CHAPTER 6

RECOVERY PLAN OF MAIN INLAND WATER TRANSPORT

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6.1 SITUATION OF MAIN INLAND WATER TRANSPORT

6.1.1 CARGO AND PASSENGER TRANSPORT

As of 2009 IWT Delta Division operated 16 long distance inland waterway routes by own passenger/cargo ships and 5 short crossing routes by RoRo and passenger ships as shown in Table 6.1.1.

Table 6.1.1 Inland Water Transport Networks

No.	Route	Ports of calls	Frequency	Distance (miles)
1	Yangon-Phyarpon (Day)	Yangon - Kyelkhtaw - Kyeikat - Phyarpon	3 trips/week	64
2	Yangon-Phyarpon (Night)	Yangon - Kyelkhtaw - Kyeikat - Phyarpon	Daily	64
3	Yangon-Bogalay	Yangon - Kyelkhtaw - Kyeikat - Mawkhhyun - Bogalay	2 trips/day	87
4	Yangon – Bogalay (Special)	Yangon - Bogalay	2 trips/ week	87
5	Yangon – Mawkhyun	Yangon - Kyekat - Kyeiktaw - Mawkhyun	Daily	100
6	Yangon – Laputta (I.R)	Yangon - Maubin - Kanbet - Labutta	3 trips/week	168
7	Yangon – Laputta (O.R)	Yangon – Maubin - Wakaema - Miyaungmy - Kyarkan - Labutta	2 trips/ week	171
8	Yangon – Laputta (Special)	Yangon - Labutta	2 trips/ week	171
9	Yangon- Myaungmya	Yangon - Maubin - Wakeame - Miyaungmya	Daily	135
10	Yangon – Pathine (night)	Yangon – Maubin - Wakaema - Miyaungmy - Pathine	Daily	172
11	Yangon - Khyungon	Yangon - Khyungon	4 trips/week	110
12	Yangon - Eainme	Yangon - Eainme	2 trips/week	105
13	Yangon - Khoanmanga	Yangon - Khoanmanga	4 trips/week	105
14	Pathine- Ngathainegyaung	Pathine - Ngathaingyaung	2 trips/week	77
15	Hinthata - Phyarpon	Hinthata - Pyarpon	2 trips/week	152
16	Yangon – Pyay	Yangon - Pyay	2 trips/week	263
Short Crossing				
17	Yangon - Kanaungto	Yangon - Kanaungto	10 trips/day	5
18	Yangon - Dalla	Yangon - Dalla	46 trips/day	3
19	Wardan – Dalla (RoRo)	Warden - Dalla	7 trips/day	3
20	Sint O Tan - Shaparchaung	Sint O Tan - Shaparchaung	12 trips/day	3
21	Wardan - Seikgyi	Wardan - Seikgyi	2 trips/day	3

Source: IWT

The Main Inland Water Transport service routes in the Delta Division are shown below;

1) Yangon – Bogale,
2) Yangon – Pharpon,
3) Yangon – Mawlamynegyun, and
4) Yangon – Labutta.

Cargo and passenger volume transported by IWT ships from FY2004/05 to 2008/09 along these 4 service routes are shown in Table 6.1.2.

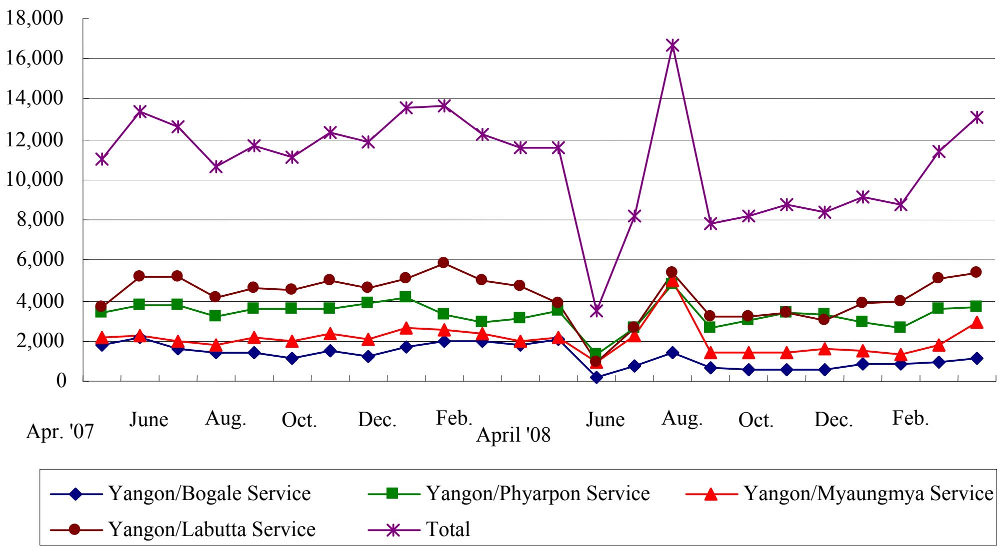
Generally, cargo volume handled by IWT ships has decreased since FY 2004/05 in the Delta Division. A modal shift of cargo transport from the inland water transport to the land transport was observed due to the development of the road network in the region. Significant drop of cargo and passenger transport was observed for the Yangon – Bogale service route where the damage by Nargis was comparatively serious.

Table 6.1.2 Cargo and Passenger Volume of the Major Service Routes (FY2004 to FY2008)

Year/Route	Yangon - Bogale		Yangon - Pharpon		Yangon - Mawlamynegyun		Yangon - Labutta	
	Cargo (ton)	Passenger	Cargo (ton)	Passenger	Cargo (ton)	Passenger	Cargo (ton)	Passenger
FY 2004/05	20.048	180,417	58,364	379,991	49,357	583,759	83,752	157,638
FY 2005/06	13,931	180,377	51,733	397,940	37,119	517,335	55,346	227,410
FY 2006/07	19,296	172,248	50,313	388,666	26,410	405,864	48,172	193,016
FY 2007/08	19,678	132,606	42,221	298,144	26,279	331,088	57,651	198,782
FY 2008/09	10,496	72,997	37,367	282,316	23,789	326,688	43,788	189,249

Source: IWT

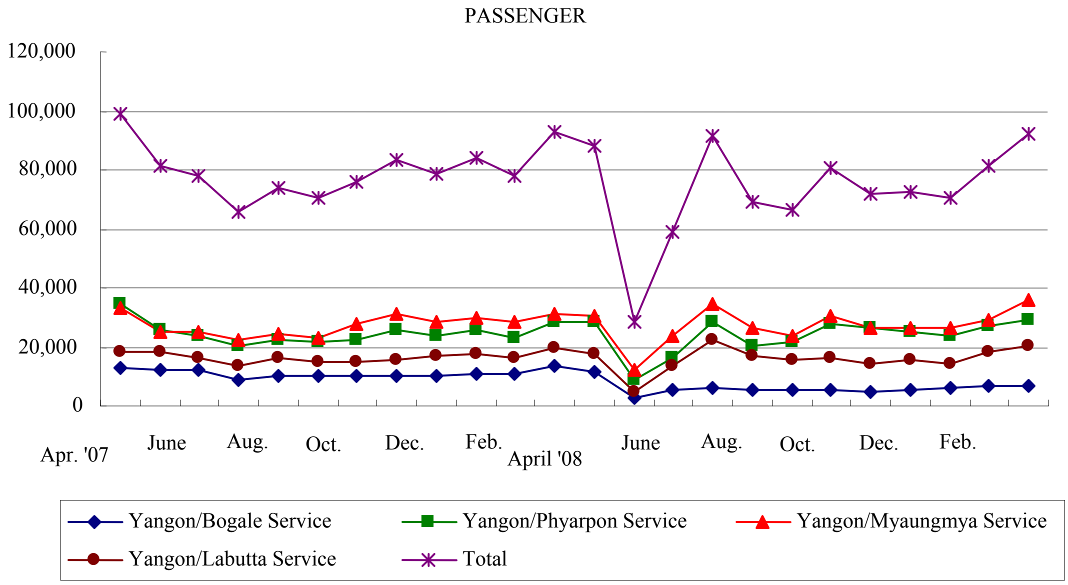
Figure 6.1.1 shows monthly movement of cargo volume for the 4 service routes. The cargo volume dropped to a low of 4,000 tons in May 2008. In the months between August 2008 and January 2009, the cargo volume recovered, ranging between 8,000 - 9,000 tons (65 – 75% of the level before Nargis). The cargo volume then exceeded 12,000 tons in March 2009. As far as cargo volume of the main inland water transport is concerned, it fully recovered to the pre-Nargis level and significant bottleneck of inland water transport could not be observed.



Source: IWT

Figure 6.1.1 Monthly Movement of Cargo Volume Transported by IWT Ships

Similarly, Figure 6.1.2 shows monthly movement of passenger traffic in the main inland waterways in the Delta Division. The passenger volume recovered two months after Nargis and exceeded the pre-Nargis record in February 2009. However, the passenger traffic of Yangon - Bogale service route remained at a lower level compared with the pre-Nargis volumes. The road facilities in the region have developed very rapidly and road travel time on this route becomes less than a half of that by IWT ships, thus it seems that there has been a significant shift to road transport.



Source: IWT

Figure 6.1.2 Monthly Movement of Passenger Traffic Transported by IWT Ships

6.1.2 INLAND WATER TRANSPORT FACILITIES

(1) General

Roles of the inland water transport which are expected to support the development of Myanmar are as below;

- To provide public services which support the daily life of the population of the Delta Areas.
- To provide traffic infrastructure that will be operated and managed by private sectors based on market economy principles.

IWT is operating cargo ship and passenger ferry services mainly between Yangon and the Delta Areas as a public service.

The Directorate of Water Resources and Improvement of River Systems (DWIR) under the Ministry of Transport is responsible for the establishment and maintenance of inland water transport facilities. DWIR maintains signal and control stations at the waterways, in particular at Twan Tay Canal where DWIR staff monitors water level, current speed and erosion of river banks.

The condition of inland waterways was not surveyed sufficiently and necessary information for the convenience of ship operators such as water depth and current flow along the most of inland waterway sections has not been provided due to budget constraints.

Night navigation is common for IWT ships in the main inland waterways, however, the number of navigation aids and information boards are insufficient.

(2) Facilities at Yangon Port

1) Jetty

IWT is a governmental organization which belongs to the Ministry of Transport to operate inland transport services. IWT uses jetties owned by MPA in Yangon Port for cargo ship and passenger ferry operation.

Before Nargis attacked Yangon Port, IWT had used 2 jetties for cargo ships and 5 jetties for passenger/cargo ferries. Nargis destroyed 3 jetties. One jetty was quickly restored but 3 jetties remained damaged as of June 2009 as shown in Table 6.1.3.

Table 6.1.3 Status of IWT Jetties in Yangon Port

No.	Cargo/Passenger	Name of Jetty	Before Nargis	Damaged by Nargis	Use as of June 2009
1	Cargo	Botahtaung No.5	○	○	
2	Cargo	Botahtaung No.6	○	○	
3	Cargo	Botahtaung No.3			○
4	Passenger/Cargo	Shwetaungdan 1&2	○		○
5	Passenger/Cargo	Phonegyilan 1	○	○	
6	Passenger/Cargo	Hledan 1	○		○
7	Passenger/Cargo	Hledan 2	○		○
8	Passenger/Cargo	Kaidan 1	○		○
	Total		**7**	**3**	**5**

Source: JICA Project Team

Source: JICA Project Team

Photo 6.1.1 Damaged Botahtaung Jetty

Photo 6.1.2 Damaged Phonegyilan Jetty

2) Buoy

IWT used 10 mooring buoys owned by MPA. 7 buoys out of 10 were sunk due to Nargis. These mooring buoys played a very important role for the safe operation of the IWT fleet.

Eight buoys were restored in a short period of time, however due to the strong current of the Yangon River, IWT needs 10 mooring buoys for safe mooring.

Source: JICA Project Team

Photo 6.1.3 Cargo Ships Moored at Mooring Buoy

(3) Landing Stations at Delta Area

IWT maintains 16 stations where the landing pontoons are provided in the 4 main inland waterways. Station pontoons are provided by IWT where the passenger and cargo traffic are significant. Responsibility of establishing station pontoon is under the development committee of respective townships. Township shall bear all necessary cost of installing station pontoons which includes cost of anchors, boarding boards or access bridges as well as sponsons.

Four station pontoons were damaged by Nargis, but operation resumed at all 16 landing stations in a short period of time. Thus, no urgent restoration work was needed for station pontoons.

