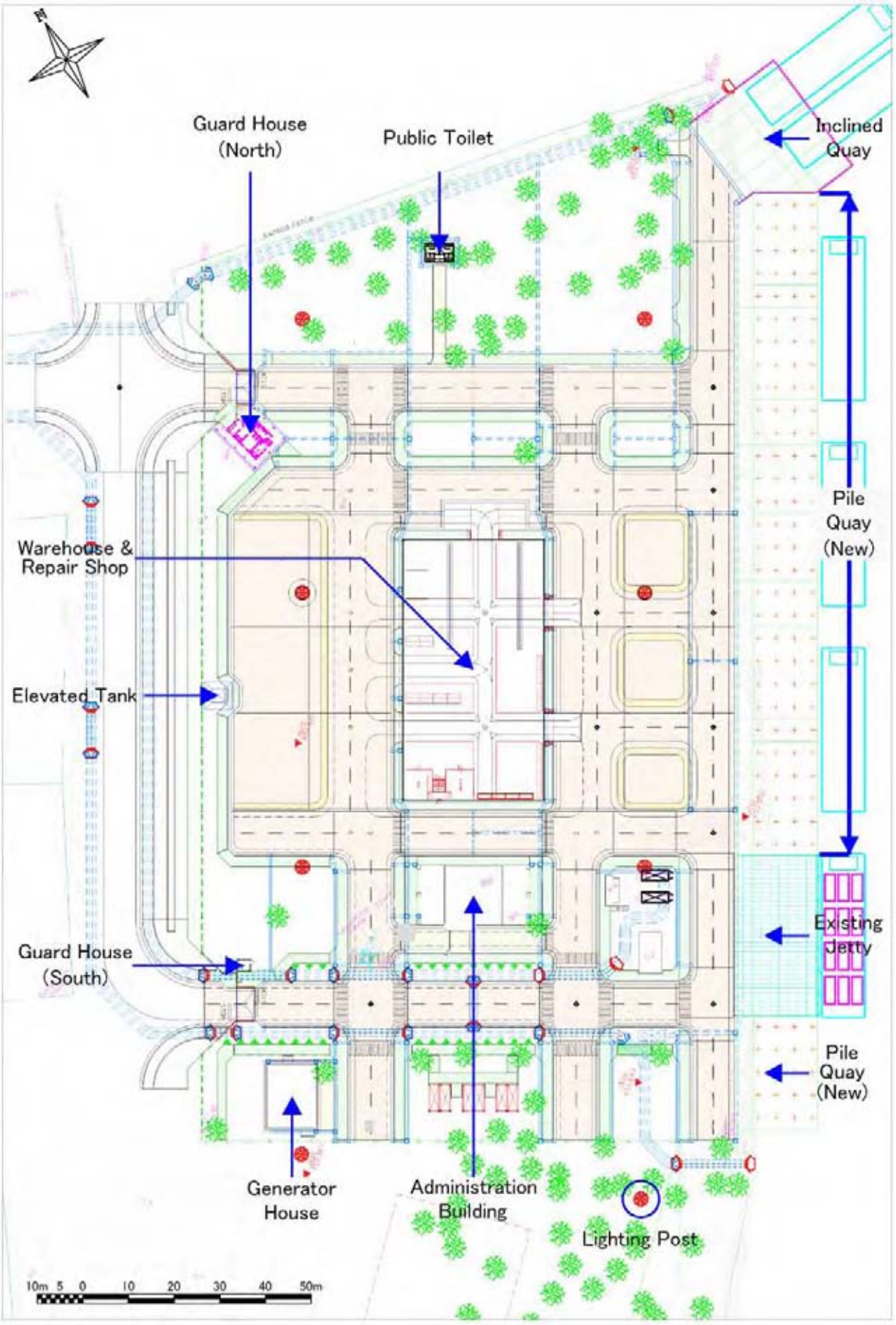

Figure-1 Layout Plan

The size of Civil and Building facilities is as follows;

Table-1 Size of Civil and Building Faculties

Facility	Work		Classified Type	Unit	Quantity
Civil Facilities	Pile Quay Work		Vertical Quay, Steel Pipe Pile φ700mm	m	170
	Cargo Handling Yard		Inter Locking Block	sq.m	12,500
	Inclined Quay		Inclined Part : RC Slab	m	28
	Oil Water Separating Tank		Same type as American Petroleum Institute	No.	2
	Drainage Facility		Open Ditch	m	2,510
			Pipe	m	570
Civil & Building Composition Facilities	Exterior		Fence, Post, Gate	m	540
	Electrical Facility		Power Supply Pipe / Hand Hall	m	780
	Water Supply Facility		Water Supply Pipe	m	1,060
	Sanitary Facility		Sewage Tank	No.	6
	Elevated Tank		H=18.0m	No.	1
	Lighting Post		H=18.0m	No.	8
Building Facilities	Administration Building		Reinforced Concrete (RC) Structure, Two Level building	sq.m	576
	Warehouse & Repair Shop		Steel Structure, Two Level Building	sq.m	1,688
	Guard House	North	Concrete Block (CB) Structure, Flat Building	sq.m	50
		South	Container / Prefabrication, Flat Building	sq.m	8
	Generator House		Steel Structure, Flat Building	sq.m	142
	Public Toilet		CB Structure, Flat Building	sq.m	25

4. Implementation Schedule and Project Cost

In case the Project is implemented by Japanese Grant Aid, the period fir the detailed design is 8.0 months and the implementation period is 25.0 months in total. The cost will be determined before conducting the Exchange of Note for the Project.

5. Project Evaluation

Validity

There is a high need in terms of the economic activity of postwar years of recovery and the strengthening of the mutual cooperation ties between the Northern and Southern Sudan. In addition, the Project is alignment with the strategy of GOSS and JICA's aid policy. Furthermore the validity of the Grant Aid is high based on the reasons as follows;

- ✓ Japanese ports have been operated and maintained well by overcoming the server natural conditions and complex topography of Japan.

- ✓ There are a lot of cooperation experiences abroad in port field, moreover there are suitable and superior port technology.

Quantitative Effect

i. To reduce the cargo loading & unloading time by introduction of safe and efficient docking facilities and large-sized cargo handling crane, and to facilitate the collection of docking fee, crane charge etc.

ii. To prevent the accident during special works such as ship handling, and to improve general work conditions.

iii. To improve the safety of the port area and detention cargo by the development of the guard houses, lightings, fences etc.

iv. To improve the sanitary condition of port facilities by the development of water supply and sanitation conditions.

The effects brought by the Project are shown as Table-2.

Table-2 The Effects of the Project

		Current Situation	Target Year
Year		2010	2016
Index		1.00	1.89
Daily Cargo Handling Volume	(ton/day)	300	600
	(barge/day)	1.0	2
	(fleet/day)	0.25	0.50
Weekly Cargo Handing Volume	(ton/day)	1,800	3,600
	(barge/day)	6.0	12.0
	(fleet/week)	1.5	3.0
Monthly Cargo Handling Volume	(ton/month)	7,200	14,400
	(barge/month)	24	48
	(fleet/month)	6.0	12.0
Yearly Cargo Handling Volume	(ton/year)	86,400	172,800
	(barge/year)	288	576
	(fleet/year)	72.0	144.0

Qualitative Effect

i. To promote the peace between the Northern and Southern Sudan by strengthening the mutual and economic cooperation

ii. To activate the local economy by providing the efficient logistics means

iii. To curb inflation, and to promote the economic activity and attract investments

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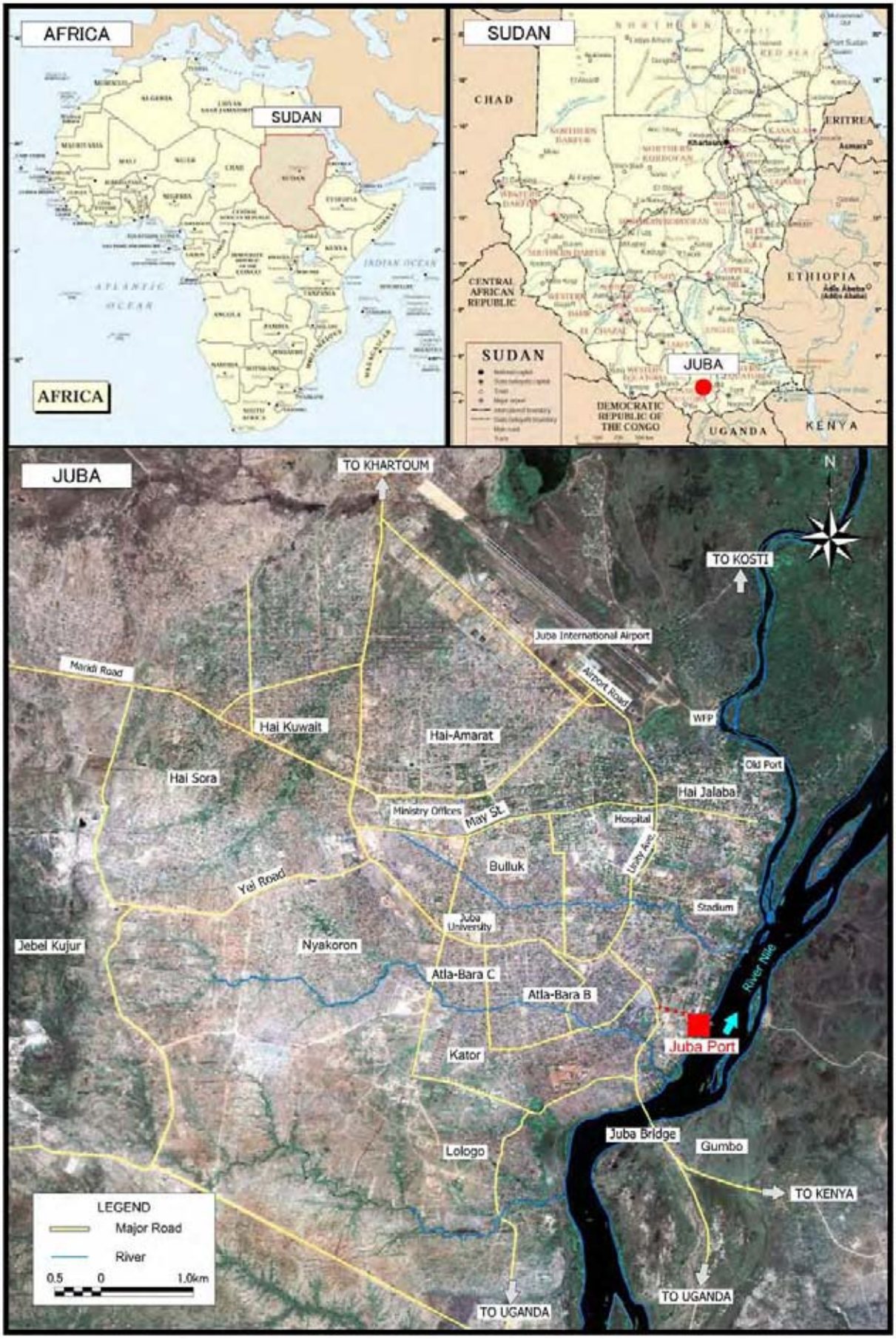
5. Technical / Non-Technical Note
6. Environmental Certificate of MOE / GOSS
7. Other Relevant Data



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Abbreviations

AASHTO	: American Association of State Highway and Transport Officials
A/C	: Approval of Cabinet
API	: America Petroleum Institute
BHN	: Basic Human Needs
BS	: British Standard
CB	: Concrete Block
CBR	: California Bearing Ratio
CES	: Central Equatoria State
DCPT	: Dynamic Cone Penetration Test
DTC	: Directorate of Transport and Communication
DRT	: Directorate of River Transport
EIA	: Environmental Impact Assessment
E/N	: Exchange of Note
G/A	: Grant Agreement
GDP	: Gross Domestic Product
GNI	: Gross National Income
GOJ	: Government of Japan
GOSS	: Government of Southern Sudan
HDI	: Human Development Index
IDP	: Internally Displaced Person
IMAC	: Inter-Ministerial Appraisal Committee
IMF	: International Monetary Fund
ILB	: Inter Locking Block
JICA	: Japan International Cooperation Agency
JIS	: Japanese Industrial Standard
JRPA	: Juba River Port Administration
MDTF	: Multi Donor Trust Fund
MOE	: Ministry of Environment
MOPI	: Ministry of Physical Infrastructure
MOTR	: Ministry of Transport and Roads
NGO	: Non-Governmental Organization
PAPs	: Project Affected Persons
RC	: Reinforced Concrete
RTC	: River Transport Corporation
S	: Steel
SIA	: Social Impact Assessment
SNTMP	: Sudan National Transport Master Plan
TEU	: Twenty-Foot Equivalent Unit

TSP	: Transport Sector Policy
T/N	: Tender Notice
UN	: United Nation
UNDP	: United Nation Development Plan
USAID	: United State Agency for International Development
V/C	: Verification of Contract
WFP	: World Food Program
WHO	: World Health Organization

CHAPTER 1 BACKGROUND OF THE PROJECT

1-1 Background

After the Comprehensive Peace Agreement in 2005 which ended the civil war over 50 years, Government of Southern Sudan (hereinafter referred to be as “GOSS”) was established. And as postwar recovery proceeds, the momentum toward the referendum on independence has been rising. With the activation of economy and community in Southern Sudan, the demand for import material for living and infrastructure development from the Northern Sudan and neighboring countries is growing fast. Therefore the stable and efficient logistics is a key to development, which makes the relationship between the Northern and the Southern Sudan strong, and promotes the peace as a result.

On the other hand, since arterial highways have not been paved in Southern Sudan and detour the vast wetland along the River Nile, the capacity and efficiency of inland transport is limited. Therefore inland waterway transport from Kosti River Port in the Northern Sudan to Juba River Port as well as inland corridor from Kenya and Uganda to Southern Sudan is a lifeline to support the reconstruction in Southern Sudan. However the inland waterway transport capacity of the Juba river port destroyed during the civil war is limited, which makes the transport from the Northern Sudan dependent on high cost air transport.

Under the above conditions, Japan International Cooperation Agency (hereinafter referred to be as “JICA”) is providing consistent support such as the development of port facility (temporal jetty of 35m, cargo handling yard, gantry crane, warehouse etc.) and capacity development (assistance of Administration Establishment, Training) through “Emergency Study on the Planning and Support for Basic Physical and Social Infrastructure in Juba Town and the Surrounding Area in the Southern Sudan" (hereinafter referred to be as “the Emergency Study”) in 2006 and “Follow-up Cooperation” in 2008.

On the other hand, as the reconstruction goes ahead, the cargo handling volume of Juba river port recovers rapidly from about 3,000 ton per year in 2006 to about 7,000 ton per year in 2008. Accordingly only existing 35m jetty is not enough to keep up with the demand, natural river bank is utilized.

It is urgent matter that the expansion of Juba River Port facilities which have suitable functions as a base port in order to support the economic activity in the Southern Sudan.

1-2 Natural Conditions

The Republic of the Sudan has territory area of 2.5 Million sq.km, or the largest country in Africa. The northern part of the country reaches the Red Sea, also tropical rain forest and the Sahara Desert are situated in south and north respectively.

The climate in Southern Sudan is divided into rainy season from April to October and dry season from November to March. Also, the mean annual precipitation is approximately 1,100mm. In the rainy season, mean temperature records 22 ^{o}C ~ 32 ^{o}C and mean precipitation records 130mm per month, meanwhile in the dry season, mean temperature records 25 ^{o}C ~ 36 ^{o}C and mean precipitation records 40mm per month.

1-3 Environmental and Social Consideration

The Project is to develop the Juba River Port Facilities and procure cargo handling equipments. However the Project has some negative impacts on environment and society such as relocation of Project Affected Persons (hereinafter referred to be as "PAPs"), Water Quality, Natural Environment, Noise and Air Quality. Therefore the Project is categorized into "B" according to JICA Guidelines for Environmental and Social Consideration, April 2004.

