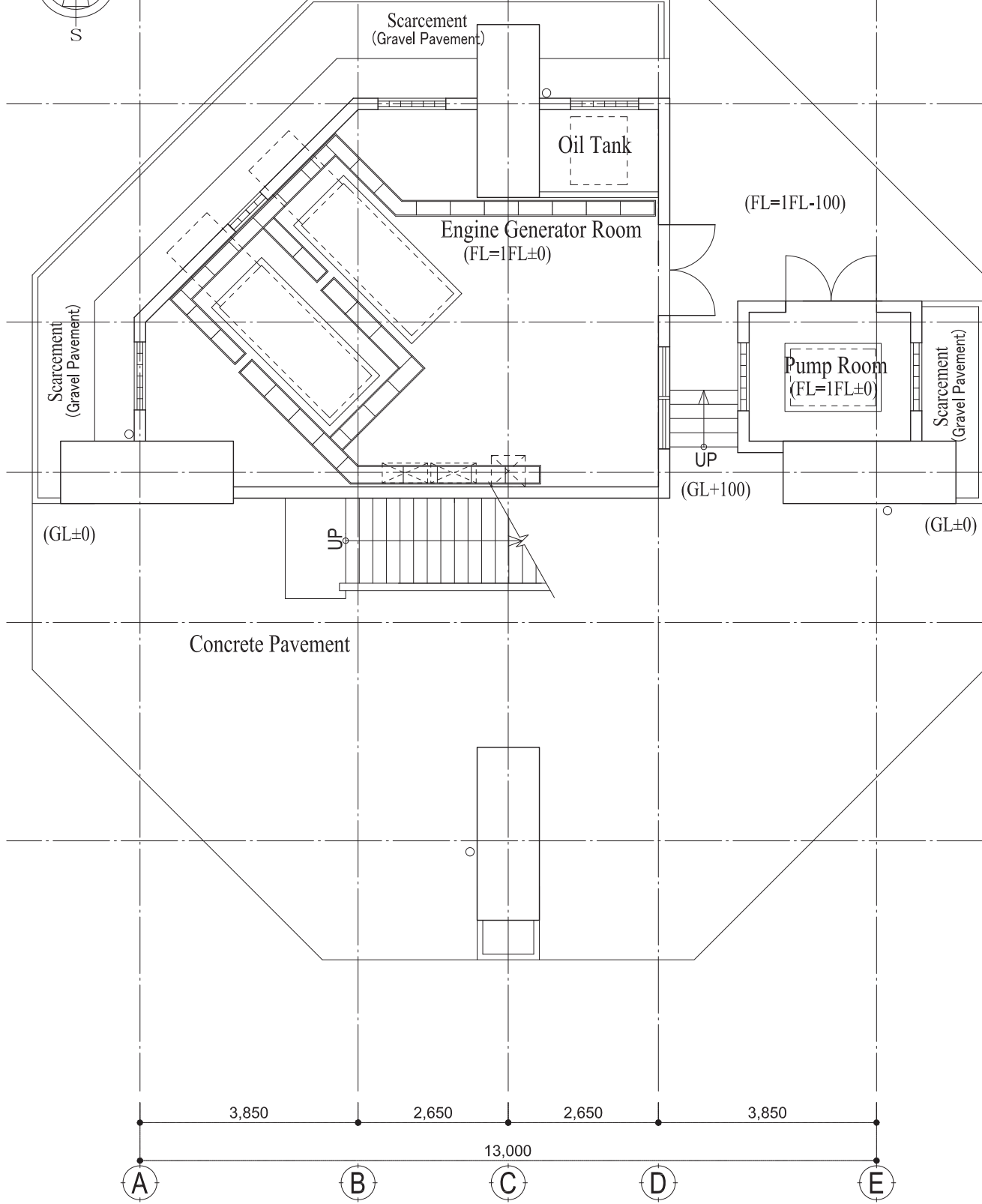
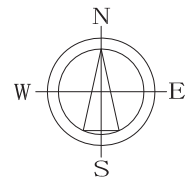
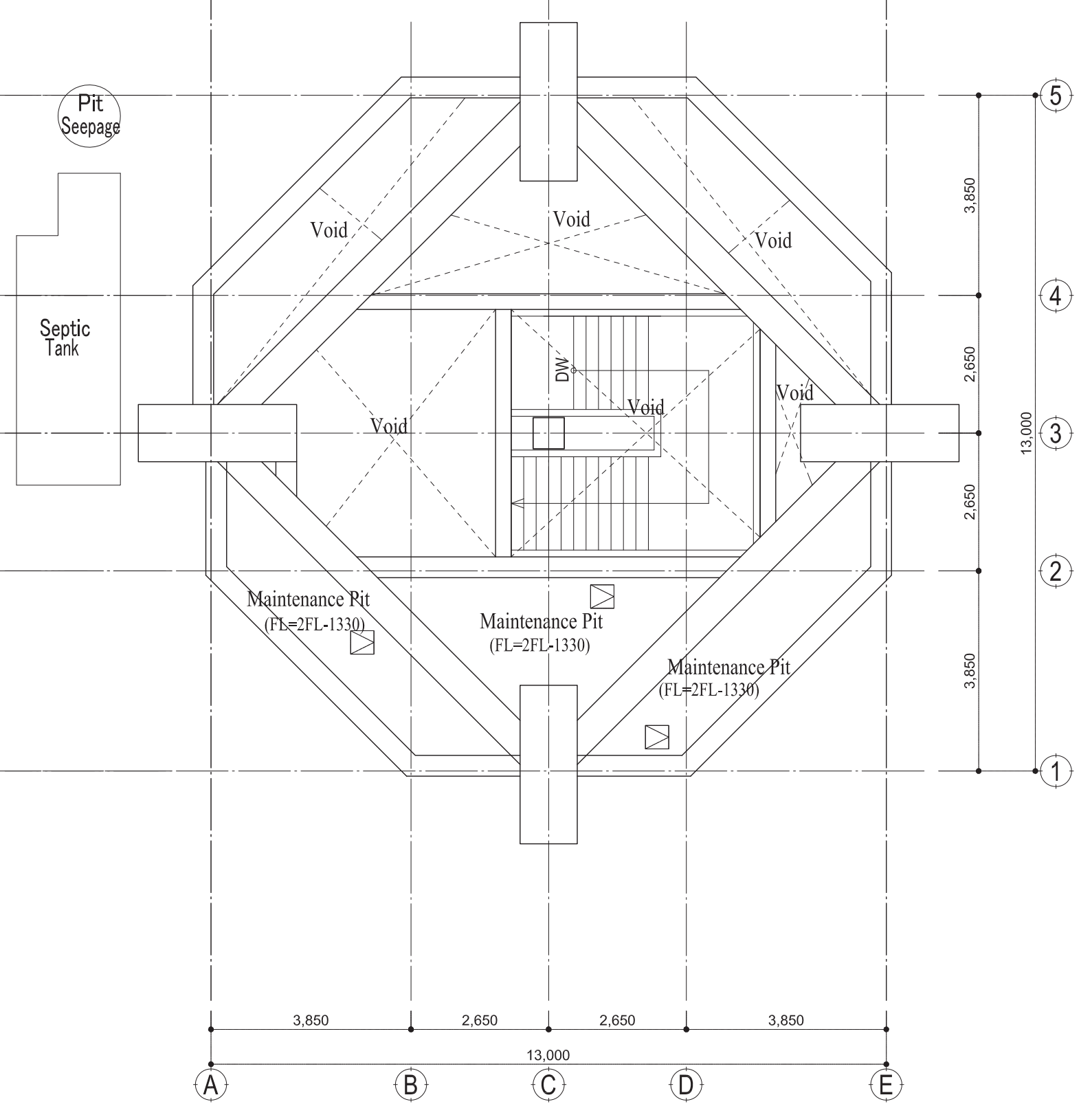


Area Calculations

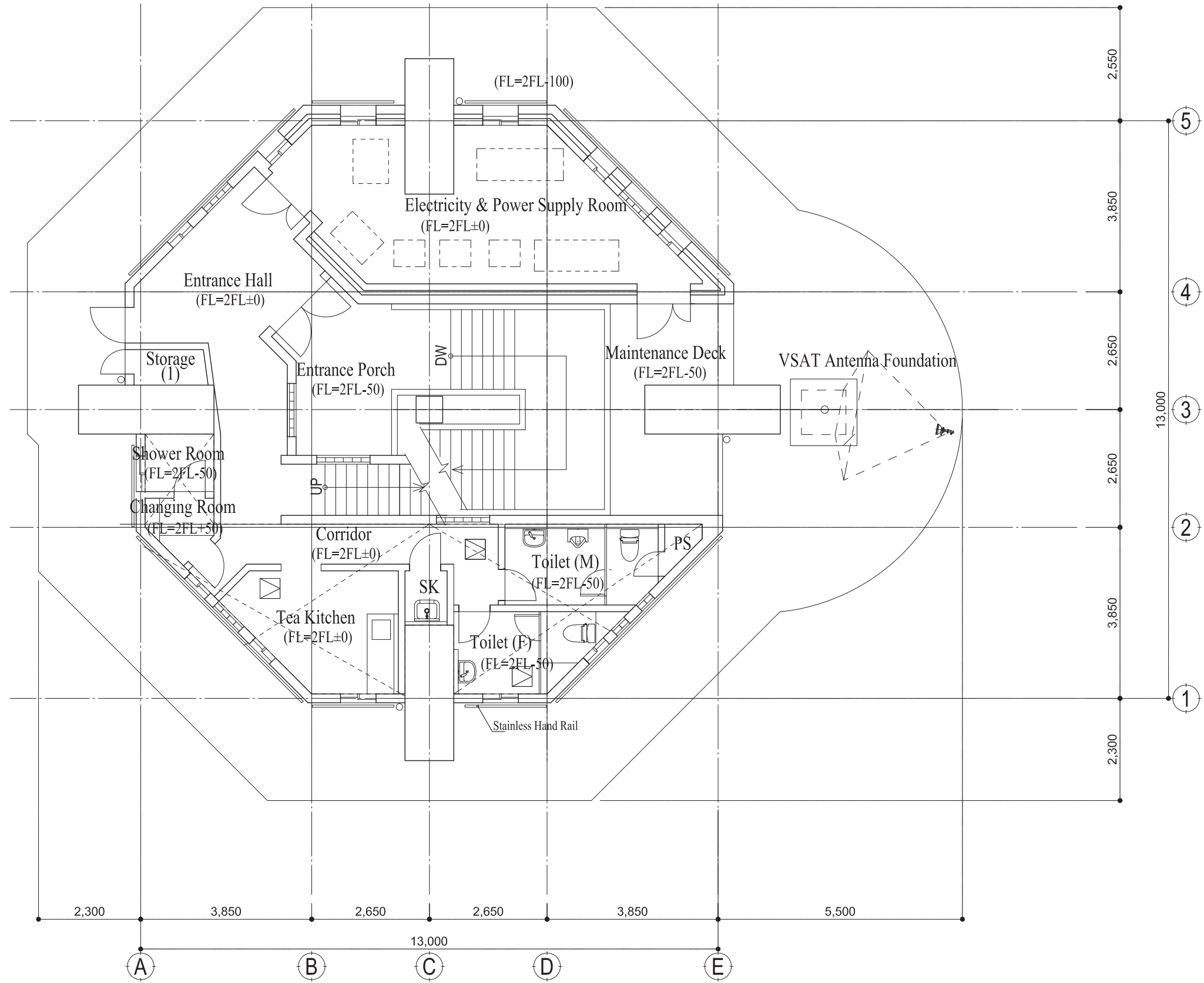
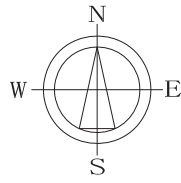
Floor	Floor Area (m <sup>2</sup> )	Construction Area (m <sup>2</sup> )
1FL	63.71	235.17
MPFL	-	36.82
2FL	96.53	276.49
3FL	145.49	204.20
4FL	16.60	217.41
5FL	-	92.15
6FL	-	92.15
7FL	-	92.15
8FL	-	92.15
9FL	-	92.15
10FL	111.03	123.97
11FL	17.29	121.36
12FL	30.19	121.36
Total	480.28 m <sup>2</sup>	1,797.53 m <sup>2</sup>
Building Coverage Area	144.93 m <sup>2</sup>	-

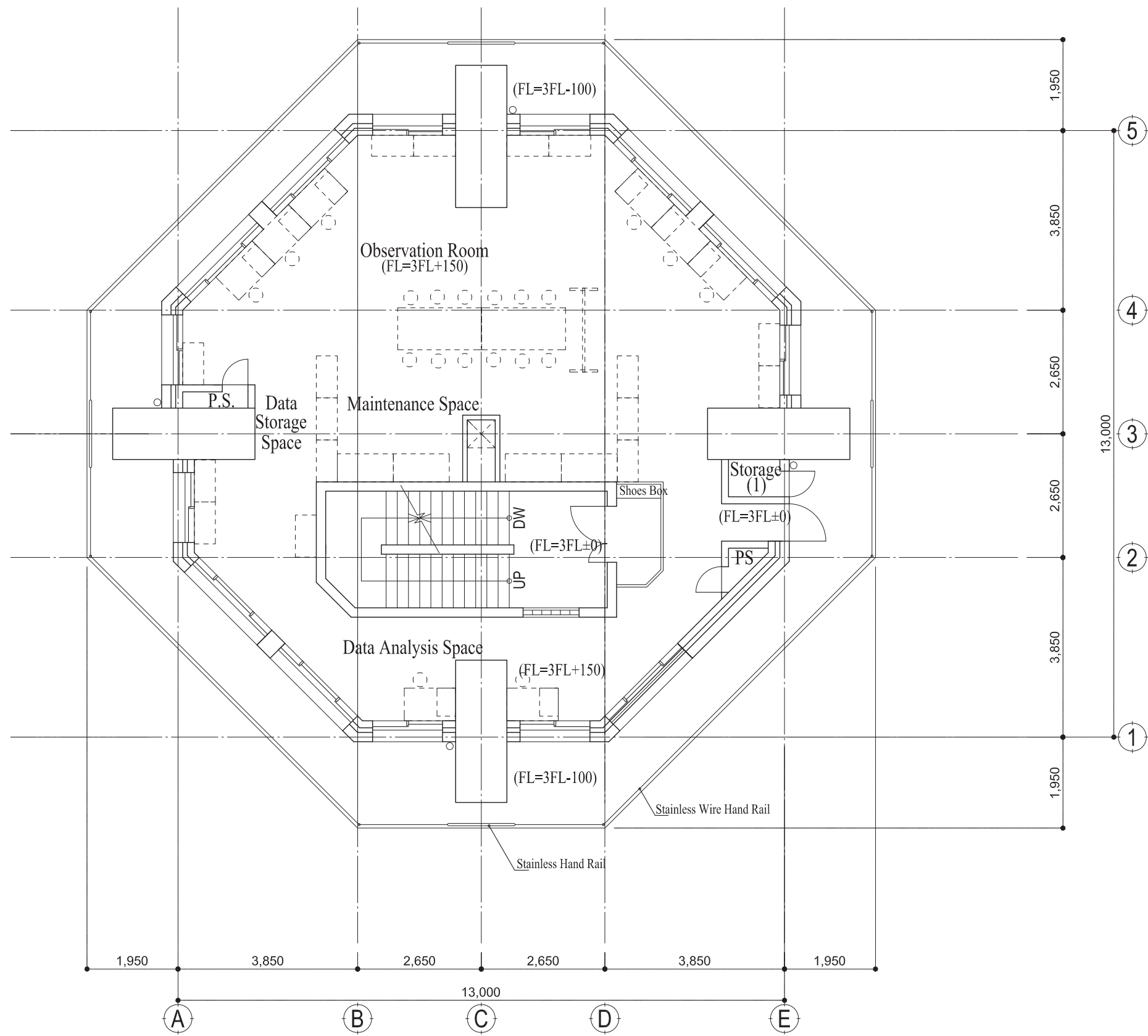


1FL PLAN

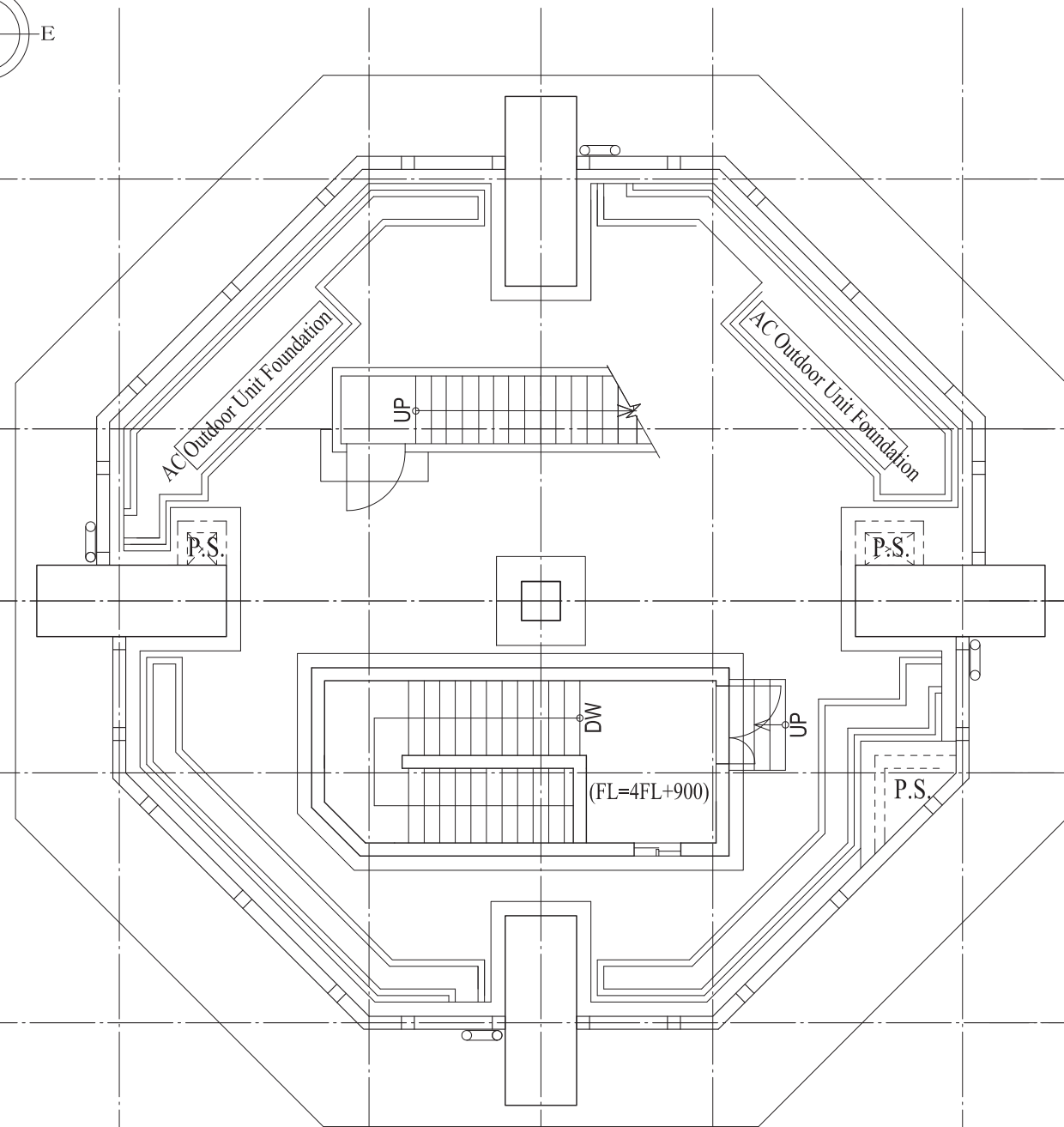
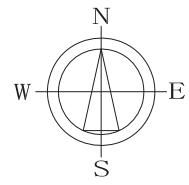


MPFL PLAN





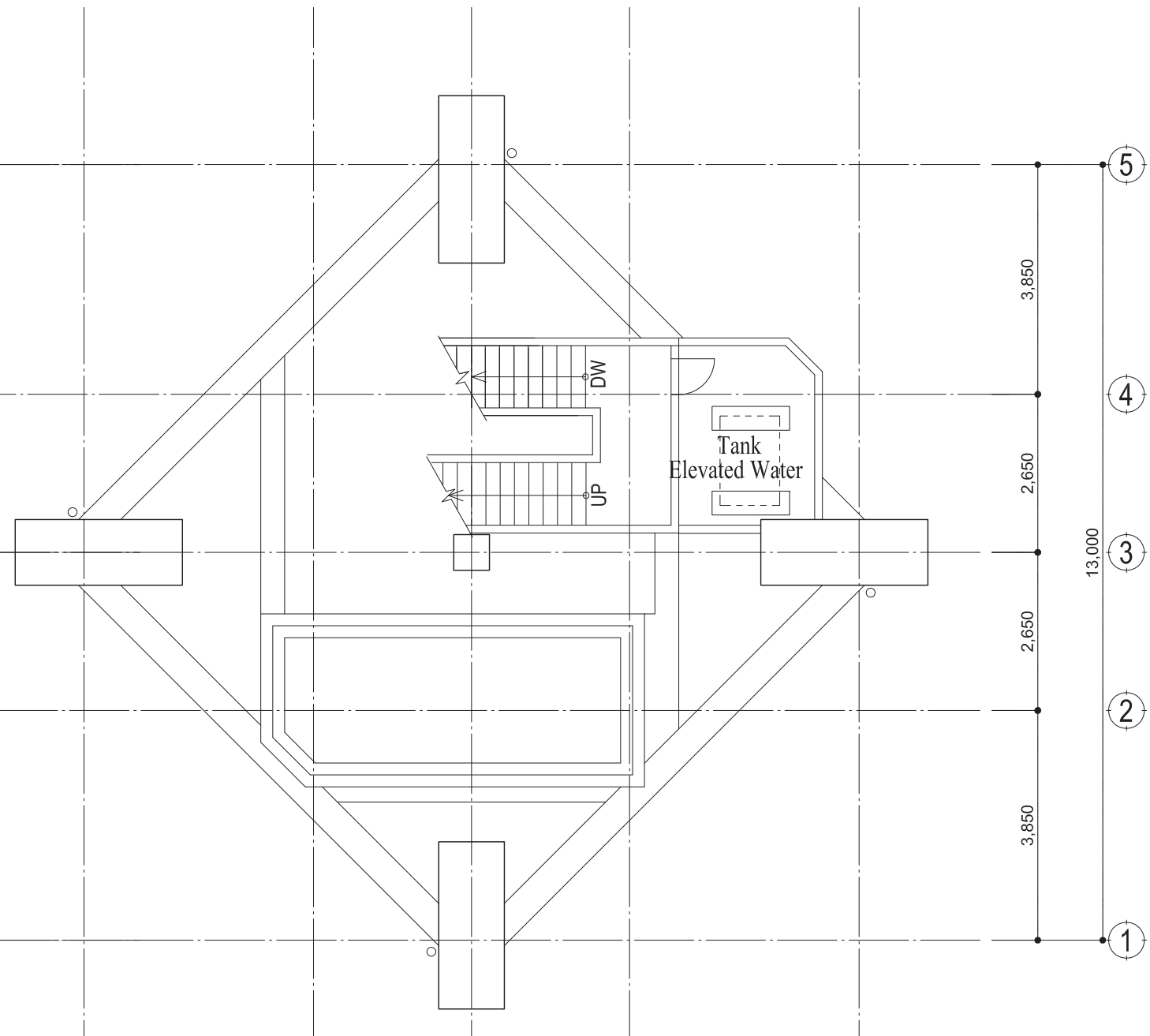
3FL PLAN



3,850    2,650    2,650    3,850    13,000

A    B    C    D    E

4FL PLAN



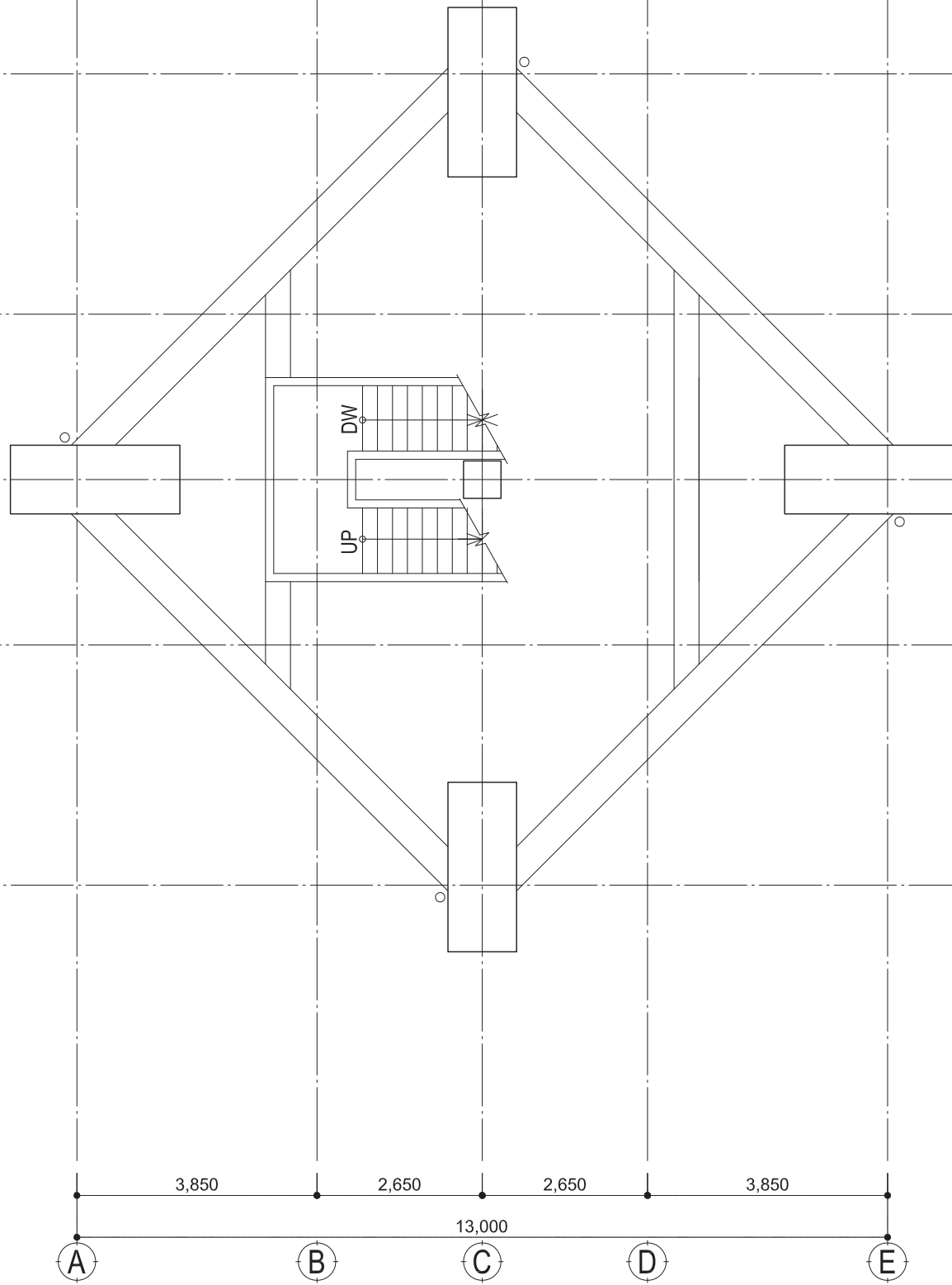
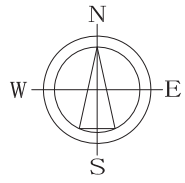
3,850    2,650    2,650    3,850    13,000