Table 6.1.4 IWT Main Landing Stations in the Delta Area

No	Name	No	Name	No	Name	No	Name
1	Twan Tay	5	Bogale	9	Wakaema	13	Kyarkan
2	Kyeikhtaw	6	Mawlamyenegyun	10	Sagamya	14	Labutta
3	Kyeiklat	7	Maubin	11	Mayaungmya	15	Kanbet
4	Phyarpon	8	Shwe Laung	12	Pathein	16	Kyonemange

Source: JICA Project Team

6.1.3 IWT FLEET AND ITS DAMAGE

IWT operates both passenger and cargo waterborne transport. There are two types of passenger ferries, the so-called 2 decker and 3 decker and one type of cargo ship as shown in Table 6.1.5, Photo 6.1.4 and Photo 6.1.5 respectively.

Table 6.1.5 Particulars of Ferries and Cargo Ship

Type	Dimension (m)			Capacity		Engine		Average
	L	B	D	Passenger	Cargo (ton)	(HP)	Nos. of Eng	Speed (Knots)
2 Decker	28.5	6.6	2.2	280	50	195	1	7.5
3 Decker	28.5	6.6	2.2	735	350	297	1	8.0
Cargo	56.0	10.3	2.6	0	508	250	1	5.0

Source: IWT

Source: JICA Project Team

Photo 6.1.4 IWT Passenger Ferry (3 Decker) Photo 6.1.5 IWT Passenger Ferry (2 Decker)

IWT fleet was damaged heavily by Nargis. Table 6.1.6 shows the size of the fleet before and after Nargis. Before Nargis, IWT operated 308 powered ships, but after Nargis only 276 ships were in operation.

Table 6.1.6 Condition of IWT Fleet and Pontoon before and after Nargis

IWT Division	Powered Ship			Non Powered Barge		Sub Total		Station Pontoon		**Total**		
	Before	After	Ratio (%)	Before	After	Before	After	Before	After	**Before**	**After**	**Ratio (%)**
Cargo Div.	96	90	93.8	123	131	219	221			**219**	**221**	**100.9**
Delta Div.	93	71	76.8	1	1	94	74	25	28	**119**	**100**	**84.0**
Ayeyar Div.	46	46	100.0	25	18	71	64	8	9	**79**	**73**	**92.0**
Chindwin Div.	27	27	100.0	4	4	31	31	1	1	**32**	**32**	**100.0**
Thanlwin Div.	20	20	100.0			20	20	6	6	**26**	**26**	**100.0**
Rakhaine Div.	26	22	84.6			26	22	3	3	**29**	**25**	**86.2**
G. Total	**308**	**276**	**89.6**	**153**	**154**	**461**	**432**	**43**	**47**	**504**	**477**	**94.6**

Source: IWT, Before: Before Nargis 31st March 2008, After: After Nargis 31st May 2009

Number of ships by type of damage is listed in Table 6.1.7. Among the damaged passenger/cargo ships 15 were sunken and 6 stranded. 121 ships of IWT fleet were heavily damaged and 40 ships were sunken. 32 ships were stranded and 49 ships were damaged by the collisions between ship or other obstacles.

Table 6.1.7 Number of IWT Ships under each Damage Category

Type	Sunken	Stranded	Collided	**Total**
Passenger /Cargo Ship	15	6	23	**44**
Cargo Ship	2	4	8	**14**
RoRo Ship	2	3	2	**7**
Barge/Oil Barge	8	9	8	**25**
Powered Tug	10	10	7	**27**
Pontoon	2	0	1	**3**
Others (Work boat)	1	0	0	**1**
Total	**40**	**32**	**49**	**121**

Source: IWT

Almost all ships were over 20 years old. As for powered ships, 173 ships (62%) were over 41 years out of the total number of 278 as shown in Table 6.1.8. The aging of the IWT fleets continues. Under the emergency situation, some ships which were under repair works or partly scrapped had to be deployed.

Table 6.1.8 Age of IWT Ships and Pontoons

No.	Age of Ship	Powered	Non-powered	Pontoon	**Total ships**
1	From 1 year to 20 years	71	43	18	**132**
2	From 21 years to 40 years	34	33	12	**79**
3	From 41 years and above	173	75	17	**265**
Total		**278**	**151**	**47**	**476**

Source: IWT

6.1.4 IWT DOCKYARDS

There are two dockyards owned by IWT in Yangon Port, namely Dalla Dockyard and Ahlone Dockyard.

Dalla dockyard is the largest one with 13 slipways and one graving dock with a maximum capacity of 1,400 DWT ships. Building, repair and periodical inspection of all type of ships are conducted at this dockyard. Ships larger than 250 DWT are docked in this yard.

Ahlone dockyard is used in ship repair, periodical inspection and new building of smaller ships and barges below 250 DWT.

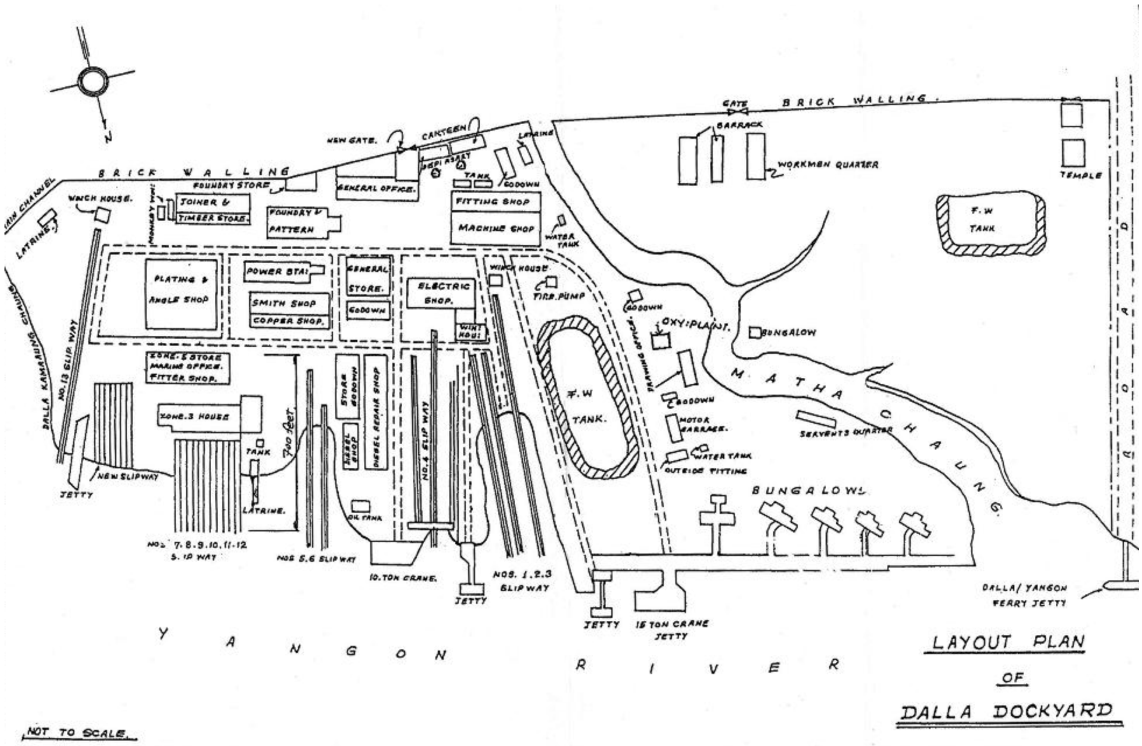
The activities of the two dockyards are elaborated in the following section.

(1) Dalla Dockyard

Dalla dockyard is located at Dalla township on the opposite side of Yangon City over the Yangon River. The yard is used mainly for ship repair and periodical maintenance of IWT ships. The layout and photo of the dockyard are shown in Figure 6.1.3 and Photo 6.1.6.

Source: JICA Project Team

Photo 6.1.6 Dalla Dockyard



Source: IWT

Figure 6.1.3 Layout of Dalla Dockyard

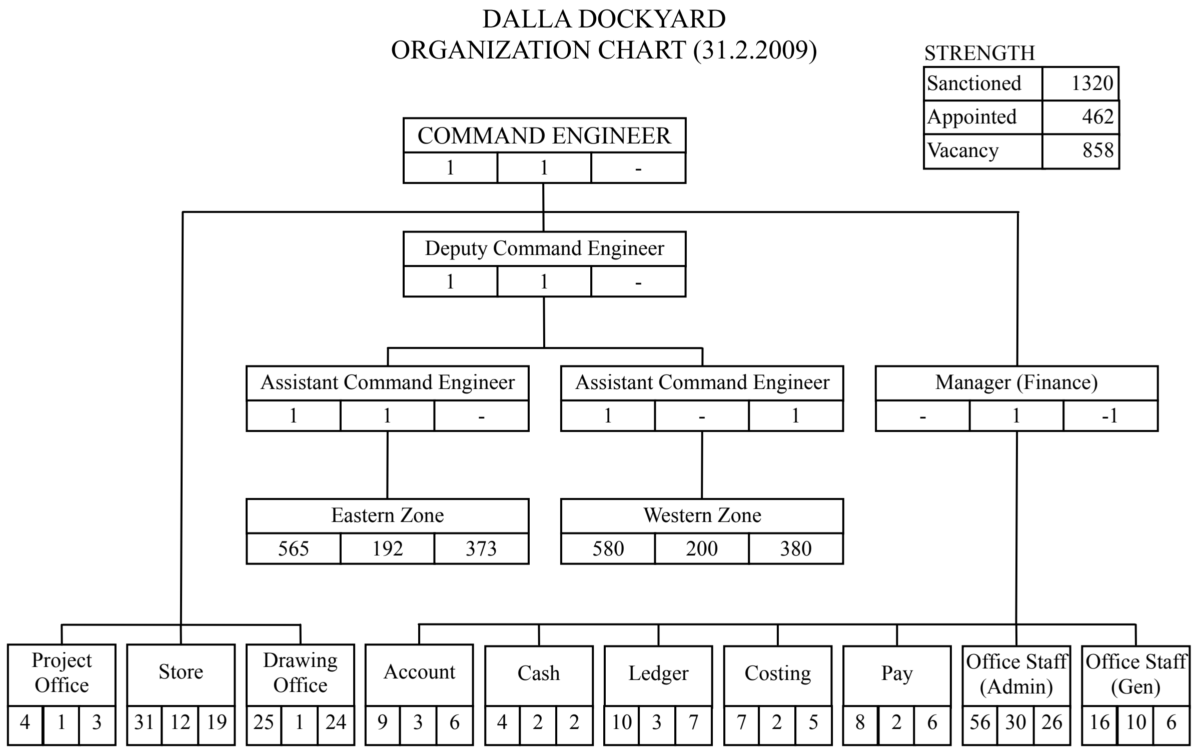
Dalla Dockyard is managed by the Engineering Division of IWT of which organization is shown in Figure 6.1.4. Total number of staff appointed as of February 2009 was 462 permanent staff including 10 engineers though the required number of staff was 1,320. Shortage of staff is observed mainly in the Engineering Division where the positions of more than a half of the required skilled laborers were vacant due to lack of manpower resources.

The Engineering Division is subdivided into two zones, one for Eastern Zone and another for Western Zone, covering their responsibility of their designated slipways as shown in Table 6.1.9.

Table 6.1.9 Designated Slipways of Each Engineering Division and Status of Staff Required

Zone	Slipway/Dock	Number of Staff as of February 2009			
		Required	Filled	Vacant	% of Vacancy
Eastern Zone	No.5~No.14 Slipway	565	192	373	66
Western Zone	No.1~3 Slipway and Graving Dock	580	200	380	66

Source: IWT



Source: IWT

Figure 6.1.4 Dalla Dockyard Organization Chart

Major facilities of Dalla dockyard are;

- Docking facility
- Hull repair facility
- Machine workshop
- Foundry shop
- Oxygen plant
- NC Cutting Machine

There are 13 slipways and one graving dock on the premises. Their capacity and construction year are shown in Table 6.1.10.