Regarding the relocation of PAPs inside the Juba River Port area, detailed surveys were carried out by a qualified consultant to assess the PAPs as shown in Table 1-1-1. Also the Social and Environmental Impact Assessment (hereinafter referred to be "SEIA"), stakeholder meetings were carried out by counterpart organization of Directorate of River Transport (hereinafter referred to be as "DRT") / MOTR / GOSS and Directorate of Transport and Communication (DTC) / MOPI / CES with assistance from qualified local consultant. Also Social and Environmental Impact Assessment Reports including Resettlement Action Plan (hereinafter referred to be as "RAP") were created and submitted to the Ministry of Environment (hereinafter referred to be as "MOE") / GOSS. After the review of MOE / GOSS over one month, the MOE / GOSS issued the Certificate for the Project to the responsible organization, DRT / MOTR / GOSS under 7 conditions.

Table 1-1-1 Number of Temporal Occupation Building and Project Affected Persons (PAPs)

Temporal Occupation Bldg. in Operation*1	Temporal Occupation Bldg.*2	Project Affected Persons (PAPs)
31	11	31

*1 : Temporal shops with owners

*2 : Temporal shops without owners and not in operation

CHAPTER 2 CONTENTS OF THE PROJECT

2-1 Basic Concept of the Project

2-1-1 Overall Goal and Project Purpose

After the Comprehensive Peace Agreement in 2005 which ended the civil war over 50 years, GOSS was established. And as postwar recovery proceeds, the momentum toward the referendum on independence has been rising. With the activation of economy and community in Southern Sudan, the demand for import material for living and infrastructure development from the Northern Sudan and neighboring countries is growing fast. Therefore the stable and efficient logistics is a key to development, which makes the relationship between the Northern and the Southern Sudan strong, and promotes the peace as a result.

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Under the conditions, the goal and purpose of the Project is to promote the economic development of cities along the River Nile and to advance investments and developments thorough the improvement of access to southern part of the Sudan.

2-1-2 Project Outline

In order to achieve the above goals and purposes, the facilities of Juba River Port is developed and cargo handling equipments is procured. This is expected to increase the cargo handling volume and secure the safety and efficiency of cargo handling activities.

2-2 Outline Design of the Japanese Assistance

2-2-1 Design and Procurement Policy

In order to expand and develop the Juba River Port facilities, the Project is designed in consideration of the request from GOSS, results of the several field surveys and discussions with authorities concerned based on policies as follows;

(1) Basic Policy

i. When drawing up the facility plan, the future extensibility is considered based on the function and activity plan for new facilities and discussion with the concerned authorities.
ii. Method for easy maintenance and economical utility costs is designed to be introduced.
iii. Crime-prevention and anti-theft are designed to be considered in consideration of the security situation in Southern Sudan. (Fence, Lighting etc.)
iv. The schedule (Detailed Design ~ Tender ~ Commencement ~ Completion ~ Handover) of the Project is well-planned in consideration of the maintenance of new facilities.
v. The equipment procurement plan is decided in the view of price, presence of agent in Southern Sudan, procurement way of spare parts, transportation time and cost etc.

(2) Natural Environmental Conditions Policy

Based on natural environmental conditions in Southern Sudan, suitable specification, material, and method are chosen and the work schedule is decided.

i. Temperature

According to the metrological observatory (Juba International Airport), mean maximum daily temperature is 34.1 ^{o}C and mean minimum daily temperature is 23.1 ^{o}C, which means the daily range of temperature is high. Based on the above mentioned condition, air condoning is necessary during the afternoon with high temperature, adversely air condition is not necessary during the morning with low temperature. Therefore building plan utilizing day lighting and ventilation is designed without the air condition basically.

ii. Precipitation, Water Level

The climate in Juba is divided into rainy season from April to October and dry season from

November to March. Also, the mean annual precipitation is approximately 1,100mm. In the rainy season, mean temperature records 22 ^{o}C ~ 32 ^{o}C and mean precipitation records 130mm per month, meanwhile in the dry season, mean temperature records 25 ^{o}C ~ 36 ^{o}C and mean precipitation records 40mm per month.

Regarding the water level of the River Nile, the highest water level is recorded normally September or October behind some months from the rainy season in Juba because the water level is affected by precipitation around the Lake Victoria.

Since the project site is located on the natural river bank along the River Nile, the groundwater level is high. Drainage ditches are designed to be constructed in necessary places and be connected to the road side drainage ditches. Also, eaves are designed to be installed to avoid rain blowing.

iii. Solar Insolation, Ultraviolet Rays

Since Juba is located under the equator, eaves are designed to be big and Jalousie windows are designed to be installed. Also, internal thermal environment is designed to be well by introducing hollow blocks at the bottom of Warehouse & Repair Shop wall as well as insulation material in folded-plate roof and wall.

iv. Topography, Soil

The basement of geological layer in Juba consists of igneous rocks and metamorphic rocks generated in the Precambrian era. Above the lawyer, thin sedimentary layer consisting of sand, laterite, clay etc. exists. From the thin layer diorite and schist are exposed on the surface of the ground.

Since the Project site used to be floodplain, there are alternated layers of sand and clay of 8m, furthermore soft ground called block cotton does exist.

v. Loading etc.

There is no record of wind hazard, flood, earthquake etc. The buildings are designed to be strong enough against high wind. Moreover the structure is designed on the assumption that photovoltaic power generation will be introduced in the future.

(3) Socio-Economic Conditions Policy

The Project plays a role in the reconstruction of the Southern Sudan through smooth logistics and improves civilian life. Furthermore the Project gives hope to civilians through improvement of infrastructures in a visible manner.

(4) Construction & Procurement Conditions Policy / Policy for Special Circumstances

Because of the civil war, there was no over two-story buildings such as governmental offices and mosques. However four-story buildings or more has been constructed. Those buildings are constructed by the contractors based in neighboring countries or India, Thailand etc.

All materials and equipments imported to Southern Sudan of the Project are covered by tax exemption such as value added tax and custom duty. However the procedure of the tax exemption is the obligation of the Southern Sudan, it is required consideration that it takes time because the Southern Sudan is unfamiliar with Japanese Grand Aid.

(5) Local Constructor and Consultant Policy

In order to endure construction quality, the lists of construction companies made by GOSS, CES and other donor organizations are referred when deciding construction companies.

(6) Operation and Maintenance Conditions

The building and facility plan is designed in consideration of easy maintenance and economical running cost. The size and specification are set according to the operation and maintenance capacity of Southern Sudan, budget, staff assignment and technical level. Regarding equipments and materials, these are procured from neighboring countries as much as possible and dedicated staff members are allocated for maintenance and operation.

(7) Grade Setting Policy for Facilities

Materials and equipments are selected strong enough against deterioration and maintained by Southern Sudan. Equipments will be procured mainly from Kenya and Japan. In case of procurement from Kenya, the cost maintenance and repair is restrained by utilizing general specification applied in East Africa.

(8) Construction Method Policy

i. Method Policy

General method applied in Southern Sudan is utilized in consideration of contractor skill in Southern Sudan. Regarding works susceptible to deficit such as fitting, Japanese methods are introduced, however materials cable to be procured in neighboring countries are selected.

ii. Procurement Way Policy

If the Southern Sudan gets independent as a result of the referendum, it is assumed that the import of equipments and materials is dependent more than ever on the neighboring countries such as

Uganda and Kenya. The equipments and materials incapable to be procured in Southern Sudan are procured from neighboring countries or Japan. Since Juba is located in inland region, the equipments and materials conveyed through marine transport and inland transport. In the marine transport, Mombasa is designated as a discharging port. Form Mombasa to Juba, route passing through Kenya and Uganda and reaching Juba is chosen as an inland transport route. At the custom clearance at each boarder, the bill of loadings and packing lists are passed to the shipping companies in advance in order to avoid delay caused by flaw in the documents.

iii. Work Schedule Policy

It is appropriate that the work period of civil work and building work are 17 months and 12 respectively according to work size. The detailed is shown in Table 2-2-13. Also, the work schedule of the equipment and material transport and civil / building works are set in consideration of rainy season.

2-2-2 Basic Plan (Construction Plan / Equipment Plan)

(1) Design Conditions

Following Design Conditions were exchanged with the Sudanese Counterparts as Technical Notes.

Item	Terms of Agreement
Area of River Port	Approx. 5.4 ha (including Road Reserve & Future Expansion Site)
Length of Perimeters	Approx. 620 m (covering above area except river side)
Length of Proposed Quay	Pile Quay 205 m (including Existing Jetty, 35m), Inclined Quay 28m, Water Depth : 2.5m
Handling Objects	Container / Pallet / Break Bulk / Vehicle / Passenger
Handling Method	Crane / Slip Way / Pontoon (Roll-On & Roll-Off & Passenger)
Design Code	Technical Standards & Commentaries for Port & Harbor Facilities in Japan (The Overseas Costal Area Development Institute of Japan)
Design Vessel	Standard 500 ton Loading Capacity Barge (Length : 36m x Width : 9.5m x Depth : 2.3m, and Max Draft : 2.0m)
Design Load (Vertical)	Crawler Crane 150 ton (evaluated as 5.0 ton per sq.m against the Super Structure)
Design Load (Horizontal)	25 ton per Mooring Post
Design Seismic Factor	0.10 ~ 0.15 (Peak Ground Acceleration of 0.8 to 1.6 m per s^2 based on USGS Africa Seismic Hazard Map)
Design High Water Level	452.86 ASL (As Same Level as that of Existing Jetty Construction)
Design Low Water Level	451.36 ASL (As Same Level as that of Existing Jetty Construction)
Design Datum Level	453.70 ASL (Top of Existing Jetty Deck)

(2) Facility Plan

Size of Civil & Building Facilities is shown in Table 2-2-1.

Table 2-2-1 Size of Civil and Building Faculties

Facility	Work		Classified Type	Unit	Quantity
Civil Facilities	Pile Quay Work		Vertical Quay, Steel Pipe Pile φ700mm	m	170
	Cargo Handling Yard		Inter Locking Block	sq.m	12,500
	Inclined Quay		Inclined Part : RC Slab	m	28
	Oil Water Separating Tank		Same type as American Petroleum Institute	No.	2
	Drainage Facility		Open Ditch	m	2,510
			Pipe	m	570
Civil & Building Composition Facilities	Exterior		Fence, Post, Gate	m	40
	Electrical Facility		Power Supply Pipe / Hand Hall	m	780
	Water Supply Facility		Water Supply Pipe	m	1,060
	Sanitary Facility		Sewage Tank	No.	6
	Elevated Tank		H=18.0m	No.	1
	Lighting Post		H=18.0m	No.	8
Building Facilities	Administration Building		Reinforced Concrete (RC) Structure, Two Level building	sq.m	576
	Warehouse & Repair Shop		Steel Structure, Two Level Building	sq.m	1,688
	Guard House	North	Concrete Block (CB) Structure, Flat Building	sq.m	50
		South	Container / Prefabrication, Flat Building	sq.m	8
	Generator House		Steel Structure, Flat Building	sq.m	142
	Public Toilet		CB Structure, Flat Building	sq.m	25

(3) Civil Work Plan

i. Facility Plan

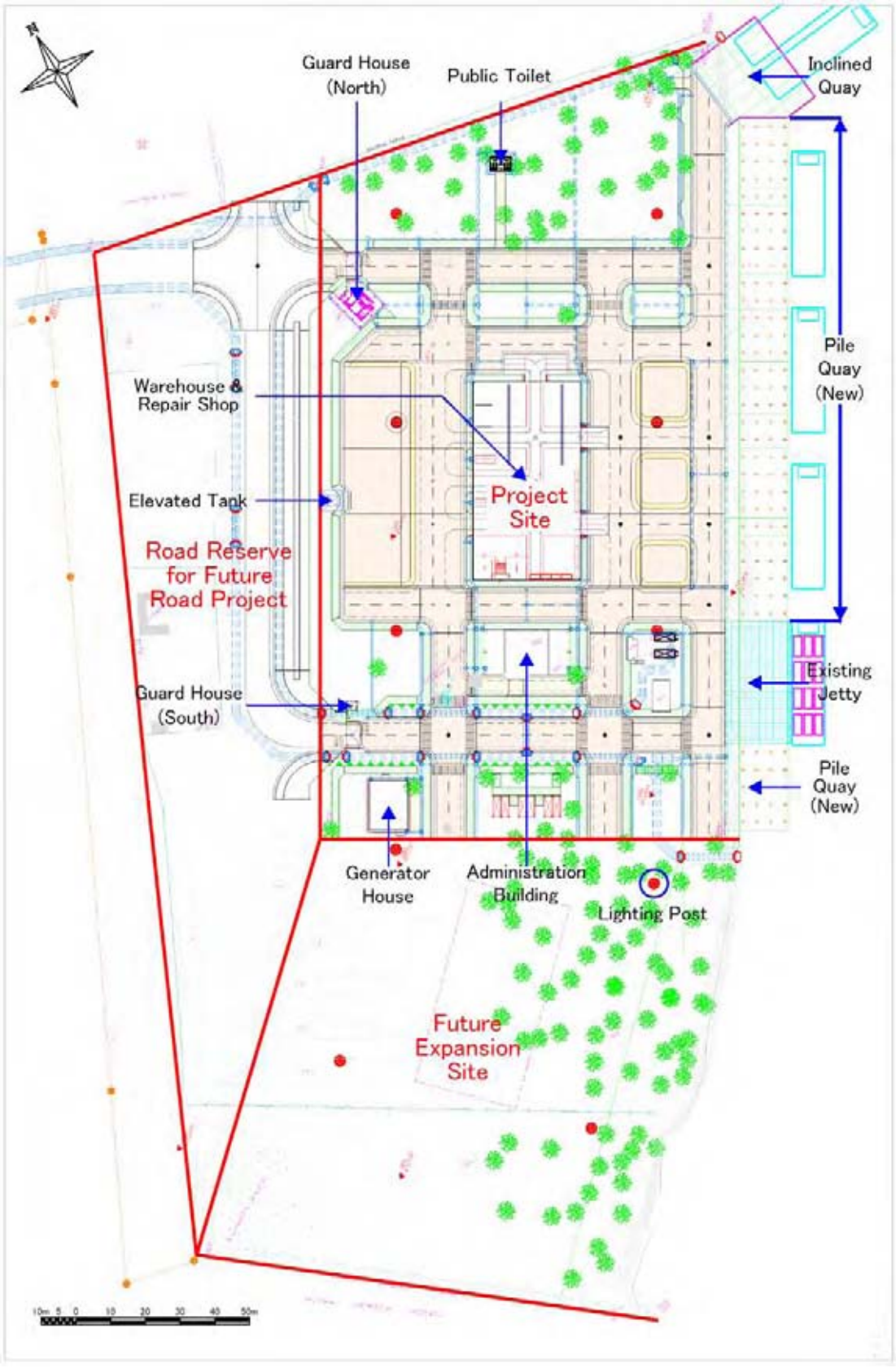


Figure 2-2-1 Layout Plan

Necessary Quay Size

Necessary quay size according to container and break bulk cargo is as follows;

✓ Container

Target Year	Target Cargo Handling Volume	20ft Container Conversion	Target Cargo Handling Efficiency*		Number of Necessary Berth
	Ton/day	TEU/day	Hours/TEU	Minutes/TEU	
2012	150	7.5	2.00	120	2.00
2018	240	12	1.25	75	
2024	300	15	1.00	60	

* : In case of 7.5 Working Hours

✓ Break Bulk Cargo

Target Year	Target Cargo Handling Volume	20ft Container Conversion	Target Cargo Handling Efficiency*		Number of Necessary Berth
	Ton/day	TEU/day	Hours/Truck	Minutes/Truck	
2012	240	12	2.50	150	4.00
2018			~	~	~
2024			1.25	75	2.00

* : In case of 7.5 Working Hours

Based on above, the number of necessary berth in the Project is as follows;

Type of Cargo	Subject Berge	Structure	Berth No.	Berth Length
Container	36m	Parallel Docking & Vertical Pile Quay	2	42～48m x 5 = 210~240m
Bulk			2	
Oil			1	
Vehicle (RORO*)		Inclined Quay	2	10.5m x 2 = 21.0m

* : Roll-on Roll-off

In the Project, the 205m long vertical pile quay including 35m of existing jetty and 28m wide inclined quay are designed to be constructed against that the necessary berth length of 210 to 240m for vertical pile quay and 21m for inclined quay.