A    B    C    D    E

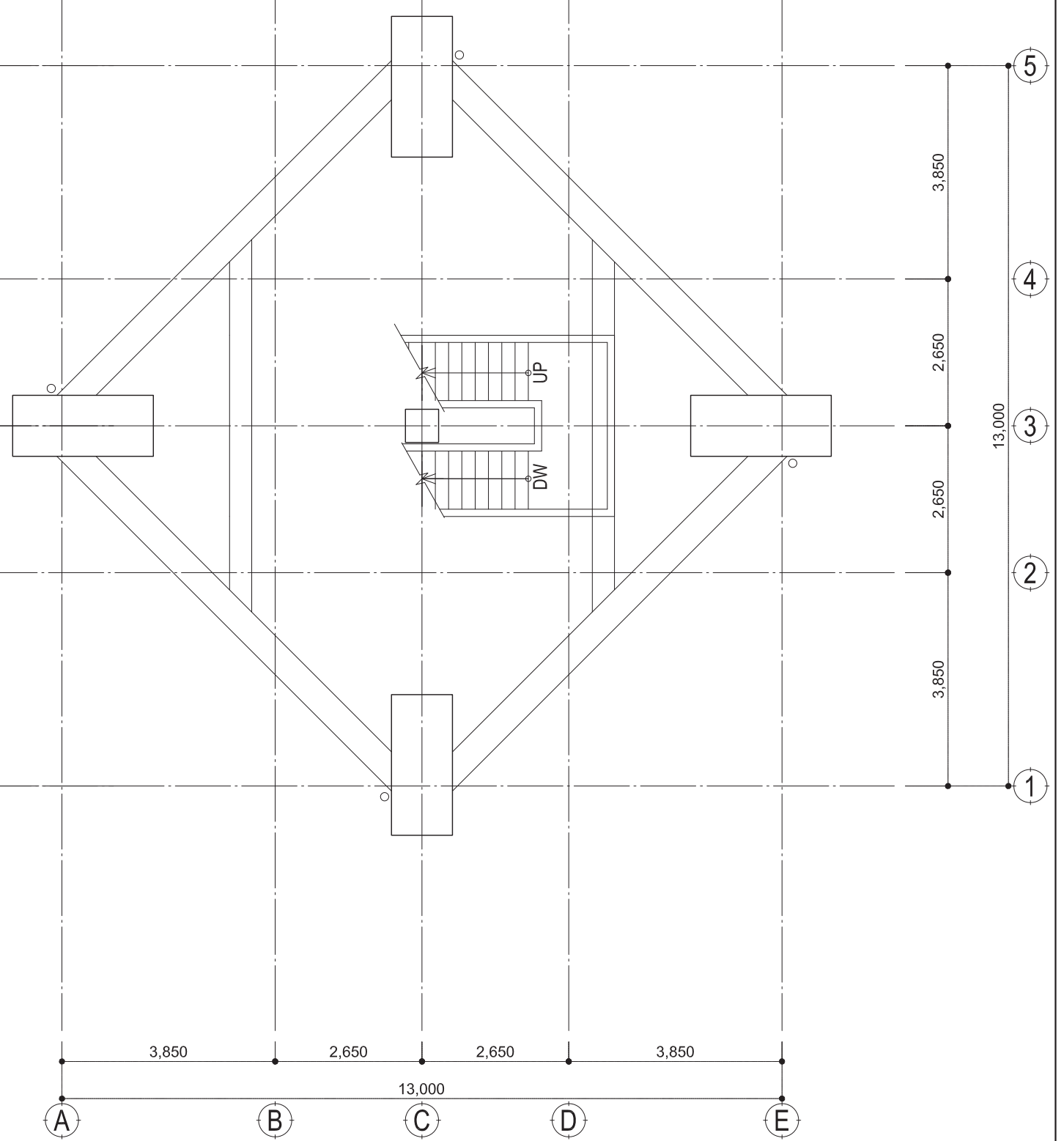
5FL PLAN

5  
4  
3  
2  
1

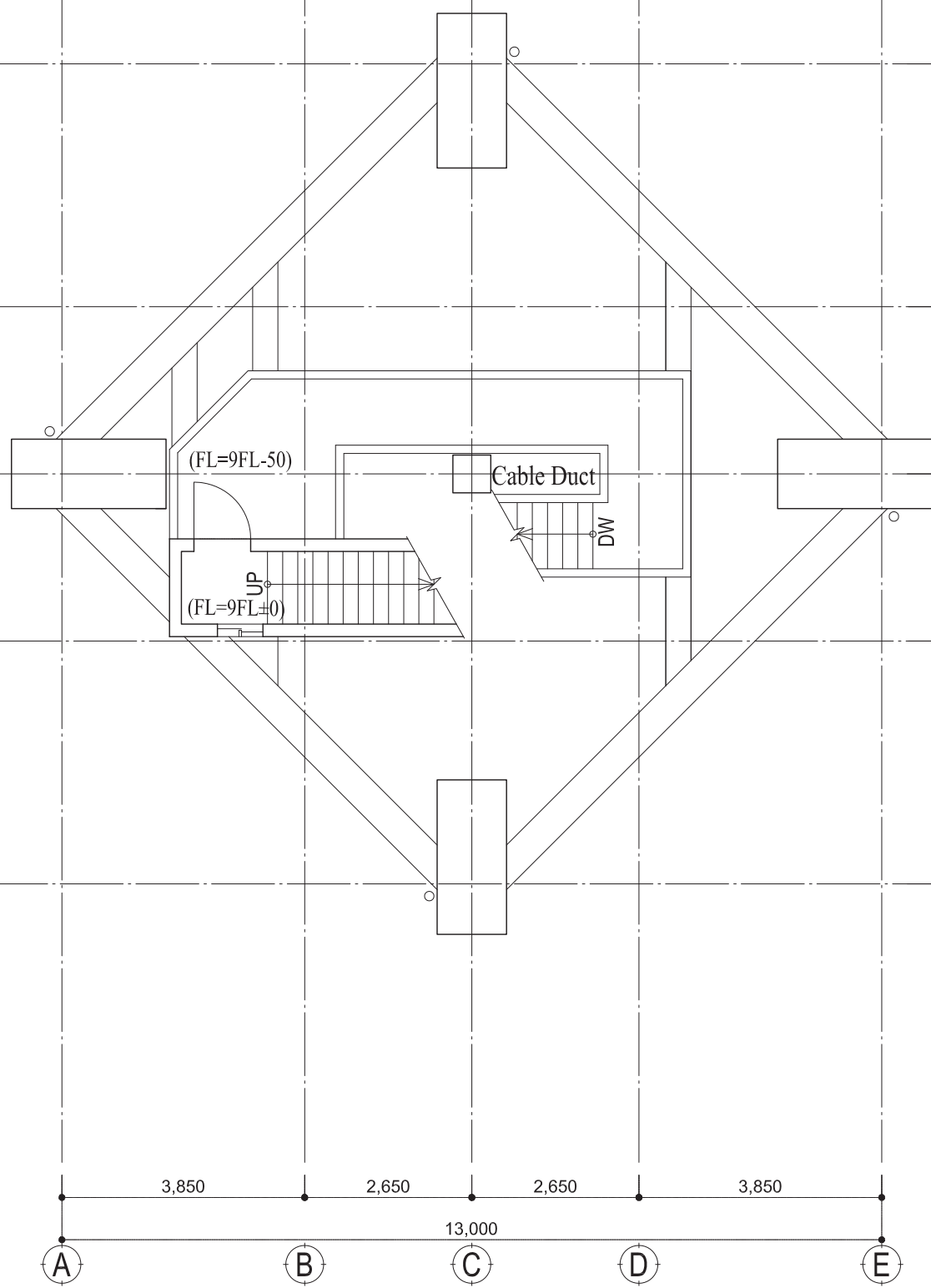
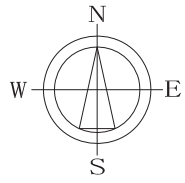
13,000



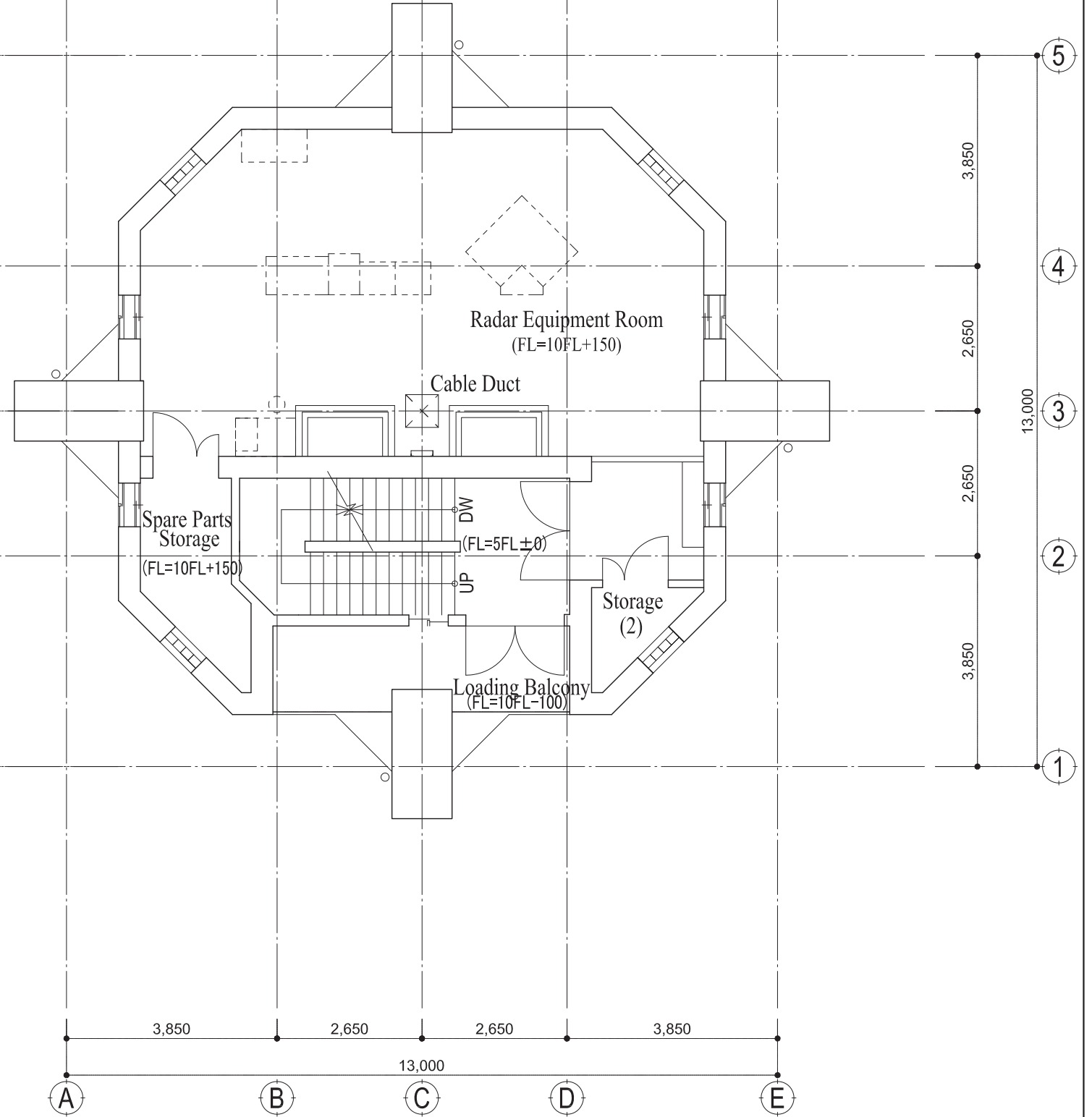
6, 7FL PLAN



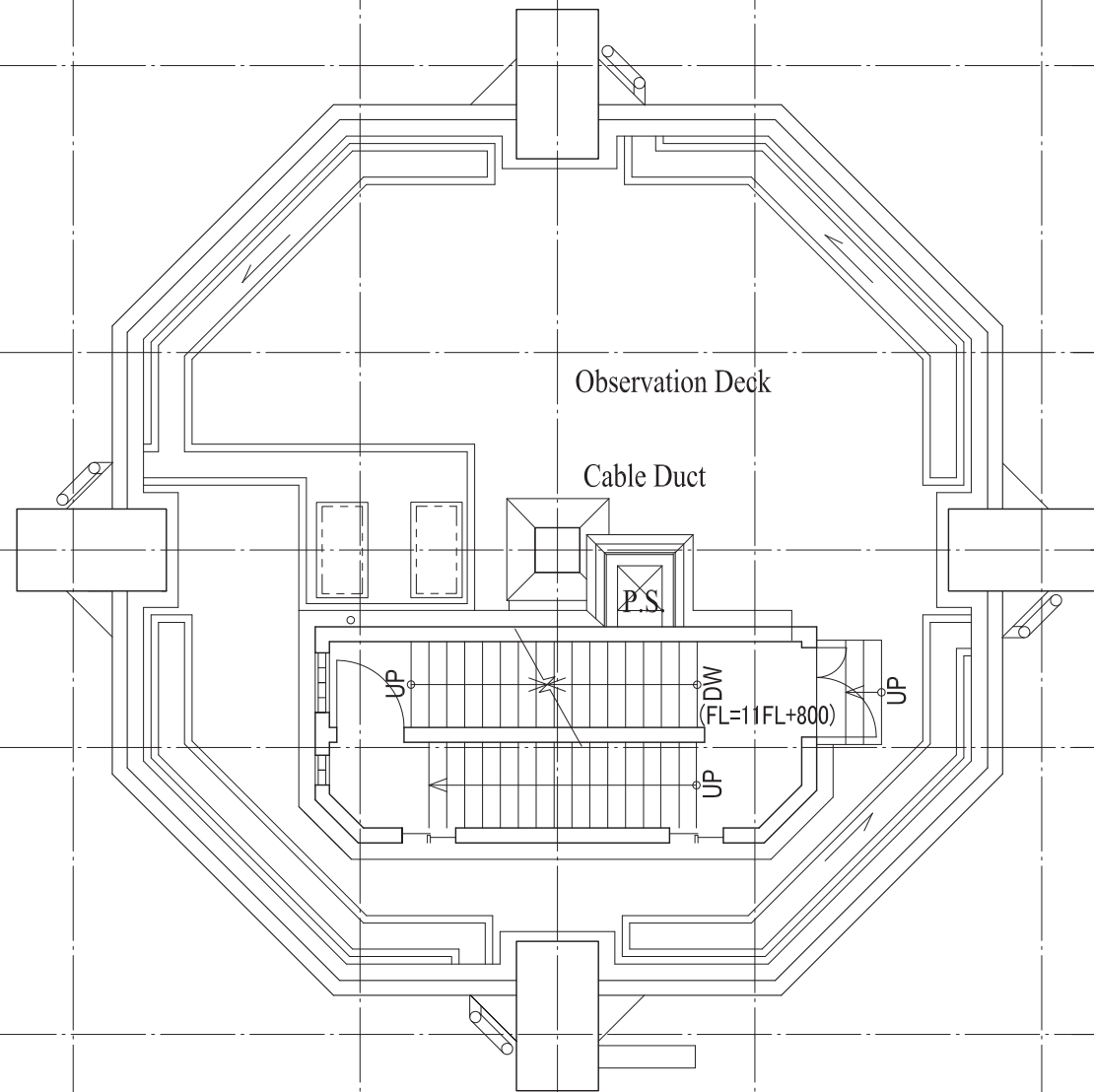
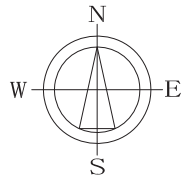
8FL PLAN