Table 6.1.10 Slipway and Dock Facility of Dalla Dockyard

Name	Docking Capacity	Winch Pull	Year Built	Remarks
No. 1 Slipway	Ship Length = 200 ft Displacement = 274 ton	38 ton	1908	
No. 2 Slipway	Ship Length = 100 ft Displacement = 205 ton	15.5 ton	1898	
No. 3 Slipway	Ship Length = 100 ft Displacement = 205 ton	15.5 ton	1898	
No. 4 Graving Dock	Ship Length = 300 ft Displacement = 1,400 ton	None	2001	
No. 5 Slipway	Ship Length=80 ft Displacement=125 ton	10 ton	1890	Under repair
No. 6 Slipway	Ship Length = 80 ft Displacement = 125 ton	10 ton	1890	
No. 7, 8, 9, 10, 11, 12 Slipway	Ship Length =250 ft Displacement = 468 ton	58 ton	1900	Side slipway
No. 13 Slipway	Ship Length =120 ft Displacement ton = 125 ton	None	1963	Side slipway
No. 14 Slipway	Ship Length = 200 ft Displacement = 274 ton	36 ton	1921	

Source: IWT

A hull repair facility and machine workshop are located behind the slipways. Details of the hull repair facility and the machine workshop are described in Appendix C.3.1.

To handle heavy materials and equipment, lifting and transport equipment which is shown in Table 6.1.11 is provided by Dalla Dockyard.

Table 6.1.11 Heavy Materials Handling Equipment

No.	Name	Capacity	Qty	Remarks
1	Jetty Crane	15 ton	1	
2	Mobile Crane	25 ton	1	
3	Mobile Crane	12 ton	2	
4	Folk Lift	10 ton	2	
5	Folk Lift	3 ton	1	
6	Truck	10 ton	1	Not serviceable
7	Truck	3 ton	2	
8	Truck	2 ton	1	

Source: IWT

According to the IWT implementation plan for the year of 2008-2009, Dalla dockyard was scheduled to conduct 125 major ship repairs including annual inspection and 250 minor repairs. However, due to the severe damage inflicted on the IWT fleet by Nargis, it was re-scheduled as priority was given to the repair of damaged ships and pontoons.

121 ships were damaged by Nargis. The progress of repair works of damaged IWT fleet is shown in Table 6.1.12.

Table 6.1.12 Progress of Repair Works of Damaged IWT Fleet (as of the end of December 2009)

Type	Damaged Total	Repair Completed			Waiting and Under Repair			To be Scrapped	
		2009.05	2009.09	2009.12	2009.05	2009.09	2009.12	2009.07	2009.12
Passenger Cargo Ship	44	29	30	30	7	5	5	9	9
Cargo Ship	14	12	12	12	1	1	1	1	1
RoRo Ship	7	5	5	7	2	2	0	0	0
Barge/Oil Barge	25	19	22	24	5	2	0	1	1
Powered Tug	27	17	18	18	8	6	3	3	6
Pontoon	3	2	2	2	1	1	0	0	1
Others	1	0	1	1	1	0	0	0	0
Total	**121**	**84**	**90**	**94**	**25**	**17**	**9**	**14**	**18**

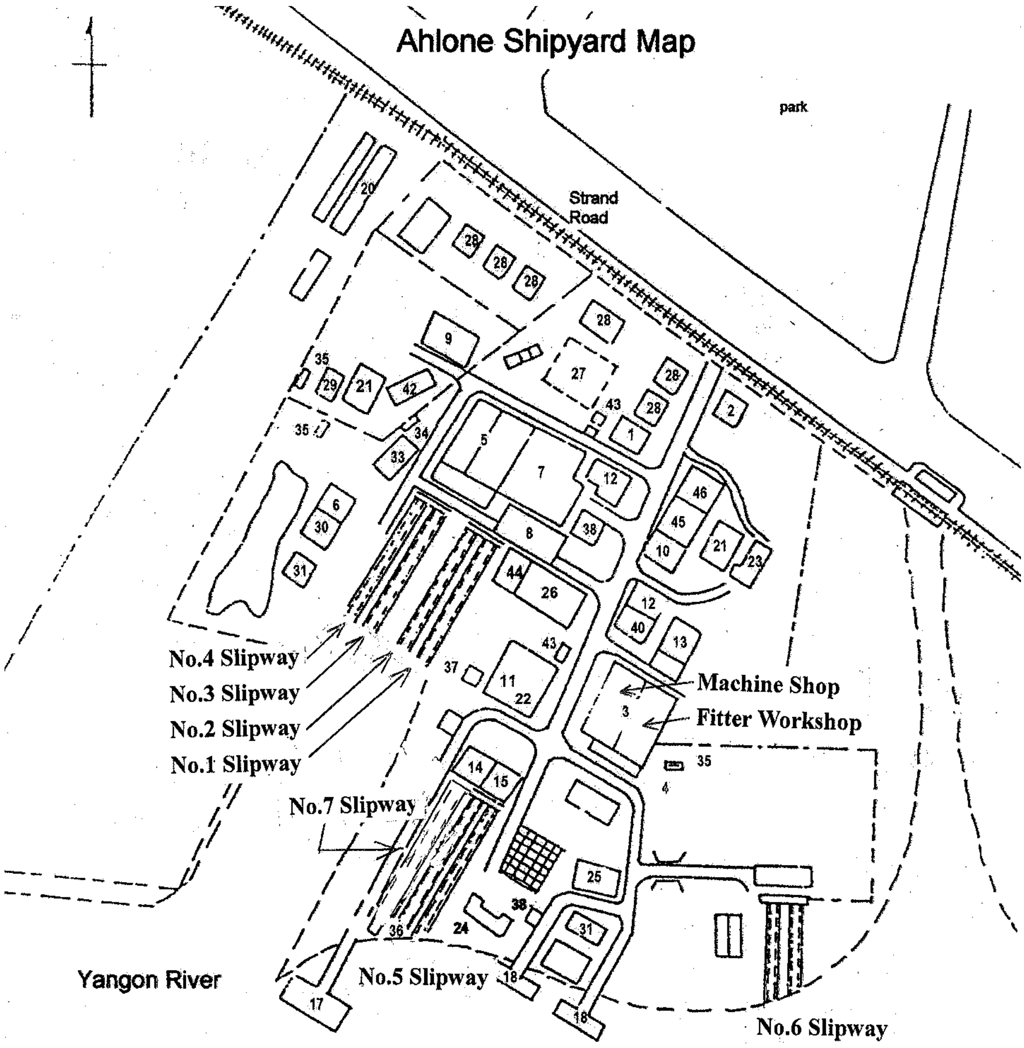
Type	Damaged Total	Repair Completed			Waiting and Under Repair			To be Scrapped	
		2010.04	2010.07		2010.04	2010.07		2010.04&07	
Passenger Cargo Ship	44	30	30		5	5		9	
Cargo Ship	14	12	12		1	1		1	
RoRo Ship	7	7	7		0	0		0	
Barge/Oil Barge	25	24	24		0	0		1	
Powered Tug	27	19	20		2	1		6	
Pontoon	3	2	2		0	0		1	
Others	1	1	1		0	0		0	
Total	**121**	**95**	**96**		**8**	**7**		**18**	

Source: IWT

(2) Ahlone Dockyard

Ahlone dockyard is located at Ahlone Township, west Yangon City. The dockyard was constructed in 1904 as ‘Rangoon Foundry’, and subsequently renamed as ‘Ahlone Dockyard’ in 1962. The dockyard has an area of 28 acres and is used for shipbuilding, ship repair and maintenance of IWT fleet.

The layout of the dockyard is shown in Figure 6.1.5.



Source: IWT

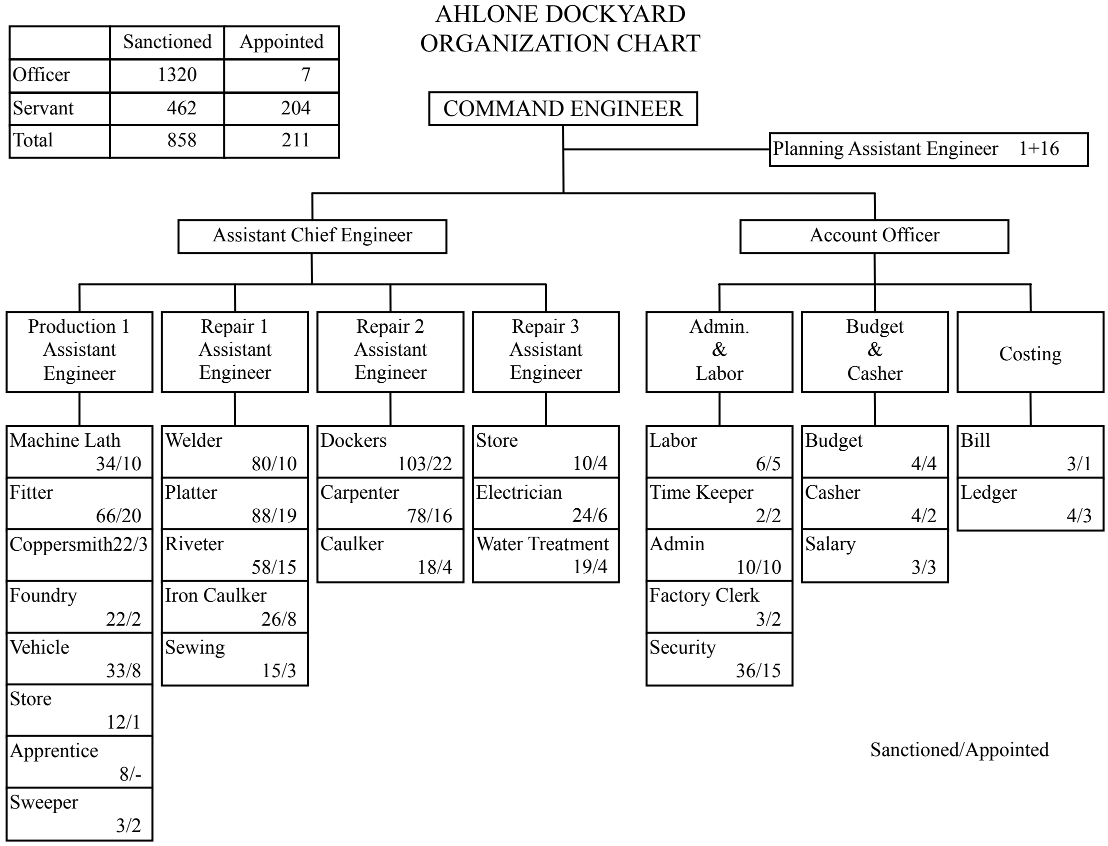
Figure 6.1.5 Layout of Ahlone Dockyard

There are 7 slipways with a docking capacity of 100 to 250 DWT. Most of the slipways are too old; 2 slipways, Nos. 1 and 2, were out of use due to malfunction of hauling winches. No.6 slipway is a side slipway type with 6 berths. IWT has a plan to upgrade the docking capacity of the No.6 slipway to accommodate 10 to 12 larger ships.

Hull fabrication shop and several store buildings were destroyed by fallen trees during Nargis. Some buildings have been re-constructed. Machine shop facility is similar in size and capacity to Dalla Dockyard.

The organization chart of Ahlone Dockyard is shown in Figure 6.1.6. Their workforce of 211 officers and 204 laborers conducted 75 major ship repairs and 225 minor repairs per annum in three years.