Necessary Container Yard

According to the container demand forecast in 2024, 300 ton per day is expected. In this case the necessary container yard size is 2,700 sq.m with 20ft container equivalent. (Containerized Ratio: 60%, 3-level Stacking, Space Ratio: 50%, Duration for 1 Rotation: 15 days, Margin: 25%) Therefore the container yard of 1,350 sq.m is designed to be developed in the Project.

ii. Pavement Structural Design

In order to select the most suitable pavement, the comparison of each pavement structure is carried out as follows and Inter Locking Block (hereinafter referred to be as "ILB") is recommended.

Table 2-2-2 Comparison of Surface Course

Comparison Item		Pavement Type		
		ILB	Asphalt	Concrete
Cost	Construction	Middle	Low	High
	Maintenance	Low	High	High
Construction & Repair	Construction Difficulty	Only small equipments are required.	Complicated equipments are required.	Complicated and large-size equipments are required.
	Speed	Middle	Fast	Slow
	Repair Work	Repair of only damaged part is possible	Repair of only damaged part is possible	Large-sized repair work is required.
Durability		Excellent	Fair	Excellent
Resistance	Axial Load	Excellent	Fair	Excellent
	Concentrated Load	Excellent	Poor	Excellent
	Turning Load	Good	Poor	Excellent
	Oil	Good	Poor	Good
	Slip	Good	Good	Good

The pavement structural design of ILB is calculated by Layer Equivalent Method (T_A) and three types of the pavement structural design (Heavy Traffic: T-25, Medium Traffic: T-14 and Light Traffic: T-2) are decided.

$$T_A = 3.43 \times N \wedge (0.16) / CBR \wedge (0.3)$$

Where, N : Number of 5 ton Equivalent Wheel Load per 1-lane during Design Period (12years)

CBR : California Bearing Ratio

Traffic Load

Based on traffic data and analysis, the total number of 5 ton Equivalent Wheel Load per 1-lane during 12 years is set to be as 17.5 million.

Design CBR

Based on the result of 22 Dynamic Corn Penetration Test (hereinafter referred to be as "DCPT") in the Project area, average CBR is 18.85, minimum CBR is 4.96, and maximum CBR is 39.12 correspondingly. However DCPT is simple method to find CBR figure, design CBR is modified

and set as follows;

Design CBR = 18.85 - (39.12 - 4.96) / 3.18[1] = 8.11 → 8

Reliability

In case of the design period of 10 years, the reliability of 90% is adopted, however the design period of 12 years in the Project, therefore the reliability of 75% is adopted.

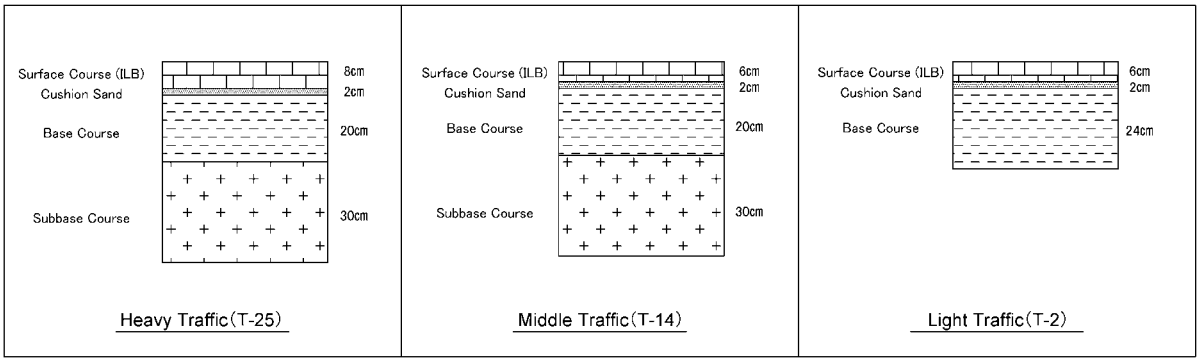


Figure 2-2-2 Pavement Structure

iii. Drainage Design

Design Rainfall Intensity

Based on weather data obtained from Sudan Metrological Authority / MOTR / GOSS, the design rainfall intensity is as follow;

- For Design Ditches : 80mm / hour (3-year return period)
- For Design Pipes : 110mm / hour (7-year return period)

Inlet Time

Since most of rainfall goes through the surface of ILB and reaches the ditches, Kerby Formula and Kinematic Wave Formula are adopted. At last, the average of above time becomes the inlet time in this case.

Kerby Formula : $t_1 = 1.445 \times (N \times L / \sqrt{S})^{0.467}$

Kinematic Wave Formula : $t_1 = 6.92 \times (n \times L / \sqrt{S})^{(0.6)} \times I^{(-0.4)}$

Where, t_1 : Inlet Time (min)
L : Flow Length (m)
S : Gradient (%)
I : Rainfall Intensity (mm per hour)

[1] Coefficient based on the number of sample

N : Kerby Coefficient of Roughness

n : Manning Coefficient of Roughness

Ditch Cross Section	Kerby Formula	Kinematic Formula	Inlet Time (t_1)
Trapezium Ditch	1.25 min	1.15 min	1.20 min
Rectangle Ditch	1.83 min	1.91 min	1.87 min

Calculation of Inlet (Discharge)

The inlet (Discharge) is calculated by utilizing Rational Formula as follows;

$$Q = (1 / 3.6 \times 10^{6}) \times C \times I \times a$$

Where, Q : Inlet (Discharge) (cu.m per sec.)

C : Runoff Coefficient (Pavement: 0.70)

I : Rainfall Intensity (mm per hour)

a : Catchment Area (Trapezoid Ditch: 8,000 sq.m, Rectangle Ditch: 2,400sq.m)

	Trapezoid Ditch	Rectangle Ditch	Pipe
Inlet (Discharge) (cu.m per sec.)	0.124	0.037	0.171

Calculation of Mean Velocity and Discharge

Mean velocity and discharge are calculated by utilizing the following Manning Formula.

$$V = (1 / n) \times R^{(2/3)} \times I^{(1/2)}$$

Where, V : Velocity (m per sec.)

n : Coefficient of Roughness

R : Hydraulic Mean Depth (Discharge Sectional Area / Wetted Perimeter)

i : Gradient of Ditch (%)

	Trapezoid Ditch	Rectangle Ditch	Pipe
Coefficient of Roughness	0.013	0.015	0.024
Gradient of Ditch	0.005	0.001	0.005
Velocity (m per sec.)	1.203	0.456	0.766
Discharge (cu.m per sec.)	0.124	0.037	0.086

Confirmation of Concentration Time

Concentration time is total of inlet time (t_1) and flow time (t_2). The flow time (t_2) is calculated by the following formula;

$t_2 = L / V$

Where, L : Flow Length (m)
V : Average Velocity (m per sec.)

	Trapezoid Ditch	Rectangle Ditch	Pipe
Flow Length (m)	610	105	Concentrate time is less than 10 minutes because water comes from trapezoid ditch.
Inlet Time t_1 (min)	1.20	1.87	
Flow Time t_2 (min)	8.45	3.84	
Concentration Time (min)	9.65	5.74	

iv. Pile Quay Design

Selection of Quay Structure

After comparison of various quay structure types concerning durability, construction method etc., steel-pipe pile quay is chosen. The steel piles (Diameter; 700mm, Thickness; 12mm) are selected in consideration of high durability.

Design Load of Quay

Design load excluding dead load of the structure is calculated as follows;

✓ Tractive Force of Vessel

P = 250 (kN) (Design Vessel: 500-ton Barge)

✓ Docking Force by Vessel

Docking force energy (Ef) is calculated by utilizing following formula;

Ef = (Ms x V^2 / 2) x Ce x Cm x Cs x Cc

Where,
Ms : Weight of Vessel : 1,400 (t)
V : Docking Speed of Vessel (m per sec.) : 0.5 (m per sec.)
Ce : Coefficient of Eccentric : 0.5
Cm : Hypothetical Coefficient of Gravity : 1.3
Cs : Coefficient of Flexibility : 1.0 (Standard)
Cc : Coefficient of Shape : 1.0 (Standard)

Based on the above formula, Docking force energy is calculated to 113.8 (kN/m).

	Dimension	Value	Remarks
Docking Force Energy (Ef)	kN/m	113.8	
Necessary Absorption Energy (Ea)	kN/m	126.4	Ef / 0.9

	Dimension	Value	Remarks
Docking Energy per Fender of 1m (Efo)	kN/m	57.4	Ea / 2.2
Absorption Energy per Fender of 1m (Er)	kN/m	61.3	Er>Efo

Moreover docking force is calculated by utilizing the following formula;

$$E = Ro \times L$$

Where, Ro : Reactive Force per Fender of 1m : 368 (kN/m)
L : Length of Fender : 2.2 (m)

Based on the above formula, docking force (E) is 810 (kN).

- ✓ Vertical Load

  Crawler Crane with 150 ton Lifting Capacity
  - Deadweight : 150 (tf)
  - Container Lifting Load : 40 (tf)

v. Inclined Quay Design

The inclined quay is designed in consideration of followings;

- ✓ The inclined quay can accommodate two standard barges (Length: 36m, Width: 9.5m, Height: 2.3m, Max Draft: 2.0) at once.
- ✓ The inclined quay has slope of 1 (Vertical): 2 (Horizontal) in lower side and 1 : 6 in upper side.
- ✓ Inclined part is made of reinforcing concrete slab and strong enough against T-25 load.
- ✓ The edge of inclined quay is stable against circular slip and protected by sheet piles against scouring.
- ✓ Rails are installed into the slope in order not to for barges touchdown directly.
- ✓ Double coffering by steel sheet pile is required in construction phase.

vi. Oil Water Separating Tank Design

In order to separate oil spilled during cargo handling activity from water, oil water separation tank is designed to be installed in consideration of followings;

- ✓ Same type structure recommended by American Petroleum Institute
- ✓ Small maintenance cost
- ✓ Enough capacity to manage against 3-year return period of rainfall intensity
- ✓ Reinforcing concrete U-shaped structure and coefficient of earth pressure at ease: 0.5

(4) Building Work Plan

i. Layout Plan

The function and area of each facility and its calculation base are shown in Table 2-2-3.

Table 2-2-3 Function and Area of Facility and Calculation Base

Facility	Room	Function	Area	Calculation Base
Administration Building	General Office	Office for Port Administration Staff including JRPA	72.0 sq.m × 1 36.0 sq.m × 2	Assumed Staff of 24 Member of Maintenance / Operation / Account / Police / Revenue / Standard Department
	Deputy Port Manager Room	Office for Deputy Manager	12.6 sq.m	1 Deputy Port Manager and Meeting Space
	Reception	Reception	16.6 sq.m	Reception, Information
	Electricity Room	Distribution Board Installation	17.0 sq.m	Distribution Board and Wiring Pit
	JICA Expert Room	Office for JICA Expert	72.0 sq.m	6 JICA Experts and 3 Local Staff (for Capacity Building Project)
	Port Manager / Auditor Room	Office for Port Manager / Auditor	40.8 sq.m	1 Port Manager and Auditor each
	Secretary Room	Office for Secretary	16.8 sq.m	2 Secretaries
	Waiting Room	Waiting Room for Visitors	15.1 sq.m	Waiting Visitor's Space
	Meeting Room	Meeting Room for both Internal and External	36.0 sq.m	Accommodate about 12 People at once
Warehouse & Repair Shop	Warehouse & Repair Space	Temporal Storage Space Cargo & Maintenance / Repair Space for Equipments	1,688 sq.m	Targeting 240 ton per day of Cargo Handling Volume in 2024, 2-level Pallet Rack, Space Ratio 50%, Duration for 1 Rotation 15 Days, Margin 25%
	Office	Office for Warehouse Keeper & Maintenance Staff	36.0 sq.m 40.0 sq.m	Occupied space per one person : 6 m^2 (Assumed Staff of 15 Member)
	Anteroom	Anteroom for Loading / Un-loading Staff	35.0 sq.m	Occupied Space per One Person : 3 m^2 (Assumed Staff of 12 Member)
	Storage	Storage for Equipments	31.0 sq.m	Equipment Storage for Antitheft
Guard House		Control of in-and-out Vehicle / People and Night Watch	North : 50.0 sq.m South : 8.0 sq.m	North : 2 Security Guards, Their Nap Room and Toilet for Port Workers South : 2 Security Guards
Public Toilet		Toilet for General Port Users	25.0 sq.m	Approx. 50 ~ 100 General Port Users per Day

Facility	Room	Function	Area	Calculation Base
Generator House		Storage for Generators and its Accessories	142.0 sq.m	Two 350kVA of New Generators, One 45kVA of Existing Generators, Two Fuel Tanks and Changeover Switch Board

Also the feature of similar facilities in Juba is as follows;

- ✓ As temporally office, store etc., container is widely utilized.
- ✓ As a conventional construction method, building frame is made of reinforced concrete, and wall is made of block.
- ✓ Steel structure buildings such as warehouse exists, however all materials of the buildings are imported from neighboring countries or Khartoum. Also, concerning the size of each office building, occupied area per person is around 6 to 10 sq.m. In case of the Project, the occupied area is designed to be 6 sq.m per person.

a) Administration Building

General Office

As a base unit of 36.0 sq.m (6.0m x 6.0m) area, 2 units for JRPA office and one unit for each department of police, custom, revenue and standard. (Occupied Area: Approx. 6.0 sq.m per Capita)

Deputy Port Manager Room

Area of 12.6 sq.m (3.0m x 4.2m) is designed to be developed for Deputy Port Manager. The area includes drawing area. (Occupied Area: Approx. 6.0 sq.m per Capita)

Reception

Area of 12.6 sq.m (3.0m x 4.2) is designed to be developed next to the entrance hall.

Electricity Room

Area of 16.6 sq.m (4.15m x 4.0m) is designed to be developed under the stair in order to accommodate a distribution board.

JICA Expert Room

Area of 72.0 sq.m (12.0m x 6.0m) is designed to be developed for JICA experts who will be dispatched for the Capacity Building Project. The area includes internal meeting space. (Occupied Area: Approx. 8.0 sq.m per Capita)

Also, the Room is designed to be converted to JRPA office room for future additional staff after the Capacity Building Project.

Port Manager / Auditor Room

Area of 40.8 sq.m (4.0m x 10.2m) is designed to be developed for Port Manager and Auditor. (Occupied Area: Approx. 8.0 sq.m per Capita)

Waiting Room

Area of 15.1 sq.m (3.6m x 4.2m) next to the Port Manager / Auditor Room is designed to be developed for visitors. (Occupied Area: Approx. 3.0 sq.m per Capita)

Meeting Room

Area of 36.0 sq.m (6.0 x 6.0) is designed to be developed for regular meetings.

b) Warehouse and Repair Shop

Warehouse & Repair Area

Necessary Area	1,500 sq.m = 240 x 0.50 / 2.50 / 0.50 x15 x 1.25
Index, Coefficient	Volume of Handling Bulk : 240 ton / day, Storage Ratio : 0.50 Area of Storage Space : 300 ton / sq.m (1.00 ton / sq.m, 3 Layers) Void Ratio : 0.50, Storage Day : 15 Days, Margin : 1.25

Office, Anteroom, Storage

Area of 36 sq.m and 40 sq.m is designed to be developed for the maintenance and operation departments of JRPA. Also, area of 35 sq.m and 31 sq.m is designed to be secured for anteroom and storage respectively.

c) Guard House

Guard House (North)

An office adjacent to the north gate for reception service, toilet, shower and nap room are designed to be developed. Also, toilet capable of access from the port is designed to be secured for port users apart from the toilet above.