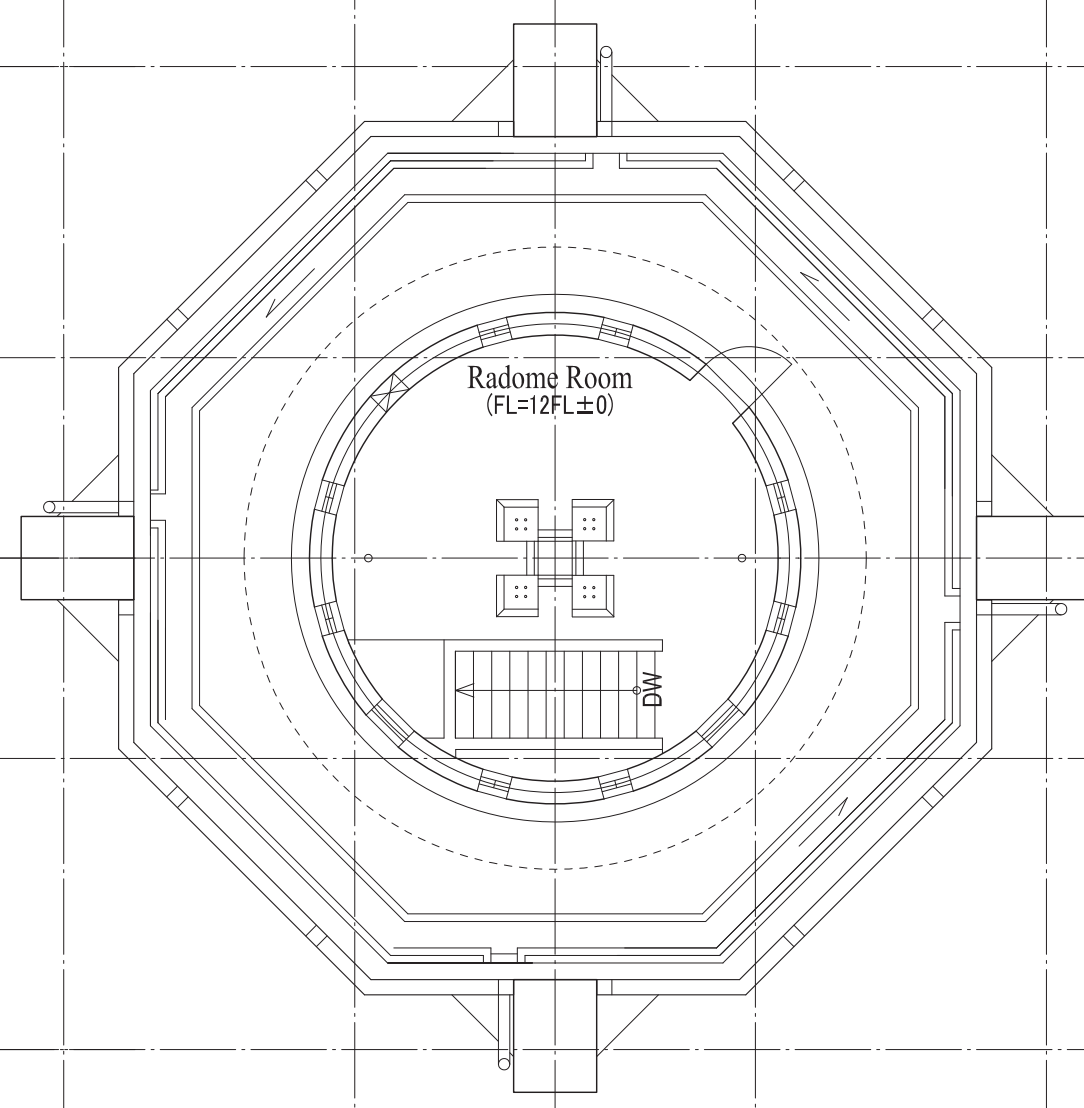
9FL PLAN



10FL PLAN



11FL PLAN

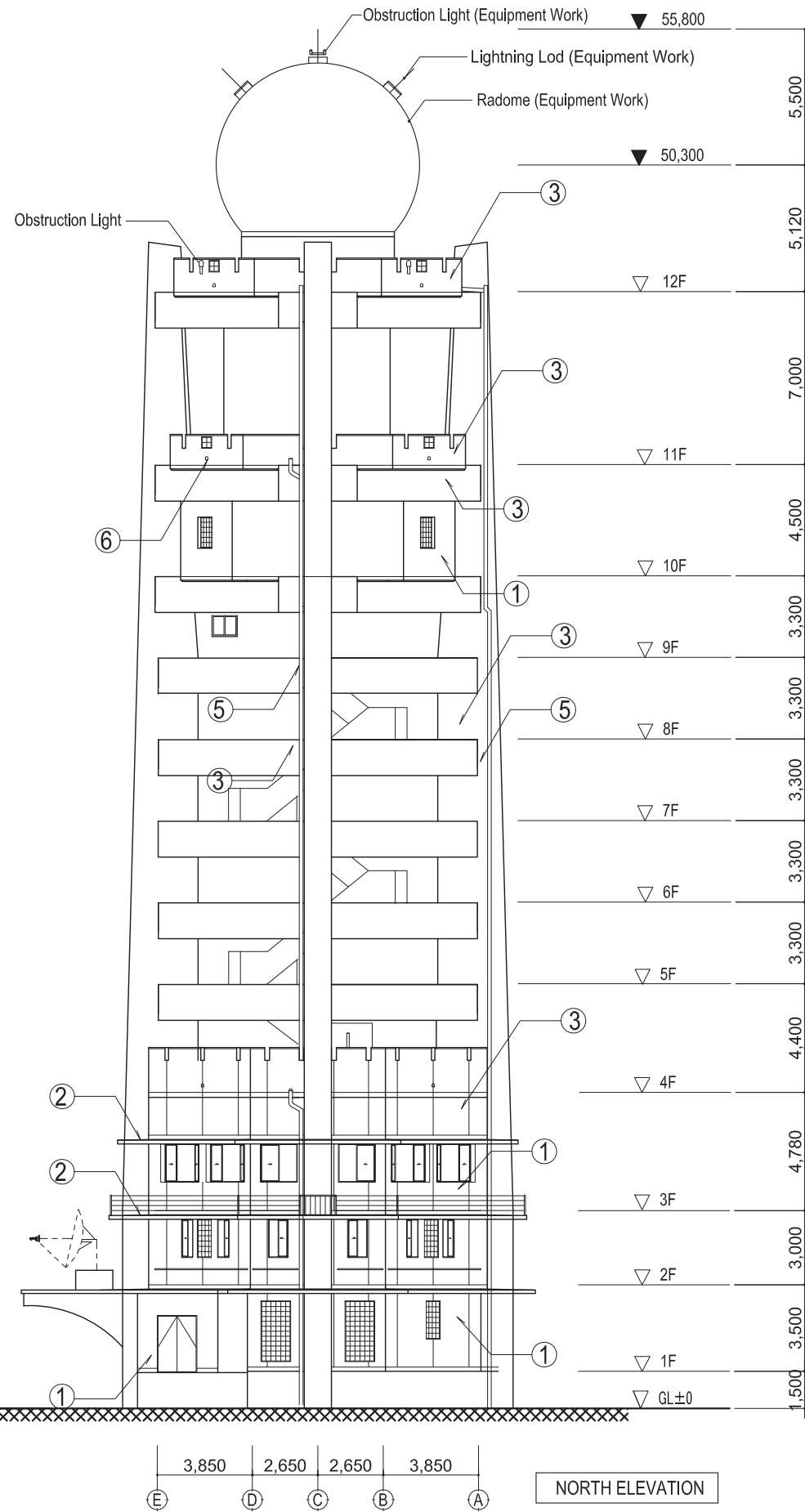
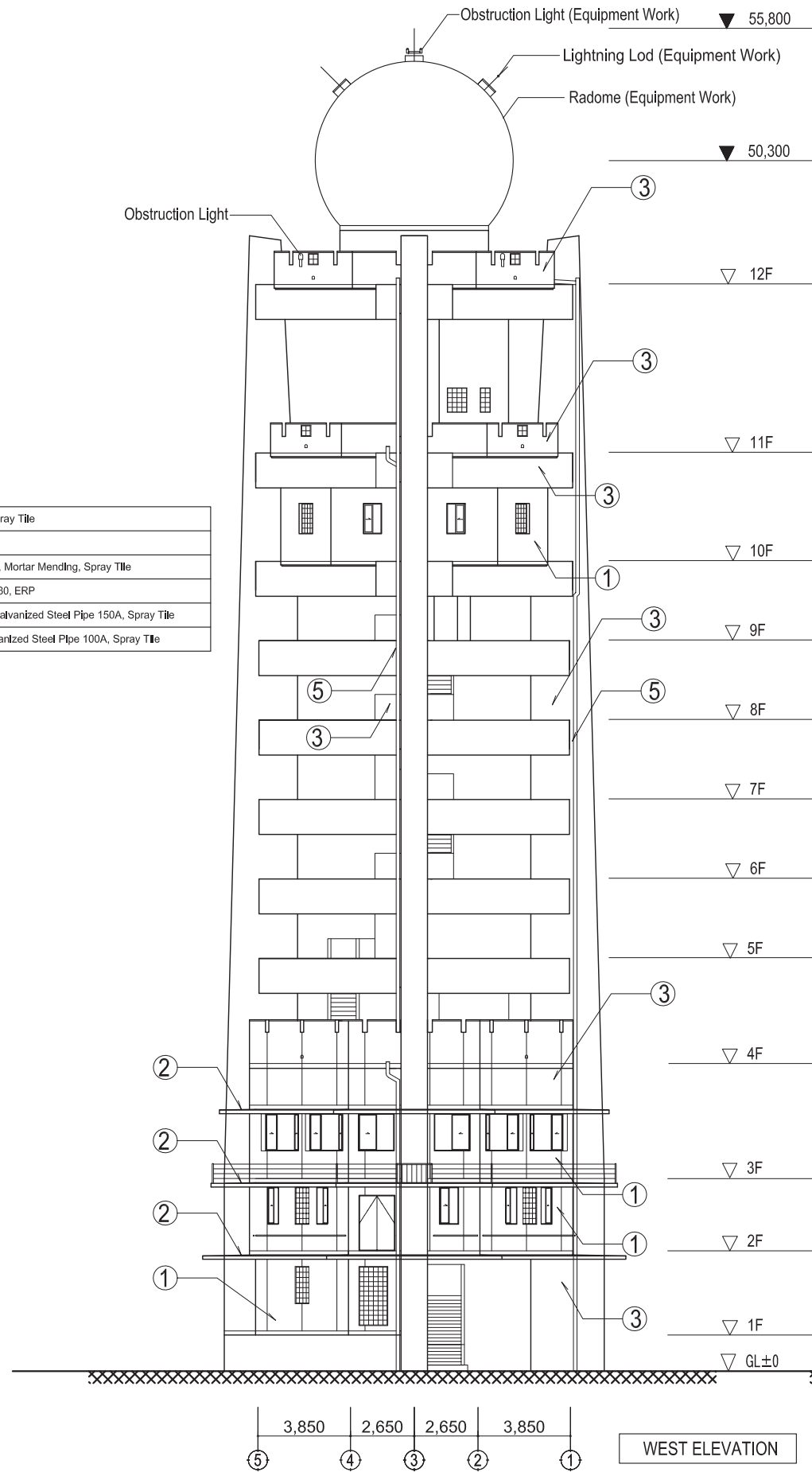


12FL PLAN



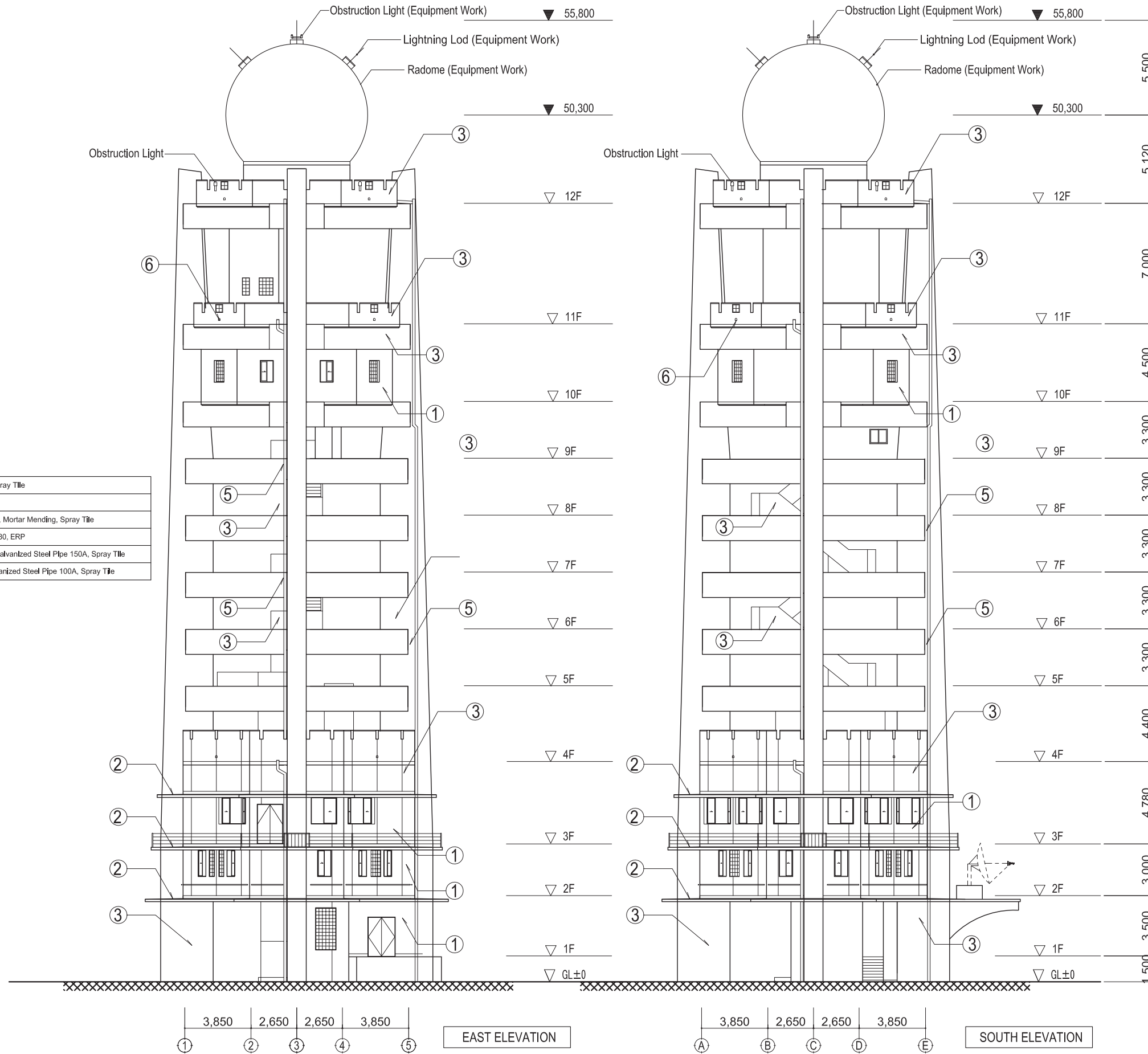
**LEGEND**

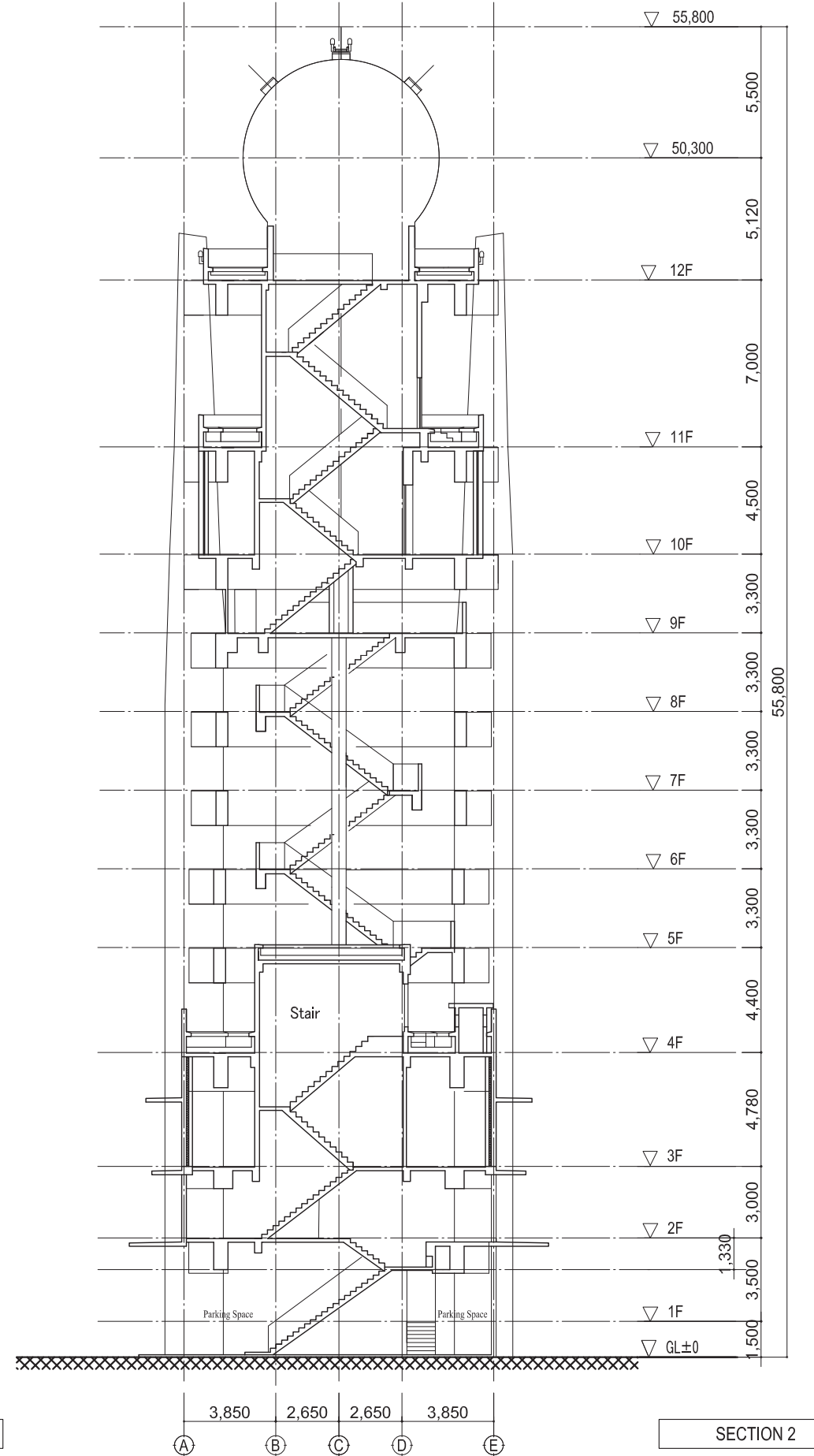
①	C.S. Mortar t=25 Spray Tile
②	C.S. Mortar t=25
③	Fair-faced Concrete, Mortar Mending, Spray Tile
④	Waterproof Mortar t=30, ERP
⑤	Rain Leader Pipe: Galvanized Steel Pipe 150A, Spray Tile
⑥	Overflow Pipe: Galvanized Steel Pipe 100A, Spray Tile



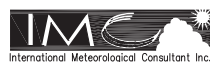
LEGEND

①	C.S. Mortar t=25 Spray Tile
②	C.S. Mortar t=25
③	Fair-faced Concrete, Mortar Mending, Spray Tile
④	Waterproof Mortar t=30, ERP
⑤	Rain Leader Pipe: Galvanized Steel Pipe 150A, Spray Tile
⑥	Overflow Pipe: Galvanized Steel Pipe 100A, Spray Tile





Joint Venture of  
 Japan Weather Association and  
 International Meteorological Consultant Inc.

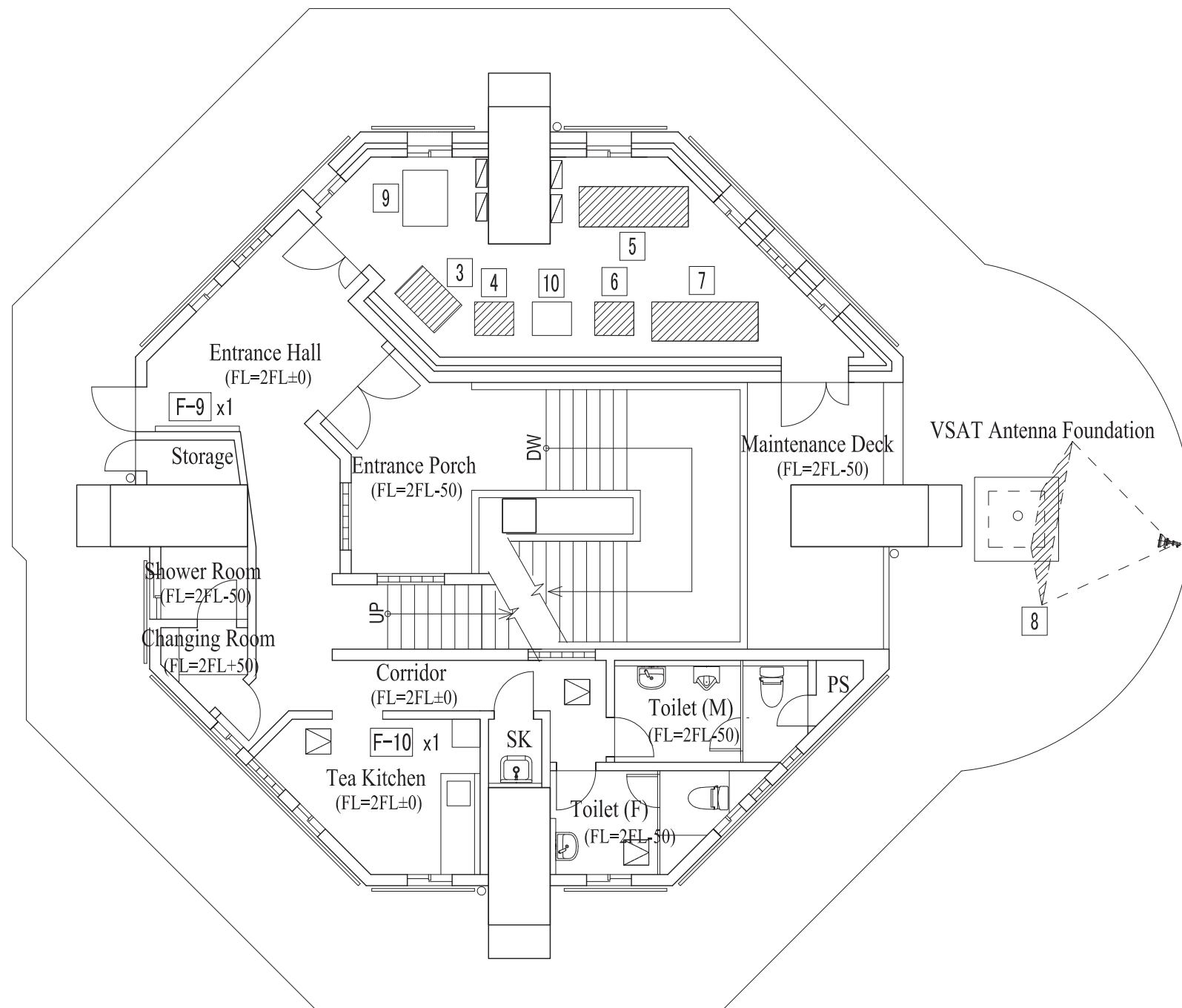


THE PROJECT FOR  
 ESTABLISHMENT OF DISASTROUS WEATHER MONITORING SYSTEM  
 IN THE REPUBLIC OF THE UNION OF MYANMAR

DRAWING TITLE  
 MANDALAY METEOROLOGICAL RADAR TOWER BUILDING  
 SECTION

SCALE  
 1:250

DRAWING No.  
 A - 11 (M)



2FL PLAN

EQUIPMENT (EQUIPMENT WORK)

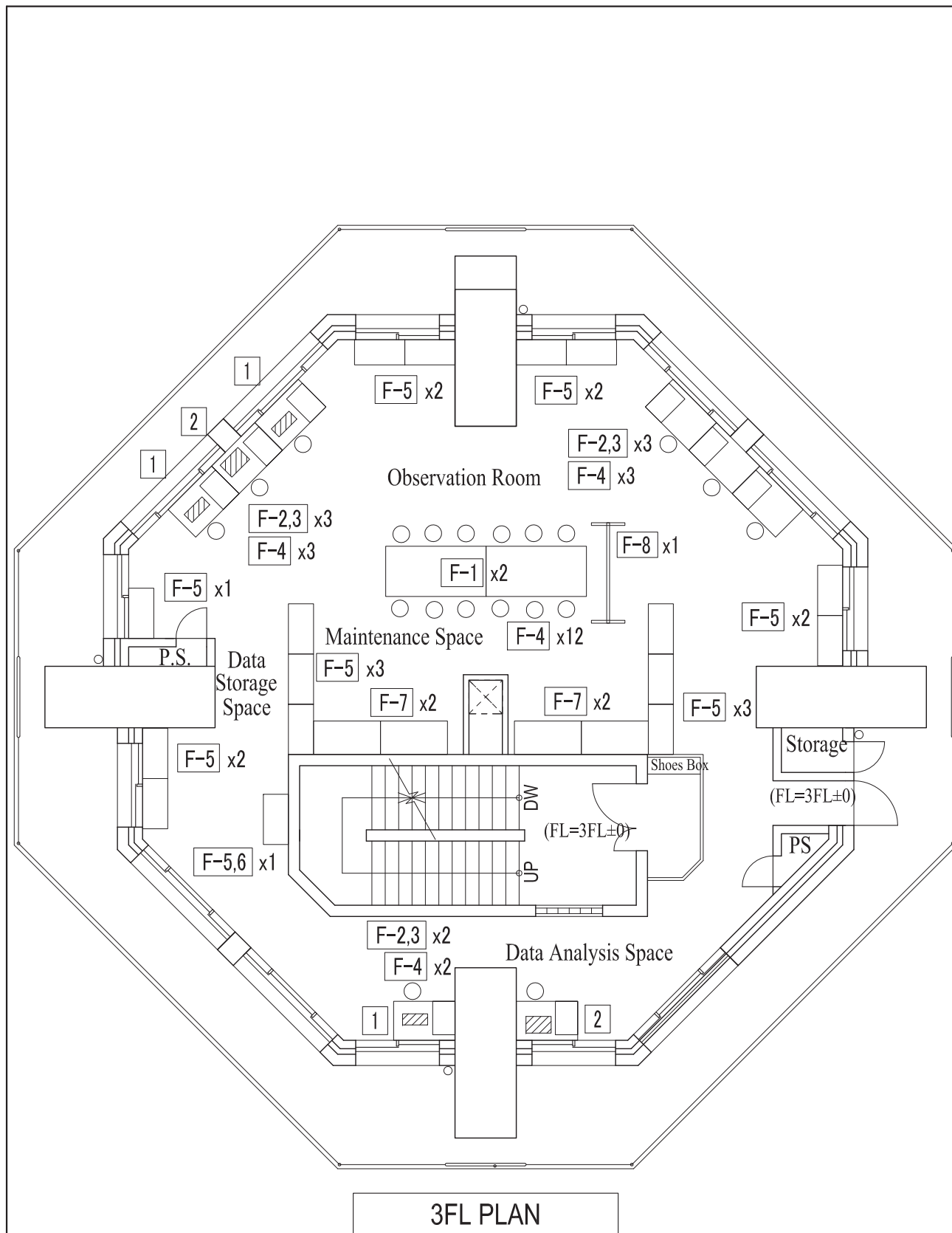
1	Indicator
2	Color Printer
3	Radar AVR
4	Isolation Transformer
5	Power Supply Capacitor
6	Emergency Power Backup Unit
7	Emergency Power Backup Battery
8	VSAT Antenna

EQUIPMENT (CONSTRUCTION WORK)

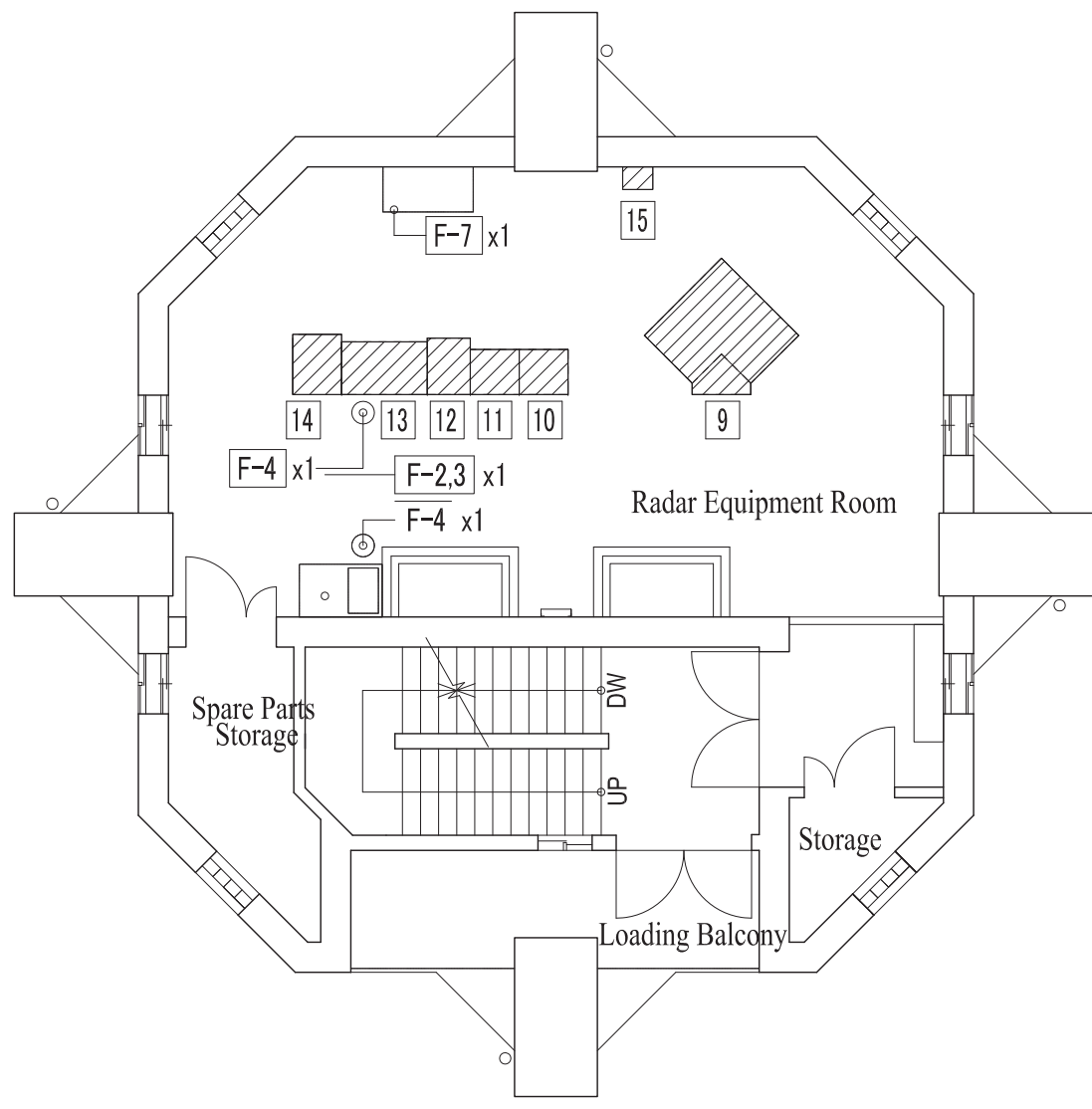
9	AVR
10	Isolation Transformer

FURNITURE (CONSTRUCTION WORK)