	Sanctioned	Appointed
Officer	1320	7
Servant	462	204
Total	858	211



Source: IWT

Figure 6.1.6 Ahlone Dockyard Organization Chart

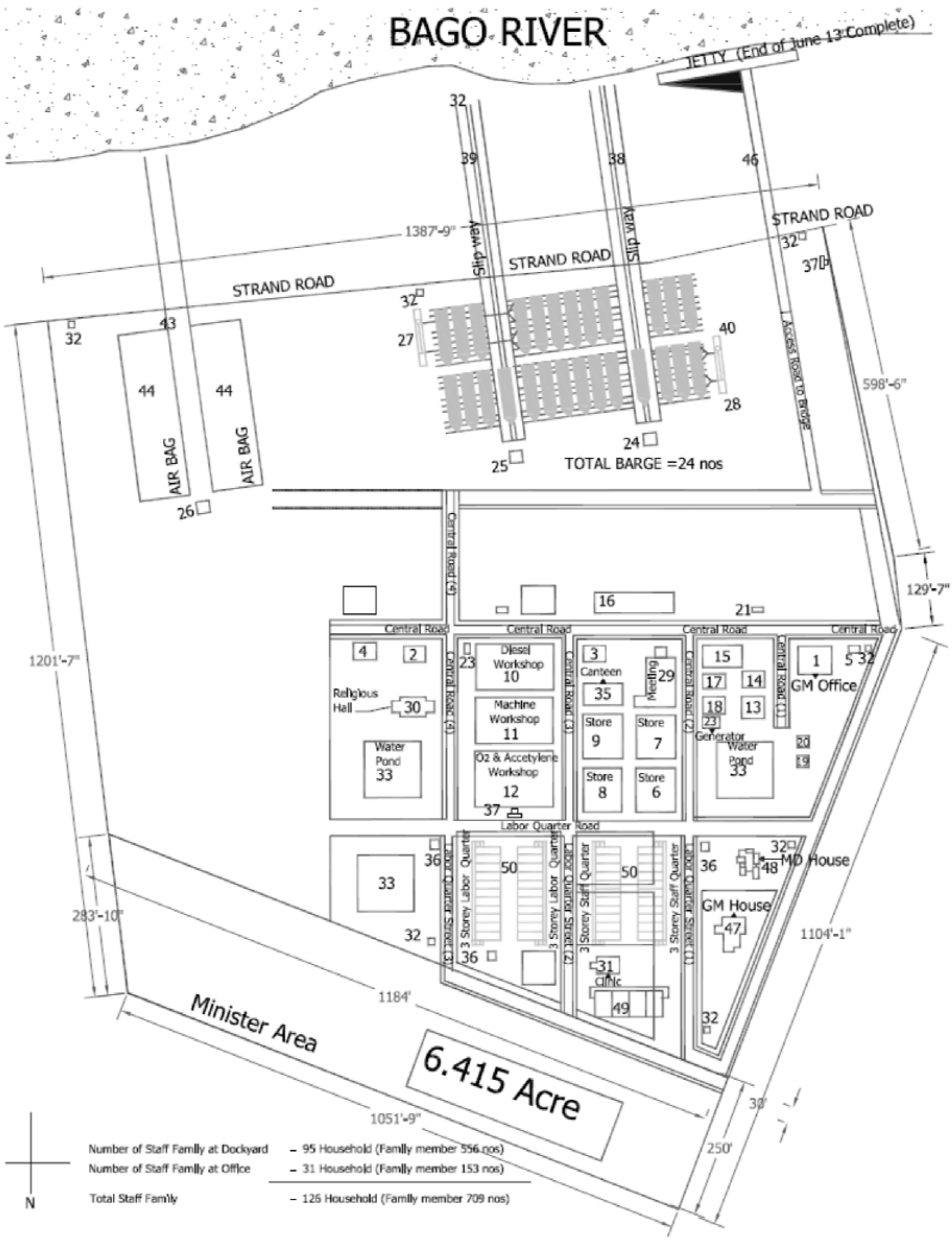
According to the IWT implementation plan for the year of 2008-2009, Ahlone dockyard was scheduled to conduct 150 major ship repairs including annual inspection and 225 minor repairs. However, due to the severe damage inflicted on IWT ships by Nargis, it was re-scheduled as priority was given to the repair of damaged ships.

(3) Further Development during the Study Period

During a six year study period, Ahlone Dockyard has been removed and its function has been shifted to Dagon Dockyard which is located at Dagon Seikkan Township and faces the right bank of the Bago River. This dockyard was constructed in 2013.

This dockyard has an area of 18ha and is used for shipbuilding, ship repair and maintenance of IWT fleet as well as private ships. The layout of Dagon Dockyard and its photo are shown in Figure 6.1.7 and Photo 6.1.7. There are 2 slipways with a docking yard area of about 3.1ha which is capable of handling 24 ships (100 ft long and 25 ft wide) and 22 barges (220 ft long, 45 ft wide and 10 ft deep) simultaneously. Three workshops, 4 store houses and other ancillary buildings including housing buildings for staff are also provided. Five winches of 10 to 30 tons capacity, 2 cranes of 10 to 25 tons capacity, 2 forklifts, 3trucks and a working boat are provided.

The organization chart of Dagon Dockyard is shown in Figure 6.1.8. The total number of staff appointed is 155 out of 808 suctioned staff.

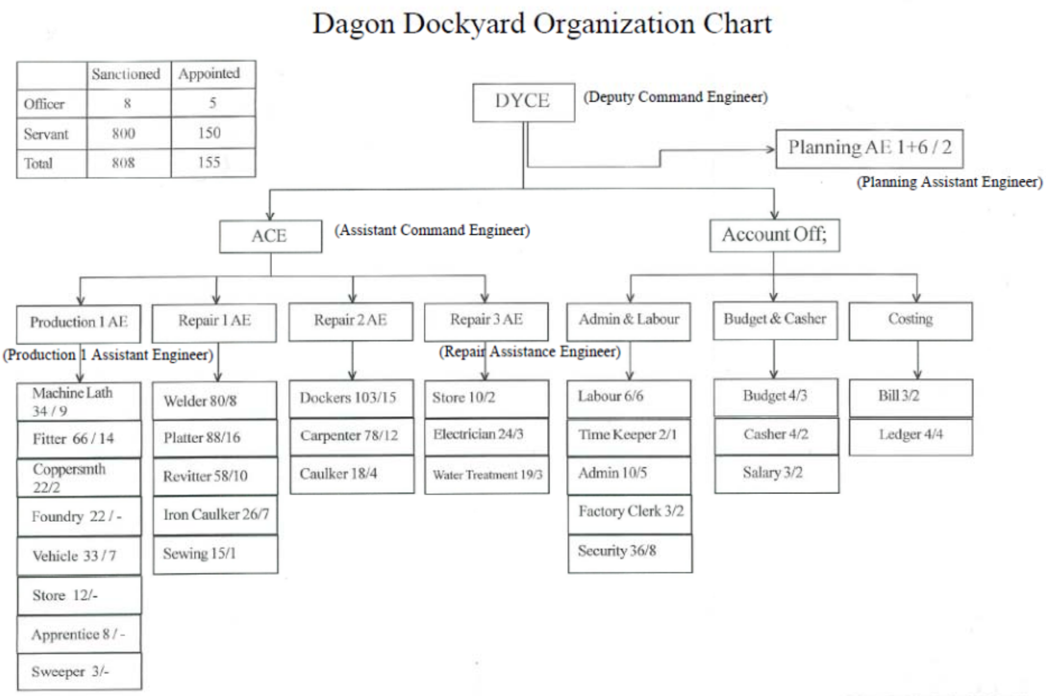


Source: IWT

Figure 6.1.7 Layout of Dagon Dockyard

Source: JICA Project Team

Photo 6.1.7 Slipway of Dagon Dockyard



Source: IWT

Figure 6.1.8 Dagon Dockyard Organization Chart

6.2 BASIC CONCEPT FOR RESTORATION OF INLAND WATER TRANSPORT

6.2.1 EVALUATION OF IWT FACILITIES

(1) Slipway and Dock Facilities

Evaluation of vulnerability of slipways and dock facilities was carried out by the JICA Project Team in a manner to examine current problems in the IWT facilities including those problems which existed before Nargis. The results of evaluation of major facilities are summarized in Table 6.2.1.

Table 6.2.1 Evaluation of Vulnerability on Major Facilities

a) Dalla Dockyard			
No.	Name of Facility	Condition	Evaluation Result
1	No.1 Slipway (Built in 1908)	Operational, but aged. Cradles heavily damaged	Wooden cradles are breakable and unstable
2	No.2 Slipway (Built in 1898)	Operational, but aged. Wooden cradles unstable	Wooden cradles are breakable and unstable
3	No.3 Slipway (Built in 1898)	Operational, but aged. Wooden cradles unstable	Wooden cradles are breakable and unstable
4	No.4 Graving Dock (Built in 2001)	In operation, but dock gate damaged by Nargis.	Dock gate water tightness is not normal condition
5	No.5 Slipway (Built in 1890)	Operational, but rails and cradles under repair	Wooden cradles are breakable and unstable
6	No.6 Slipway (Built in 1890)	Operational, but aged. Wooden cradles unstable	Wooden cradles are breakable and unstable
7	No.7-12 Slipway (Built in 1900)	Operational, but aged. Winch/cradles damaged	Winches and cradles need to be urgently repaired
8	No.13 Slipway (Built in 1963)	Operational, but no winches equipped	No.14 winch is utilized, but very unsafe.
9	No.14 Slipway (Built in 1931)	Operational, but aged. Wooden cradles unstable	Cradles to be replaced with rigid steel ones
10	Hull Shop Machinery	In operation, relatively good condition	To be utilized more widely
11	Machine Shop	Serviceable 27 units. Out of use 22 units	All are aged
12	Arc Welding Generator	Serviceable 52 units. Unserviceable 19 units	Quantity is not enough to improve work efficiency
b) Ahlone Dockyard			
No.	Name of Facility	Condition	Evaluation Result
1	No. 1&2 Slipway	Slipways and winches out of use	Slipway should be repaired and new winches procured
2	No. 3 Slipway	Hauling winch is out of use	Winch should be repaired
3	No. 4 Slipway	Operational, but damaged by Nargis.	Aged winch should be renewed, cradles replaced by steel ones
4	No. 5 Slipway	Operational, used for mainly ship repair	Wooden cradles are breakable and unstable
5	No. 6 Slipway	In operation, age of winch is over 40 years	Winch pull force be increased for larger ships docking
6	No. 7 Slipway	Operated in good condition	No specific comments
7	Hull Shop Machinery	In operation, made in China in 1994-95	No specific comments
8	Machine Shop	30 units in operation. Some out of use.	All are aged
9	Arc Welding Generator	26 units in operation	Quantity is not enough to improve work efficiency

Source: JICA Project Team

Due to aging of experienced engineers working at the dockyards, IWT has a lack of engineers familiar with new ship building technology. Thus, it is necessary to transfer naval architect design and other skills of new ship building to new staff.

(2) Fleet

Ships operated by IWT are old and provision of navigation equipment is limited for securing safe navigation. At the dockyards, some new ships were built but it was limited in number.

Of the 121 damaged ships, 18 had to be scrapped. Thus, IWT needs to replace or renew 18 ships.

(3) Navigation Facilities

The waterways where IWT ships navigate has very few navigation facilities. DWIR is responsible for carrying out the following practices;

- to implement sounding survey periodically,
- to prepare navigation charts along navigable inland waterways,
- to provide necessary navigation guiding boards at major interchange of waterways,
- to provide marker buoys to indicate shallow water area, and
- to provide light buoy and navigation lights for the most important and dangerous locations.

6.2.2 PROBLEMS TO BE SOLVED URGENTLY

Through evaluation of IWT facilities, following issues were identified.

- Capacity development of ship's crew in securing safe navigation skill is necessary,
- Improvement of technical skill of dockyard workers is urgently needed,
- Acceleration of delayed annual inspection of IWT fleets is needed,
- Introduction of new cradles and hauling winch system are required for Dalla dockyard, and
- Capacity development of ship design and new ship building skill are required.

6.2.3 BASIC CONCEPT FOR RESTORATION OF INLAND WATER TRANSPORT

(1) Navigation Assistance

1) Facilities and Navigation Aids of Inland Waterways

(a) Navigation Buoy and Aids

The narrow river channels and restricted maneuvering space, and strong current make maneuvering of IWT ferries very difficult. DWIR is responsible for the development and maintenance of river channels and navigation aids. It is required to keep good communications between IWT and DWIR because IWT needs to request DWIR to improve facilities for the safety navigation.

(b) Chart

No proper chart of inland waterways is available. The experience of captains is relied on for save navigation.

To enhance navigation safety, it is necessary to develop navigation chart in coordination with DWIR.

2) Nautical Instruments

Provisions of nautical instruments for IWT fleet are shown in Table 6.2.2. As shown in the table, the installation ratio is very small. This means that ferries have to navigate without proper nautical instruments.

Considering narrow and restricted river channel, it is necessary to install some nautical instruments to improve navigation safety.

Abbreviations of Nautical Instruments are as below;

Table 6.2.2 Installation of Nautical Instruments

IWT Division	No. of ship	Gyro	Mag.	Radar	GPS	Echo	Anemo	Barom	Bino	Radio
Cargo Div.	90	0	2	6	0	0	0	0	11	5
Delta Div.	71	0	11	5	0	5	0	0	21	12
Ayeyar Div.	46	0	9	0	0	0	0	3	14	6
Chindwin Div.	27	0	6	0	0	0	0	0	6	6
Thanlwin Div.	20	0	0	0	0	0	0	0	0	0
Rakhaine Div.	22	0	9	0	0	0	0	0	9	9
Total	**276**	**0**	**37**	**11**	**0**	**5**	**0**	**3**	**61**	**38**
Installation ratio (%)		0	13.4	4.0	0	1.8	0	1.1	22.1	13.8

Gyro: Gyro Compass
Mag: Magnet Compass
Radar: Marine Radar
GPS: Geographic Positioning System
Echo: Echo Sounder
Barom: Barometer
Bino: Binocular
Radio: VHF and/or HF
Anemo: Anemometer

Source: DWIR

In order to improve safe navigation along inland waterways, it is recommended to perform a capacity development type training of ship crew to acquire skill by using nautical instruments.