Guard House (South)

A pre-fabrication office adjacent to the south gate for reception service is designed to be installed.

d) Public Toilet

A public toilet is designed to be developed for port visitors.

e) Generator House

Storage area for two newly procured 350kVA-output generators, one existing 45kVA-output generator and two fuel tanks is designed to be developed.

f) Elevated Tank

An 18-meter-height elevated tank (Capacity: 2.0 cu.m) is designed to be installed, and water is planned to be distributed to each buildings and sill cocks.

g) Lighting Post

18m-height lighting posts are designed to be installed for the purpose of night work at 60m intervals. Also, security lights are designed to be installed at the basal portion of the lighting posts and along the internal roads.

ii. Cross Section Plan

The Cross Section of each facility is designed in consideration of follows;

Facilities	Main Consideration Point
Administration Building	✓ 2nd floor-slab is designed to be constructed for future 3rd floor expansion. ✓ The floor height is designed to be more than 3.0m in order to install ceiling fan.
Warehouse & Repairer Shop	✓ Heavy duty pallet racks are planned to be installed, and the eave height is designed to be more than 6.5m in order to take in-and-out of cargo by forklifts. ✓ The floor is designed to be 50cm higher than surrounding cargo handling area in order to make loading work to trucks efficient. ✓ The part of the wall is designed to be built by hollow blocks, and ventilation system is planned to be installed on the roof in consideration of proper air circulation. ✓ The gantry crane installed by the Pilot Project of Emergency Study is planned to be moved into the northern part of the building for the purpose of maintenance and repair works for equipments.
Guard House	✓ In north guard house, nap room is designed to be constructed for 24-hour operation. ✓ South guard house is designed to be minimal building.
Public Toilet	✓ The eave height is designed to be 3.0m and install opening space for ventilation as much as possible.
Generator House	✓ The wall is designed to be constructed by concrete block up to 180cm high, and the upper part to be wire mesh structure.

iii. Structure Design

Structure Design Policy

Since building standards of Southern Sudan do not exist yet, therefore Standards of Architectural Institute of Japan are referred in order to design each structure.

Structure Dimension

Since the wind design standard in Juba is 40m per second and earthquake intensity (Japanese Scale) is Grade-3, therefore the structure dimensions are as follows;

✓ Coefficient of Regional Earthquake : 1.0

- ✓ Type of Soil : Second-Class
- ✓ Seismic Cycle : 0.6 (second)
- ✓ Coefficient of Vibration Property : 1.0

Structure Plan

Structure Plan of each facility is as follows;

Facilities	Structure Plan
Administration Building	✓ The building is designed to be Two-Story RC structure building. ✓ Basic span is 6m wide and 6m long. ✓ The foundation structure is designed to be cast-in-place pile foundation.
Warehouse & Work Shop	✓ The building is designed to be partial Two-Story steel structure building. ✓ Basic span is 5m at short side and 6.25m at long side. ✓ The building structure is designed to be rigid frame structure consisting of H-steel pillar and beam. ✓ The foundation structure is designed to be independent footing foundation.
Guard House	✓ North Guard House is designed to be flat reinforced CB structure building with Continuous Foundation. ✓ South Guard House is designed to be container type or prefabrication structure.
Public Toilet	✓ The building is designed to be flat reinforced CB structure building. ✓ The foundation structure is designed to be continuous foundation.
Generator House	✓ The structure is designed to be flat steel structure building. ✓ The foundation structure is designed to be continuous foundation.

Major Structural Material and Strength

Major Structural Material and its Strength are as follows;

- ✓ Concrete
  - Category : Ordinary Concrete
  - Strength : Fc = 18, 21N/mm2
  - Aggregate : Coarse aggregate is crushed stone, fine aggregate is river sand matching with JIS / AASHTO standards.
- ✓ Reinforcing Bar
  - Specification : Deformed Reinforcing Bar (SD295A, SD345) D6~D22
- ✓ Steel
  - Specification : Structural Rolled Steel (SS400)
    Structural Light Steel (SSC400)

iv. Utility Design

Water Supply Facility

Two shallow wells are designed to be constructed in the Juba River Port area. The well water is pumped up by a pump of 150-liter per minute capacity. Since the well water has some turbidity, some filters are designed to be installed

Water distribution system is gravity water distribution by installing 18m-hight of Elevated Tower with 2.0 cu.m capacity Elevated Tank. One well is for regular use and the other is for backup use, and the changeover is performed manually. There is no public water supply facility in the Juba River Port at this moment, however it is expected that the public water will be lead to the Juba River Port in the future and switching from well water to public water is planned.

Also buried sill cocks are designed to be installed in various parts of the Juba River Port area.

Drainage Facility

Drainage system has not developed in the Juba River Port area except that which constructed during the Emergency Study. Therefore rainwater water generated from the port area is designed to be discharged to the River Nile through the ditches. Also leaked oil during cargo handling and port activity are designed to be collected and separated from rain water in order to minimize pollution of the River Nile.

Sanitary Facility

All laboratory basins are designed to be simple water washing type. All closet bawls are Western style and hand showers for Muslim are planned to be installed. Washing clasp of urinals is tap system. Public toilet is designed to be attached to the north Guard House.

Sewage water from the toilet is designed to be collected into septic tanks and pumped up by honey trucks. The size of each septic tank has enough capacity capable of accumulating for one month usage (in case of the Administration Building; a half month)

Fire Fighting Facility

Fire extinguishers are designed to be installed.

Air Conditioning Facility

Wall-hanging Air Conditioners is planned to be installed each office of Administration Building and Warehouse & Repair Shop.

Ventilation Facility

Wall ventilation fans are planned to be installed to necessary places in addition to air conditioning

facility. However ceiling implantable ventilation fans are planned to be installed in the small kitchen of Administration Building.

Roof fans are planned to be installed to the repair works area of the Warehouse & Repair Shop in order to handle hot-air and odor generated from equipment repair and maintenance works. Also, air supply is designed to be handled by natural ventilation

v. Building Material Plan

When selecting construction materials, construction materials are planned to be decided in consideration of ease of maintenance and availability in Southern Sudan or neighboring countries, and construction method widely utilized in Southern Sudan is applied.

Roof

In order to prevent the buildings from becoming older, roof inclination is designed to be 2/10 ~ 4/10 and roof materials are planned to be Steel-Sheet in consideration of ease of maintenance and protection against incoming objects. Also in order to prevent heat from transferring into a room, insulation type paint is applied.

External Wall

Materials are planned to be concrete block which is economical to make and easy for maintenance. Also air vent type hollow blocks are utilized to part of the wall of Warehouse & Repair Shop in consideration of ventilation. Also, wire meshes are planned to be introduced to part of the wall of Generator House in consideration of air supply and heat release.

Floor

According to use application and necessary specification of each building, materials as follows are planned to be applied.

- ✓ Administration Building: Ceramic Tiles are applied to entrance, porch, offices, stairs, corridors, toilet and kitchens for easy maintenance and cleaning, the balcony is made of water-proof mortal.
- ✓ Warehouse & Repair Shop: Epoxy Resin is applied on the mortal finished floor of warehouse and repair area for dustproof purpose and PVC tile is applied for office spaces.
- ✓ Guard House: (North) Mortal finished floor for easy maintenance.
  (South) Ready-made floor of container / prefabrication office.
- ✓ Public Toilet: Ceramic Tiles are utilized for easy maintenance and cleaning.
- ✓ Generator House: Mortal finished floor for easy maintenance.

Internal Wall

Ceramic Tiles are planned to be applied to wall around sinks for easy maintenance and cleaning. Other general Internal Walls are planned to be made of mortal trowel with surface coat.

Ceiling

- ✓ Office: Widely applied and economical light-gauge steel, T-bar with square-shaped Plaster Board is planned to be applied.
- ✓ Public Toilet: Silicate Calcium Board with Vinyl Paint is planned to be applied.

Fittings

Aluminum sashes are planned to be applied for external fittings. Steel sashes are planned to be applied to entrances etc. which required durability.

Table 2-2-4 Finishing Materials and Method

Facility	Part	Member	Finished
Administration Building	Roof	Inclined Roof	Galvalume Sheet Roofing, t=0.6 mm
		Deck Roof	Water-Proof Mortal
		Roof Gutter, Down Pipe	PVC
	Wall	-	Mortal Finished + AEP
	Window, Door	-	Aluminum Sash, Steel Door, Wood
	Foundation Skirting	-	Mortal Trowel
Warehouse & Repair Shop	Roof	Inclined Roof	Galvalume Sheet Roofing, t=0.8mm + Heat Insulating Material, t=100mm
		Roof Gutter, Down Pipe	PVC
	Wall	Upper Part	Galvalume Sheet Roofing, t=0.6 mm
		Lower Part	Mortal Finished + AEP
	Window, Door	-	Aluminum Sash, Steel Door, Wood
	Foundation Skirting	-	Mortal Trowel
Guard House (North)	Roof	Inclined Roof	Corrugated Galvalume Siding, t=0.6 mm
	Wall	-	Mortal Finished + AEP
	Window, Door	-	Aluminum Sash, Steel Door, Wood
	Foundation Skirting	-	Mortal Trowel
	Outdoor Facility	Concrete Wall	Mortal Finished + AEP
			Mesh Fence
Guard House (South)	Roof	Deck Roof	Rubber Roofing
	Wall	-	Metal Siding
	Window, Door	-	Aluminum Sash, Aluminum Door
Generator House	Roof	Inclined Roof	Galvalume Sheet Roofing, t=0.6 mm
	Wall	Upper Part	Clamp Wire Mesh
		Lower Part	Mortal Finished + AEP
	Window, Door	-	Steel Door
	Foundation Skirting	-	Mortal Finished + AEP
Toilet	Roof	Inclined Roof	Galvalume Sheet Roofing, t=0.6 mm
	Wall	-	Mortal Finished + AEP
	Window, Door	-	Aluminum Sash, Steel Door
	Foundation Skirting	-	Mortal Skirting
Elevated Tank	Structural Material	-	Hot Dip Galvanizing
Lightning Post	Structural Material	-	Hot Dip Galvanizing

Table 2-2-5 List of Internal Finishing

Facility	Name of Room	Ceiling Height (mm)	Floor (mm)	Skirting (mm)	Window Back	Wall	Ceiling	Fixture etc.
Administration Building	Entrance Hall	2,850	Ceramic Tile : 200×200	Ceramic Tile : 100×100	-	Mortal Finished + AEP	Plaster Board + Rock Wool Acoustic Board	-
	Office	2,700	Ceramic Tile : 200×200	Ceramic Tile : 100×100	-	Mortal Finished + AEP	Plaster Board + Rock Wool Acoustic Board	-
	Electricity Room	-	Concrete	Mortal Trowel	-	Mortal Trowel	-	Pit Cover : CHPL t=4.5mm
	Stair	2,800	Ceramic Tile : 200×200	Ceramic Tile : 100×100	-	Mortal Finished + AEP	Mortal Finished + AEP	-
	Entrance Porch	2,500	Ceramic Tile : 200×200	Ceramic Tile : 100×100	-	Mortal Finished + AEP	Resin Mortar Trowel + AEP	-
	Balcony	-	Water-Proof Moltal Finished	Mortal Trowel	-	Mortal Finished + AEP	-	-
	Corridor	2,700	Ceramic Tile : 200×200	Ceramic Tile : 100×100	-	Mortal Finished + AEP	Plaster Board + Rock Wool Acoustic Board	Kitchen Cabinet
	Male Toilet	2,500	Ceramic Tile : 100×100	Ceramic Tile : 100×100	-	Mortal Finished + AEP Ceramic Tile : 200×100	Silicate Calcium Board	Toilet Bowl, Handwash, Mirror
	Femail Toilet	2,500	Ceramic Tile : 100×100	Ceramic Tile : 100×100	-	Mortal Finished + AEP Ceramic Tile : 200×100	Silicate Calcium Board	Toilet Bowl, Handwash, Mirror, Cleaning Sink
Warehouse & Repair Shop	Warehouse	-	Epoxy Resin Coating	-	-	Mortal Finished + AEP	-	-
	Anteroom	2,500	Mortal Trowel	Mortal Trowel	-	Mortal Finished + AEP	T-bar Plaster Board + EP	-
	Storage	2,500	Mortal Trowel	Mortal Trowel	-	Mortal Finished + AEP	T-bar Plaster Board + EP	-
	Office	2,500	P Tile	Soft Vinyl	-	Plaster Board, + EP	T-bar Plaster Board + EP	-
	Mini Kitchen	2,500	P Tile	Soft Vinyl	-	Plaster Board, + EP Ceramic Tile : 100×100	T-bar Plaster Board + EP	Kitchen Cabinet
	Stair	-	PVC Sheet	-	-	-	-	-
Guard House (North)	Guard Room	2,350	Mortal Trowel	Ceramic Tile : 100×100	-	Mortal Finished + AEP	T-bar Plaster Board + EP	Kitchen Cabinet Handwash, Urinal
	Nap Room	2,350	Mortal Trowel	Ceramic Tile : 100×100	-	Mortal Finished + AEP	T-bar Plaster Board + EP	-
	Internal Toilet	2,450	Ceramic Tile : 100×100	-	-	Mortal Finished + AEP Ceramic Tile : 100×100	Silicate Calcium Board	Toilet Bowl, Shawer
	Male External Toilet	2,450	Ceramic Tile : 100×100	-	-	Mortal Finished + AEP Ceramic Tile : 100×100	Silicate Calcium Board	Toilet Bowl, Handwash, Mirror
	Female External Toilet	2,450	Ceramic Tile : 100×100	-	-	Mortal Finished + AEP Ceramic Tile : 100×100	Silicate Calcium Board	Toilet Bowl, Handwash, Mirror, Cleaning Sink
Guard House (South)	Guard Room	2,330	P Tile	Soft Vinyl	-	Decorated Board	Ceiling Board	-
Generator House	Generator Room	-	Concrete Trowel	-	-	Mortal Finished + AEP	-	-
Public Toilet	Male	-	Ceramic Tile : 100×100	Ceramic Tile : 100×100	-	Ceramic Tile : 200×100	-	Toilet Bowl, Handwash, Mirror
	Female	-	Ceramic Tile : 100×100	Ceramic Tile : 100×100	-	Ceramic Tile : 200×100	-	Toilet Bowl, Handwash, Mirror, Cleaning Sink
Levated Tank	-	-	-	-	-	-	-	-
Lighting Post	-	-	-	-	-	-	-	-

(5) Equipment Plan

The port operation and maintenance activities which have been carrying out are classified as below. However the efficiency of these activities is not so quite good because of labour shortage and damage of the gears which were procured in the Emergency Study and Follow-up Cooperation. Therefore equipment plan shall be drawn up by combining these existing gears and equipments in order to improve the efficiency.

Cargo Handling

As the lifting capacity of the existing gantry crane is limited only 1.25 ton, currently the crane has been used only for light cargo such as drum, small construction materials, foods etc. Other heavy and long cargoes such as container, heavy duty equipment have been off-loaded by cranes hired by consignees themselves, which makes cargo handling activities inefficient.

Also the shortage of accommodation capacity of the existing jetty also affects the efficiency of cargo handling activities. Under current condition, other barges waiting for using the gantry crane are forced to berth to natural river bank, and cargoes are off-loaded by manpower because the existing jetty accommodates only one barge at once. This is one of the reasons that the efficiency of cargo handling does not improve drastically.

In this regard, concerning the management activity, equipments targeting for improvement of the cargo handling efficiency and large-sized capacity handling are given priority.

Maintenance

Currently there is no facility for maintenance and repair of equipments. In order to maintain and repair newly procured equipments and machinery by the Project, the repair shop is designed to be constructed. Therefore maintenance equipments necessary for the repair shop are given priority.

Operation

JRPA does not possess its own vehicles, communication tools and security gears. JRPA has only container offices and its accompanied power and water supply and sanitary facility handed over through the Follow-up Cooperation by JICA.

In this regard, concerning operation activity, equipments targeting for the reinforcement of operating function are given priority.

In consideration of the above, equipments necessary for each activity is shown in Table 2-2-6.

Table 2-2-6 Usage Equipment according to Activity

Work Item / Equipment	Purpose of Use
Cargo Handling	
Crawler Crane	Handling of Large-size and Container
Forklift (Diesel)	Loading, Off-loading & Transfer of Cargo (Yard)
Forklift (Battery)	Loading, Off-loading & Transfer of Cargo (Warehouse)
Yard Tractor	Handling of Small-size Cargo (Yard)
Yard Trailer	
Belt Conveyor	Loading, Off-loading & Transfer of Small-size Cargo (Jetty)
Oil Pump	Transshipment of Liquid Fuel (Jetty)
Pallet Jack	Loading, Off-loading & Transfer of Small-size Cargo (Warehouse)
Pallet Rack	Storage & Management of Cargo (Warehouse)
Sling	Handling of Large-size & Container (Yard & Jetty)
Maintenance	
Maintenance & Repair Parts	Repair & Maintenance of Cargo Handling Equipment & Machineries
Operation	
Multi-purpose Truck	Cargo Handling, Repair & Maintenance of Port Equipments
Port Wireless Radio System	Maintenance & Security for Port Activities
Port Security Equipment	Maintenance & Security for Port Activities

The model, specification and number of equipments and machinery are decided based on the maintenance and operation condition of the port activities. Basic specification of each equipment and procurement number are shown in Table 2-2-7.