F-9	Pin Board: W1,800xH900
F-10	Water Dispenser



3FL PLAN



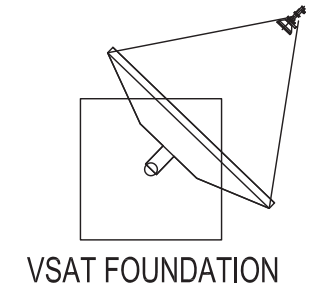
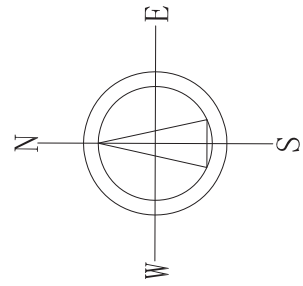
10FL PLAN

EQUIPMENT (EQUIPMENT WORK)

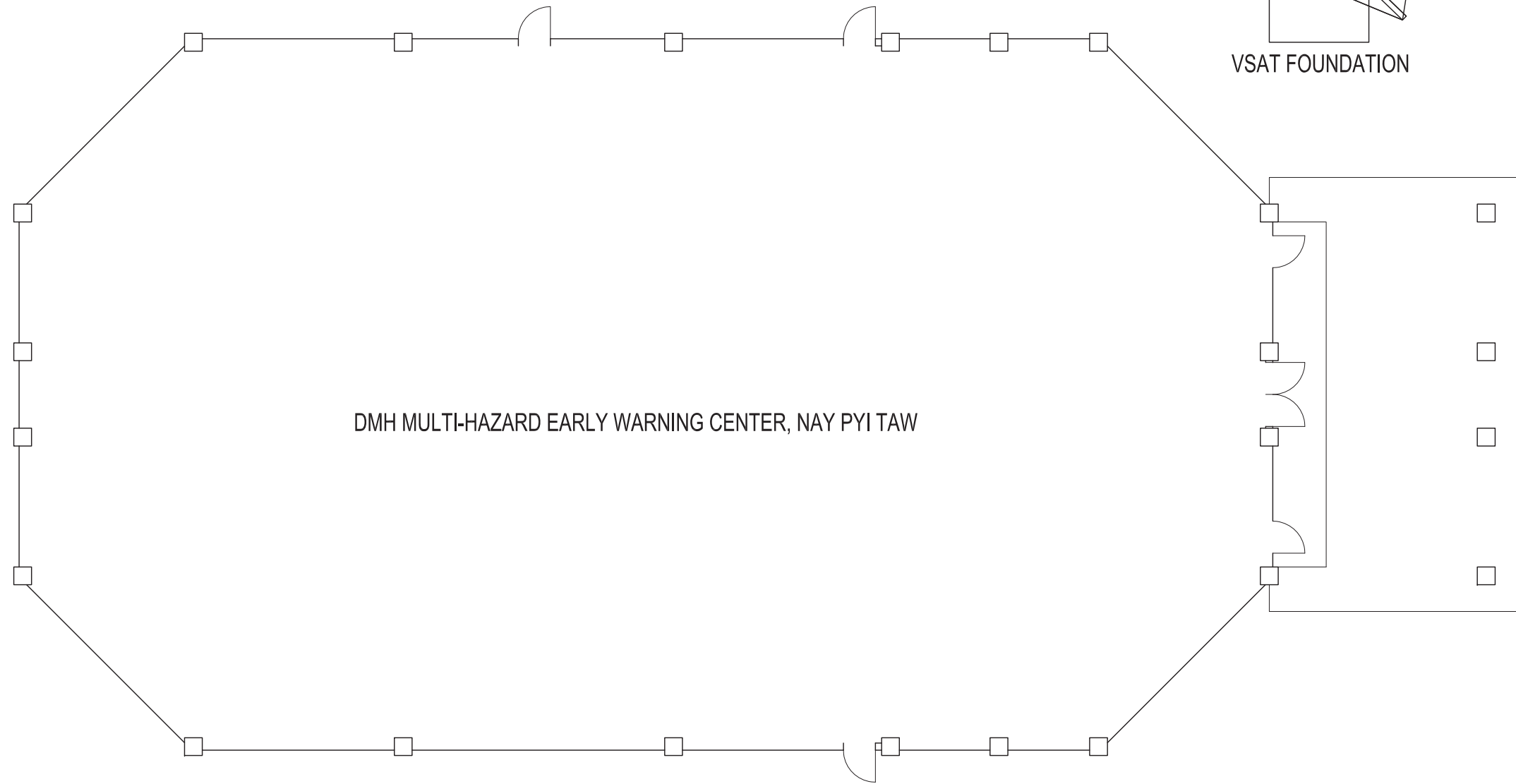
1	Indicator
2	Coolor Printer
3	Radar AVR
4	Isolation Transformer
5	Power Supply Capacitor
6	Emergency Power Backup Unit
7	Emergency Power Backup Battery
8	VSAT Antenna
9	Transmitter
10	Antenna Controller & Dehydrator
11	DRSP
12	Data & Protocol Converter
13	Radar TASK Controller
14	VSAT In-Door Unit (IDU)
15	Radar Power Maintenance Panel

FURNITURE (CONSTRUCTION WORK)

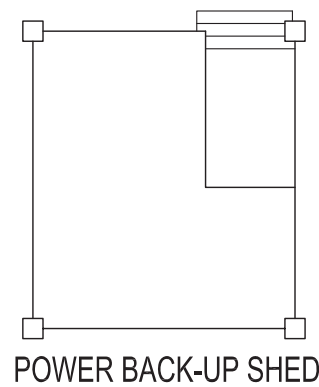
F-1	Meeting Table (W900xL1,800)
F-2	Pedestal-free Desk (W1,100xD700)
F-3	Drawer Unit with Casters
F-4	Chair
F-5	Lateral Filling Cabinet H1,100
F-6	Cabinet (Double Hinged Doors) H1,000
F-7	Shelves (Double Hinged Doors) H2,100
F-8	White Board: W1,800xH900



VSAT FOUNDATION



DMH MULTI-HAZARD EARLY WARNING CENTER, NAY PYI TAW



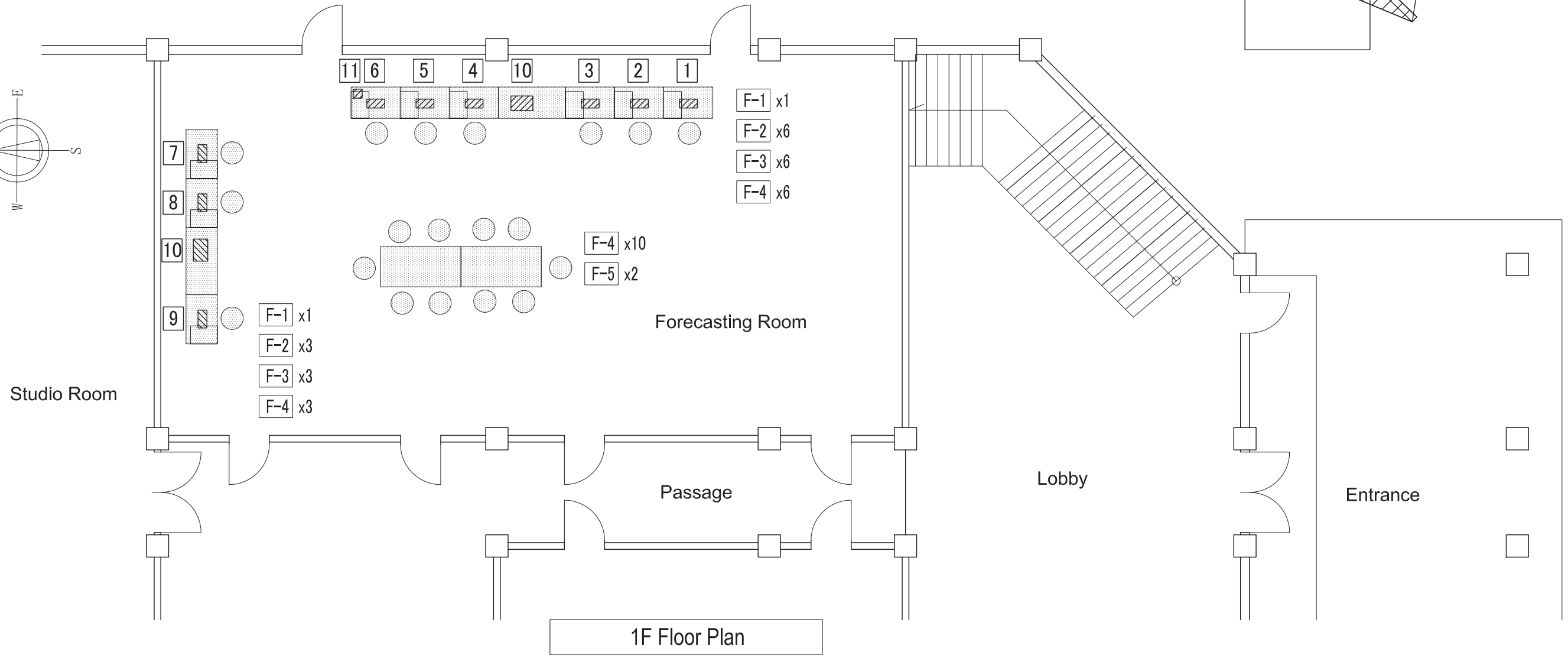
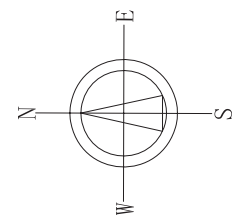
POWER BACK-UP SHED

EQUIPMENT (EQUIPMENT WORK) 

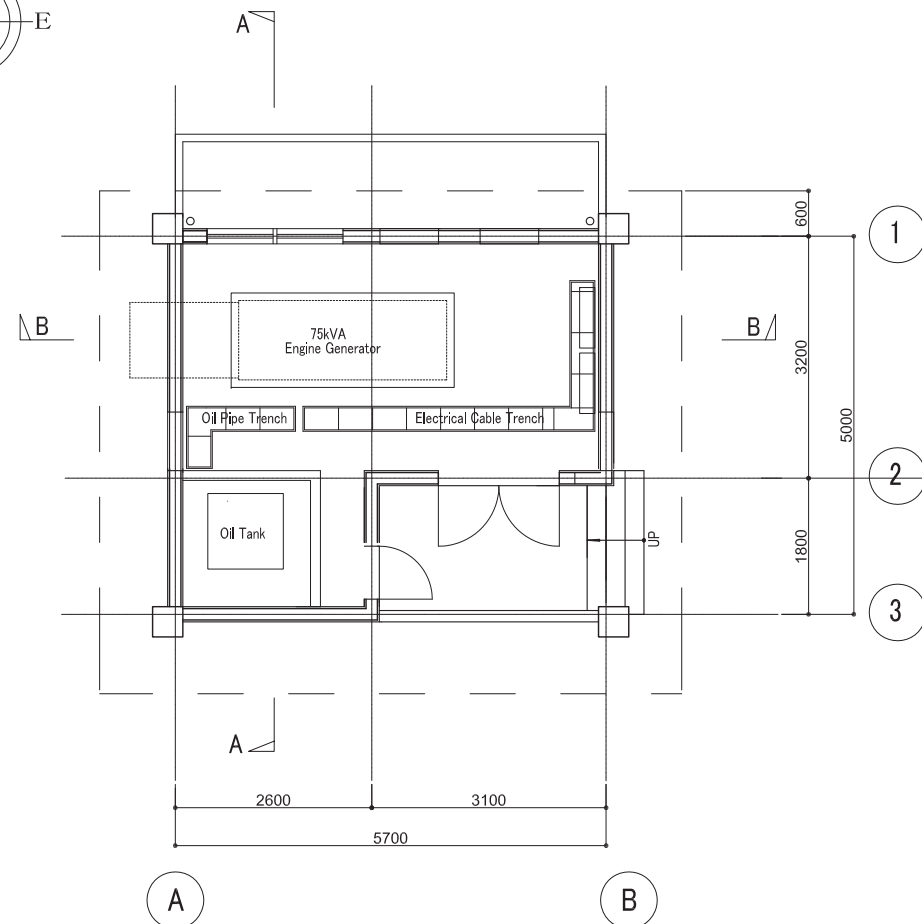
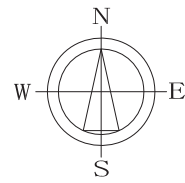
1	Composite Processor
2	Meteorological Data Archiving Unit
3	Product Retrieval Unit
4	Doppler Velocity Indicator
5	Cyclone Tracking Monitor
6	Accumulated Rainfall Processor
7	Automatic Weather Observation System Display Unit
8	Automatic Weather Observation System Data Acquisition Unit-1
9	Radar WEB Server
10	Color Printer
11	IT Telephone
12	HUB VSAT Antenna

FURNITURE (CONSTRUCTION WORK) 

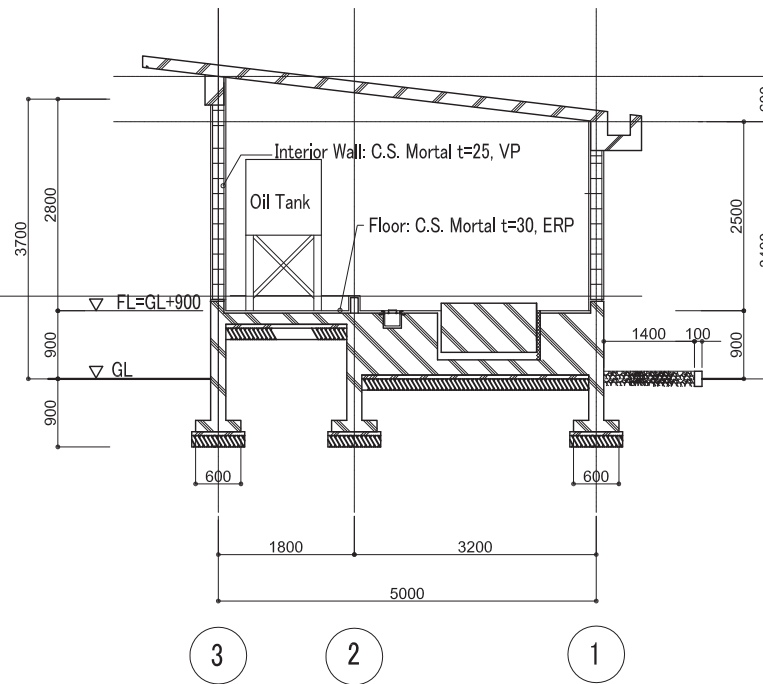
F-1	Pedestal-free Desk (W1,500xD700)
F-2	Pedestal-free Desk (W1,100xD700)
F-3	Drawer Unit with Casters
F-4	Chair
F-5	Meeting Table (W900xL1,800)