(2) Landing Station

All landing stations along main inland waterways have become operational, thus no immediate recovery plan is needed.

(3) Sunken Ship

121 ships damaged by Nargis were salvaged. Some repair works were completed and some ships were waiting for repair at IWT dockyards. Therefore, no further recovery work of sunken ships is needed.

(4) Dockyard

IWT dockyards are used mainly for maintenance jobs of their fleet in accordance with the rules and regulations stipulated in the Inland Steam Ships Act (ISV-Act) and DMA survey system. As for dry-docking of the ships, the Act states the following:

a) Power-driven passenger ships must be docked annually for examination of the under-water portion of the hull. Ships plying solely in freshwater such as Upper Burma may be docked once in two years provided surveyors are satisfied with the internal condition of the ship during annual surveys.

b) Power-driven inland cargo ships shall be docked at least once in two years. Surveyors, however, may cause any ship to be docked at any earlier date of he considers it to be necessary.

However, due to Nargis, IWT dockyards were forced to carry out emergency repairs of 121 damaged ships prior to annual inspections of other ships. The progress of these emergency repairs was mentioned in Table 6.1.12. (repairs were completed for 96 ships while 7 ships were under repair or waiting to be repaired as of July 2010).

Table 6.2.3 shows the number of ships which were docked in 2007/08 and 2008/09 for periodical survey.

Table 6.2.3 Ship Docking Record

Year	250DWT and above		Less than 250DWT	
	Completed	On going	Completed	On going
2007/08	26	--	49	--
2008/09	7	3	17	7
Damaged by Nargis	11	2	10	6

Source: IWT

Major problems of dockyards are:

1) Lack of technical skill of workers for achieving repair work of damaged ships and new shipbuilding,
2) Lack of manpower and facilities for restoration of normal execution of annual survey/inspection,
3) Restoration of aged dock facilities to achieve effective repair and maintenance work which include capacity development of naval architect and ship building skill is needed,
4) Increase of docking capacity is essential for improving capacity of ship repair, maintenance of ships, and annual survey/inspection of own ships.

6.3 RECOVERY PLAN OF MAIN INLAND WATER TRANSPORT

Considering urgent needs of the restoration of damaged facilities, the restoration works shall be implemented in accordance with phase-wise recovery plans as shown in Table 6.3.1.

Table 6.3.1 Definition of Phased Plans

Phased Plan	Target
Urgent Recovery Plan	Restoration for securing basic needs of the peoples' life urgently with small budget and relatively easy way (implementation before 2011)
Short-term Recovery Plan	Restoration for recovering original functions and capacity in shorter time (implementation up to 2014)
Medium to Long-term Recovery Plan	Complete restoration taking account future needs in medium to longer time with necessary budget allocation (implementation after 2014)

Source: JICA Project Team

(1) Urgent Recovery Plan (before 2011)

1) Capacity Development of Captains and Ship Crew of IWT Ships

Installation of nautical instruments such as Radar, Compass, Echo-Sounder, GPS, VHF, HF, Anemometer, Barometer etc. is insufficient at waterways. It is very dangerous for captains to maneuver ships without such nautical instruments.

In order to secure the safe navigation, it is necessary to maintain high level maneuvering skill of captains under difficult navigation condition. Therefore, education and training for captains and other ship crew is indispensable.

It will be possible to provide training curriculum for captains and ship crew of IWT under the current JICA Project.

2) Capacity Development of Repairing Ships and Metal Structure

Both Dalla and Ahlone dockyards were used to repair a large number of damaged ships. It was expected to take a long time to repair the damaged ships, consequently the docks were expected to be occupied by ships undergoing repair works for a long time. Under this situation, many other ships which need annual inspection survey have to wait until a dock becomes available. As a result, many ships were obliged to wait to obtain their operating licenses for a long time. This situation should be avoided to secure the safe navigation of ships in Myanmar.

In order to increase the productivity of ship repair works, the enhancement of engineers' quality is an important factor. IWT engineers are trained by an on-the-job training program or at local training schools which are controlled by the Ministry of Labor. Some other training courses concerned with marine engineering are available at Myanmar Maritime University. Therefore, IWT needs to be provided with systematic technical training including transfer of know-how and skill as human resources development.

It will be possible to provide training curriculum for the capacity development of IWT engineers under the current JICA Project.

3) Introduction of Steel Cradle for Dalla Dockyard

Cradles for docking and undocking operation of ships were made of wood which are easily broken and not durable. The wooden cradles from No.7 to 12 slipways were damaged by a collision with drifting ships by Nargis. An emergency repair of the cradles was carried out, however, it is necessary to replace these cradles with steel made stable ones immediately to recover and improve the original capacity of facilities.

IWT engineers who might be trained by the above mentioned program "2) Capacity Development of Repairing Ships and Metal Structure" will able to produce a steel made cradle.

(2) Short-term Recovery Plan (up to 2014)

1) Acceleration of Delayed Annual Inspection of IWT Fleet

The disaster had a great impact on the safe navigation of the many IWT fleet as ships were operated without inspection. According to the report of Marine Department, 109 ships were non-licensed state at the end of April, 2009.

There are 92 larger ships (passenger cum cargo 19, cargo barge 73) exceeding 275 DWT in the IWT fleet and it takes 3 to 4 months for the completion of their docking repairs. The docking facilities for larger ships, however, are limited to two in Dalla dockyard. In order to accelerate annual docking work and inspection of larger ships, it is necessary to provide a capacity development training program aiming at improving welding skill and transfer of ship design technology by the JICA trained IWT engineers.

2) Master Plan Study of Dalla Dockyard

Dalla dockyards have aging and deterioration problems. Rehabilitation of the dockyard including provision of transverse slip ways and renewal of winch facilities is needed.

In order to rehabilitate the dock facilities, it is important to take into consideration the future facility utilization plan to avoid duplicated investment in the future. From this point of view, a master plan study of Dalla dockyard is needed by utilizing foreign financial assistance.

3) Improvement of Navigation Aids along Inland Waterways

DWIR is responsible for the provision and maintenance of navigational aids. In providing sufficient navigation aids along the inland waterway channel, it is necessary to provide necessary assistance to DWIR by phase-wise implementation.

- Step 1: Provision of aerial photos and maps covering the delta region and necessary area.
- Step 2: Provision of necessary sounding and survey equipment and implementation of sounding survey along navigable channels.
- Step 3: Planning and design of necessary navigation aids and installation of such navigation aids as well as navigation sign boards.

It will take a long time and involve a significant investment to complete all steps and thus foreign financial assistance should be applied.

(3) Medium to Long-term Recovery Plan

1) Improvement of Facilities for Ahlone Dockyard

Ahlone dockyard is used for the repair and survey of smaller sized ships of IWT. But several slipways are damaged and cannot be used. It is necessary to improve facilities including the provision of an additional slipway by utilizing foreign financial assistance.

Implementation of this plan is no more needed because Ahlone Dockyard moved to Dagon Dockyard.

Schedule of recovery plans for main inland water transport is shown in Table 6.3.2.

Table 6.3.2 Schedule of Recovery Plans for Main Inland Water Transport

Recovery Work Components	Urgent Recovery Plan (before 2011)	Short-term Recovery Plan (up to 2014)	Medium to long-term Recovery Plan (after 2014)
1) Capacity Development of Captain and Ship Crew of IWT Ships	Training by JICA on high level maneuvering skill under difficult navigation condition		
2) Capacity Development of Repairing Ships and Metal Structure	Training by JICA including transfer of know-how and skill of repair works		
3) Introduction of Steel Cradle for Dalla Dockyard	Replacing wooden cradle with steel made ones by IWT engineers		
4) Acceleration of Delayed Annual Inspection of IWT Fleet		Enhancing repair capacity of damaged ship to allow acceptance of ships for annual inspection by IWT	
5) Master Plan Study on Dalla Dockyard		Providing a master plan to avoid duplication of investment in the future by utilizing foreign financial assistance	
6) Improvement of Navigation Aids along Inland Waterways		Provide navigation aids by DWIR by utilizing foreign financial assistance	
7) Improvement of Facilities for Ahlone Dockyard (Implementation of this plan is no more needed because Ahlone Dockyard moved to Dagon Dockyard)			Provide slipway to increase repair capacity of small ships by utilizing foreign financial assistance

Source: JICA Project Team

CHAPTER 7

CAPACITY DEVELOPMENT SCHEME AND COMPONENT

CHAPTER 7 CAPACITY DEVELOPMENT SCHEME AND COMPONENT

7.1 PILOT PROJECT AND CAPACITY DEVELOPMENT TRAINING

In the previous Chapters 4, 5 and 6, the recovery plans for the damaged facilities by Cyclone Nargis in respect of the safe navigation along the main channels of Yangon Port, the restoration of Yangon Port and re-establishment of the main inland waterway transport in Delta Division have been proposed with phased implementation respectively.

Bearing in mind the current issues on the waterborne transportation system of the project area and the possible assistance to MPA and IWT by the Japanese government within the framework of technical assistance and humanitarian support, the following three types of assistance have been proposed as appropriate:

- Capacity development training,
- Further study for providing effective assistance to MPA and IWT in implementing their recovery plans of Nargis damages, and
- A pilot project implementation, constructing a model component of restoration works out of the whole recovery plan.

In selecting the adequate components of the above technical assistance schemes to be extended under the project, high priority has been given to those categorized and listed as urgent recovery plans and with due consideration of the following selection criteria:

- Urgency of recovery plans in resolving bottlenecks of inland waterway transport system damaged by Nargis,
- Significance and effectiveness in respect of technical transfer for capacity development of MPA and IWT, and
- Sustainability of skills and capacities to be transferred focusing on possible self-help efforts by MPA and IWT.

Considering the above as well as the efficient use of the budget allocated for the project, the recovery components of the respective schemes, by which the urgent recovery plans are duly covered, have been recommended by the JICA Project Team and agreed in the 1st Steering Committee meeting held in July 2009.

(1) Capacity Development Training

In order to facilitate and efficiently assist the recovery plans to be implemented by MPA and IWT, the following two components of the capacity development scheme have been recommended as technology transfer-type training:

1) Capacity development for ship crew and navigation, and
2) Capacity development for repairing ships and metal structures (IWT and MPA).

(2) Study

Besides the pilot project and capacity development training schemes, it is further recommended to carry out the following two additional study components, by which possible assistance can be provided for the recovery plan for Nargis damages, to be implemented by MPA and IWT:

1) Further Study on Maritime disaster Risk Management, and

2) Further Study of Tide Observation System.

(3) Pilot Project: Reconstruction of Botahtaung Jetties Nos. 5 and 6 (MPA)

The Botahtaung Jetties have been well used by MPA, IWT, and private ships before Nargis. Due to their disadvantageous location against adverse natural conditions such as high waves and strong current, the conventional pontoon type jetties were completely destroyed.

Considering the importance and urgency of the restoration of the jetties, Botahtaung Jetties Nos. 5 and 6 were recommended as the pilot project by use of a different type of jetty structure, which is a rigid concrete pier type and more stable than the conventional pontoon type against such adverse conditions.

At a later stage however, during its implementation preparation, the location of this pilot project has been shifted from the Botahtaung Jetty to Dalla Ferry Terminal. Further details on this location change are described in the following sub-chapters (Sub-chapter 7.4).

7.2 CAPACITY DEVELOPMENT TRAINING

7.2.1 CAPACITY DEVELOPMENT FOR SHIP SAFETY AND NAVIGATION

(1) Capacity Development of Ship Crew of IWT Ships (Step 1)

When Nargis attacked Yangon Port, IWT was not able to take proper emergency response and action, having no adequate aids to acknowledge and assess the impact of the cyclone. Further, defects and insufficiency of basic nautical instruments such as anemoscope, barometer, radar, and communication devices worsened the situation. It is therefore important and necessary to implement educational training on emergency response and action for persons involved in operations, and to equip with necessary nautical instruments.

All of the operating routes of IWT exist within navigable rivers. Along the operating routes, ships are facing maneuvering difficulties due to the presence of considerable bends and shallow places. Further, the flows of the rivers are as fast as 6 knots at the maximum.

In the meantime, most of the ships have heavily deteriorated, and are not equipped with necessary nautical instruments such as radar, GPS, eco-sounder, and communication devices. Therefore, the ships are typically navigated, day and night, much relying on their captain’s experience and hunch, which must be quite risky.

In order to improve the above situation, it is essential to provide such training that develops safe ship maneuvering capacity of IWT crews through the use of appropriate navigation system and equipment.