Table 2-2-7 Specification and Number of Procurement Equipment

Equipment	Consideration of Specification	Basic Specification	Procurement Number
Crawler Crane	Lifting Capacity	Lifting Capacity: 120 ton	1
Forklift (Diesel)	Load Capacity	Load Capacity: 3.0 ton	1
Forklift (Battery)	Load Capacity	Load Capacity: 1.5 ton	1
Yard Tractor	Towing Load Capacity	Towing Load Capacity: 3.5 ton	1
Yard Trailer	Load Capacity	Load Capacity: 3.0 ton	2
Belt Conveyor	Carrying Capacity	0.75m×10m+0.75m×5m	1
Pallet Jack	Load Capacity	Load Capacity: 3.0 ton	2
Multi-purpose Truck	Load Capacity	w/ 3.0 ton Load Capacity Crane	1
Pallet Rack	Load Capacity	1 ton / Shelf	35
Sling	Lifting Capacity	3.2 ton	1
Maintenance & Repair Parts	Work Condition, Facility Item	Maintenance & Repair Gears	1
Port Security Equipment	Work Condition	Fire Pump, Security Equipment & Gear	1
Port Wireless System	Output, Extensibility	Wave Range : 136-174MHz, 50W Repeater x 1, 5W Hand Set x 10, 25W Mobile × 2	1
Oil Pump	Uplift Volume & Lifting Range	More than 500L per min., 6m	1

2-2-3 Outline Design Drawing

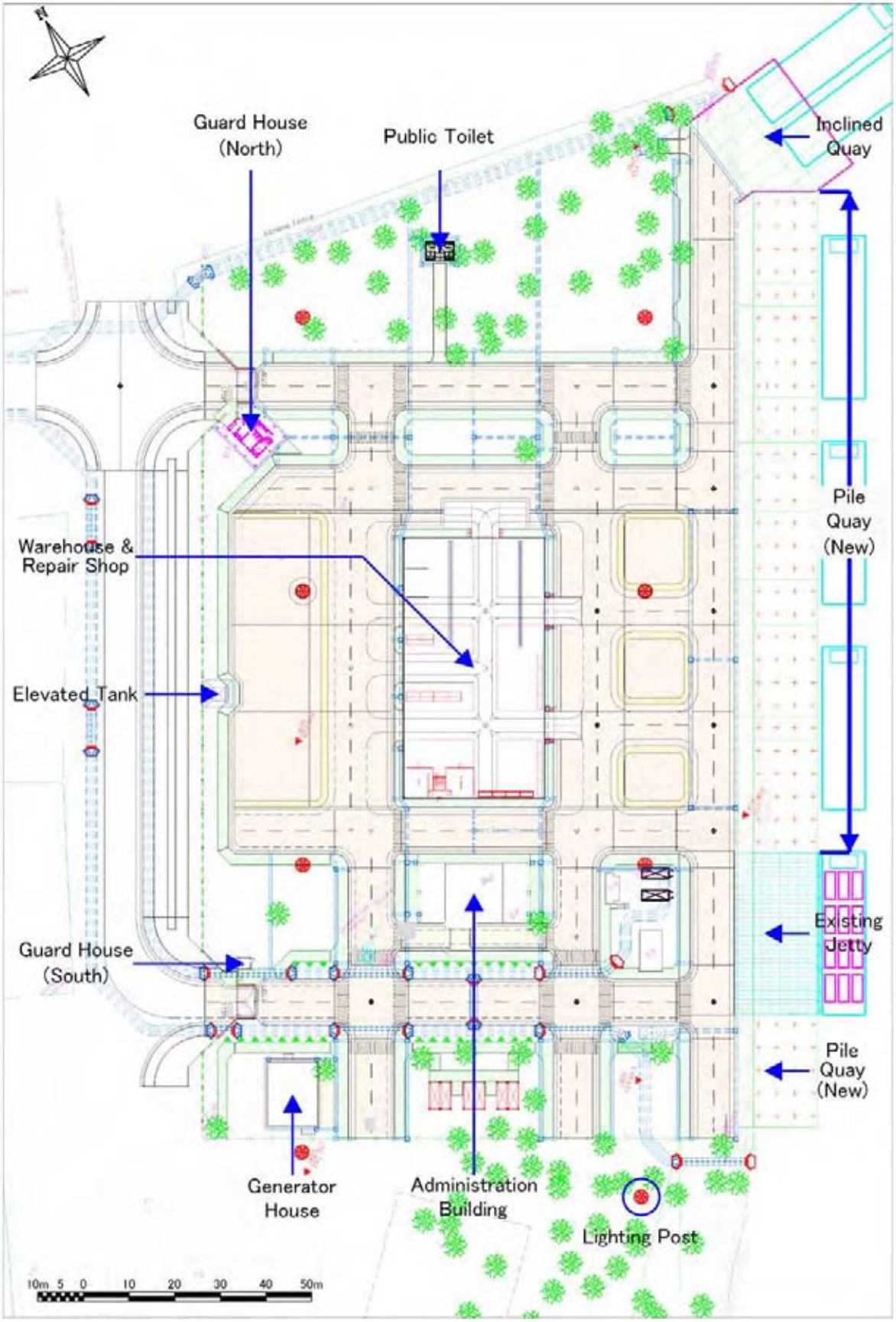


Figure 2-2-3 Layout Plan

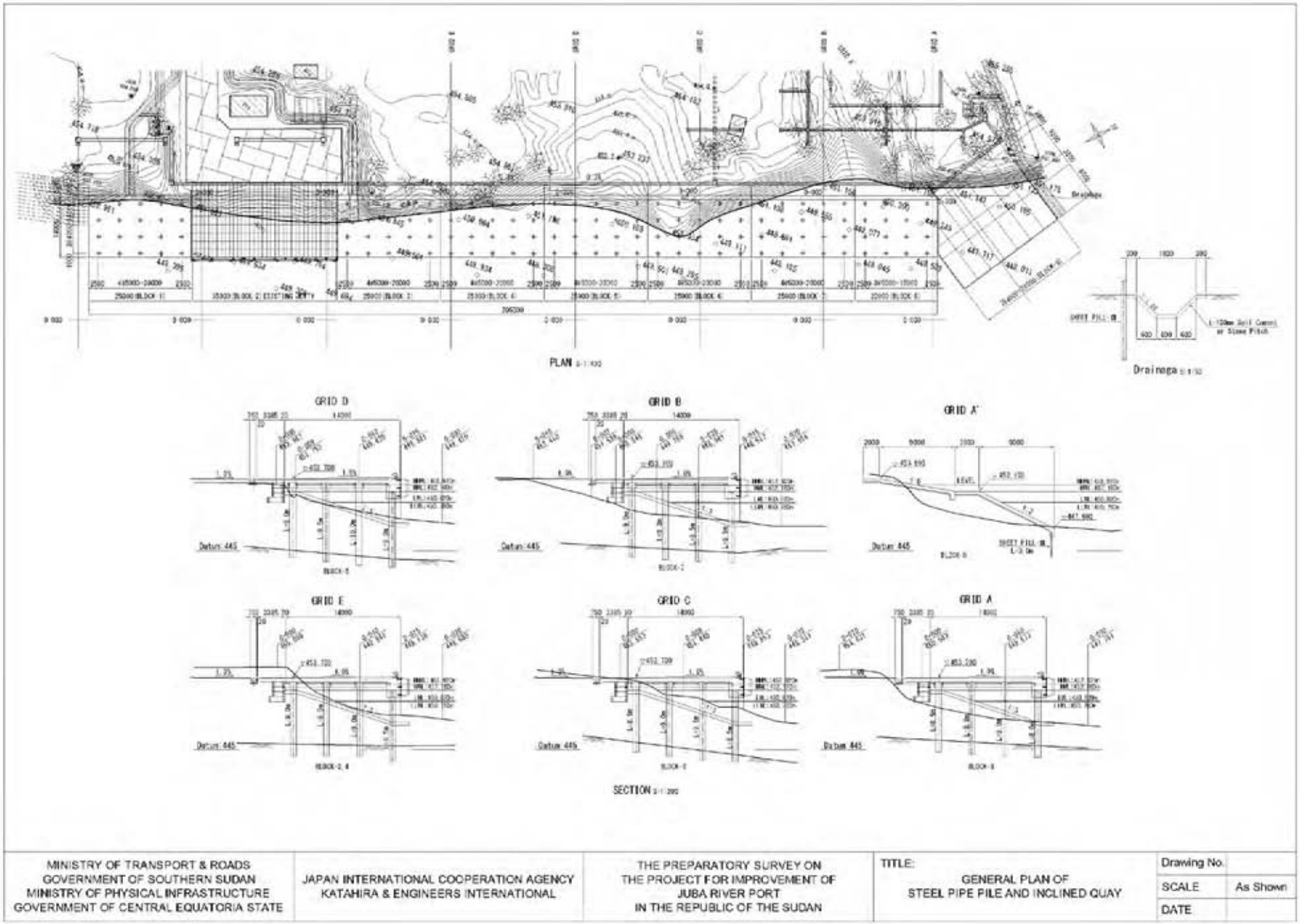
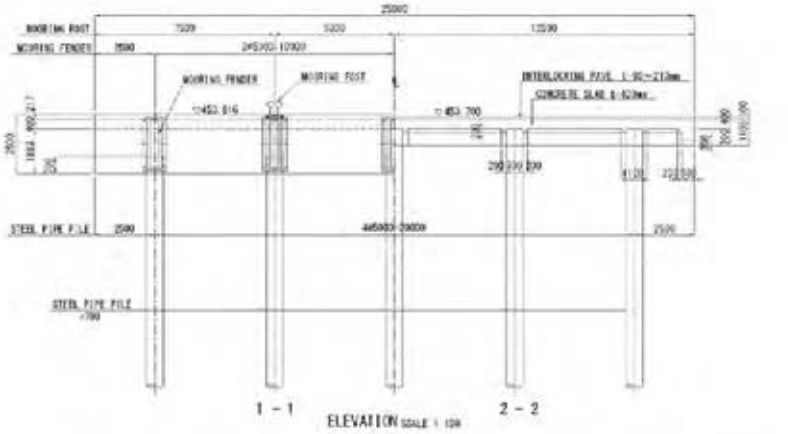
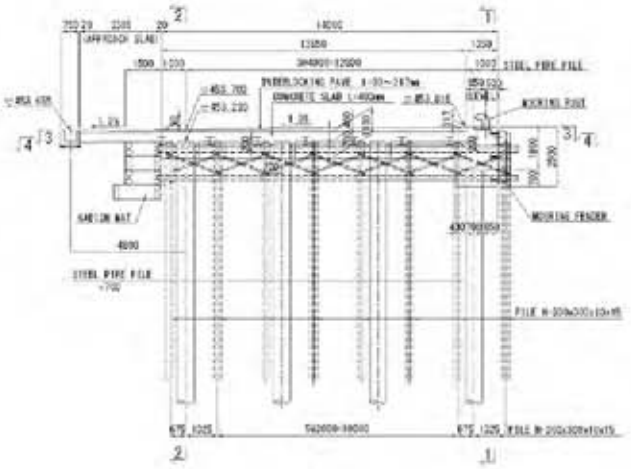
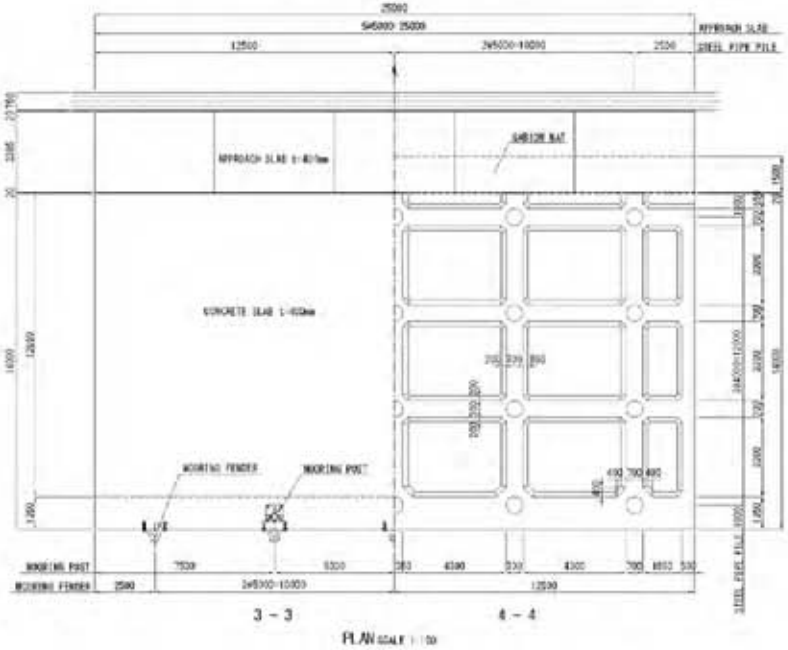
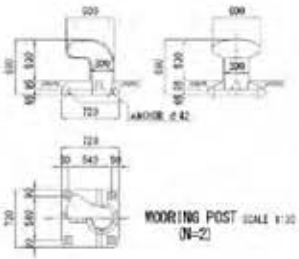


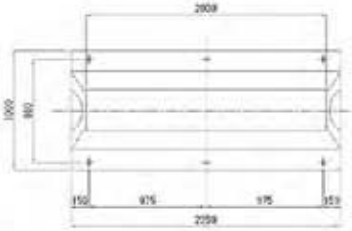
Figure 2-2-4 General Plan of Steel Pipe Pile / Inclined Quay

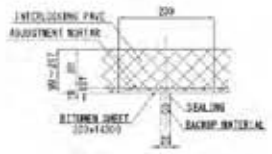


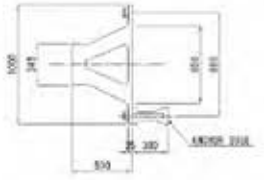












MINISTRY OF TRANSPORT & ROADS GOVERNMENT OF SOUTHERN SUDAN MINISTRY OF PHYSICAL INFRASTRUCTURE GOVERNMENT OF CENTRAL EQUATORIA STATE	JAPAN INTERNATIONAL COOPERATION AGENCY KATAHIRA & ENGINEERS INTERNATIONAL	THE PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF JUBA RIVER PORT IN THE REPUBLIC OF THE SUDAN	TITLE: DETAIL OF STEEL PIPE PILE QUAY	Drawing No.	
				SCALE	As Shown
				DATE	