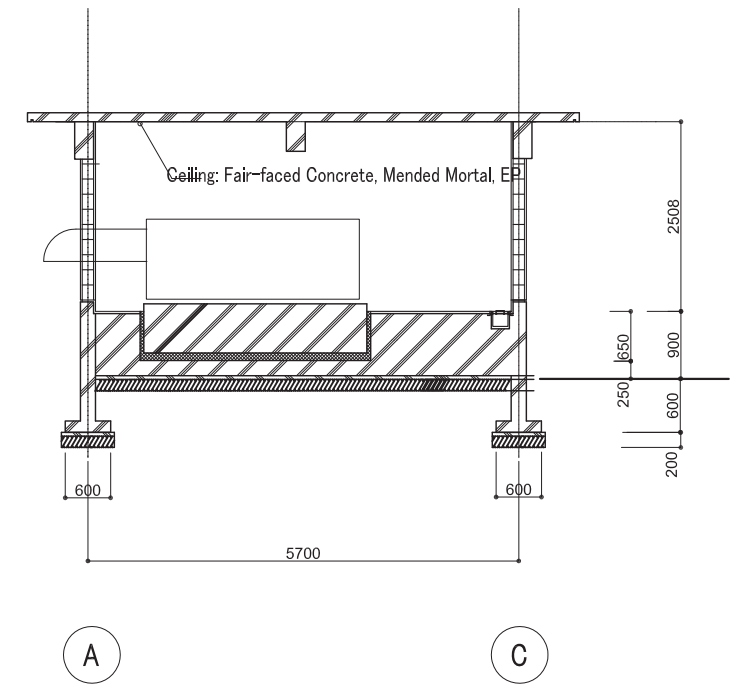
1F Floor Plan



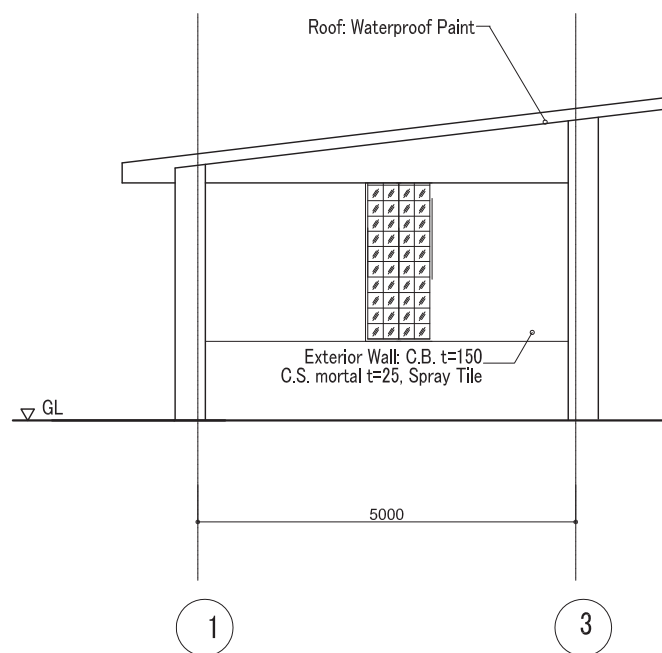
FLOOR PLAN SCALE 1:100



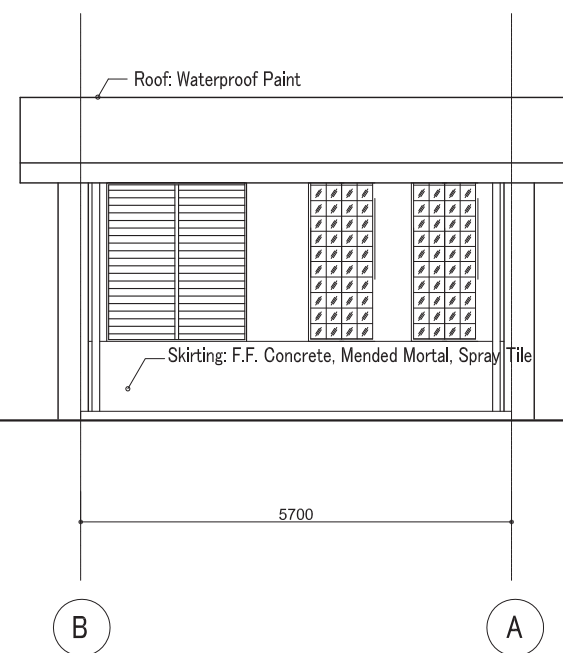
SECTION A-A SCALE 1:100



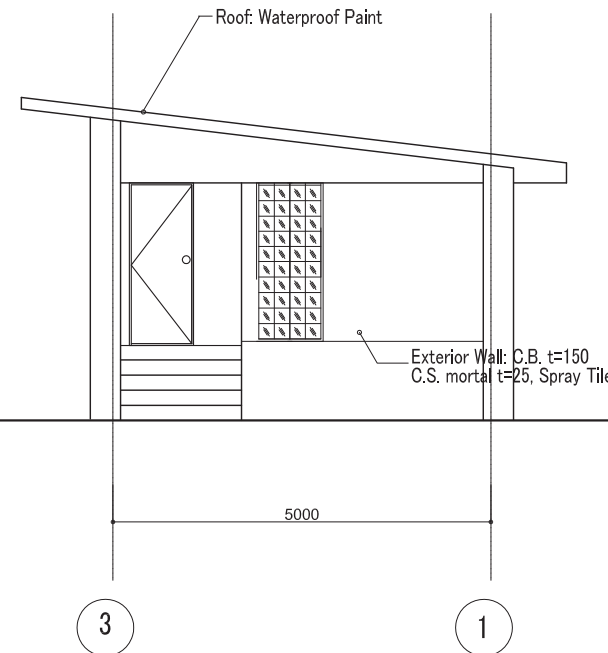
SECTION B-B SCALE 1:100



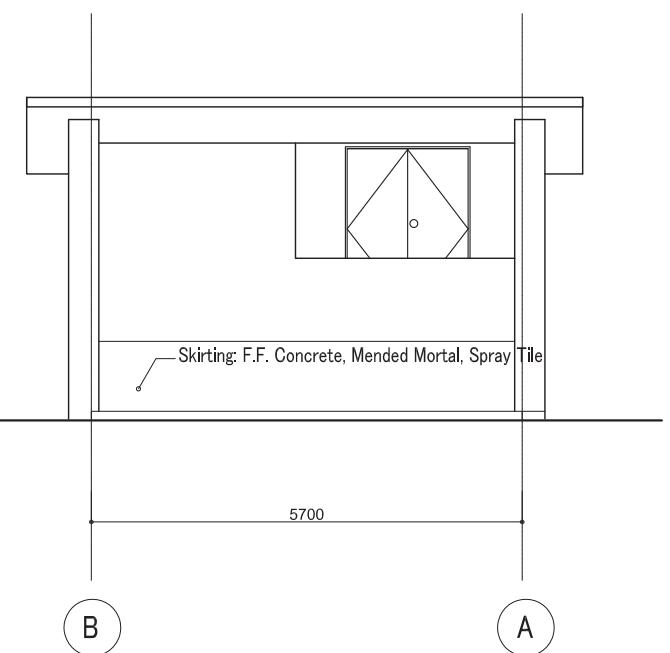
WEST ELEVATION SCALE 1:100



NORTH ELEVATION SCALE 1:100

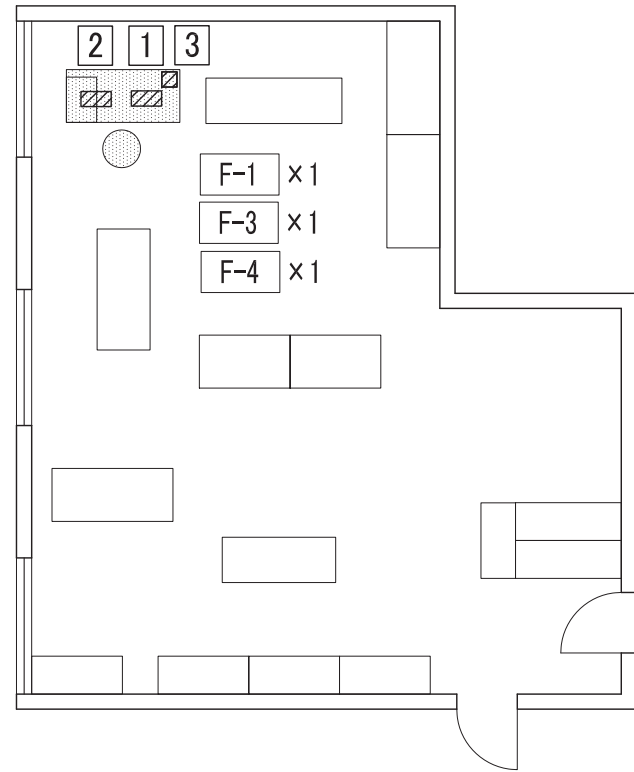


EAST ELEVATION SCALE 1:100

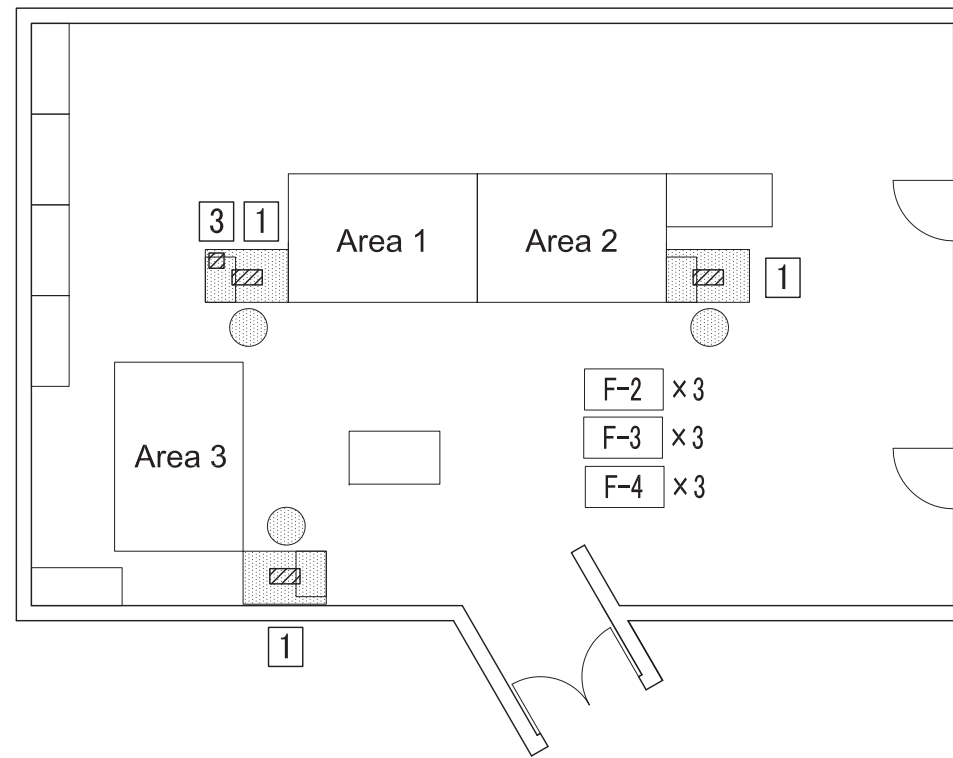


SOUTH ELEVATION SCALE 1:100

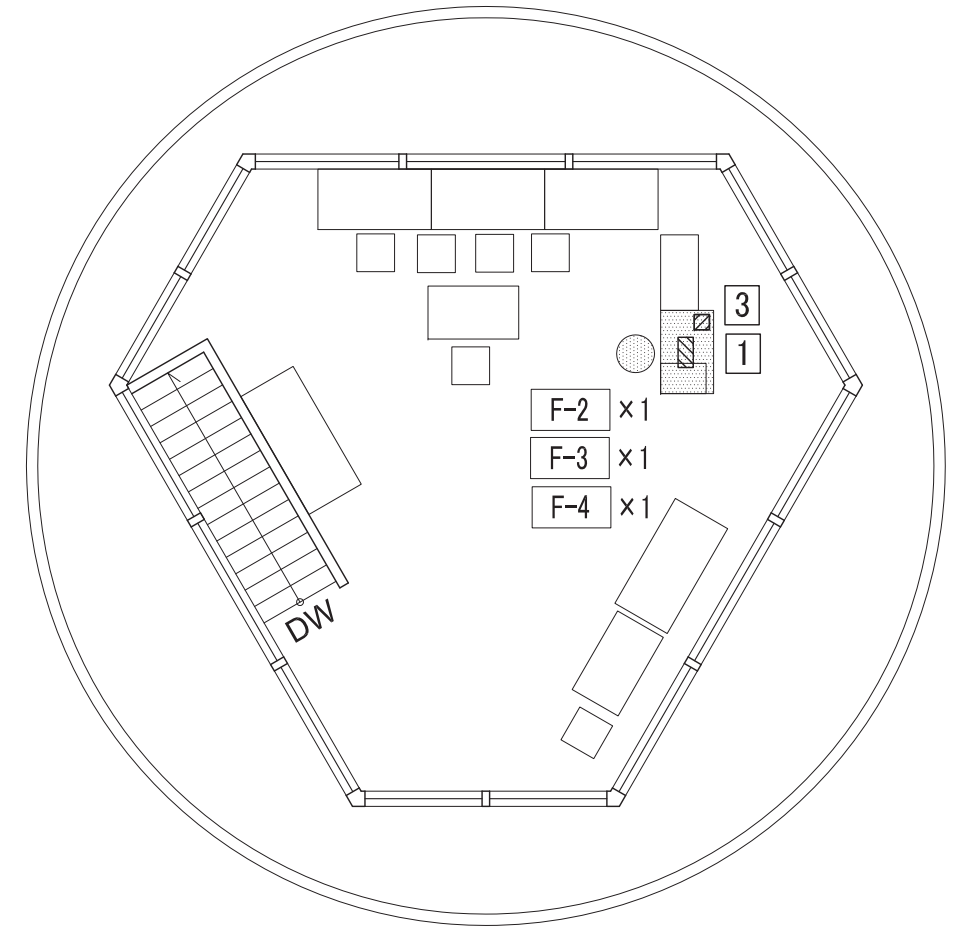




Airport Meteorological Office



Area Control Center



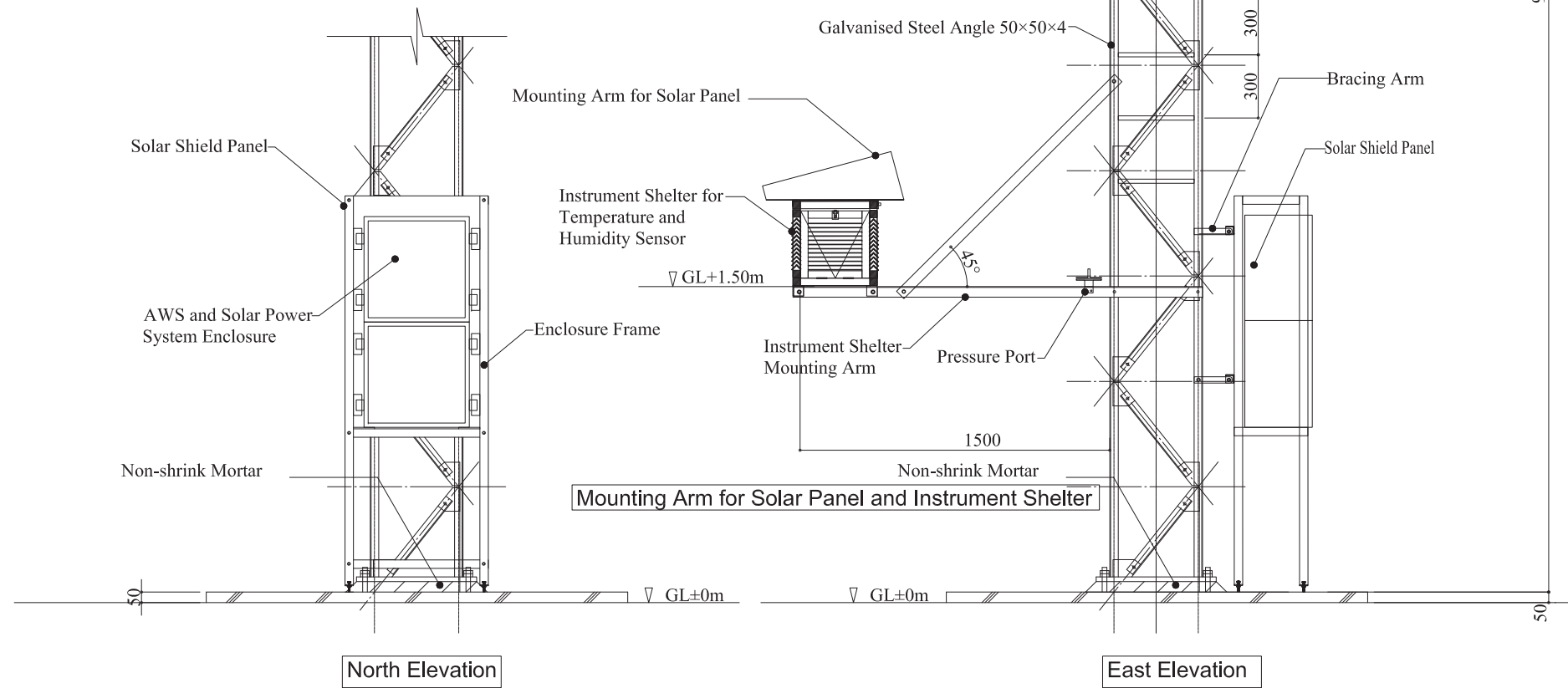
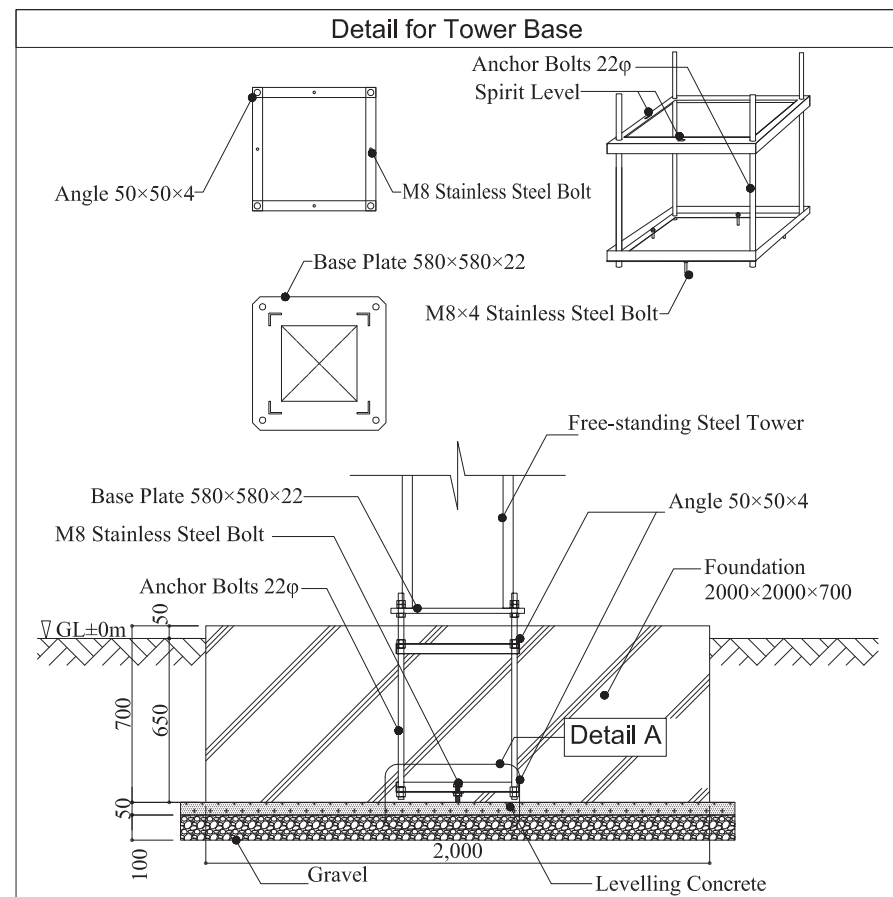
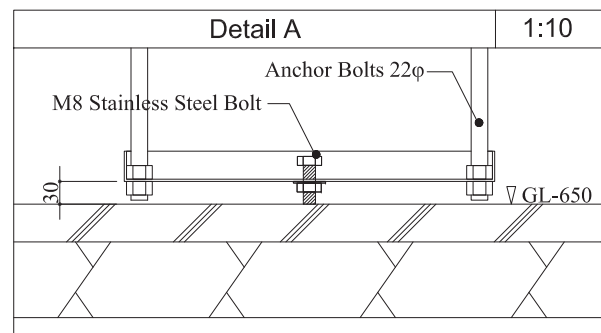
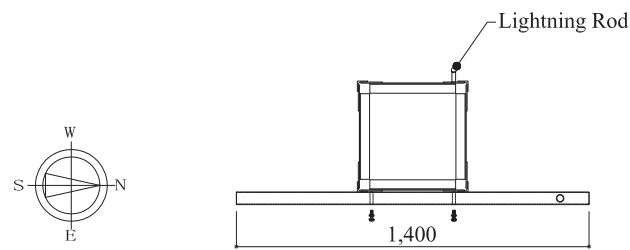
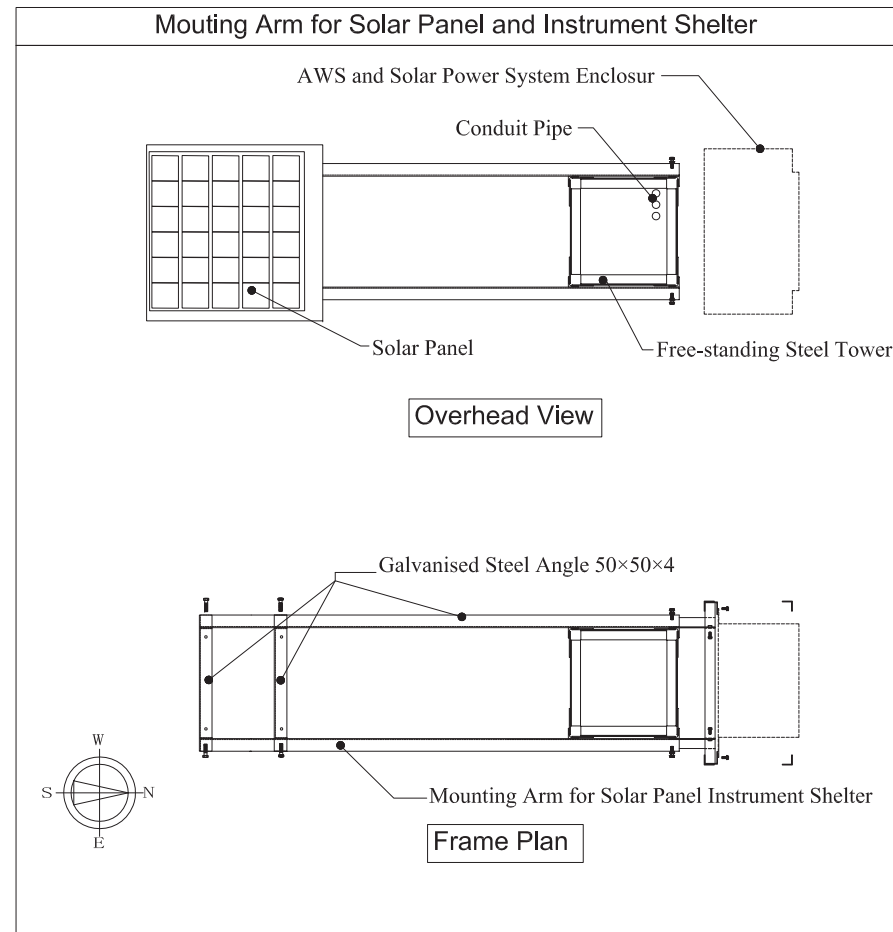
Air Traffic Control Room

FURNITURE (CONSTRUCTION WORK)

F-1	Pedestal-free Desk (W1,500xD700)
F-2	Pedestal-free Desk (W1,100xD700)
F-3	Drawer Unit with Casters
F-4	Chair

EQUIPMENT (EQUIPMENT WORK)

1	Aviation Weather Indicator
2	Color Printer
3	IT Telephone



## 2-2-4 Implementation Plan

### 2-2-4-1 Implementation Policy

The Project covers numerous fields, including procurement and installation of meteorological and communication equipment, construction work, etc. For the successful completion of the Project, close coordination will be required among all parties. Since the periods May to October is the southwest-monsoon and tropical cyclone season in Myanmar and Kyauk Phyu and Yangon receive quite ample rainfall between June and August, the management of the implementation schedule should be given particular attention.

The total number of rainy days during the southwest-monsoon between May and October, 2011 (184 days) and the number of days required for the building construction work schedule to be given special consideration are indicated in the following table.

**Table42: Total Rainy Days during the Southwest-Monsoon between May and October, 2011 and Number of Days for the Building Construction Work Schedule required Special Consideration**

The total rainy days during the southwest-monsoon between May and October, 2011 (for 184 days)			
Area in which the project site is located	Kyauk Phyu	Yangon	Mandalay
A: No raining days	104days	91days	143days
B: Rainy days with rainfall over 30mm/day (C + D)	80days	93days	41days
C: Rainfall less than 100mm/day (the expected days the construction work interrupted)	50days	71days	34days
D: Rainfall over 100mm/day ( the expected days the construction work suspended)	30days	22days	7days
The number of days between May and October (A + B)	184days	184days	184days
The number of days for construction work to be given special consideration during the southwest-monsoon			
Area in which the project site is located	Kyauk Phyu	Yangon	Mandalay
A: No raining days	104days	91days	143days
The required days: the expected days the construction work interrupted $C \times 1.35$	68days	96days	46days
The required additional days: the expected days the construction work suspended $D \times 1.6$	48days	35days	11days
The total required days for the building construction work between May and October	220days	222days	200days

#### 1) Implementing agency for the Project

The responsible government agency of Myanmar for the implementation of the Project is the DMH under the supervision of the Ministry of Transport. The DMH, as the Client, will be a signatory to the Consultancy Agreement and to the Contract.

#### 2) Consultant

After the signing of the Exchange of Notes (E/N) between the Government of Myanmar and the Government of Japan and the Grant Agreement (G/A) between the Government of Myanmar and JICA for the Project, it is important to finalize the Agreement of Consulting Services as early as possible. The Agreement of Consulting Services will be signed by the DMH and a Japanese consulting firm,

having its principal office in Japan and recommended by the JICA.

The consulting firm will become the Consultant for the Project by signing the Agreement. The Consultant then will conduct a detailed design study in Myanmar with the DMH and, in Japan, prepare the tender documents including technical specifications, drawings, diagrams, etc. In addition, the Consultant, instead of the DMH, will conduct a tender and supervise the Project implementation for the successful completion of the Project as part of Japan's Grant Aid Assistance.

### 3) Contractor

A contractor with the required qualifications (an equipment supplier and a construction company) incorporated and registered in Japan, having its principal office in Japan, will be selected through an open public tender, in accordance with the tender documents prepared by the Consultant and in accordance with JICA guidelines as approved by the DMH.

## **2-2-4-2 Implementation Conditions**

### 1) Natural Disaster in Myanmar

In the Bay of Bengal, about 10 tropical depressions and tropical cyclones are generated per year and affect Myanmar during the pre-monsoon (April-May) and post-monsoon (October-November) seasons. In addition, the southwest monsoon brings heavy rain from the middle of May to October (Peak season: June-August). The project implementation schedule should give particular attention on the probable occurrence/seasons of tropical cyclones and heavy rains.

### 2) Conditions for the Installation of Equipment

The meteorological radar system, computing equipment and other sophisticated equipment with electric and electronic circuits will be installed in the radar tower building. In accordance with the construction schedule, the dispatch of an electrical engineer is required at the time of the installation, adjustment and wiring of the electric power supply and power back-up equipment (auto voltage regulator: AVR, radar power back-up unit, etc.). During the construction period, it is important that there should be smooth procurement of required materials and hiring of skilled laborers to meet the construction schedule. In addition, specialized skilled engineers are needed for the installation, adjustment and commissioning of the radar system, computing equipment and the sophisticated meteorological equipment. They are essential to ensure the quality of the installation work necessary for accurate meteorological observations. Furthermore, as part of the technology transfer to the DMH staff, specialized highly skilled engineers are required as on-the-job trainees to ensure that the DMH can operate and maintain

the equipment efficiently.

### 2-2-4-3 Scope of Works

The scope of works to be undertaken by Japan’s Grant Aid Assistance and the Myanmar side for the implementation of the Project are as follows.

Table 43: Scope of Works to be undertaken by each side under Implementation of the Project

No	Items	To be covered by Japan’s Grant Aid	To be covered by Myanmar (DMH)
<b>General Items</b>			
1	To undertake all necessary institutional and juridical procedures in Myanmar.		•
2	To handle duty (Tax) exemption procedures and to take necessary measures as well as provide requisite legal and/or administrative documentations for customs clearance to customs broker/forwarder to be employed by Contractor at the port of disembarkation for the materials and equipment imported for the Project.		•
3	To provide necessary working spaces with Internet Connection at the DMH Offices in Nay Pyi Taw and Yangon for the Consultant and the Contractor for the implementation of the Project, if required.		•
4	Marine (Air) transportation of the materials and equipment imported from overseas (Japan).	•	
5	In-land transportation from the port of disembarkation in Myanmar to each Project site.	•	
6	To accord Japanese and other foreign nationals including their dependent/s (if any), whose services may be required in connection with the supply of products and services under the signed contracts, such facilities as may be necessary for their entry into Myanmar and stay therein for the smooth and uninterrupted performance of their work i.e. to secure appropriate Visa including its extension/s required by the recipient country in connection thereof.		•
7	To exempt Japanese and other foreign nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the signed contracts.		•
8	To pay bank commission to the Myanmar Foreign Trade Bank (MFTB) for issuance of the Authorization to Pay (A/P) and amendments of A/P, if required, for the Consultant and the Contractor.		•
9	To bear all the expenses, other than those to be borne by the Japan’s Grant Aid, necessary for the implementation of the Project		•
10	To ensure the security of the whole Project site/s and of the Japanese and other foreign nationals assigned to the Project prior to commencement and all throughout the Project implementation.		•
<b>For the Construction of the Radar Tower Building(s)</b>			
11	To clear, level and reclaim the land prior to commencement of the		•

	construction.		
12	To secure sufficient spaces at the respective Project sites for temporary facilities such as a contractor's office, workshop, building materials storage, etc. for the construction work.		•
13	To carry out vital earth moving tasks particularly on the existing hump (small hilly part) in order to secure enough space for the construction of a new Radar Tower Building in the Kyauk Phyu Meteorological Radar Observation Station.		•
14	To carry out graveling of the existing unpaved access road (from the main road to the Kyauk Phyu Meteorological Radar Observation Station) with enough strength and width suitable for the construction of the new Radar Tower Building.		•
15	To demolish the existing workshop shed in Yangon DMH Compound in order to secure and allocate ample space for the construction of a new Radar Tower Building.		•
16	To make available the 30m required extension of the allocated land at Mandalay DMH Observatory to the south side in order to be able to construct and/or put up a new Radar Tower Building.		•
17	To extend the existing boundary lines of the Mandalay DMH Observatory according to the required land extension.		•
18	To obtain necessary permissions for the construction of the Radar Tower Building(s).		•
19	To provide commercial power (440V, 3-phase, 4-wire, 50Hz) supply (capacity: 100kVA) for the Radar Tower Buildings in Yangon and Mandalay.		•
20	To install the required step-down transformers as well as service entrance connections for the commercial power supply at the site(s) for the Radar Tower Buildings in Yangon and Mandalay.		•
21	To provide the incidental facilities such as water supply, telephone line, and internet provision for Radar Tower Building(s) in Yangon and Mandalay.		•
22	To provide temporary facilities for the availability or accessibility of electricity, water, etc. for construction work.		•
23	To construct the Radar Tower Building(s) including a) Architectural and civil works b) Electrical works including lightning protection system c) Air-conditioning and Ventilation works d) Plumbing works	•	
24	To construct buildings other than the Radar Tower Building(s), if required by the DMH.		•
25	To procure standard furniture for the Radar Tower Building(s)	•	
26	To undertake incidental outdoor works such as gardening, fencing, gates, boundary walls and exterior lighting in and around the sites, if necessary.		•
27	To provide On-the-job Trainings (Initial Trainings) by the contractor on the operation and maintenance of the Radar Tower Building(s) as well as its inherent facilities for the DMH.	•	
28	To shoulder the dispatching cost of the trainees to the training sites, such as daily allowances, transportation fees, accommodation fees.		•
29	To provide the contractor's written guarantee to the DMH that the Radar Tower Building(s) will be constructed under the Project for a period of twelve (12) months from the completion date of the construction work.	•	

For Installation Work of the Equipment			
30	To remove and relocate the existing facilities if available for the installation of the equipment, if necessary.		•
31	To provide and allocate secure temporary storage area/room for the materials, tools and equipment needed during the installation process.		•
32	To obtain the required frequency(ies) for the meteorological radar system(s).		•
33	To obtain the required space segment and the VSAT user license from the Ministry of Communication, Posts and Telegraphs for the use of satellite communication for the meteorological data satellite communication system (VSAT) to be installed as well as the provision of redundant communication link such as broadband or dedicated leased line for internet communication.		•
34	To procure mobile SIM card (GSM/GPRS) for transmitting/receiving data observed by the Automatic Weather Observation System (AWS).		•
35	To secure ample and strategically located space/s at the existing facilities (Multi-Hazard Early Warning Center, Nay Pyi Taw) for the installation of the equipment (PC terminals and peripherals) to be supplied.		•
36	To secure suitable space at the existing observation stations for the installation of Automatic Weather Observation System (AWS).		•
37	To extend the existing observation field fence around the installation location of the Automatic Weather Observation System (AWS) in the existing observation stations which have small size observation field.		•
38	To procure, install and adjust the required Equipment (including lightning protection system) for Project implementation	•	
39	To conduct the commissioning for the total system	•	
40	To provide On-the-job Trainings (Initial Trainings) by the contractor on operation and maintenance of the equipment for the DMH	•	
41	To shoulder dispatching cost of the trainees to the training sites (including AWS sites which are not accessible to foreigners due to security issues), such as, daily allowances, transportation fees, accommodation fees.		•
42	To provide the contractor's written guarantee to the DMH for the Equipment and Installation Work executed under the Project for a period of twelve (12) months from the completion date of the equipment installation work.	•	
After the completion of the Project			
43	To renovate the existing gates, boundary walls and exterior lighting in and around the sites, if required.		•
44	To assign staff necessary for the smooth operation and maintenance of the equipment.		•
45	To remove the existing radar system/structure in order to prevent it from collapsing due to an earthquake and/or strong wind associated with tropical cyclones especially as the existing Kyauk Phyu Radar Tower Building is obsolete.		•
46	To renovate the existing Kyauk Phyu Radar Tower Building for the establishment of staff quarters.		•
47	To renovate the existing Kyauk Phyu Meteorological Radar Observation Office.		•
48	To procure the required spare parts and consumables for the smooth operation and maintenance of the equipment.		•

49	To provide adequate maintenance of the Radar Tower Building(s) constructed under the Project, so that they can function effectively.		•
50	To operate, maintain, and properly and effectively utilize the facilities constructed and the equipment procured under the Project.		•
51	To allocate the necessary budget and personnel for appropriate meteorological radar observation and forecasting works.		•

#### 2-2-4-4 Consultant Supervision

##### 1) Principal Guidelines

- a) To take responsibility for expediting the project implementation as well as smooth supervision, in accordance with the guidelines of Japan's Grant Aid Assistance and the Outline Design.
- b) To communicate closely with the responsible organizations and personnel of both countries, and complete the Project in time and in accordance with the implementation schedule.
- c) To provide appropriate advice to the personnel of the DMH and the contractor.
- d) To ensure the safety of the project implementation as its top priority by earlier/advance detection of severe weather phenomena.