(2) Recovery of Navigation System of Yangon Port (Step 2)

In order to secure safe navigation along three channels, namely: Western Channel, Middle Bank Channel, and Monkey Point Channel, MPA had installed at six locations leading lights along these 35 miles channels, but all these were damaged by Nargis. Consequently, this has caused a serious issue to the ships navigating in and around the entrance area of Yangon Port, where very complicated river flows are often observed due to the meeting of two rivers and a creek.

Among the six leading lights, those at Monkey Point and Thanlyin Point have been selected for a model case to secure safe navigation, as the Monkey Point Channel is located at the right entrance of Yangon Port.

The lighting system used for the leading lights in the Yangon Port area is an old gas-powered system, which is not an eco-friendly type system commonly used in these days. It is therefore proposed to transfer modern technology of navigation aids system and equipment through seminars and workshops arranged by the JICA Project Team. In addition, four sets of navigation light at the selected model locations, i.e., Monkey Point and Thanlyin Point, are to be provided by JICA, while MPA is requested to reconstruct four light towers at the locations where the navigation lights are to be installed.

(3) Capacity Development of Ship Crew of IWT Ships (Step 3)

Navigable route of the inland waterways in Myanmar suffer from frequent changes. The river configurations are surveyed at the interval of several years at limited routes, thus the water depths of some routes are not completely recognized by the vessel captains. IWT vessels use probe rods to gauge the water depths, but often the vessels go aground, resulted in navigation delay.

Thus, automatic GPS tide gauges were provided to the IWT vessels for the safe navigation. The obtained data will be utilized for the maintenance for the navigation routes.

7.2.2 CAPACITY DEVELOPMENT FOR REPAIRING SHIPS AND METAL STRUCTURES

Due to severe damages to the ships/fleet, the repair work took considerably long time. One of the causes of the delay in repairing damaged ships is the lack of skills of dockyard workers. In order to improve the appropriate productivity and work quality, it is advisable to provide proper training to the workers. Another issue related to the repair work was the delay in implementing annual inspection of IWT ships, and 109 ships were at that time being operated with overdue operating licenses. It has therefore been also urged to accelerate the annual docking survey to obtain licenses for all IWT-registered ships as early as possible.

Under such situation, the JICA Project Team has proposed to assist IWT in performing capacity development of their work skill and improving capability of dockyard through technology transfer in a form of training.

Similarly, the dockyard workers of MPA need training for their capacity improvement in repairing steel structures such as access bridges and pontoons. Accordingly, selected officers and dockyard workers of MPA have been invited to the training at Ahlone Dockyard.

The training has been so planned to take place mainly at Dalla and Ahlone dockyards and performed in four steps, as follows:

(1) Step 1

The JICA Project Team conducts the training of basic welding skills for repairing ships and steel structures by adopting arc welding method. This training is performed to the selected candidates for training instructors of IWT and MPA during Step 1. Main part of this training is focused on the welding skill and quality control of repairing ships and steel structures.

(2) Step 2

Following the training in Step 1, the JICA Project Team provides further training of dockyard workers through the instructors trained in Phase 1 and performs technology transfer to those officers who formulate and establish the routine training program of IWT. The objectives of the training at this stage include:

- To assist IWT and MPA in performing training of their dockyard workers by IWT instructors in order to improve their skills in repairing ships and steel structures,

- To assist IWT in preparing training curriculum and text for its own annual training program to be implemented in the future.
- To design a steel-made cradle for Dalla Dockyard and manufacture the steel cradle as an actual training, together with further welding skills such as sustainable arc welding and CO_2 welding, and in collaboration between the experts of the JICA Project Team and IWT dockyard, and
- To transfer planning knowhow on dockyard expansion and improvement to IWT engineers and staff.

Two components under the capacity development scheme, namely, 1) capacity development on repairing ships and steel structures, and 2) capacity development of the ship crew of IWT ships, were proposed to be implemented by a fast-track program within three months between September and November 2009.

(3) Step 3

Training on CO_2 welding (semi auto welding) is important for efficiency improvement. The efficiency of the CO_2 welding is two to three times of that of normal hand welding. Due to the lack of inspection equipment and technique, the welding quality was not able to be inspected. Thus, the inspection equipment was provided.

(4) Step 4

As the part of the pilot project, pontoons were manufactured at the Dalla Dockyard. The guidance was made to IWT engineers on method of blocking manufacturing, block assembling, welding method, and quality control. Furthermore, a lecture on pontoon design as conducted. The pontoon manufacturing was engaged by the trainees who have completed Step 3 training.

7.3 FURTHER STUDY

7.3.1 STUDY ON MARITIME DISASTER RISK MANAGEMENT

Many ships and port facilities such as pontoons and jetties were damaged by Nargis. The major cause of the damages was collisions between ships and port/on-land structures. A hazard map for inundation by storm surge has been prepared by the JICA Project Team during the Phase 1 period of the project. The hazard map shows disaster prevention measures displaying the effects of cyclones. Following the hazard map analysis in Phase 1, it has been proposed to conduct an additional study in order to analyze the potential motion of ships and floating objects in the port through a simulation study during the Phase 2 period. Further, the information obtained in the additional study is expected to provide useful reference data for the disaster prevention program being prepared by MPA.

7.3.2 STUDY OF TIDE OBSERVATION SYSTEM

To predict tide levels at any date and time in the future, it is necessary to carry out harmonic constants analysis using the collected observation results.

Since automatic recoding-type tide gauges have been installed at two stations, i.e., in Thilawa and Monkey Point, it was useful to obtain sufficient number of harmonic constants required for predicting precise tide levels in Yangon. Although it may take a long time before obtaining sufficient and appropriate observation records, it is worthy to provide training on tide prediction method in a rather early stage, so that MPA is able to predict tidal levels at the designated date and time soon after the recorded data has become available. In comparing the predicted tides with the actual observation results obtained by the installed tide gauges, the sufficiency of input data and the accuracy of the prediction can be assessed in the course of the data collection and prediction. As the tide prediction has currently been contracted to an Indian institute, the MPA has a strong desire in obtaining knowhow of tide prediction in the future.

7.4 PILOT PROJECT

The main aim of the pilot project is to introduce, through the project implementation, an advanced technology or to adopt some technology not common in Myanmar but effective for MPA in implementing further recovery plans by themselves. In this sense, it is expected that technology transfer covers the aspects of port planning, design, and construction.

As aforementioned, the selected pilot project was the reconstruction of the damaged Botahtaung Jetties No.5 and No.6 according to the decision of the 1st Steering Committee meeting held in July 2009.

Following this decision, the detailed design of the pilot project at Botahtaung Jetties was conducted and completed in November 2009, and immediately followed by the bidding for the implementation before the end of 2009.

In December 2011, just during the contract finalization, the location change for the pilot project was requested by MPA, and was officially agreed in the 3rd Steering Committee meeting held in March 2012, concluding that the pilot project has to be shifted to the Dalla Ferry Terminal.

Under the above situation, this chapter only describes the design concept of the previous pilot project at Botahtaung Jetties in the following Sub-chapter 7.4.1, and more design details are described in Chapter 13. And for recording purposes, the events occurring until the project location change are stated in Sub-chapter 7.4.2.

7.4.1 CONCEPT OF THE PILOT PROJECT AT BOTAHTAUNG JETTIES

Before the onslaught of Nargis, Botahtaung Jetties No.5 and No.6 were composed of two units of steel pontoons, 200 ft (60 m) long, respectively.

Considering the design ships and the purpose of the pilot project, the following mooring pier construction was requested:

A mooring pier with total length of 127 m, constructed with a combination of floating type pier and rigid concrete piled type pier, in which three types of landing facilities were involved, is composed of the following pier structures:

- A 78 m long section of floating type pier built with two units of pontoon, 120 ft x 20 ft in size, for receiving IWT market ships. The pontoons were to be provided by MPA. And, this pier section needs three RC dolphins for anchoring the two pontoons;
- A 30 m long section of piled concrete pier with a 15 m long lower platform at elevation + 5.0 m above CDL, as a minimum necessary part of the 172 m long rigid pier to be required in the future to receive coastal cargo ships;
- A total of 19 m long section of rigid concrete deck at elevation +7.5 m CDL;
- Access bridge for workers and vehicles, 95 m long and 8.4 m wide;
- Porter way, 35.1 m long and 4.5 m wide;
- Movable access steel bridge (80 ft x 10 ft) with associated sponson (30 ft x 20 ft), both to be provided and installed by MPA; and
- Associated pier accessories such as mooring bollards, fenders, and other miscellaneous items.

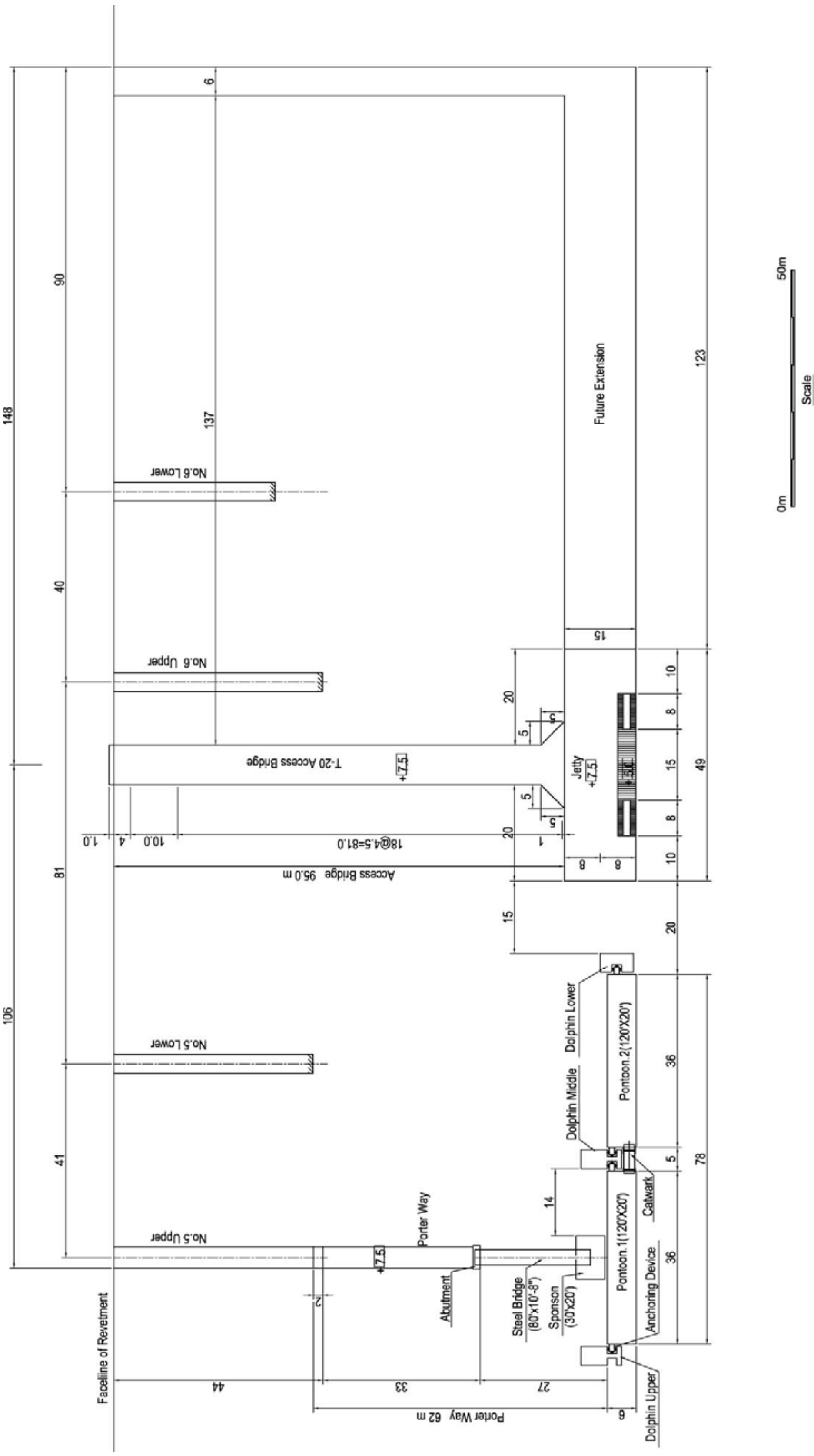
Layout plan of the project is as shown in Figure 7.4.1.