Figure 2-2-5 Detail of Steel Pipe Pile Quay

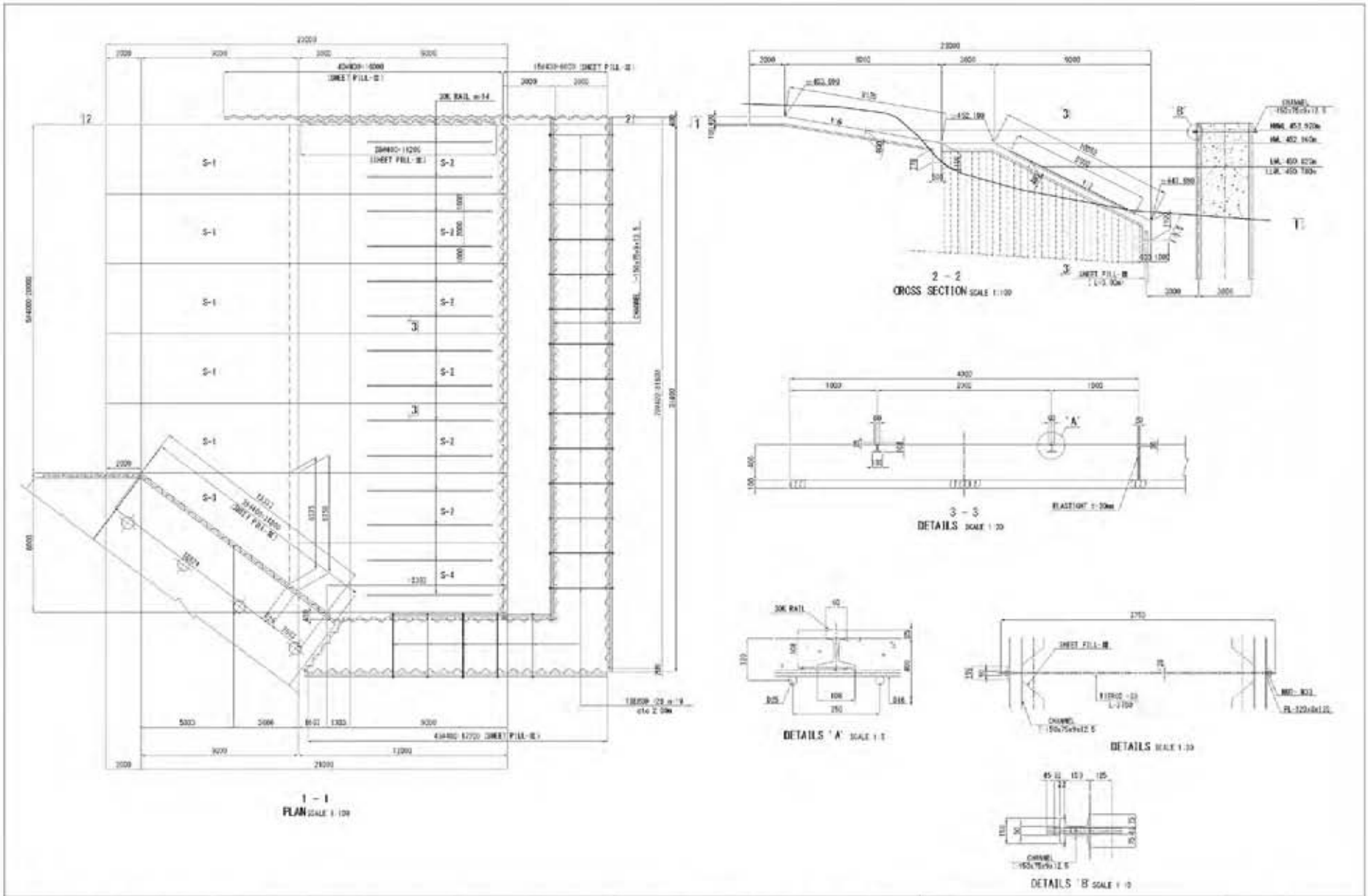


Figure 2-2-6 Detail of Inclined Quay

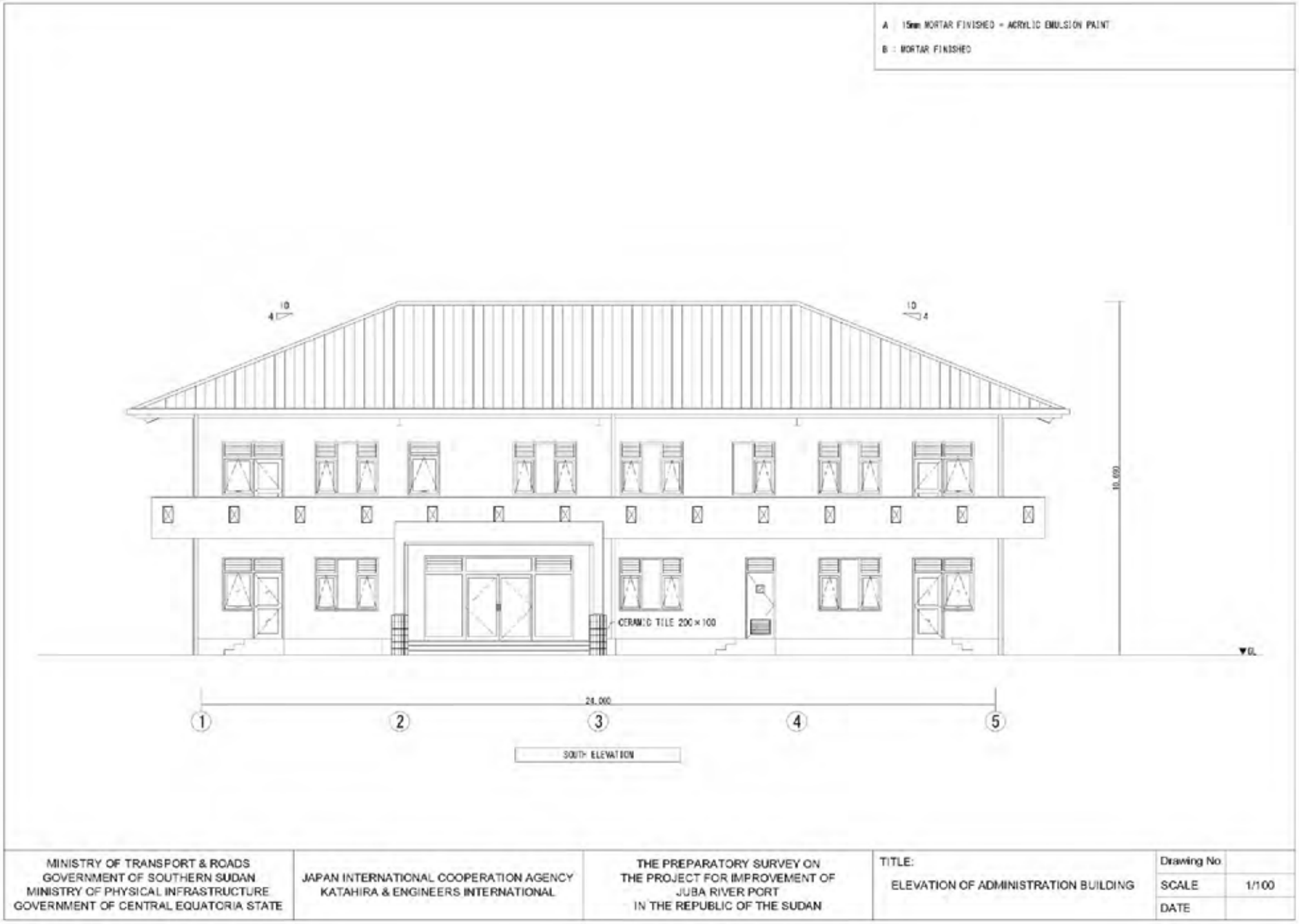


Figure 2-2-7 Elevation of Administration Building

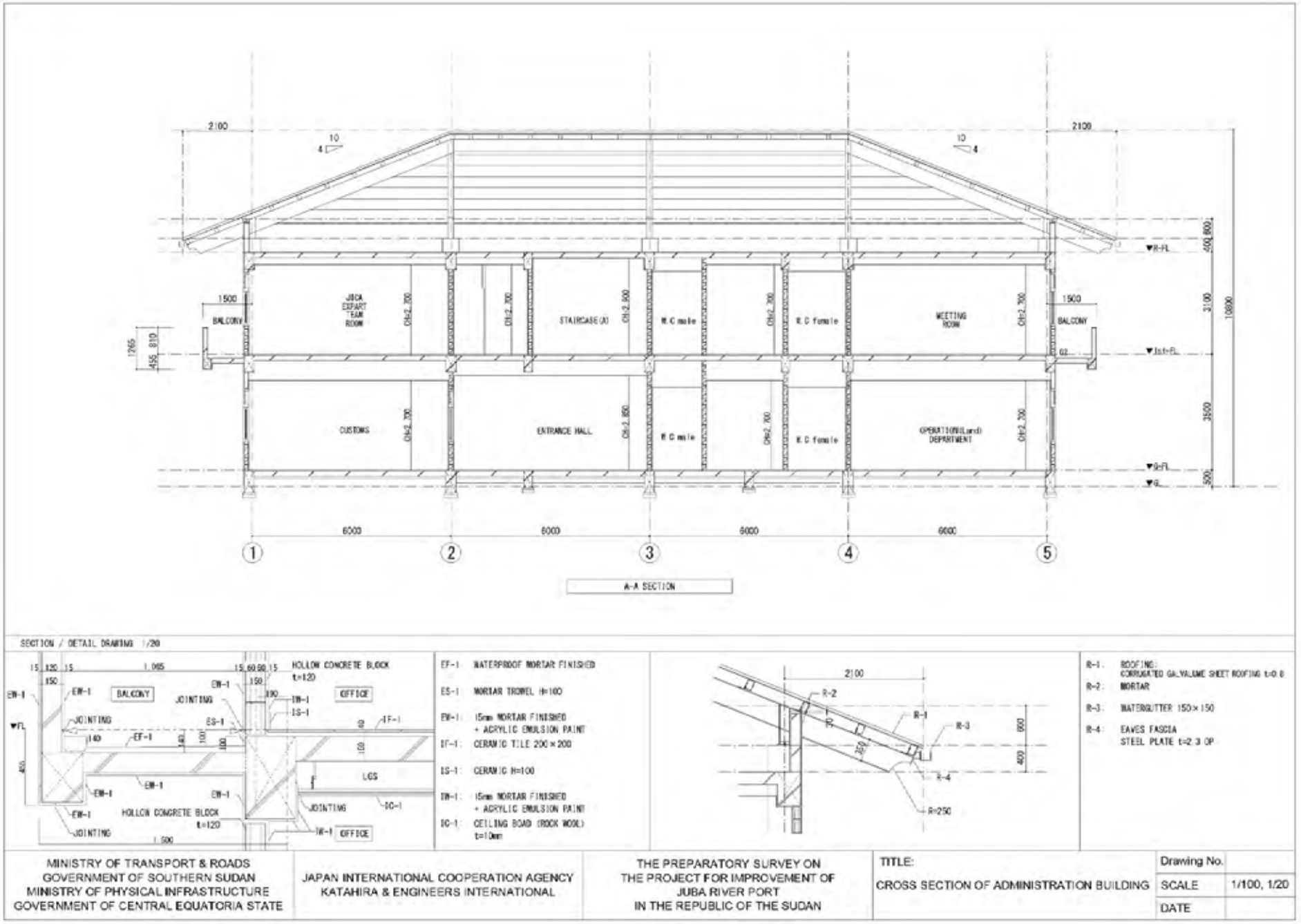


Figure 2-2-8 Cross Section of Administration Building

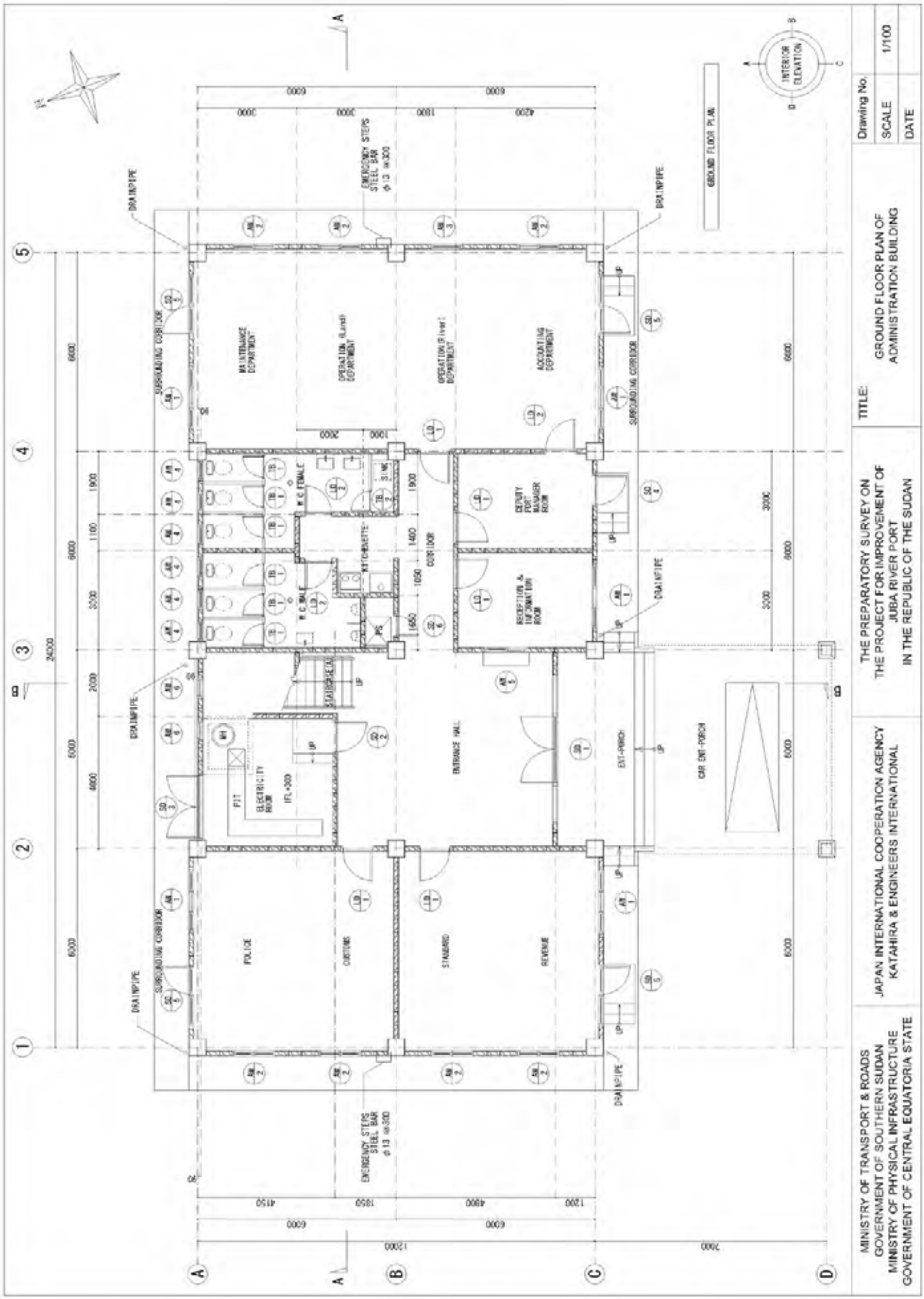


Figure 2-2-9 Ground Floor Plan of Administration Building

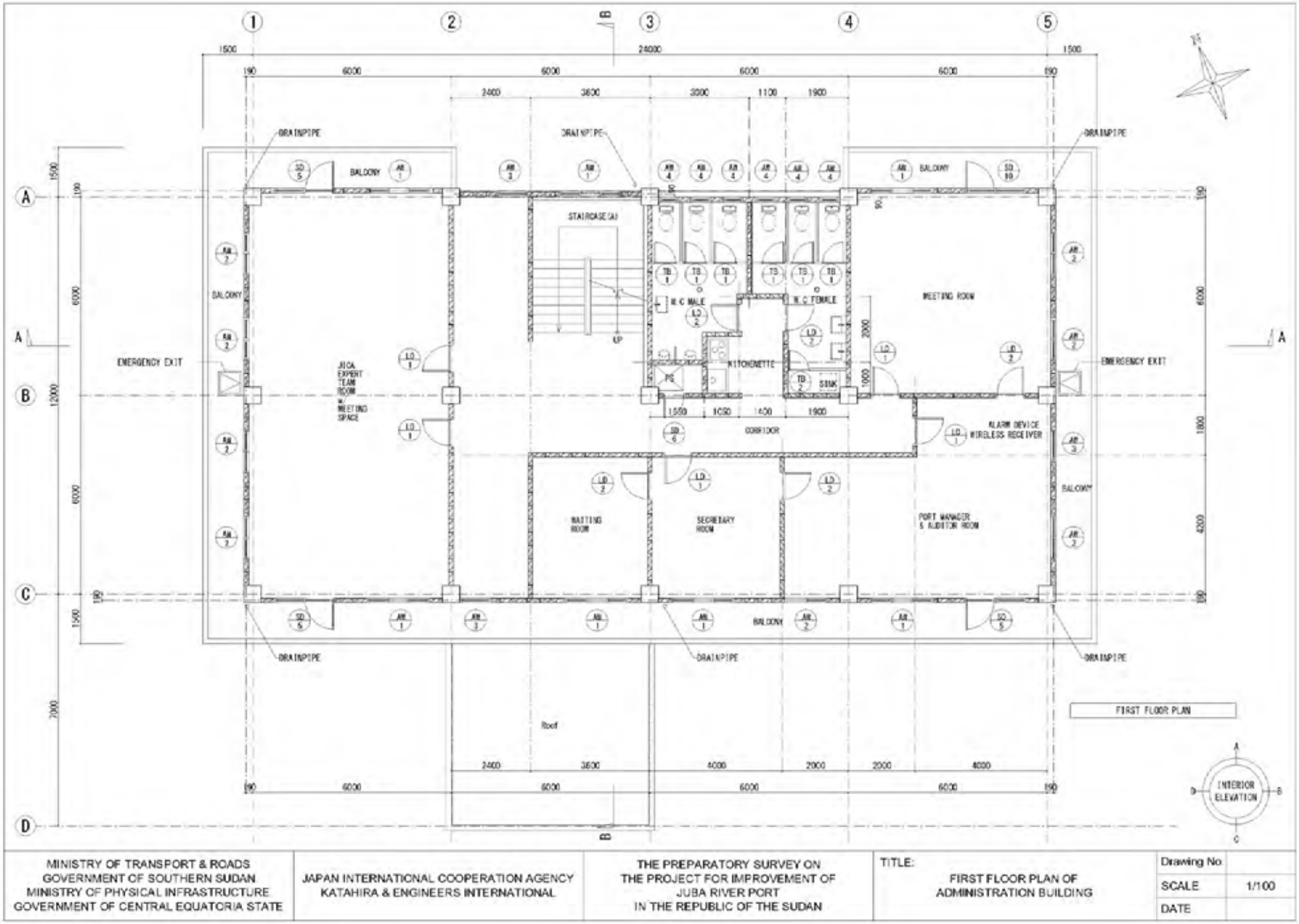