##### 2) Consultant Supervision

- a) The Consultant will dispatch at least one responsible and highly capable personnel to Myanmar during each implementation stage in the Project.
- b) Consultant technical specialists will be dispatched to Myanmar for installation guidance, inspection work, etc. for the installation and configuration work of the major hardware, data communication equipment, computing equipment and system software.
- c) The Consultant will attend factory performance tests, configuration verifications and inspections of the equipment on behalf of and instead of the DMH.
- d) Qualified engineer(s) will be dispatched for data transmission tests in Myanmar.

##### 3) Scope of Work for Supervision

- a) The Consultant, in coordination with the DMH, will prepare the contract in accordance with JICA standards; select a Japanese prime contractor through tendering; and recommend the nominated contractor to the Government of Myanmar.
- b) The Consultant will inspect and approve shop-drawings, system drawings & diagrams and material samples submitted by the contractor, and verify the performance and function of all



equipment.

- c) Based on a review of the implementation schedule, the Consultant will provide instructions to the contractor and submit progress reports on the implementation of the Project to the DMH, the Embassy of Japan in Myanmar, the JICA Myanmar local office, etc.
- d) The Consultant will cooperate in the certification of payment, such as through the examination of notices of approval and invoices in connection with implementation cost to be disbursed during the implementation period and upon completion of the Project.

#### 2-2-4-5 Quality Control Plan

According to past local meteorological data at the DMH Head Office in Nay Pyi Taw, the temperature could reach to more than 30°C. In view of this, the ambient temperature and the concrete temperature will be measured during concrete pouring, to ensure correct concrete quality. The quality control plan for the main work is described in the table below.

Table 44: Quality Control Plan

Work	Work Type	Control Item	Method	Remarks
Structural Work	Concrete work	Fresh concrete Concrete strength	Slump, air volume, temperature Comprehensive strength test Chloride Quantity Test Alkali Aggregate Reactivity Test	Concrete strength test will be conducted at the Project site. Chloride quantity test and alkali aggregate reactivity test will be conducted in Japan.
	Reinforcing work	Reinforcing bar Arrangement	Tensile test, mill sheet check Bar arrangement check Factory inspection sheet check	Tensile test of reinforcing bar will be conducted by ISO-Tech Laboratory.
	Pile work	Material, bearing capacity	Bearing capacity check	
Finishing Work	Roof work	Workmanship, leakage	Visual inspection, water spray test	
	Tile work	Workmanship	Visual inspection	
	Plastering work	Workmanship	Visual inspection	
	Door & window work	Products, Installation accuracy	Factory inspection sheet check Visual inspection, dimension check	
	Painting work	Workmanship	Visual inspection	
	Interior work	Products, workmanship	Visual inspection	
Electrical Work	Power Receiving & Transforming	Performance, operation installation check	Factory inspection sheet check; withstand voltage, megar, operation, visual inspection	
	Conduit work	Bending, support check	Visual inspection, dimension	
	Wiring and cable work	Sheath damage, loose connection check	Performance sheet check, cleaning before laying, marking after bolt fixing	
	Lightning work	Resistance, conductor support pitch check	Resistance measuring, visual inspection, dimension	
	Lighting work	Performance, operation, installation check	Performance sheet check, illumination measurement, visual inspection	

Mechanical Work	Water Piping Work	Support pitch, leakage	Visual inspection, leakage, water pressure test
	Pump Installation	Slope, Support pitch, leakage	Visual inspection, leakage, flow test
	Air-Con. work	Performance, operation installation check	Performance sheet check, temperature measurement
	Sanitary Fixture	Operation, installation, leakage check	Visual inspection, flow test

#### 2-2-4-6 Procurement Plan

##### (1) Equipment Procurement

Maintenance requirements and the availability of the necessary parts and consumables in Myanmar are two of the most important factors in selecting the equipment. The equipment procurement process must provide for continuing maintenance after the completion of the Project. None of the meteorological equipment such as the pulse compression solid state Doppler radar system, the meteorological radar data display system, etc. to be supplied under the Project is produced in Myanmar. The pulse compression solid state Doppler radar system which has already been put into practical use for meteorological observation and has confirmed its reliability, durability, accuracy and performance is only available and made in Japan. The designed mean time between failure (MTBF) of transmitter for this system is more than 100,000 hours and the designed mean time to repair (MTTR) of transmitter is 0.5 hours. In addition, since almost all the Japanese meteorological radar systems established by Japan's Grant Aid in the developing countries have been working well over the years, Japanese systems have received a high degree of confidence in the world. Therefore, it is recognized, even by the WMO, that a Japanese system is the most suitable system for developing countries normally faced with operation and maintenance difficulty.

The activities of the private sector in Myanmar will be useful in support of the computer systems and other sophisticated systems. There are major computing equipment manufacturers and local agents/suppliers. The procurement plan for the equipment is designed with a view to achieve a maximum possible degree of standardization as well as facilitating the acquisition of spare parts and maintenance services for the chosen computing equipment.

##### (2) Procurement of Construction Material

###### 1) Procurement Policy of Construction Material

As the main construction materials can be procured locally, they will, in principle, be procured in

Myanmar. Some construction materials imported from the Association of Southeast Asian Nations (ASEAN) are marketed throughout Myanmar. As these imported materials can be easily procured locally, they are considered as part of the procurement of local products. In order to ensure the easy maintenance of the radar tower building, locally available materials will be utilized for construction.

## 2) Procurement Plan of Construction Materials

### [1] Structural Work

Ordinary portland cement packed in a 50kg bag locally manufactured and imported from Thailand can be procured. Concrete coarse aggregate can be obtained from quarries located in Yangon and Mandalay. The main materials for the structural works, such as fresh concrete, plywood for form works, etc., can be procured locally. Locally made bricks are available and are common material for building construction.

### [2] Building Exterior and Interior Work

Timber, tiles, paint, glass, aluminum window frames, etc. used for the exterior and interior of a building are imported and, as such, are readily available in the local market. For the proposed buildings, airtight aluminum and steel doors & windows, treated for salt-corrosion, are required.

### [3] Air-Conditioning and Plumbing Work

Imported air-conditioning equipment, exhaust fans, sanitary-fixtures, etc. are popular in Myanmar. As a result, those products can be procured in the local market with a view to ease repair and maintenance. Large air-conditioning units and exhaust fans are also available in the local market.

### [4] Electrical Work

Imported and local lighting fixtures, switches, lamps, electrical wires and cables, conduits and other items are available in the local market. They will be procured in Myanmar for the convenience of repair and maintenance. Custom-made building equipment such as control panels, power distribution boards and switch boards imported from ASEAN countries can also be procured in the local market.

Table 45: Major Materials Procurement Plan (Architectural Work)

Materials	Local Market		Procurement Plan		
	Condition	Import	Myanmar	Third Country	Japan
Portland cement	○		○		
Sand, aggregate	○		○		
Reinforcing bar	○		○		

Form (plywood)	○		○		
Brick	○		○		
Asphalt waterproofing	△		○		
Wood	○		○		
Aluminum door & window	△		○		
Steel door & window	△		○		
Wooden door & window	○		○		
Door handle, lock	○		○		
Floor hinge	○		○		
Plane glass	○		○		
Laminated safety glass	○		○		
Access floor panel	○		○		
Access floor panel (heavy duty type)	△		○		
Paint	○		○		
Gypsum board (T-bar)	○		○		
Cement board	○		○		
Rockwool acoustic board (T-bar)	○		○		
Glass wool, glass cloth	○		○		
Carpet tile	△		○		
PVC tile	○		○		
Porcelain tile	○		○		
Ceramic tile	○		○		
Floor maintenance hatch	○		○		
Kitchen	○		○		
Roof drain	○		○		
Steel drainage pipe (galvanized)	○		○		
Concrete pavement block	○		○		
Spray tile	○		○		
Caulking	○		○		

○ : Easy to procure in Myanmar

△ : Available in the local market in Myanmar but model and quantity are limited

× : Difficult to procure in Myanmar

Table 46: Major Materials Procurement Plan (Mechanical and Electrical Work)

Work type	Materials	Local Market		Procurement Plan		
		Condition	Import	Myanmar	Third Country	Japan
Air-conditioning work	Air conditioner	△		○		
	Heat exchanger	△		○		
	Exhaust fan (salt-proof)	△		○		
Plumbing work	Sanitary fixture	○		○		
	Pipe	○		○		
	Fire extinguisher	○		○		
	Water lifting pump	○		○		
Electrical work	Lighting fixture (including LED)	○		○		
	Obstruction light (LED)	△	Japan			○
	Panel	△		○		
	Wire, cable	○		○		
	Conduit (PVC)	○		○		
	Conduit (Steel)	○		○		
	Cable-rack	○		○		
	Telephone system	△		○		
	Isolation Transformer	△	Japan			○
	AVR	△	Japan			○
	Fire alarm system	○		○		
	Diesel engine generator	○		○		
	Lightening protection	○		○		

○ : Easy to procure in Myanmar

△ : Available in the local market in Myanmar but model and quantity are limited

× : Difficult to procure in Myanmar

### 3) Transportation Plan

<Allocation of vessels from the major International port>

The required number of days and the schedule of vessels from the major International port to Yangon Port are indicated in the following table.

Table 47: Scheduled Vessels to Yangon Port

Country	Name of Port	Schedule	Number of Days
Japan	Yokohama, Osaka, Kobe	6 ships/week	Approx. 21days
Australia	Sydney	1 ships/week	Approx. 23days
EU Countries	Antwerp, Rotterdam, Hamburg, etc.	2 ships/week	Approx. 40days
United States of America	East Coast (New York, Baltimore)	1 ships/week	Approx. 43days
	West Coast (Long Beach)	2 ships/week	Approx. 28days

<Import License & Permit Procedure >

For importing the equipment from overseas, the acquisition of an Import License (commercial base) and an Import Permit (non-commercial base) is required before the shipping of the equipment. Since any equipment to be supplied under the Japan's Grant Aid is categorized as non-commercial base, an Import

Permit is required for the equipment of the Project. The Import Permit acquisition must be completed before shipping and the issuance dates of Import Permits and shipping documents are confirmed at the time of a custom clearance. This requires scrupulous attention to the issuance dates of Import Permits and shipping documents since a large amount of penalty charges may be imposed, if the issuance date of an Import Permit is after the shipment.

<Tax Exemption>

As is the case with the Import Permit, a Tax Exemption Clearance for the Import Goods is also required by the time the ship gets into Yangon port.

For the acquisition of the Import Permit and the Tax Exemption Clearance, approximately 1 month is required respectively after individual submission of the required documents indicated in the following table to the Ministry of Transport. It is important that the required procedures must be commenced as soon as possible (for in some cases, several months are required).

Table 48: Required Procedures for Tax Exemption and Import Permit

Required Procedures	Office Concerned	Submission Time	Required Period	Required Documents to be submitted to Ministry of Transport by Department of Meteorology and Hydrology (DMH)	Applicant
Tax Exemption Clearance for the Import Goods	Ministry of Transport	Immediately after a determination of shipping items (at least 1.5 month before shipment left from the port)	1 month	Shipping Documents · Shipping Invoice: 1 original Photocopy of the Exchange of Notes and Grant Agreement	Department of Meteorology and Hydrology (DMH)
Import Permit	Ministry of Transport	Immediately after a shipment left from the port	1 month	Shipping Documents · Shipping Invoice: 1 original · Bill of Lading: 1 original · Packing List: 1 original · Certificate of Country of Origin: 1 original Photocopy of the Exchange of Notes and Grant Agreement	

<Situation of Yangon Port>

Since Yangon port is a river port, the water depth at the quay walls is very shallow and the port is not suitable for large-sized vessels. Therefore, only middle-sized vessels which are less than 10,000 tons are able to get into the port. The quays to which the middle-sized vessels come alongside are the Asia World Port (AWPT), the Myanmar Industrial Port (MIP) and the Myanmar International Terminal Thilawa (MITT). Each quay lacks storage space for cargos and is always crowded compared to other International ports, so there is a big concern that the cargos cannot be taken out smoothly even after the completion of custom clearance. Since this situation may be worsened as the cargos' volume increase in conjunction with market opening, making a transportation plan should be taken into consideration.

#### <Inland Transport>

In Myanmar, since a container vehicle is prohibited to enter the urban areas and the access roads to the Project sites located in the local areas are of terrible conditions, it is required to transship the equipment from a container and onto a truck in a warehouse located in the Yangon Port area after the completion of Import Custom Clearance.

Yangon: The main roads from the Yangon Port to the Project sites in Yangon City are well-maintained, so there is no problem for transportation.

Mandalay: An express motorway has been constructed from the Yangon Port to Mandalay. However, since container-trailers and trucks are prohibited to go into the express motorway, it is required to use the old highways instead. Though the conditions of the old highways are no better than the express motorway, it is considered that there is no problem for transportation.

Kyauk Phyu: Since there is no usable road by which the large cargos can be safely transported from the Yangon Port to Kyauk Phyu, a domestic vessel will be used for transportation from the Yangon Port.

AWS Project Sites (30): A lot of access roads from the Yangon Port to the Project sites located in the local areas are still unpaved which is quickly and terribly muddy with heavy rain, and also sometimes submerged and frequently closed due to landslides during the rainy season. It is indispensable that the transportation must be implemented except during the rainy season.

#### **2-2-4-7 Operational Guidance Plan**

The required operational guidance will be implemented through the practical operation simulation of each system in the course of the completion of equipment installation. During the equipment installation period, the operational guidance for cabling, piping (wave guide), unit replacement/adjustment, transmitter discharge, etc. of the meteorological radar system will be imparted to the DMH. As such, operational guidance for the said items will no longer be implemented after the completion of the equipment installation. The operational guidance for each system will be implemented at the following places indicated in the table attached hereunder.

Table 49: Operation and Maintenance Training (OJT)

Equipment	DMH Multi-Hazard Early Warning Center, Nay Pyi Taw	Kyauk Phyu Meteorological Radar Observation Station	Yangon Meteorological Radar Observation Station	Mandalay Meteorological Radar Observation Station	Air Traffic Control Tower in Yangon International Airport	AWS Stations
Meteorological Radar System • Power Unit • Antenna • Radar Unit • Meteorological Radar Transmission Unit • Computer Network Unit • Application Software	—	○	○	○	—	—
Meteorological Radar Data Display System • Power Unit • Computer Network Unit • Application Software	○	○	○	○	○	—
Meteorological Data Satellite Communication System (VSAT) • Power Unit • VSAT Communication Unit • Computer Network Unit • Application Software	○	○	○	○	—	—
Meteorological Data Communication System • Power Unit • Communication Unit • Computer Network Unit • Application Software	—	—	○	—	○	—
AWS • AWS Installation • Power Unit (Solar Panel, Controller, Battery) • GSM/GPRS Modem • Each Sensor • Data Acquisition Unit • Application Software	○	—	○	○	—	— (Procedures for Equipment Cleaning only)

Apart from Operation and Maintenance Training (OJT), technology transfer through the practical installation and adjustment works to be carried out by the DMH staff together with the Consultant and the contractor will be necessary and quite effective if done during the installation period. If technology transfer is conducted after completion of the installation work, it is difficult to simulate training on some parts/areas located in deeper places within the system such as cabling and wiring routes, connecting points of each unit, etc. which require disassembling the radar system to be able to see them. In addition, software installation by the DMH staff themselves is important to have further familiarization and technical knowledge. In case of a down in the system, disassembling the system and software reinstallation by the DMH staff may be required. Therefore, all the significant parts of technology transfer must be completed during the installation work period.



#### **2-2-4-8 Soft Component Plan**

<Soft Component>

Eight (8) years have passed since the existing meteorological radar system of Myanmar operationally stopped. And only 2 technicians having practical experience to operate the existing meteorological radar system currently remains with the DMH. It is good to note that the DMH's technicians are proficient in the use of computers and computerized meteorological observation equipment. However, no technician in the DMH has practical experience to operate a digital meteorological radar system which is planned to be procured under the Project. For the smooth operation and maintenance of the digital meteorological radar system and the assurance of the required sustainability of the Project outcomes, the implementation of the following technology transfers in the soft component (soft component schedule is indicated in the Implementation Schedule attached hereunder) is required.

<Soft Component Target>

The Soft Component Targets are as follows.

- Operation, maintenance, fault finding, remedy and recovery of installed equipment to be appropriately carried out by the DMH
- Prompt and appropriate meteorological radar operation and maintenance utilizing the meteorological radar system manual summary and the meteorological radar system maintenance & management record book
- Meteorological radar observation in accordance with the sequence & schedule for Intensity Mode and Doppler Mode in order to appropriately understand weather phenomena and to utilize the observed radar data for forecasting
- Meteorological radar products to be reflected in weather forecasting and aeronautical weather operation
- Installation work of the Automatic Weather Observation System (AWS) to be carried out by the DMH

<Soft Component Outputs>

Soft Component Outputs are as follows.

Table 50: Soft Component Outputs

No.	Item	Output
1	Meteorological Doppler Radar Operation, Maintenance, Fault Finding, Remedy and Recovery	Acquisition of technical know-how of appropriate operation, maintenance, fault finding, remedy and recovery 1) Routine maintenance using measuring instruments and tools 2) Practice of replacement of spare parts to actual system and confirmation of system operation 3) Practice of countermeasures, fault finding, remedy and recovery
2	Prompt and Appropriate Meteorological Doppler Radar Operation and Maintenance utilizing Meteorological Radar System Manual Summary and Meteorological Radar System Maintenance & Management Record Book	Technical knowledge acquisition of prompt and appropriate meteorological Doppler radar operation and maintenance utilizing meteorological radar system manual summary and meteorological radar system maintenance & management record book
3	Meteorological Radar Observation in accordance with Sequence & Schedule for Intensity Mode and Doppler Mode	Commencement of meteorological radar observation in accordance with the sequence & schedule for Intensity Mode and Doppler Mode in order to appropriately understand weather phenomena and to utilize the observed radar data for forecast operation.
4	Reflection of thirty-nine (39) Meteorological Radar Products (Rain Intensity and Doppler) to Weather Forecasting and Aeronautical Weather Operation	Utilization of meteorological radar products for weather forecasting and aeronautical weather operation
5	Installation, Operation, Maintenance, Inspection, Fault Finding, Remedy and Recovery of Automatic Weather Observation System (AWS)	Technical know-how acquisition of AWS installation work, setup of data transmission interval, remedy and recovery (replacement of spare parts, confirmation of system operation, remedy and recovery)

<Means of Verification for Outputs Achievement>

Means of verification for outputs achievement of Soft Component are as follows.

Table 51: Soft Component Indicators

No.	Item	Objectively Verifiable Indicators	Means of Verification
1	Meteorological Doppler Radar Operation, Maintenance, Fault Finding, Remedy and Recovery	Operation, maintenance, fault finding, remedy and recovery are carried out appropriately by the DMH	Confirmation of proficiency through 1) routine maintenance using measuring instruments and tools, 2) practice of replacement of spare parts to actual system and confirmation of system operation, and 3) practice of countermeasures, fault finding, remedy and recovery
2	Prompt and Appropriate Meteorological Doppler Radar Operation and Maintenance utilizing Meteorological Radar System Manual Summary and Meteorological Radar System Maintenance & Management Record Book	Meteorological Doppler radar operation and maintenance utilizing meteorological radar system manual summary and meteorological radar system maintenance & management record book are implemented promptly and appropriately.	<ul style="list-style-type: none"> <li>· Evaluation of frequency of usage of the meteorological radar system manual summary</li> <li>· Confirmation of indication (daily, weekly, monthly) in the meteorological radar system maintenance &amp; management record book</li> </ul>
3	Meteorological Radar Observation in accordance with Sequence & Schedule for Intensity Mode and Doppler Mode	Meteorological radar observation is implemented according to radar observation sequence & schedule for Intensity Mode and Doppler Mode	Confirmation of meteorological radar observation in accordance with the sequence & schedule for Intensity Mode and Doppler Mode in order to appropriately understand weather phenomena and to utilize the observed radar data for forecast operation.

4	Reflection of thirty-nine (39) Meteorological Radar Products (Rain Intensity and Doppler) to Weather Forecasting and Aeronautical Weather Operation	Meteorological Radar Products are reflected for weather forecasting and aeronautical weather operation	Confirmation of utilization situation of meteorological radar products to be reflected for meteorological forecasting and aeronautical weather operation
5	Installation, Operation, Maintenance, Inspection, Fault Finding, Remedy and Recovery of Automatic Weather Observation System (AWS)	Installation work, operation, maintenance, fault finding, remedy and recovery are implemented appropriately by the DMH	<ul style="list-style-type: none"> <li>Confirmation of AWS installation work at several sites where foreigners cannot enter for security reason</li> <li>Confirmation of receiving status of the observed data at DMH Multi-Hazard Early Warning Center, Nay Pyi Taw</li> </ul>

<Scheduled Activities of Soft Component>

Scheduled Activities of Soft Component are as follows.