7.4.2 CONCEPT OF THE PILOT PROJECT AT DALLA FERRY TERMINAL

After the design completion of the pilot project at Botahtaung Jetties, the following activities were carried out, as preparation for its implementation:

- Prequalification of prospective contractors for the pilot project took place according to the planned schedule during August and September 2009. As a result, two prospective contractors were prequalified.
- Bidding was executed in November 2009. As a result, bidding prices of the two bidders were revealed to exceed the threshold value.
- The second bidding was executed in March 2010. As a result, contract negotiations were conducted with the lowest evaluated bidder.
- JICA Myanmar office awarded contract to the lowest evaluated bidder in June 2010.
- Due to disagreements over such matters as bank guarantee, denomination of currency for payment and sudden appreciation of kyat, the eligible contractor withdrew from negotiations.
- In order to solve the above problems, JICA Myanmar Office proposed to MPA to change the structural type of the pilot project in January 2011 but failed.
- JICA considered an increase of the budget for the pilot project to complete it as originally planned.
- Bidding documents including specifications were revised in order to cope with changes in circumstances on technical and procurement matters envisaged during the last two years after the original design.
- Three applicants successfully passed a new prequalification evaluation in November 2011.
- MPA proposed to change location of the pilot project due to the change of the land use plan of Botahtaung area in December 2011.
- At the 3rd Steering Committee meeting held on 31st March 2013, it was agreed to change the project location from Botahtaung to Dalla Ferry Terminal.

With the change of the pilot project location, the synergy effect of the two projects of the Dalla Ferry Terminal reconstruction and provision of ferry boats through Japanese Grant Aid was expected.



Source: JICA Project Team

Figure 7.4.1 General Layout (Botahtaung Jetty)

Table 7.4.1 Implementation Schedule of Capacity Development Scheme

Packages	2009	2010	2011	2012	2013	2014
Steering Committee Meeting	▲ ▲				▲	
Implementation of Capacity Development Scheme for Ship Crew and Navigation						
Ship Crew of IWT (Step 1)	━					
Navigation System of Yangon Port (Step 2)		━				
Ship Crew of IWT (Step 3)						━
Implementation of Capacity Development Scheme for Repairing Ships and Metal Structure						
Step 1: Arc Welding (Basic)	━					
Step 2: Sustainable Arc Welding & Cradle		━				
Step 3: CO2 welding and Test				━		
Step 4: Pontoon Construction					━	━
Study of Tide Observation System						
Instalation of ATG	━					
Observation by ATG	━	━	━			
Analysis		━				━
Seminar	▲		▲			▲
Study on Maritime Disaster Risk Management						
Study of disaster prevention program, Field survey of damage truck and simulation of Nargis	━					
Storm surge and Tsunami Risk in Yangon		━	━			
Storm surge and Tsunami Risk in Delta				━	━	━
Seminar	▲		▲			▲
Preparation and Implementation of Pilot Project						
Design (Botahtaung)	━	━				
Tender (Botahtaung)	━	━	━			
Relocation			━	━	━	
Design (Dalla)					━	
Tender (Dalla)					━	━
Construction (Dalla)						━
Seminar/Workshop/Lecture		▲	▲		▲	▲

CHAPTER 8

ENVIRONMENTAL
AND SOCIAL CONSIDERATIONS

CHAPTER 8 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

8.1 ENVIRONMENTAL CONDITION OF THE PROJECT

(1) Introduction

Recent international guidelines on infrastructure development suggest that the environmental and social considerations have become critical factors that affect the feasibility of the projects. Environmental and social considerations are mandatory, especially in cases when the financial resources are mobilized or sourced from international financial institutions (IFIs). In the case of JICA, they have an established guideline, entitled "JICA Guideline on Environmental and Social Considerations (2010 April version)". Basically, the guideline is applied in all JICA project implementations.

The proposed projects would surely require a clearance based on the environmental and social guideline of JICA, which mandates adequate environmental and social considerations for development projects.

(2) Environment Laws and Regulations of Myanmar

The Environment Conservation Law has been promulgated in 2012. Myanmar is still at an initial stage of promoting environmental conservation and enhancing its management aspects. The Ministry of Environmental Conservation and Forestry (MOECAF) is preparing environmental conservation rules for execution of the law. This law stipulates the following key points:

1) The ministry assigned for environmental conservation, which is currently MOECAF, has to give proper and necessary advices to concerned government departments and organizations, private organizations, and persons (Article 17).
2) The ministry has to prescribe hazardous materials from industry, agriculture, mining, etc. (Article 7).
3) The entity or the person running a business or a factory in industrial zones, special economic zones, or any industry approved by the ministry shall contribute financially or give material assistance in environmental conservation activities like waste management and purification (Article 16).

There are no standards of construction activities for receptors in Myanmar and international organization's standards such as the World Health Organization (WHO) and Environmental, Health, and Safety (EHS) guidelines prepared by the International Finance Corporation (IFC), which is a member of the World Bank group; therefore, the target noise level at the construction stage is set based on the standards in other foreign countries and international guidelines.

(3) Environment Analysis

The purposes of the initial environmental evaluation for the "The Pilot Project of Restoration of Dalla Ferry Terminal Jetty at the Dalla Side for Rehabilitation of Yangon Port and Main Inland Water Transportation in the Union of Myanmar" are to:

- Investigate the area that would directly and indirectly be affected by the implementation of the proposed project;
- Identify significant environmental and social issues due to the project location, construction, and operation;
- Recommend measures to mitigate the adverse effects and/or enhance the beneficial effects of the proposed project; and
- Prepare a matrix for scoping for the project including study of alternative plan for the project.

A scoping matrix on assessment of potential environmental impacts by the port development project is given in Appendix F, Table F.1.4. The top row represents the activities to be carried out during the project implementation. The activities are divided into three phases: planning phase, construction phase, and operational phase. Left-hand side column, on the other hand, represents an environmental element that might be triggered by the project implementation.

(4) Public Consultation Meeting for the Implementation of the Project

The environment involves not only the biophysical aspect but also the socioeconomic dimension of a proposed development. People are part of the environment and are often the subject of or directly affected by projects or undertakings. Public participation therefore becomes crucial in making decisions that affect their lives and their environment.

Public consultation is a form or stage of public participation that involves information dissemination and gathering of public opinion. It is a form of participation where citizens can directly be involved in planning or decision making. It aims to produce the widest and most diversified public consultation possible involving people directly affected by a project. Proponents of projects shall initiate the conduct of public consultation to ensure that the concerns of the public are fully integrated into the project implementation process.

EIA systems in Myanmar were formulated by MOECAF after the construction work of the Dalla Project was started. The new EIA law requires public consultations; the JICA guideline on environmental and social considerations also requires the project owner to explain the project outline and its consequences from the environmental and social impact, and to respond adequately to the comments raised by the stakeholders. However, the ferry port project is considered small in scale, and the project is simply a restoration project. All of the port facilities are planned at the same location of the existing ferry port. Based on these conditions, public consultation was not carried out by IWT/MPW.

(5) Environmental Monitoring Program

Environment monitoring shall be undertaken to:

- Ensure that the recommended mitigation and enhancement measures as embodied in the environmental monitoring plan and conditionality are being implemented;
- Undertake regular monitoring of specific parameters in compliance with related standards; and
- Determine the effectiveness of the monitoring plan and make recommendations for any corrective or additional mitigating measures.

A monitoring plan shall be developed based on the mitigation/enhancement measures identified for significant environmental impacts and those that are moderately significant, including the key parameters to be monitored as shown below. This covers both the pre-construction/construction and operation phases of the project.

The key parameters to be monitored are as follows:

- Traffic of access roads to port for the transportation of construction materials;
- Traffic of access roads to port for the operation of the port (Operation of the port will potentially increase the overall traffic density in nearby area); and
- Noise source during construction (pile driver, concrete batching plant, etc.).

Based on the anticipated impact, the frequency of monitoring will be more constant and rigid during the construction phase. Monitoring during operation phase will be closely coordinated with the related organizations (MPA/IWT). The monitoring team will be established to take charge of the preparation of the final monitoring program and annual monitoring plan including the implementation plan of the monitoring activities. The organized monitoring team shall review and validate, among others, the following:

- Coverage of monitoring;
- Frequency of monitoring;
- Standard procedures/method of monitoring;
- Schedule of monitoring;
- Manpower requirements and budget; and
- Logistics.

8.2 EXISTING ENVIRONMENTAL CONDITIONS

8.2.1 SOCIAL CONDITIONS

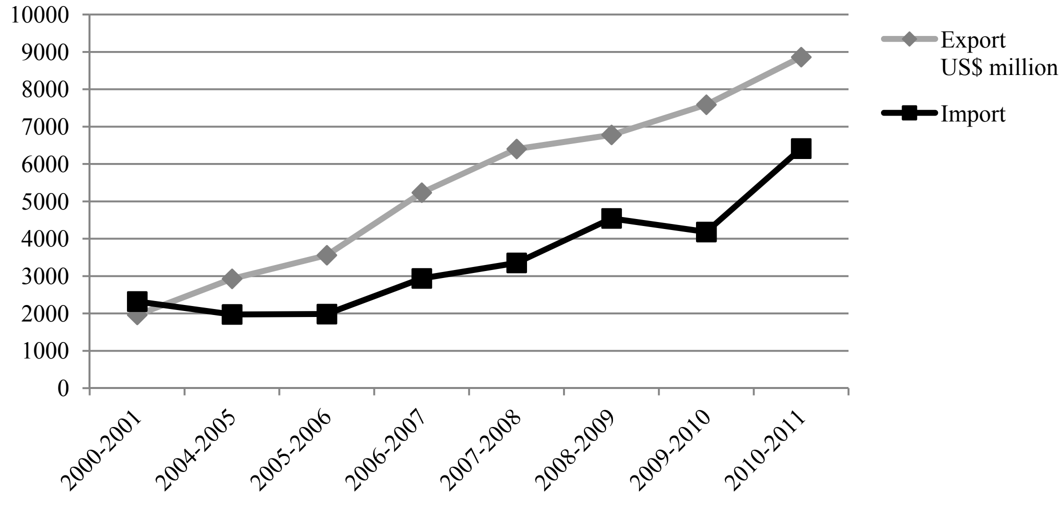
(1) Economic Activity

Myanmar's economy grew by 6.5% in fiscal year (FY) 2013 and is seen expanding by 6.8% in FY 2014. Growth is supported by investor optimism following policy reforms, the reinstatement of Myanmar in the European Union's Generalized System of Preferences for duty-free and quota-free market access, and a gradual easing of restrictions on financial institutions that facilitate credit to the private sector. Inflation rose to 5.7%, year on year, in April and May 2013, from around 5% in January-March, largely because of higher food prices.

The economy of the country is partially dependent on its agriculture and also on its export trade. The agricultural products of the country are groundnuts, sugarcane, rice, beans, pulses, and sesame. The fast growing industries of Myanmar are textile industry, copper industry, iron industry, cement industry, wood products industry and so on. A huge amount of the country's revenue is earned by the export business.

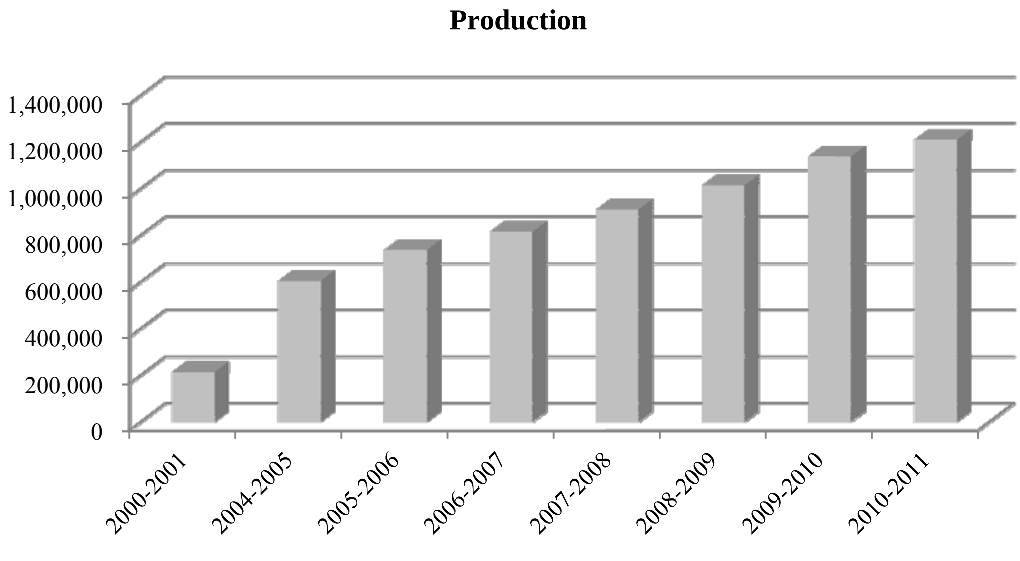
The logging of teak and other hardwood and the mining of precious gemstones contribute significantly to the gross domestic product (GDP). Other major economic activities include manufacturing with emphasis on heavy industrial production. Major exports include rice, timber and wood products (especially quality hardwood), petroleum, and various minerals and precious gems. The nations with which Myanmar runs its export trade are Thailand, China, India, and Japan. Energy production is an increasingly important activity and several foreign companies are engaged in oil exploration and hydroelectric projects.