Figure 2-2-10 First Floor Plan of Administration Building

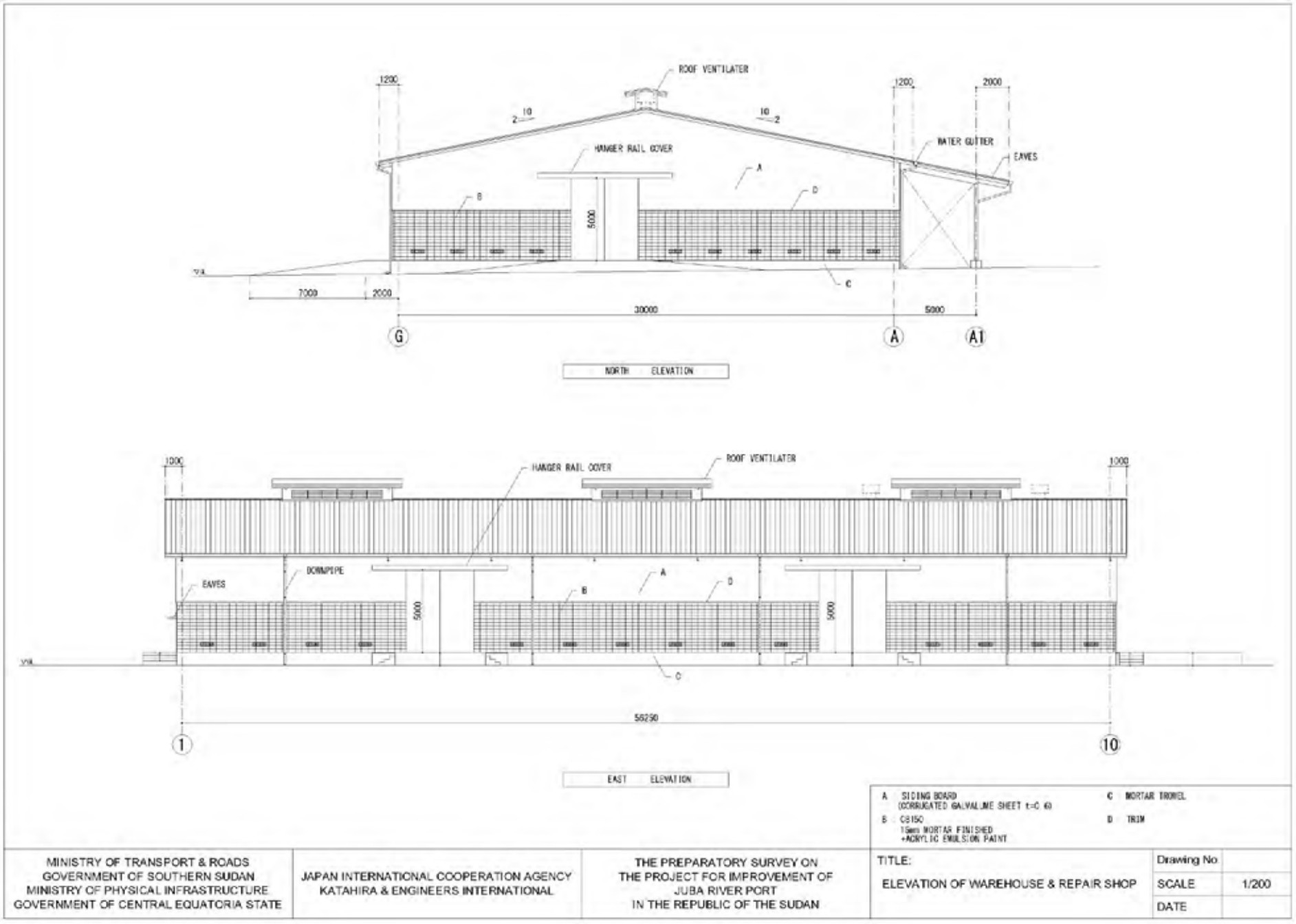


Figure 2-2-10 Elevation of Warehouse & Repair Shop

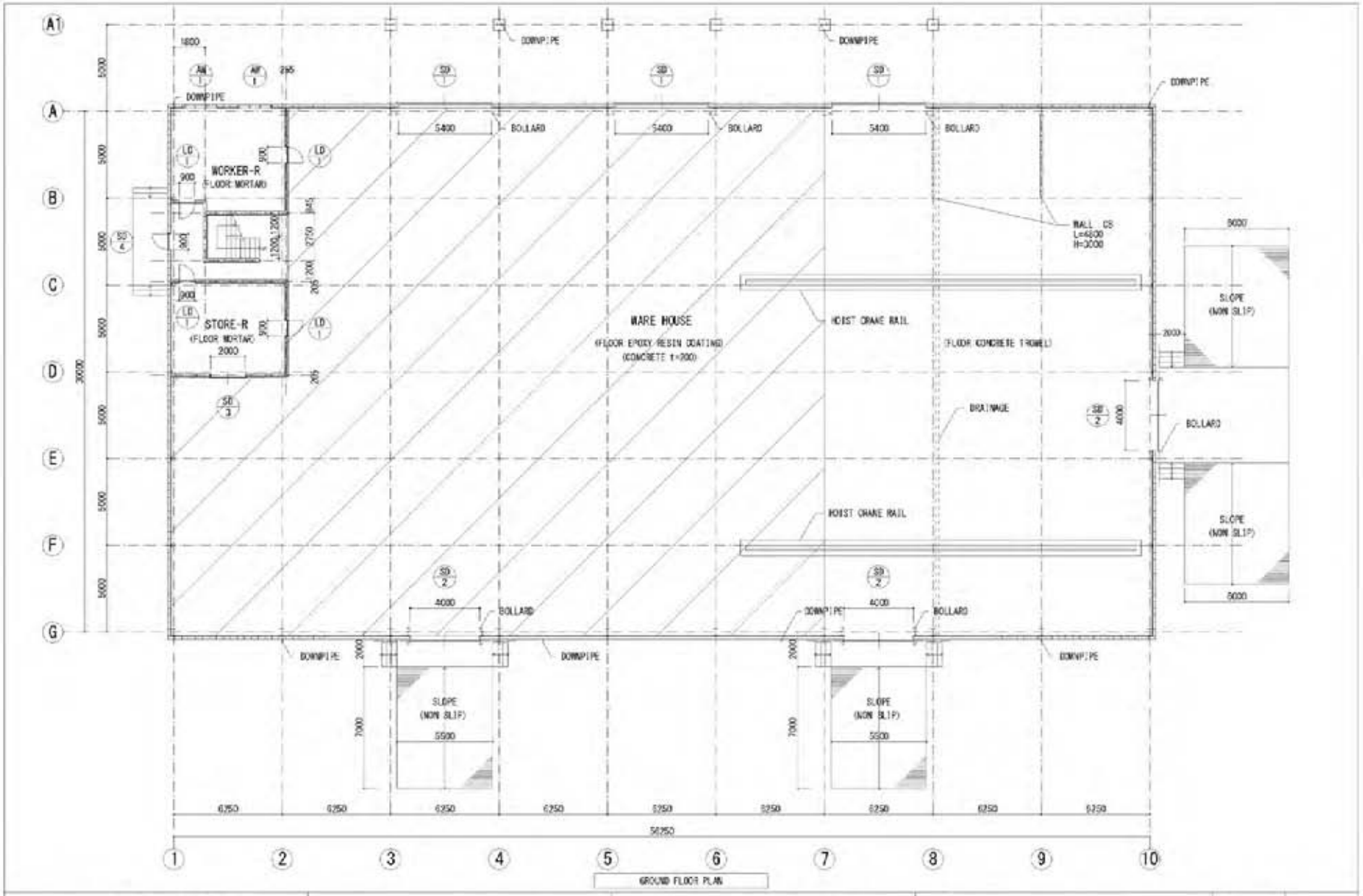


Figure 2-2-11 Ground Floor Plan of Warehouse & Repair Shop

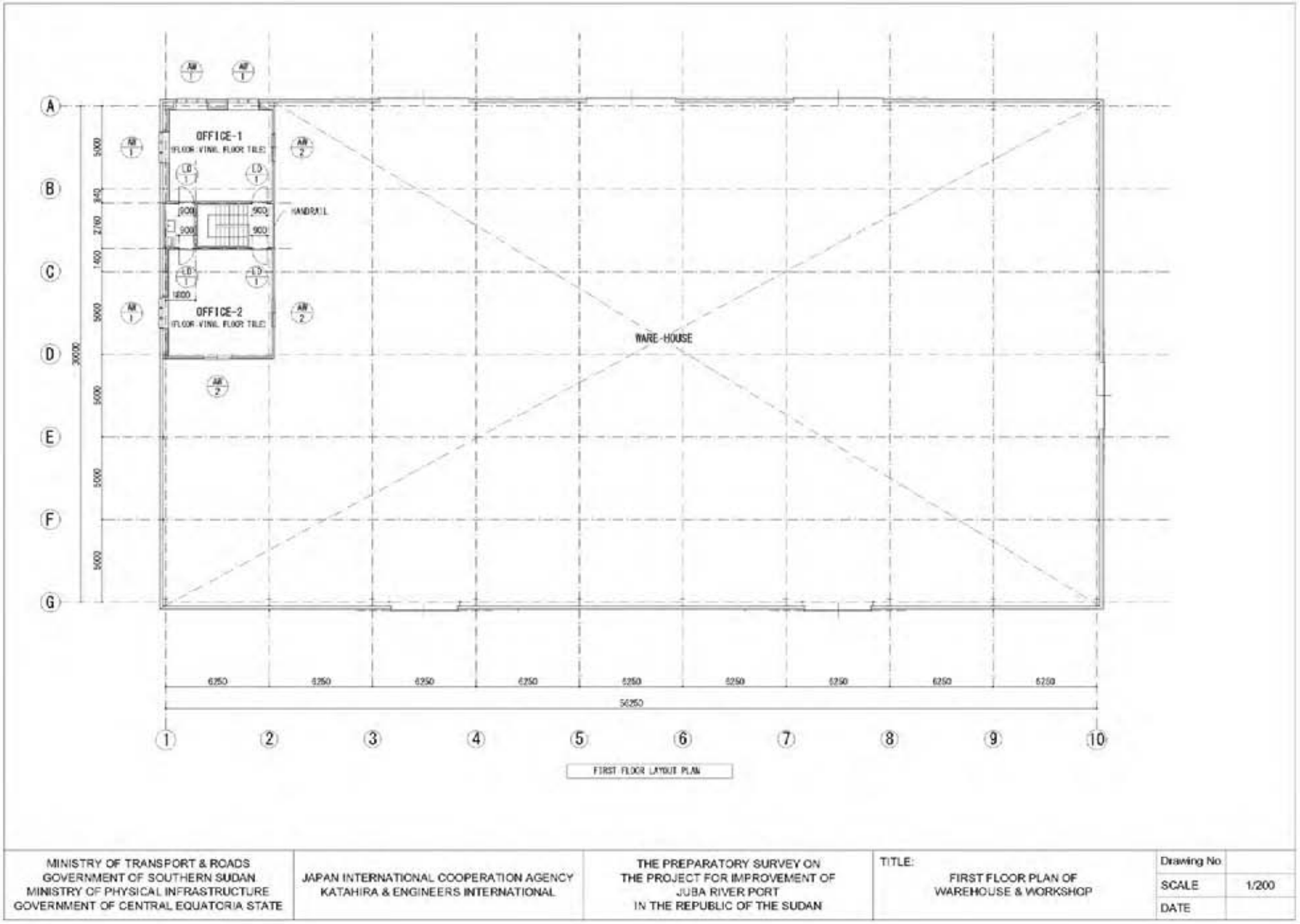


Figure 2-2-12 First Floor Plan of Warehouse & Repair Shop

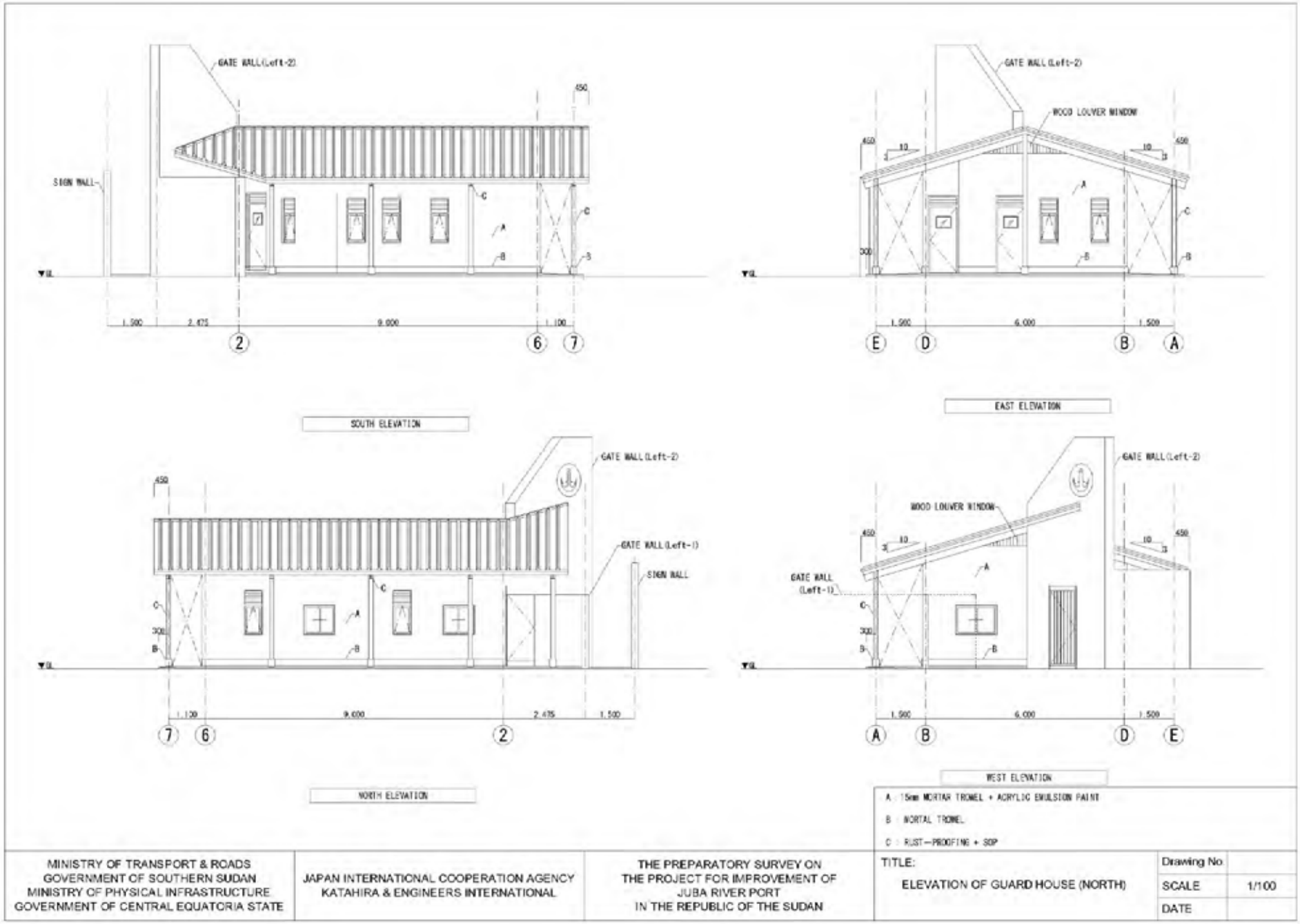


Figure 2-2-13 Elevation of Guard House (North)