Table 52: Scheduled Activities of Soft Component

Output	Required Technique and Field	Current Technique and Required Technique Level	Target Group	Means of Implementation	Source of Implementation	Products	
1. Meteorological Doppler Radar Operation, Maintenance, Fault Finding, Remedy and Recovery	Engineer who has a meteorological radar adjustment and fault finding technique	Since technicians in the DMH have no practical experience of adjustment and fault finding of a digital meteorological radar system, it is required that the DMH technicians should obtain meteorological radar adjustment and fault finding technique.	Indicated in the table below	Routine maintenance using measuring instruments and tools	Expert Consultant on meteorological radar adjustment and fault finding (Dispatch: 3 times)	Manual of routine maintenance using measuring instruments and tools	
				Practice of replacement of spare parts to actual system and confirmation of system operation			Kyauk Phyu: 1.13 Man-Months Yangon: 0.97 Man-Month Mandalay: 1.0 Man-Month
				Practice of countermeasures, fault finding, remedy and recovery			
				Production of operation and maintenance manual			
2. Preparation of Meteorological Radar System Manual Summary and Meteorological Radar System Maintenance & Management Record Book	Engineer who has a meteorological radar operation and maintenance technique	Since technicians in the DMH have no practical experience of operation and maintenance of a digital meteorological radar system, it is required that the DMH technicians should obtain meteorological radar operation and maintenance technique utilizing meteorological Doppler radar system manual summary and meteorological radar system	Indicated in the table below	Discussion with the DMH technicians	Expert Consultant on meteorological radar operation and maintenance (Dispatch : 3 times)	Meteorological Doppler radar system manual summary	
				Selection and explanation of the most important points from meteorological Doppler radar system manual			Kyauk Phyu: 1.13 Man-Months Yangon: 0.97 Man-Month Mandalay: 1.0 Man-Month
				Production of meteorological Doppler radar system manual summary			
				Production of meteorological radar system maintenance & management record book			
Utilization of meteorological Doppler radar system manual and meteorological							

		maintenance & management record book.		radar system maintenance & management record book by the DMH technicians		who perform the repair /troubleshooting
3. Preparation of Sequence & Schedule for Intensity Mode and Doppler Mode	Engineer who can identify Clutter and Blind Area by radar observation data and prepare sequence & schedule for meteorological radar observation which is suitable to weather phenomena in Myanmar	Since technicians in the DMH have no practical experience of CAPPI observation using digital meteorological Doppler radar system and has no technique of sequence & schedule for Intensity Mode and Doppler Mode, it is required that the DMH technicians should obtain preparation technique of sequence & schedule for meteorological radar observation with awareness of its importance.	Indicated in the table below	<p>Discussion with the DMH technicians and lecture</p> <p>Identification of Clutter of meteorological radar system and Blind Area at antenna elevation angle (0.5 interval degree, between 1-3 degrees)</p> <p>Preparation of Blind Area at antenna elevation angle (0.5 interval degree, between 1-3 degrees)</p> <p>Preparation of Sequence &amp; Schedule for Intensity Mode and Doppler Mode</p> <p>Implementation of radar observation using Sequence &amp; Schedule for Intensity Mode and Doppler Mode</p>	<p>Expert Consultant on meteorological radar observation (Dispatch: 3 times)</p> <p>Kyauk Phyu: 0.97 Man-Month Yangon: 0.97 Man-Month Mandalay: 1.0 Man-Month</p> <p>Direct Support</p>	Sequence & Schedule for Intensity Mode and Doppler Mode
4. Reflection of thirty-nine (39) Meteorological Radar Products (Rain Intensity and Doppler) to Weather Forecasting and Aeronautical Weather Operation	Engineer who can reflect meteorological radar products for weather forecasting and aeronautical weather operation	Since the DMH and Department of Civil Aviation have no technique to utilize digital meteorological radar products for weather forecasting and aeronautical weather operation, it is required that the DMH technicians should understand all the contents of thirty-nine (39) meteorological radar products and obtain the technique to reflect them for operation.	Indicated in the table below	<p>Production of meteorological radar products details</p> <p>Discussion with the staff of the DMH (forecasters &amp; technicians) and Air Traffic Control Room, Department of Civil Aviation and lecture (DMH Yangon)</p> <p>Practical training of forecasting operation by use of meteorological radar products details and actual meteorological radar products (DMH Nay Pyi Taw)</p> <p>Practical training of aeronautical weather operation by use of meteorological radar products details and actual meteorological radar products (Yangon International Airport)</p>	<p>Expert Consultant on meteorological radar products (Dispatch: 1 time)</p> <p>1.0 Man-Month</p> <p>Direct Support</p>	Meteorological radar products details
5. Installation, Operation, Maintenance,	Engineer who has an AWS installation, adjustment	Since technicians in the DMH lack practical experience of AWS installation,	Indicated in the table below	Explanation of procedures and schedules on AWS installation and	Expert Consultant on AWS operation and maintenance (Dispatch: 1 time)	AWS installation manual

Inspection, Fault Finding, Remedy and Recovery of Automatic Weather Observation System (AWS)	and fault finding technique	adjustment and fault finding, it is required that the DMH technicians should obtain AWS installation, adjustment and fault finding technique.		adjustment to the DMH technicians	1.17 Man-Months Direct Support	<ul style="list-style-type: none"> <li>↘ Implementation of AWS installation and adjustment work at several sites where foreigners cannot enter for security reason</li> <li>↘ Receipt of the observed data in good condition at DMH Multi-Hazard Early Warning Center, Nay Pyi Taw</li> </ul>	
				Production of AWS installation manual			AWS operation and maintenance manual
				Production of AWS operation and maintenance manual			
				Training of AWS installation and adjustment work at DMH Nay Pyi Taw and DMH Yangon			
				Training of AWS operation and maintenance at DMH Nay Pyi Taw and DMH Yangon			
				Amendment of AWS installation manual			
				Implementation of AWS installation and adjustment work at several sites where foreigners cannot enter for security reason			
				Confirmation of receipt of the observed data in good condition at DMH Multi-Hazard Early Warning Center, Nay Pyi Taw			
				Amendment of AWS operation and maintenance manual			

Timing of each activity commencement in Soft Component is indicated in the following table.

**Table 53: Timing of Activity Commencement in Soft Component**

Activity of Expert Consultant	Timing of Activity Commencement
Meteorological radar adjustment and fault finding	This activity must be implemented during the actual operation of the meteorological radar system. The installation work of the meteorological radar system is targeted to be completed during the rainy season and this activity is expected to commence approximately one month before the completion of the installation work (i.e. during the adjustment and initial operation period of the meteorological radar system).
Meteorological radar operation and maintenance	This activity must be implemented during the actual operation of the meteorological radar system. The installation work of the meteorological radar system is targeted to be completed during the rainy season and this activity is expected to commence approximately one month before the completion of installation work (i.e. during the adjustment and initial operation period of the meteorological radar system).
Meteorological radar observation	This activity must be implemented through the utilization of observed rain intensity and Doppler velocity data. The installation work of the meteorological radar system is targeted to be completed

	during the rainy season and this activity is expected to commence approximately one month before the completion of installation work (i.e. during the adjustment and initial operation period of the meteorological radar system).
Meteorological radar products	This activity must be implemented by using actual meteorological radar products (rain intensity and Doppler velocity). The installation work of the meteorological radar display system at the Yangon International Airport is targeted to be completed during the rainy season and this activity is expected to commence approximately one month before the completion of installation work (i.e. during the adjustment and initial operation period of the meteorological radar display system)
AWS operation and maintenance	This activity is planned to be implemented in Yangon and Nay Pyi Taw during the AWS installation work in the dry season and to be commenced 7 days after the concrete work completion of Yangon AWS foundation. (AWS Installation work must be implemented during the dry season in consideration of the accessibility of all the 30 sites).

The three activities indicated in the following table are planned to be implemented consistently across the three project sites: Kyauk Phyu, Yangon and Mandalay. The necessity of consistently and repetitively implementing the activities is also indicated below.

**Table 54: Necessity of Repetitive Activity Implementation**

Three Activities	Necessity of Repetitive Activity Implementation
Meteorological radar adjustment and fault finding, Meteorological radar operation and maintenance, Meteorological radar observation	Installation works of the meteorological radar systems in Kyauk Phyu, Yangon and Mandalay are planned to be individually completed during different rainy seasons by shifting the construction schedules of the meteorological radar tower buildings. As such, the three activities will be implemented three times during three different rainy seasons in the duration of the Project. By consistently and repetitively implementing the activities, 1) the familiarization of DMH engineers with the meteorological radar systems will be increased, 2) the relative insufficient skills of DMH engineers who received technology transfer during the Soft Component that are included in routine radar operation will be supplemented, and 3) through the ample exchange of technical point of views and technology transfer between DMH engineers who are newly allocated and have already started the meteorological radar operation, DMH engineers will additionally acquire the necessary skills to ensure project sustainability.

Target personnel for each technology transfer in the Soft Component is indicated below. For No. 1, 2 and 5, thirty six (36) engineers to be recruited by the DMH for the meteorological radar operation will be included in the target personnel in addition to the existing engineers.

**Table 55: Target Personnel in DMH for Technology Transfer in Soft Component**

Technology Transfer of No. 1, 2 and 5		Technology Transfer of No. 3 and 4	
	Number		Number
Engineer (DMH Nay Pyi Taw)	7	Meteorologist	15
Engineer (DMH Yangon)	5	Airport Meteorological Office Staff	4
Engineer (DMH Mandalay)	1	Air Traffic Control Staff (Yangon International Airport)	10
Engineer to be recruited	36		

<Soft Component Product>

Soft Component Products are as follows.

**Table 56: Soft Component Products in Technology Transfer**

Product Name	Submission Time	No. of Pages	
Implementation report on 1) routine maintenance using measuring instruments and tools, 2) practice of replacement of spare parts to actual system and confirmation of system operation, and 3) practice of countermeasures, fault finding, remedy and recovery	After Technology Transfer	20	
Meteorological radar system manual summary		30	
Meteorological radar system maintenance and management record book		10	
Radar observation sequence & schedule for Intensity Mode and Doppler Mode		10	
Meteorological radar components details		45	
AWS installation manual		20	
AWS operation and maintenance manual		20	
Output Name	Content	Submission Time	No. of Pages
Soft Component Completion Report	<ul style="list-style-type: none"> <li>• Scheduled Activities and Actual Achievement</li> <li>• Scheduled Outputs and Achievement</li> <li>• Factors which influence Achievement of Outputs</li> <li>• Recommendation</li> <li>• Outputs</li> </ul>	Completion of Soft Component	60

2-2-4-9 Implementation Schedule

Table 57: Implementation Schedule

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
Detailed Design																																												
Internal Work in Japan																																												
Tendering Procedures																																												
Total: 5.0 months																																												
Kyaukpadaung Meteorological Observation Station																																												
Construction Work at Kyaukpadaung Radar Tower Building																																												
Preparation Work																																												
Temporary/Piling/Earth Works																																												
Structure Work																																												
Finishing Works																																												
Building Equipment																																												
External Work																																												
Equipment Manufacturing for Kyaukpadaung																																												
Equipment Transportation for Kyaukpadaung																																												
Equipment Installation/Adjustment for Kyaukpadaung																																												
Soft Component																																												
Meteorological Doppler Radar Operation, Maintenance, Fault Finding, Remedy and Recovery																																												
Prompt and Appropriate Meteorological Doppler Radar Operation and Maintenance utilizing Meteorological Radar System Manual Summary and Meteorological Radar System Maintenance & Management Record Book																																												
Meteorological Radar Observation in accordance with Sequence & Schedule for Intensity Mode and Doppler Mode																																												
1.13 MM																																												
1.13 MM																																												
0.97 MM																																												
Yangon Meteorological Observation Station																																												
Construction Work at Yangon Radar Tower Building																																												
Preparation Work																																												
Temporary/Piling/Earth Works																																												
Structure Work																																												
Finishing Works																																												
Building Equipment																																												
External Work																																												
Equipment Manufacturing for Yangon																																												
Equipment Transportation for Yangon																																												
Equipment Installation/Adjustment for Yangon																																												
Soft Component																																												
Meteorological Doppler Radar Operation, Maintenance, Fault Finding, Remedy and Recovery																																												
Prompt and Appropriate Meteorological Doppler Radar Operation and Maintenance utilizing Meteorological Radar System Manual Summary and Meteorological Radar System Maintenance & Management Record Book																																												
Meteorological Radar Observation in accordance with Sequence & Schedule for Intensity Mode and Doppler Mode Sequence & Schedule																																												
0.97 MM																																												
0.97 MM																																												
0.97 MM																																												
Mandalay Meteorological Observation Station																																												
Construction Work at Mandalay Radar Tower Building																																												
Preparation Work																																												
Temporary/Earth Works																																												
Structure Work																																												
Finishing Works																																												
Building Equipment																																												
External Work																																												
Equipment Manufacturing for Mandalay																																												
Equipment Transportation for Mandalay																																												
Equipment Installation/Adjustment for Mandalay																																												
Soft Component																																												
Meteorological Doppler Radar Operation, Maintenance, Fault Finding, Remedy and Recovery																																												
Prompt and Appropriate Meteorological Doppler Radar Operation and Maintenance utilizing Meteorological Radar System Manual Summary and Meteorological Radar System Maintenance & Management Record Book																																												
Meteorological Radar Observation in accordance with Sequence & Schedule for Intensity Mode and Doppler Mode Sequence & Schedule																																												
1.0 MM																																												
1.0 MM																																												
1.0 MM																																												
Multi-Hazard Early Warning Center and Yangon International Airport																																												
Equipment Work for Multi-Hazard Early Warning Center																																												
Equipment Manufacturing for Multi-Hazard Early Warning Center																																												
Equipment Transportation for Multi-Hazard Early Warning Center																																												
Equipment Installation/Adjustment for Multi-Hazard Early Warning Center																																												
Equipment Work for Yangon International Airport																																												
Equipment Manufacturing for Yangon International Airport																																												
Equipment Transportation for Yangon International Airport																																												
Equipment Installation/Adjustment for Yangon International Airport																																												
Soft Component																																												
Reflection of thirty-nine (39) Meteorological Radar Products (Rain Intensity and Doppler) to Weather Forecasting and Aeronautical Weather Operation																																												
1.0 MM																																												
Automatic Weather Observation Systems (AWS)																																												
Equipment Work for AWS																																												
Equipment Manufacturing for AWS																																												
Equipment Transportation for AWS																																												
Equipment Installation/Adjustment for AWS																																												
Soft Component																																												
Installation, Operation, Maintenance, Inspection, Fault Finding, Remedy and Recovery of Automatic Weather Observation Systems (AWS)																																												
1.17 MM																																												



## 2-3 Obligations of Recipient Country

In the course of the implementation of the Project under Japan's Grant Aid Assistance, the DMH is responsible for the following tasks.

Table 58: Major Undertakings to be done by DMH under Implementation of the Project

No	Items
<b>General Items</b>	
1	To undertake all necessary institutional and juridical procedures in Myanmar.
2	To handle duty (Tax) exemption procedures and to take necessary measures in providing requisite legal and/or administrative documentations for customs clearance to customs broker/forwarder to be employed by Contractor at the port of disembarkation for the materials and equipment imported for the Project.
3	To provide necessary working spaces with Internet Connection at the DMH Offices in Nay Pyi Taw and Yangon for the Consultant and the Contractor for the implementation of the Project, if required.
4	To accord Japanese and other foreign nationals including their dependent/s (if any), whose services may be required in connection with the supply of products and services under the signed contracts, such facilities as may be necessary for their entry into Myanmar and stay therein for the smooth and uninterrupted performance of their work i.e. to secure appropriate Visa including its extension/s required by the recipient country in connection thereof.
5	To exempt Japanese and other foreign nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the signed contracts.
6	To pay bank commission to the Myanmar Foreign Trade Bank (MFTB) for issuance of the Authorization to Pay (A/P) and amendments of A/P, if required, for the Consultant and the Contractor.
7	To bear all the expenses, other than those to be borne by the Japan's Grant Aid, necessary for the implementation of the Project
8	To ensure the security of the whole Project site/s and to the Japanese and other foreign nationals engaged in the Project prior to the commencement of and all throughout the Project implementation.
<b>For the Construction of the Radar Tower Building(s)</b>	
9	To clear, level and reclaim the land prior to the commencement of the construction.
10	To secure sufficient spaces at the respective Project sites for temporary facilities such as a contractor's office, workshop, building materials storage, etc. for the construction work.
11	To carry out vital earth moving particularly on the existing hump (small hilly part) in order to secure enough space for the construction of a new Radar Tower Building in the Kyauk Phyu Meteorological Radar Observation Station.
12	To carry out the graveling of the existing unpaved access road (from the main road to the Kyauk Phyu Meteorological Radar Observation Station) with enough strength and width suitable for the construction of the new Radar Tower Building.
13	To demolish the existing workshop shed in Yangon DMH Compound in order to secure and allocate ample space for the construction of a new Radar Tower Building.
14	To make available the 30m required extension of the allocated land at Mandalay DMH Observatory to the south side in order to be able to construct and/or put up a new Radar Tower Building.
15	To extend the existing boundary lines of the Mandalay DMH Observatory according to the required land extension.
16	To obtain necessary permissions for the construction of the Radar Tower Building(s).
17	To provide the commercial power (440V, 3-phase, 4-wire, 50Hz) supply (capacity: 100kVA)

	for the Radar Tower Buildings in Yangon and Mandalay.
18	To install the required step-down transformers as well as service entrance connections for the commercial power supply at the site(s) for the Radar Tower Buildings in Yangon and Mandalay.
19	To provide the incidental facilities such as water supply, telephone line and internet provision for the Radar Tower Building(s) in Yangon and Mandalay.
20	To provide temporary facilities for the availability or accessibility of electricity, water, etc. for the construction work.
21	To construct buildings other than the Radar Tower Building(s), if required by the DMH.
22	To undertake incidental outdoor works such as gardening, fencing, gates, boundary walls and exterior lighting in and around the sites, if necessary.
23	To shoulder dispatching cost of the trainees to the training sites; such as daily allowance, transportation fee, accommodation, if any.
<b>For Installation Work of the Equipment</b>	
24	To remove and relocate the existing facilities if available for the installation of the equipment, if necessary.
25	To provide and allocate secure temporary storage area/room for the materials, tools and equipment needed during the installation process.
26	To obtain the required frequency(ies) for the meteorological radar system(s).
27	To obtain the required space segment and the VSAT user license from the Ministry of Communication, Posts and Telegraphs for the use of satellite communication for the meteorological data satellite communication system (VSAT) to be installed as well as the provision of redundant communication link such as broadband or dedicated leased line for internet communication.
28	To procure mobile SIM card (GSM/GPRS) for transmitting/receiving data observed by the Automatic Weather Observation System (AWS).
29	To secure ample and strategically located space/s at the existing facilities (Multi Hazard Early Warning Center, Nay Pyi Taw) for installation of the equipment (PC terminals and peripherals) to be supplied.
30	To secure suitable space at the existing observation stations for installation of Automatic Weather Observation System (AWS).
31	To extend the existing observation field fence around the installation location of Automatic Weather Observation System (AWS) in the existing observation stations which have small size observation field.
32	To shoulder dispatching cost of the trainees to the training sites (including AWS sites which are not accessible to foreigners due to security issue), such as daily allowances, transportation fees, accommodation fees, if any.
<b>After the completion of the Project</b>	
33	To renovate the existing gates, boundary walls and exterior lighting in and around the sites, if required.
34	To assign staff necessary for the smooth operation and maintenance of the Equipment.
35	To remove the existing radar system/structure in order to prevent it from collapsing due to an earthquake and/or strong wind associated with tropical cyclones especially as the existing Kyauk Phyu Radar Tower Building is obsolete.
36	To renovate the existing Kyauk Phyu Radar Tower Building for the establishment of the staff quarter.
37	To renovate the existing Kyauk Phyu Meteorological Radar Observation Office.
38	To procure the required spare parts and consumables for the smooth operation and maintenance of the Equipment.
39	To provide for the adequate maintenance of the Radar Tower Building(s) constructed under the Project, so that they can function effectively.
40	To operate, maintain and properly and effectively utilize the facilities constructed and the Equipment procured under the Project.

41	To allocate necessary budget and personnel for appropriate meteorological radar observation and forecasting works.
----	--

The detailed obligations required for the construction of the Radar Tower Buildings to be taken by the DMH are indicated below.

<Kyauk Phyu Meteorological Radar Observation Station>

- (1) Removal of the existing radar system/structure in order to prevent it from collapsing due to an earthquake and/or strong wind associated with typhoons because the existing radar tower building is obsolete.



- (2) Renovation of the existing radar tower building encircled in the picture for the establishment of the staff quarters.



- (3) Graveling or Concreting of the unpaved existing access road from the main road to the site (approximately 350m length).



- (4) In order to secure enough space for the construction of a new radar tower building in the Project, the demolition of the existing hump is required.



- (5) Renovation of the existing Kyauk Phyu Meteorological Radar Observation Office encircled in the picture.



<Yangon Meteorological Radar Observation Station>

- (1) In order to secure and allocate enough space for the construction of a new radar tower building in the Project, the demolition of the existing workshop shed is required.
- (2) Supply of the commercial power (440V, 3-phase 4-wire, 50Hz) and the step down transformer is specified as follows for the new radar tower building.



Table 59: Requirements of Step Down Transformers for Yangon Radar Tower Building

Number	1 set
Capacity	100 kVA
Output Power	440V, 3-phase 4-wire, 50Hz

<Mandalay Meteorological Radar Observation Station>

- (1) In order to be able to construct and/or put up the Radar Tower Building within the First Candidate Area, the compound extension (required width is 30m) which currently belongs to the Department of Civil Aviation is indispensable.



- (2) Supply of the commercial power (440V, 3-phase 4-wire, 50Hz) and the step down transformer is specified as follows for the new radar tower building.

Table 60: Requirements of Step Down Transformers for Mandalay Radar Tower Building

Number	1 set
Capacity	100 kVA
Output Power	440V, 3-phase 4-wire, 50Hz

**2-4 Project Operation Plan**

- (1) Operation and Maintenance Plan for the Equipment

1) Operational Plan of Meteorological Radar System

Upon completion of the Project, the hours of operation of each meteorological radar system has been planned in accordance with the annual transition of the climate in Myanmar. The DMH has agreed to

meet the following operational plan.

Table 61: Estimated Annual Operation Hours of Kyauk Phyu Meteorological Radar System

	Terms	Operation Hours (h/day)	Operation Days	Operation Hours
Dry Season	January - April	4	119	476
	November and December	4	60	240
Monsoon Season	May - October	8	183	1464
Pre & Post Monsoon Season (Tropical Depression/Cyclone)	April, May, October and November	24	3	72
			<b>365</b>	<b>2,252</b>

Table 62: Estimated Annual Operation Hours of Yangon Meteorological Radar System

	Terms	Operation Hours (h/day)	Operation Days	Operation Hours
Dry Season	January - April	4	119	476
	November and December	4	60	240
Monsoon Season	May - October	12	183	2196
Pre & Post Monsoon Season (Tropical Depression/Cyclone)	April, May, October and November	24	3	72
			<b>365</b>	<b>2,984</b>

Table 63: Estimated Annual Operation Hours of Mandalay Meteorological Radar System

	Terms	Operation Hours (h/day)	Operation Days	Operation Hours
Dry Season	January - April	4	120	480
	November and December	4	61	244
Monsoon Season	May - October	12	184	2208
			<b>365</b>	<b>2,932</b>

2) Staff Allocation and Radar Observation System Plan at Radar Observation Stations

For the appropriate operation of the meteorological radar systems, the following staff allocation and radar observation system are required.

Table 64: Required Radar Observation System in DMH

Radar Observation	Shift	Number of Staff in Observation Team	On-duty Hours	Number of Supervisor	On-duty Hours of Supervisor
Normal Observation (Dry Season: December-March)	2 Shifts	3/Team	08:00-15:00 14:00-21:00	1	09:00-17:00 (DMH Normal Operation Hour)
Normal Observation (Pre-monsoon, Monsoon and Post-monsoon Seasons: April-November)	2 Shifts	3/Team	08:00-21:00 20:00-09:00	1	09:00-17:00 (DMH Normal Operation Hour)
Special Observation	3 Shifts	5/Team	08:00-17:00 16:00-01:00 24:00-09:00	1/Shift	24 Operation

### 3) Operation and Maintenance Plan for the Equipment

For the appropriate operation and maintenance of the meteorological radar systems, meteorological radar display system, meteorological data satellite communication system (VSAT), meteorological data communication system and automatic weather observation system, the following number of staff is required.

**Table 65: Required Staff at each Meteorological Radar Station**

Position	Kyauk Phyu Meteorological Radar Station	Yangon Meteorological Radar Station	Mandalay Meteorological Radar Station
Station Leading Engineer	1	1	1
Meteorological Radar Observer (Meteorologist)	2	2	2
Senior Engineer for Electronic Equipment	1	1	1
Junior Engineer for Electronic Equipment	2	2	2
Senior Engineer for Data Communication Equipment	1	1	1
Junior Engineer for Data Communication Equipment	2	2	2
Senior Engineer for Mechanical Equipment	1	1	1
Junior Engineer for Mechanical Equipment	2	2	2
Technical Assistant	4	4	4
<b>Total</b>	<b>16</b>	<b>16</b>	<b>16</b>

<Station Chief Engineer's Duty>

Management for Radar Observation Station

<Meteorological Radar Observer's Duty>

Data Achieving, Data Processing & Analysis, Radar Observation Schedule Control, Reflection of Radar Observation Instructions from DMH Multi-Hazard Early Warning Center, Nay Pyi Taw to Radar Observation

<Engineer's Operation & Maintenance Duty>

- Engineer for Electronic Equipment: Transmitter, Digital Receiver and Signal Processor, Dehydrator, Radar Power Maintenance Panel, Radar Operation Software, Power Back-up System and Building Electrical Equipment (Isolation Transformer, Power Distribution Board, Lightings, etc.), Lightening Protection System
- Engineer for Data Communication Equipment: Data Communication Equipment (VSAT In-door & Out-door Units, VSAT Antenna, PoE-Injector, Dual Router, Optical Repeater, Dual Switch, Terminal (PC), Printer, Peripherals, Wireless LAN Unit, Data Communication Software
- Engineer for Mechanical Equipment: Radar Antenna, Radar Antenna Pedestal, Radome, Engine Generator, Air-conditioning Unit, Water Pump, Ventilation Duct & Fan, Door & Window, Furniture
- Technical Assistant: Assistant for all the Engineer's Works

### 4) Quick Response Team for Operation and Maintenance of the Equipment

In order to assist the Meteorological Radar Stations and DMH observatories where the automatic weather observation system is installed in making very prompt actions required for the quick recovery during the failure of significant equipment such as the meteorological radar systems, meteorological radar display system, meteorological data satellite communication system (VSAT), meteorological data communication system, automatic weather observation system, existing GTS message switch & MTSAT receiver, etc., the following members of the quick response teams directly supervised by the Deputy Director General are required.

**Table 66: Required Staff of Quick Response Team of Data Communication System located in DMH Multi-Hazard Early Warning Center, Nay Pyi Taw and Mandalay**

Position	Number of Staff
Quick Response Team Leading Engineer, Nay Pyi Taw	1
Nay Pyi Taw	
Senior Engineer (VSAT, GSM Equipment, Network & Computer Equipment, Software)	3

Senior/Junior Engineer (AWS Equipment, Software)	2
Technical Assistant	1
Mandalay	
Senior/Junior Engineers (AWS Equipment & Software + Instrument)	2

Table 67: Required Staff of Quick Response Team of Meteorological Radar System located in Yangon

Position	Number of Staff
Quick Response Team Leading Engineer, Yangon	1
Senior/Junior Engineer (Radar System & Software)	3
Senior/Junior Engineer (AWS Equipment & Software + Instrument)	3
Technical Assistant	1

#### 5) Operation and Maintenance Plan for the Equipment

In connection with equipment maintenance, consideration must be given to the followings.

- Technical training for the DMH staff
- Establishment of appropriate measures against system failure
- A fully documented maintenance system, with proper document control
- Scheduled replacement of parts and overhauls
- Strengthening of the operation and maintenance structure of the DMH
- Establishment of technical and financial self-reliance of the DMH

#### <Recruitment of Engineer/Staff >

The DMH fully recognizes the need to strengthen its engineering sections. The JICA Preparatory Survey Team therefore strongly recommends recruiting capable engineer(s) and technical assistant(s) indicated in the following table. For staff recruitment, the Ministry of Transport, as the supervising organization of the DMH, should give its effective cooperation and special attention on this matter.

In order for the DMH to become self-reliant in technical areas such as the operation and maintenance of radar systems, it is essential that it make continuing efforts to recruit and promote technology transfer across all staff levels.

Table 68: Required Number of Engineers and Technical Assistants to be recruited in DMH

	2014	2015	2016
Engineers	6	6	-
Technical Assistant for Engineers	6	4	4

#### (2) Operation and Maintenance Plan for the Radar Tower Building

There are three key issues for the maintenance of the radar tower building to be implemented by the

DMH: (i) daily cleaning; (ii) maintenance to cover wear and tear, damage and aging; and (iii) security measures to ensure safety and to prevent crimes.

The daily cleaning of the building gives a good impression on the visitors/users and encourages people to respect the building and the equipment in it. Cleaning is also important to ensure the equipment continues to operate correctly. It helps in the rapid detection and repair of damaged equipment and prolongs the life of the building equipment. The main repair work will be refurbishing or replacing the exterior and interior materials protecting the building structure. The required inspections are outlined below.

**Table 69: Outline of Regular Inspection for the Building**

	Items of Maintenance Work	Frequency
Exterior	Repair and repainting of external walls	Repair: every 5 years, Repaint: every 15 years
	Inspection and repair of roofs	Inspection: every year Repair: as required
	Regular cleaning of drain pipes and drainage systems	Monthly
	Inspection and repair of sealing of external windows and doors	Every year
	Regular inspection and cleaning of ditches and manholes	Every year
Interior	Renewal of interior finishing	As required
	Repair and repainting of partition walls	As required
	Adjustment of window and door fitting	Every year

It is important that regular preventive maintenance of the building equipment is carried out before the equipment fails or requires repair or replacement of part(s). The life of the building equipment can be significantly extended by proper operation and regular inspection, lubrication, adjustment and cleaning. These regular inspections can prevent equipment failure and accidents. The regular inspection, replacement of consumables and cleaning/replacement of filters for ventilation and air-conditioning units should be carried out in accordance with the maintenance manual.

It is essential to establish a proper maintenance structure in the DMH, involving the rigorous implementation of regular inspection and maintenance procedures. This work may be assigned to the private sector (local agents), if required. The general life expectancy of the major building equipment is shown below.

**Table 70: Life Expectancy of Building Equipment**

System	Building Equipment	Life Expectancy
Electrical System	• Distribution panels	20 – 30 years
	• LED lamps	20,000 – 60,000 hours
	• Fluorescent lamps	5,000 – 10,000 hours
	• Incandescent lamps	1,000 – 1,500 hours
Water Supply and Drainage Systems	• Pipes and valves	15 years
	• Sanitary fixture	25 – 30 years
Air-Conditioning System	• Pipes	15 years
	• Air-conditioning units and exhaust fans	15 years



## 2-5 Project Cost Estimate

### 2-5-1 Estimate of Project Cost and Capital Cost to be borne by the DMH

The required capital cost for the Project to be borne by the DMH has been estimated and is shown in the following tables.

#### Project Cost to be borne by the DMH

Total Project Cost: 142,025,600 kyat (approx. 13.8 Million JP Yen)

Table 71: Estimated Capital Cost to be borne by DMH

No.	Items	Capital Cost (kyat)
1	To carry out vital earth moving particularly on the existing hump (small hilly part) in order to secure enough space for the construction of a new Radar Tower Building in the Kyauk Phyu Meteorological Radar Observation Station.	6,000,000
2	To carry out the graveling of the existing unpaved access road (from the main road to the Kyauk Phyu Meteorological Radar Observation Station) with enough strength and width suitable for the construction of the new Radar Tower Building.	25,000,000
3	To remove the existing radar system/structure in order to prevent it from collapsing due to an earthquake and/or strong wind associated with tropical cyclones especially as the existing Kyauk Phyu Radar Tower Building is obsolete.	5,500,000
4	To renovate the existing Kyauk Phyu Radar Tower Building for the establishment of the staff quarter.	7,000,000
5	To renovate the existing Kyauk Phyu Meteorological Radar Observation Office.	5,000,000
6	To demolish the existing workshop shed in Yangon DMH Compound in order to secure and allocate ample space for the construction of a new Radar Tower Building.	6,000,000
7	To provide the commercial power (440V, 3-phase, 4-wire, 50Hz, capacity: 100kVA) supply (including installation of the required step-down transformer for the commercial power supply) for the Radar Tower Building in Yangon.	20,000,000
8	To provide the commercial power (440V, 3-phase, 4-wire, 50Hz, capacity: 100kVA) supply (including installation of the required step-down transformer for the commercial power supply) for the Radar Tower Building in Mandalay.	20,000,000
9	To provide the public water supply for the Yangon Radar Tower Building.	3,000,000
10	To provide the telephone line for the Yangon Radar Tower Building.	1,000,000
11	To provide the telephone line for the Mandalay Radar Tower Building.	1,000,000
12	To extend the existing boundary lines of the Mandalay DMH Observatory according to the required land extension.	9,000,000
13	To extend the existing observation field fence around the installation location of the Automatic Weather Observation System (AWS) in the existing observation stations which have small size observation field.	19,800,000 (1,320,000/Observatory)
14	To procure mobile SIM card (GSM/GPRS) for transmitting/receiving data observed by the Automatic Weather Observation System (AWS).	7,200,000 (240,000/SIM)
15	To pay bank commission to the Myanmar Foreign Trade Bank (MFTB) for issuance of the Authorization to Pay (A/P) for the Consultant.	1,230,000 (US\$1,500)
16	To pay bank commission to the Myanmar Foreign Trade Bank (MFTB) for amendments of A/P, if required, for the Consultant.	32,800 (US\$40)
17	To pay bank commission to the Myanmar Foreign Trade Bank (MFTB) for issuance of the Authorization to Pay (A/P) for the Contractor.	1,230,000 (US\$1,500)
18	To pay bank commission to the Myanmar Foreign Trade Bank (MFTB) for amendments of A/P, if required, for the Contractor.	32,800 (US\$40)

19	To shoulder dispatching cost of the trainees to the training sites (including AWS sites which are not accessible to foreigners due to security issue); such as daily allowances, transportation fees, accommodation fees.	4,000,000
Total		142,025,600

Applied Exchange Rate: US\$ 1 = 81.06 JP Yen, 1 Kyat = 0.097 JP Yen

The Capital Cost Disbursement Schedule of the DMH is attached hereunder.

Table 72: Capital Cost Disbursement Schedule of DMH

		1	2	3	4	5	6	7	8																																				
<b>Detailed Design</b>																																													
<b>Tendering Procedures</b>																																													
<b>Banking Arrangement</b>																																													
<b>Banking Arrangement for Detailed Design and Project Implementation</b>																																													
Payment of bank commission to the Myanmar Foreign Trade Bank (MFTB) for issuance of the Authorization to Pay (A/P) for the Consultant																																													
										Total: 5.0 months																																			
<b>Project Cost to be borne by DMH</b>																																													
Payment of bank commission to the Myanmar Foreign Trade Bank (MFTB) for issuance of the Authorization to Pay (A/P) for the Contractor																																													
Payment of bank commission to the Myanmar Foreign Trade Bank (MFTB) for amendments of A.P. if required, for the Consultant																																													
Payment of bank commission to the Myanmar Foreign Trade Bank (MFTB) for amendments of A.P. if required, for the Contractor																																													
Dispatching cost of the trainees to the Project sites, such as daily allowance, transportation fee, accommodation																																													
										Total: 19.0 months																																			
<b>Construction Work at Kyaukpadaung Radar Tower Building</b>																																													
<b>Preparation Work</b>																																													
<b>Temporary/Piling/Earth Works</b>																																													
<b>Structure Work</b>																																													
<b>Finishing Works</b>																																													
<b>Building Equipment</b>																																													
<b>External Work</b>																																													
<b>Equipment Manufacturing for Kyaukpadaung</b>																																													
<b>Equipment Transportation for Kyaukpadaung</b>																																													
<b>Equipment Installation/Adjustment for Kyaukpadaung</b>																																													
<b>Project Cost to be borne by DMH</b>																																													
Demolishment of the existing small hump in the Premises of the existing Radar Station																																													
Conduct of graveling or concreting of the unpaved existing access road from the main road to the existing Radar Station																																													
Remove of the existing radar system/structure of the existing Radar Station																																													
Renovation of the existing Radar Station for establishment of the staff quarter																																													
Renovation of the existing Radar Observation Office																																													
										Total: 16.0 months																																			
<b>Multi-Hazard Early Warning Center and Yangon International Airport</b>																																													
<b>Equipment Work for Multi-Hazard Early Warning Center</b>																																													
<b>Equipment Manufacturing for Multi-Hazard Early Warning Center</b>																																													
<b>Equipment Transportation for Multi-Hazard Early Warning Center</b>																																													
<b>Equipment Installation/Adjustment for Multi-Hazard Early Warning Center</b>																																													
<b>Equipment Work for Yangon International Airport</b>																																													
<b>Equipment Manufacturing for Yangon International Airport</b>																																													
<b>Equipment Transportation for Yangon International Airport</b>																																													
<b>Equipment Installation/Adjustment for Yangon International Airport</b>																																													
<b>Project Cost to be borne by DMH</b>																																													
Contract with VSAT Space Segment Provider																																													
										Total: 13.5 months																																			
<b>Automatic Weather Observation Systems (AWS)</b>																																													
<b>Equipment Work for AWS</b>																																													
<b>Equipment Manufacturing for AWS</b>																																													
<b>Equipment Transportation for AWS</b>																																													
<b>Equipment Installation/Adjustment for AWS</b>																																													
<b>Project Cost to be borne by DMH</b>																																													
Extension of the existing observation field fence around the installation location of Automatic Weather Observation Systems (AWS) in the existing observation stations which have a small size observation field																																													
Procurement of mobile SIM card (GSM/GPRS) for transmitting/receiving data observed by Automatic Weather Observation Systems (AWS)																																													
										Total: 23.0 months																																			
<b>Construction Work at Yangon Radar Tower Building</b>																																													
<b>Preparation Work</b>																																													
<b>Temporary/Piling/Earth Works</b>																																													
<b>Structure Work</b>																																													
<b>Finishing Works</b>																																													
<b>Building Equipment</b>																																													
<b>External Work</b>																																													
<b>Equipment Manufacturing for Yangon</b>																																													
<b>Equipment Transportation for Yangon</b>																																													
<b>Equipment Installation/Adjustment for Yangon</b>																																													
<b>Project Cost to be borne by DMH</b>																																													
Demolishment of the existing (workshop) shed in the Premises of the Yangon DMH Compound																																													
Provision of the commercial power (440V, 3-phase, 4-wire, 50Hz, capacity: 100kVA) supply (including installation of the required step-down transformer for the commercial power supply) for Radar Tower Building																																													
Provision of the public water supply for Radar Tower Building																																													
Provision of the telephone line for Radar Tower Building																																													
										Total: 20.0 months																																			
<b>Construction Work at Mandalay Radar Tower Building</b>																																													
<b>Preparation Work</b>																																													
<b>Temporary/Earth Works</b>																																													
<b>Structure Work</b>																																													
<b>Finishing Works</b>																																													
<b>Building Equipment</b>																																													
<b>External Work</b>																																													
<b>Equipment Manufacturing for Mandalay</b>																																													
<b>Equipment Transportation for Mandalay</b>																																													
<b>Equipment Installation/Adjustment for Mandalay</b>																																													
<b>Project Cost to be borne by DMH</b>																																													
Provision of the commercial power (440V, 3-phase, 4-wire, 50Hz, capacity: 100kVA) supply (including installation of the required step-down transformer for the commercial power supply) for Radar Tower Building																																													
Provision of the telephone line for Radar Tower Building																																													
Extension of the existing boundary wall of the Mandalay DMH Observatory																																													

## 2-5-2 Estimate of Recurrent Cost for the Project to be borne by Myanmar

### (1) Recurrent Cost to be borne by the DMH

The annual recurrent costs considered as 3% of the annual inflation rate to be borne by the DMH for the first decade after the completion of the Project are attached hereunder. The recurrent costs have been calculated in accordance with the following fundamental conditions.

- Operation and maintenance to be carried out by the DMH
- Appropriate operation in accordance with the operations manuals
- Regular and proper maintenance according to the maintenance manuals

Table 73: Recurrent Cost of DMH Multi Hazard Early Warning Center in Nay Pyi Taw

#### Recurrent Cost of DMH Multi Hazard Early Warning Center in Nay Pyi Taw

##### Estimated Recurrent Cost

Equipment	Item	Qty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
1 Product Monitor	Hard disk	9	0	0	0	2,613,803	0	0	0	2,941,858	0	0	Every 4 years
	CD for archiving product data (20 sheets/1set)	2	33,333	34,333	35,363	36,424	37,517	38,643	39,802	40,996	42,226	43,493	
2 Printer	Printer ink cartridge	4	148,148	152,593	157,171	161,886	166,743	171,745	176,897	182,204	187,670	193,300	
	Paper (500 sheets/1set)	2	8,148	8,393	8,645	8,904	9,171	9,446	9,729	10,021	10,322	10,632	
3 Compact UPS	Battery	10	0	0	82,514	0	0	90,165	0	0	98,526	0	Every 3 years
4 SLVA UPS	Battery	1	0	0	214,323	0	0	234,197	0	0	255,913	0	Every 3 years
5 Diesel Engine Generator	Oil seal and filter	2	0	32,807	186,640	34,805	198,006	36,925	210,065	39,174	222,888	41,560	Every 1 and 2 years
	Battery for Engine start	2	0	0	0	0	0	71,274	0	0	0	80,220	Every 5 years
Sub total (Kyat)			189,630	195,519	498,016	2,821,017	213,431	544,196	226,428	3,175,079	594,657	247,425	

##### Others

Cost Item	Details	Qty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
1 Electricity Charge		1	2,062,192	2,124,057	2,187,779	2,253,412	2,321,014	2,390,644	2,462,363	2,536,234	2,612,321	2,690,691	*1
2 Fuel cost	Fuel consumption of DEG	1	405,588	417,756	430,289	443,198	456,494	470,189	484,295	498,824	513,789	529,203	*2
3 VSAT Communication Cost	Space Segment for VSAT communication	1	11,921,700	12,279,351	12,647,732	13,027,164	13,417,979	13,820,518	14,235,134	14,662,188	15,102,054	15,555,116	*3
4 GSM Communication Cost	AWS Observation Data Transmission	1	13,140,000	13,534,200	13,940,226	14,358,433	14,789,186	15,232,862	15,689,848	16,160,543	16,645,359	17,144,720	*4
5 Internet Cost	Internet Connection	1	25,000	25,750	26,523	27,319	28,139	28,983	29,852	30,748	31,670	32,620	*4
6 Daily Allowance	For Quick Response Team (travels for 70 days/year)	1	77,000	79,310	81,689	84,140	86,664	89,264	91,942	94,700	97,541	100,467	
7 Transport	Car, Bus, Train, Air, etc. for Quick Response Team	1	729,900	751,797	774,351	797,582	821,509	846,154	871,539	897,685	924,616	952,354	
8 Special Maintenance	System brush-up by manufacturer's engineer	1	0	0	6,522,570	0	0	7,127,388	0	0	7,788,289	0	For 5 days at site
Sub total (Kyat)			28,361,380	29,212,221	36,611,159	30,991,248	31,920,985	40,006,002	33,864,973	34,880,923	43,715,639	37,005,171	
Total (Kyat)			28,551,009	29,407,540	37,109,175	33,812,265	32,134,416	40,550,198	34,091,401	38,056,001	44,310,296	37,252,596	
Total (JPY)			¥2,855,101	¥2,940,754	¥3,710,918	¥3,381,227	¥3,213,442	¥4,055,020	¥3,409,140	¥3,805,600	¥4,431,030	¥3,725,260	

##### Estimate of annual electricity charge

Annual operation hours of Radar System	(H)	8,760
Annual operation hours of Radar System by DEG	(H)	438
Annual operation hours of Radar System by commercial power	(H)	8,322

Annual power consumption of commercial power	(kWh)	58,920
Annual power consumption of DEG	(kWh)	3,101
Annual fuel consumption	(L)	775

*1 Annual electricity charge of commercial power	(Kyat)	2,062,192
*2 Annual fuel cost of DEG	(Kyat)	405,588
*3 Annual Space Segment fee	(USD)	13,860
*4 Annual AWS Observation Data Transmission Cost (50 Kyat/Text Message)	(Kyat)	13,140,000

Power consumption = 7.08 KW

Fuel consumption of DEG = 0.25 L/kWh

Electrical charge = 35.0 Kyat/kWh

Fuel cost = 926 Kyat/L

Exchange rate = 10.0 Kyat/JPY

Exchange rate = 811 Kyat/USD



Table 76: Recurrent Cost of Mandalay Meteorological Radar Observation Station

Recurrent Cost of Mandalay Meteorological Radar Observation Station

Estimated Recurrent Cost														
Equipment	Item	Qty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks	
1	Antenna	Grease (For AZ/EL)	1	0	0	0	0	20,919	0	0	0	24,251	16kg/year, Every 5 years	
		Timing belt (For AZ/EL)	2	0	0	0	0	0	0	200,424	0	0	Every 8 years	
2	Antenna controller	AC fan	3	0	0	0	0	0	0	0	0	483,249	Every 10 years	
3	Transmitter/Receiver	AC fan	24	0	0	0	0	0	0	0	0	3,865,995	Every 10 years	
4	Receiver	AC fan	3	0	0	0	0	0	0	0	0	483,249	Every 10 years	
5	Product Monitor	Hard disk	5	0	0	0	7,260,564	0	0	8,171,829	0	0	Every 4 years	
		CD for data storage (20 sheets/Isst)	1	16,667	17,167	17,682	18,212	18,758	19,321	19,901	20,498	21,113	21,746	
6	Printer	Printer ink cartridge	2	74,074	76,296	78,585	80,943	83,371	85,872	88,448	91,101	93,834	96,649	
		Paper (500 sheets/Isst)	1	4,074	4,196	4,322	4,452	4,586	4,724	4,866	5,012	5,162	5,317	
7	Compact UPS	Battery	6	0	0	495,087	0	0	540,995	0	0	591,160	Every 3 years	
8	Emergency Power Back-up Unit	Battery	1	0	0	0	0	0	0	9,729,315	0	0	Every 7 years	
9	Electric Double Layer Capacitor type UPS	AC fan	3	0	0	0	0	0	0	0	0	483,249	Every 10 years	
		Arrester (6 sets)	1	0	0	0	0	0	0	0	0	212,630	Every 10 years	
10	Diesel Engine Generator	Oil seal and filter	2	0	32,807	186,640	34,805	198,006	36,925	210,065	39,174	222,858	41,560	Every 1 and 2 years
		Battery for Engine start	2	0	0	0	0	0	71,274	0	0	80,220	Every 5 years	
Sub total (Kyat)				94,815	130,466	782,316	7,398,976	325,640	759,111	10,052,595	8,528,038	934,127	5,798,115	

Others

Cost Item	Details	Qty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
1	Electricity Charge		1,807,343	1,861,564	1,917,411	1,974,933	2,034,181	2,095,206	2,158,062	2,222,804	2,289,488	2,358,173	*1
2	Fuel cost	Fuel consumption of DEG	1	2,109,580	2,172,867	2,238,053	2,305,195	2,374,351	2,445,582	2,518,949	2,594,517	2,672,353	*2
3	Special maintenance	System brush-up by manufacture's engineer	1	0	0	6,522,570	0	0	7,127,388	0	0	7,788,289	0
4	Daily Allowance	For Quick Response Team (travels for 20 days/year)	1	22,000	22,660	23,340	24,040	24,761	25,504	26,269	27,057	27,869	28,705
5	Transport	Car, Bus, Train, Air, etc. for Quick Response Team	1	194,640	200,479	206,493	212,688	219,069	225,641	232,410	239,382	246,563	253,960
6	Radome	Caulking repair	1	81,481	83,926	86,444	89,037	91,708	94,459	97,293	100,212	103,218	106,315
7	Pest-control	Exterminating vermination	1	185,185	190,741	196,463	202,357	208,428	214,681	221,121	227,755	234,588	241,626
8	Internet Cost	Internet Connection	1	25,000	25,750	26,523	27,319	28,139	28,983	29,852	30,748	31,670	32,620
Sub total (Kyat)				4,425,230	4,557,987	11,217,297	4,835,569	4,980,637	12,257,444	5,283,956	5,442,475	13,394,038	5,773,923
Total (Kyat)				4,520,045	4,688,453	11,999,613	12,234,545	5,306,277	13,016,555	15,336,551	13,970,513	14,328,165	11,572,038
Total (JPY)				¥452,004	¥468,845	¥1,199,961	¥1,223,455	¥530,628	¥1,301,656	¥1,533,655	¥1,397,051	¥1,432,817	¥1,157,204

Estimate of annual electricity charge

Annual operation hours of Radar System	(H)	2,932
Annual operation hours of Radar System by DEG	(H)	440
Annual operation hours of Radar System by commercial power	(H)	2,492
Annual power consumption of commercial power	(kWh)	51,638
Annual power consumption of DEG	(kWh)	9,113
Annual fuel consumption	(L)	2,278

Power consumption= 20.72 KW

Fuel consumption of DEG= 0.25 L/kWh

\*1 Annual electricity charge of commercial power (Kyat) 1,807,343

Electrical charge= 35.0 Kyat/kWh

\*2 Annual fuel cost of DEG (Kyat) 2,109,580

Fuel cost= 926 Kyat/L

Exchange rate= 10.0 Kyat/JPY

Table 77: Recurrent Cost of Air Traffic Control Tower in Yangon International Airport

Recurrent Cost of Air Traffic Control Tower in Yangon International Airport

Estimated Recurrent Cost													
Equipment	Item	Qty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
1	Product Monitor	Hard disk	5	0	0	0	1,452,113	0	0	1,634,366	0	0	Every 4 years
		CD for archiving product data (20 sheets/Isst)	2	33,333	34,333	35,363	36,424	37,517	38,643	39,802	40,996	42,226	43,493
2	Printer	Printer ink cartridge	4	148,148	152,593	157,171	161,886	166,743	171,745	176,897	182,204	187,670	193,300
		Paper (500 sheets/Isst)	2	8,148	8,393	8,645	8,904	9,171	9,446	9,729	10,021	10,322	10,632
3	Compact UPS	Battery	8	0	0	660,116	0	0	721,327	0	0	788,213	Every 3 years
Sub total (Kyat)				189,630	195,319	861,295	1,659,327	213,431	941,161	226,428	1,867,587	1,028,431	247,425

Others

Cost Item	Details	Qty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
1	Electricity Charge		442,722	456,004	469,684	483,775	498,288	513,237	528,634	544,493	560,828	577,653	*1
Sub total (Kyat)				442,722	456,004	469,684	483,775	498,288	513,237	528,634	544,493	560,828	577,653
Total (Kyat)				632,352	651,323	1,330,979	2,143,102	711,719	1,454,398	755,062	2,412,080	1,589,259	825,078
Total (JPY)				¥63,235	¥65,132	¥133,098	¥214,310	¥71,172	¥145,440	¥75,506	¥241,208	¥158,926	¥82,508

Estimate of annual electricity charge

Annual operation hours of Radar System	(H)	4,980
Annual operation hours of Radar System by commercial power	(H)	4,980
Annual power consumption of commercial power	(kWh)	12,649

Power consumption= 2.54 KW

\*1 Annual electricity charge of commercial power (Kyat) 442,722

Electrical charge= 35.0 Kyat/kWh

Exchange rate= 10.0 Kyat/JPY

811 Kyat/USD

(2) Annual Budget Trends

The estimated recurrent cost of the DMH is only approximately 2-3% of the total amount of the DMH budget. In addition, the DMH, under the supervision of the Ministry of Transport, has committed to the Preparatory Survey Team to allocate the required budget for the Project. Therefore, it has been assessed that there is no problem in this regard.

Table 78: Movement of DMH Annual Budget

Year (April-March)	Budget (Thousand Kyat)	Comparison with the previous year (%)
2008	725,177	-
2009	916,853	126.4
2010	954,192	104.1
2011	1,030,959	108.0
2012	2,116,145	205.3