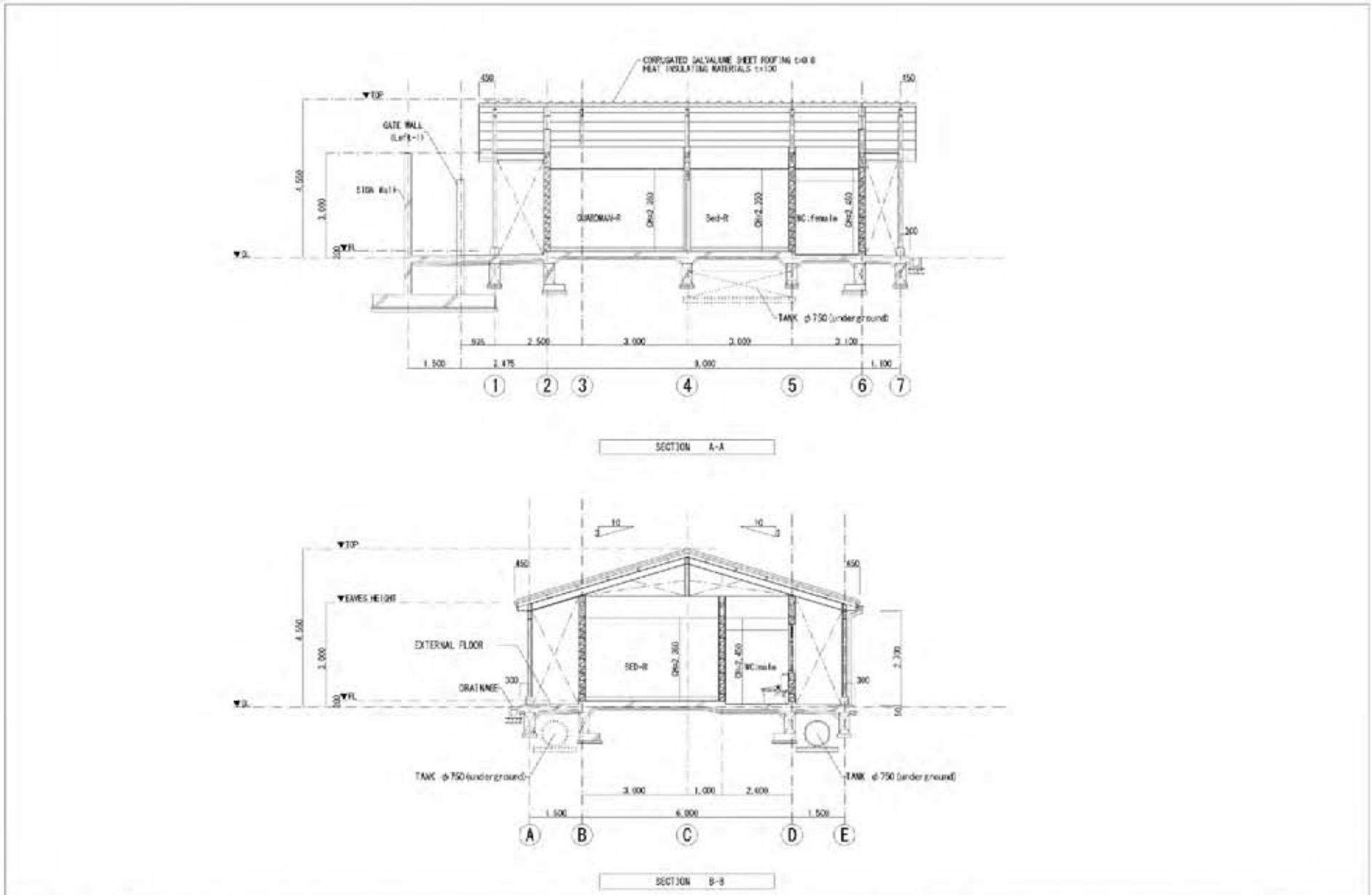


Figure 2-2-14 Cross Section of Guard House (North)

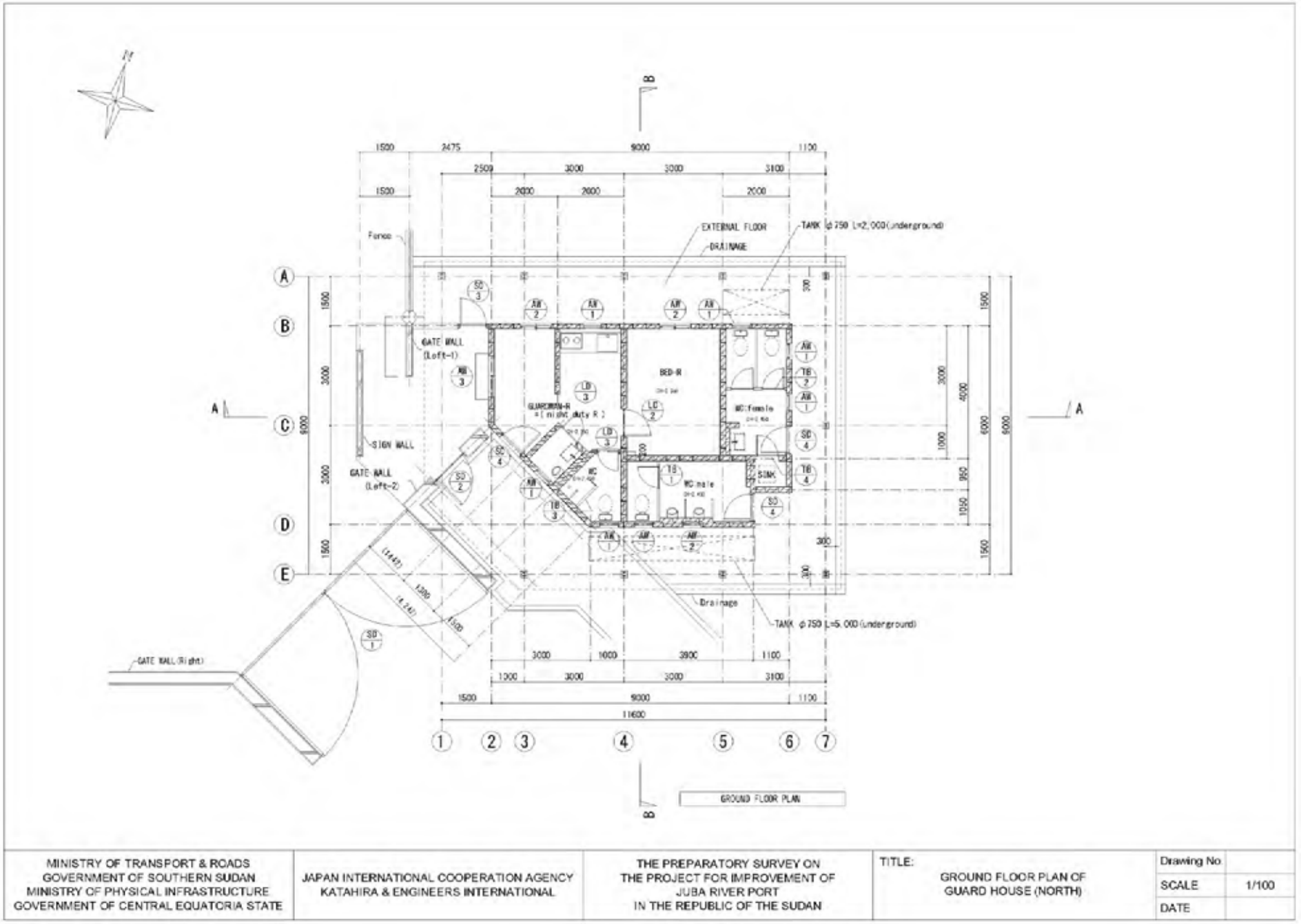


Figure 2-2-15 Ground Floor Plan of Guard House (North)

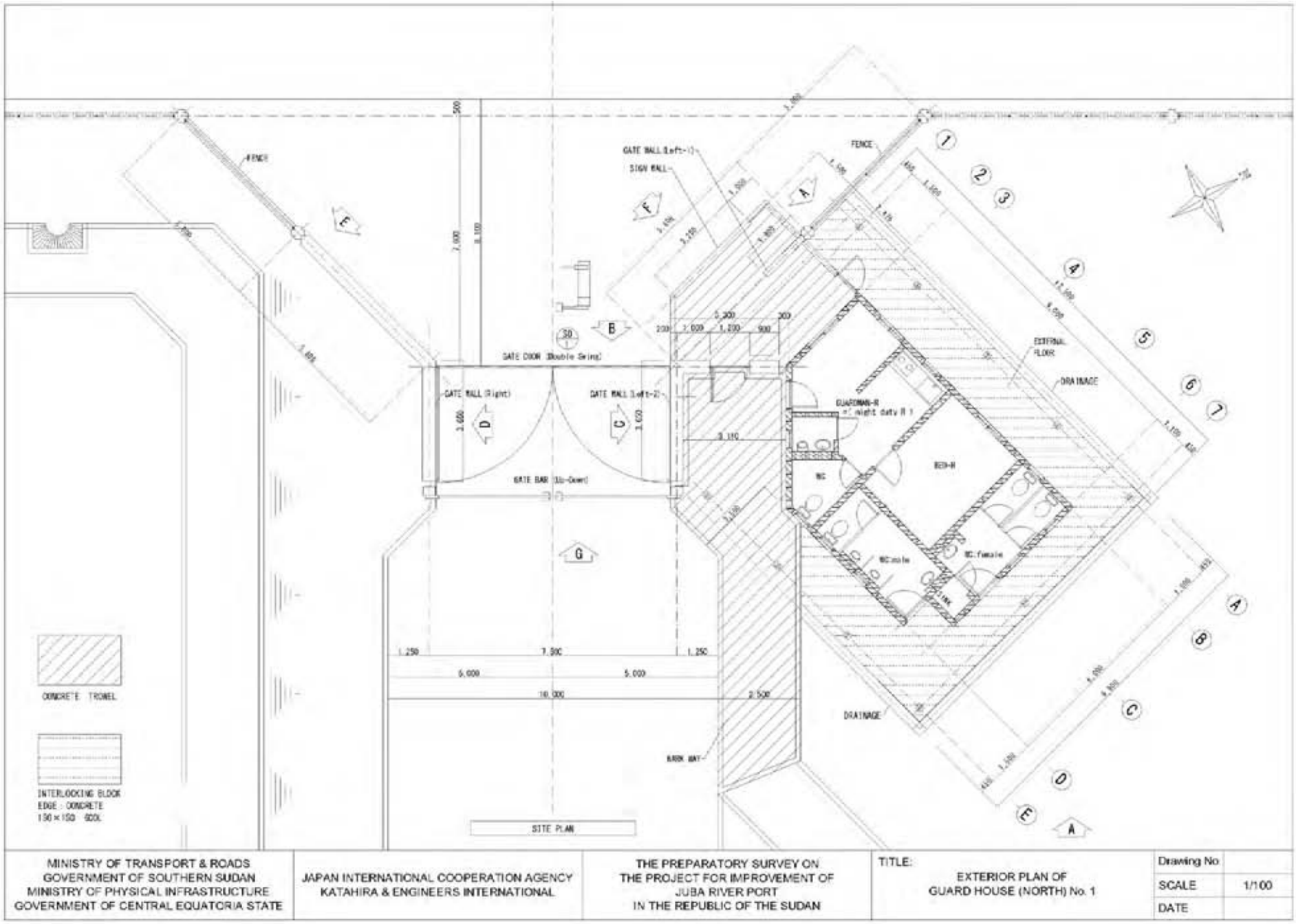


Figure 2-2-16 Exterior Plan of Guard House (North) No.1

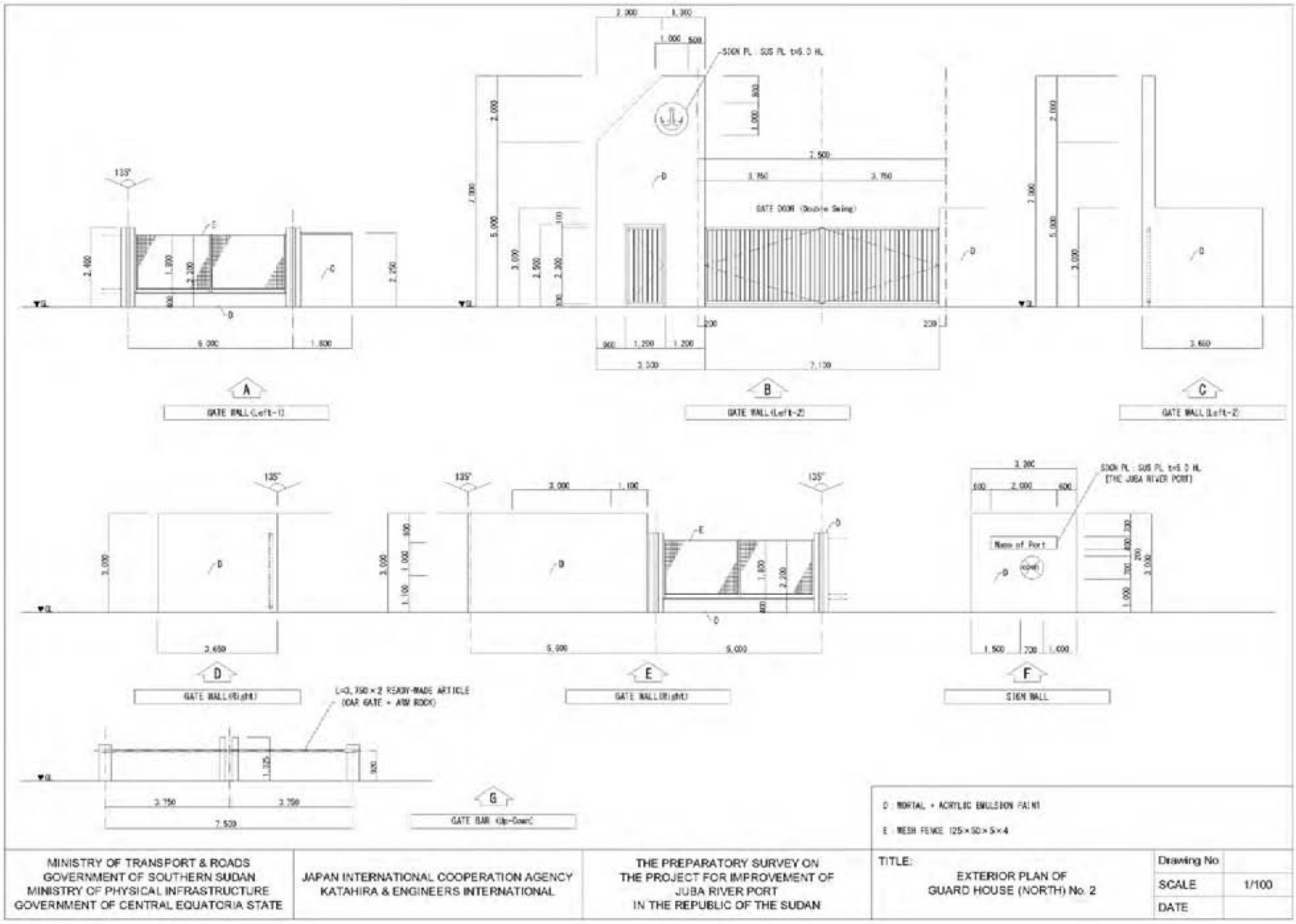


Figure 2-2-17 Exterior Plan of Guard House (North) No.2