Agriculture, including livestock and fishery and forestry, is the most important sector of Myanmar's economy. It is the main source of livelihood for the nearly three quarters of the population who live in rural areas. On the average, the sector accounted for nearly 60% of GDP. Myanmar's economy has long suffered from high unemployment, minimal foreign investment, and crumbling infrastructure. Value of foreign trade is shown in Figure 8.2.1, and the production of fish and prawns in Yangon Division is shown in Figure 8.2.2.



Source: Statistics Year Book 2011

Figure 8.2.1 Value of Foreign Trade



Unit: Viss, 1Viss = 1.6 kg

Source: Statistics Year Book 2011

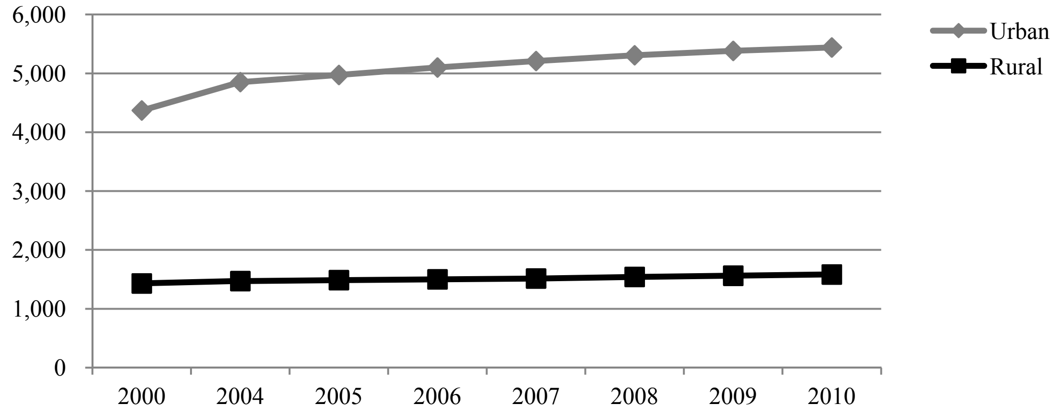
Figure 8.2.2 Production of Fish in Yangon Division

(2) Population

The total population of Myanmar was estimated officially at 54.5 million in 2012, and this population comprises some 130 ethnic people. The major part of this huge population is covered by Burmese people. The other minorities of the country include the Shan, Rakhine, Chinese, Karen, Mon, Indian, and some other races. The official language of the country is Burmese. However, Karen, Shan, and Kachin are also widely spoken in Myanmar.

Roughly, three quarters of the population are rural inhabitants, with the remaining population living in urban Yangon, Mandalay, and Moulmein. About two thirds of Myanmar's population is Burman with other minorities making up the other third. Of the minorities, the Karen and the Shan groups, which together make up less than ten percent of Myanmar's population, are considered to be the two most important ones. In the British colony, most of the ethnic minorities were kept separately within their borderlands, thus enabling them to maintain their traditions.

Yangon is the biggest city in Myanmar and has a population of nearly 7.2 million (2011). Other cities with a large population are Mandalay, Mawlamyaing, Bago, and Pathein. The total population of Yangon City is shown in Figure 8.2.3 and the population of its townships is shown in Table 8.2.1.



Unit: Thousand (x 1,000)

Source: Statistics Year Book 2011

Figure 8.2.3 Population of Yangon City

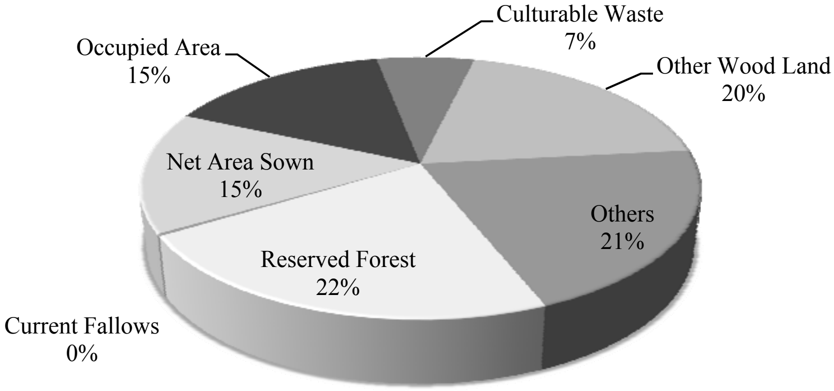
Table 8.2.1 Population of Townships in Yangon City

Name of Township	Population	Name of Township	Population
Pazuntaung	53,648	North Okkalapa	333,484
Botahtaung	49,134	South Okkalapa	191,388
Kyauktada	34,797	Thaketa	253,284
Lanmadaw	43,137	Hlaing	151,014
Latha	34,125	Kamaryut	87,881
Pabedan	37,551	Thingangyun	231,621
Dagon	24,492	Yankin	125,909
Bahan	100,695	Insein	311,200
Seikkan	2,241	Mingalardon	288,858
Dawbon	87,284	Mayangone	205,403
Kyeemyindaing	115,841	South Dagon	370,403
MingalarTaung Nyunt	155,767	North Dagon	221,200
Ahlone	65,510	East Dagon	145,505
Sanchaung	105,208	Dagon Seikkan	120,161
Tarmwe	191,114	Shwe Pyi Thar	295,993
Dalla	181,087	Hiaing Thar Yar	488,768
Seik Gyi Kha Naung To	38,425		

Dalla: Project Site
Source: Yangon Municipal Report 2011

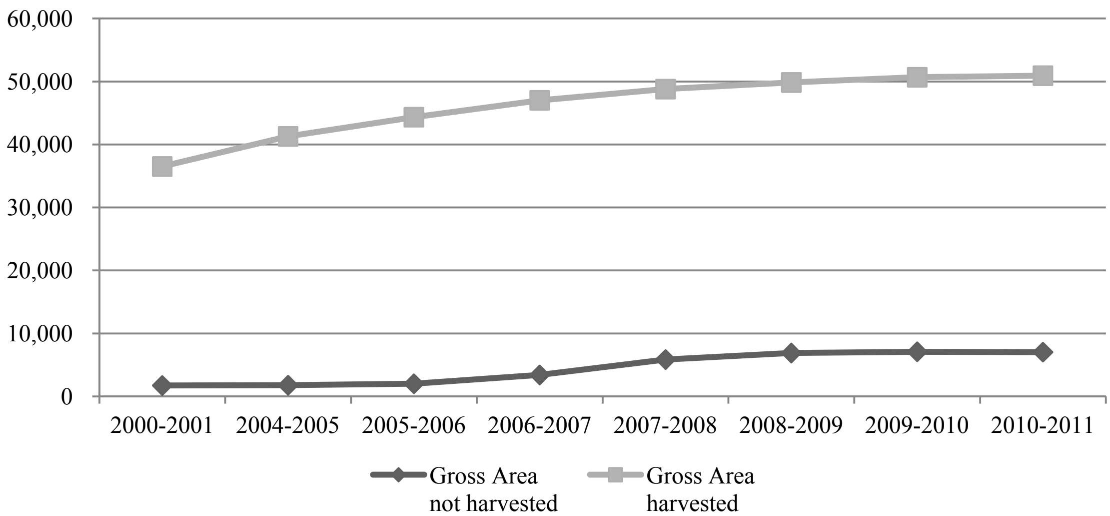
(3) Land Use Condition

Myanmar covers an area of 677,000 km^2 with 2,229 km of coastline along the Indian Ocean. It is bordered by five nations, namely: China, Laos, and Thailand in the east and northeast, and India and Bangladesh in the west. Myanmar is the largest country in mainland Southeast Asia; twice the size of Vietnam and over a quarter larger than Thailand. People are spread over seven states and seven divisions, with over three quarters of the population living in the rural areas. Percentage of land utilization of the country is shown in Figure 8.2.4, and Figure 8.2.5 shows the gross area of the harvested and unharvested area.



Source: Statistics Year Book 2011

Figure 8.2.4 Land Utilization (%)



Unit: Thousand Acres

Source: Statistics Year Book 2011

Figure 8.2.5 Gross Area of Harvested and Unharvested Area

(4) NGO

At present, there are lots of non-government organizations (NGOs) posted in the country with the aim of assisting the needs of the people of Myanmar and these NGOs are working in different sectors of the society. The methodology and approaches conducted by these NGOs are somewhat common as far as relief, recovery, rehabilitation, and sustainable development of the country are concerned. Due to the budget limitation and shortage of technical knowhow of the state organization, NGOs have also been carrying out activities in many different fields and sectors in the country such as agriculture, early recovery, education, food, health, nutrition, protection, water supply, hygiene, and sanitation. After the disaster caused by Cyclone Nargis, many NGOs have started working in the field of risk reduction program from natural disaster in order for the local communities to be resilient in future calamities such as cyclone. The number of NGOs currently in Myanmar is shown in Table 8.2.2.

Table 8.2.2 Number of NGOs in Myanmar

Sector of NGO	Number
Multi-sector	44
Food Assistance	2
Education of Hygiene and Health	1
Health	4
Agriculture	1
Child Protection	2
Environment	1
Livelihood, Shelter, Hygiene	1
Protection of Children and Women	2

Source: Myanmar Information and Management Unit (MIMU)

(5) Tourism

In September 2007, a political dispute occurred that significantly strained the economy in the tourism industry which directly employs about 500,000 people. Dramatic decline in foreign visitors reduced the income of employees engaged in tourism industry in Myanmar, especially after Cyclone Nargis and previous global economic crisis. However, due to the current conditions of economy, tourist arrivals rose by 36% in the first two months of FY 2013. Figure 8.2.6 shows the overseas visitors to Myanmar from 2004 to 2011.

Source: Statistics Year Book 2011

Figure 8.2.6 Overseas Visitors to Myanmar

(6) Water Use

Myanmar has an extensive water resource, both inland and marine. The river system consists of 2,000 km of the Ayeyarwady, Sittaung, and Thanlwin rivers and 2,600 km of tributaries and smaller rivers combined. There are many natural lakes and 260 reservoirs. Inland fisheries production comes from floodplain; the water surface covers 6 million hectares for 4-5 months in a year. It also has 2,229 km of coastline which provides rich resources for fishing.

Inland water bodies like natural lakes, reservoirs, river systems, and ponds cover a total area of about 13,400 km^2 in Myanmar. These inland water systems together with annual rainfall provide vast amount of water resources for the country. Underground water resources are also available. With the increase of population and enhanced need for water for economic activities, there is an increasing pressure on extraction of groundwater. Inland water pollution is a great concern for environmental management.

(7) Infrastructure

Most of the infrastructures in Yangon City were constructed many years back. In recent years, increases in demand due to economic recovery and decrease in their capacities due to aging/ deterioration lead to remarkable shortage of capacity. Utilities such as electricity, water, and the like, which will be required in the construction work, shall therefore be designed taking the following factors into consideration:

- Sufficient and stable supply of electricity and water; and
- Application of stand-by units for stable construction work, if necessary.

(8) Heritage

In the presence of various ethnicities, Myanmar has grown a diverse and rich cultural atmosphere. Influence of different tribes, races, and religions can be perceived in the tradition of Myanmar. Some festivals of the country are the Kachin Manaw Festival, Htamane (Sticky Rice) Festival, Shwedagon Pagoda Festival, Kason Watering Festival and so on. There are 65 different ethnic groups in Myanmar officially recognized and clustered into seven "national" races: Shan, Mon, Karen, Kayah Chin, Katchin, and Rakhine. Altogether, there are over 130 ethnic groups speaking more than 100 different languages and dialects. Myanmar's diverse ethnic groups are unevenly distributed throughout the country. The dominant ethnic groups are the majority in the central lowlands while the ethnic minorities are the majority in the border states. Figure 8.2.7 shows the ethnic composition in Myanmar, and Figure 8.2.8 shows the ethnic groups in Myanmar.

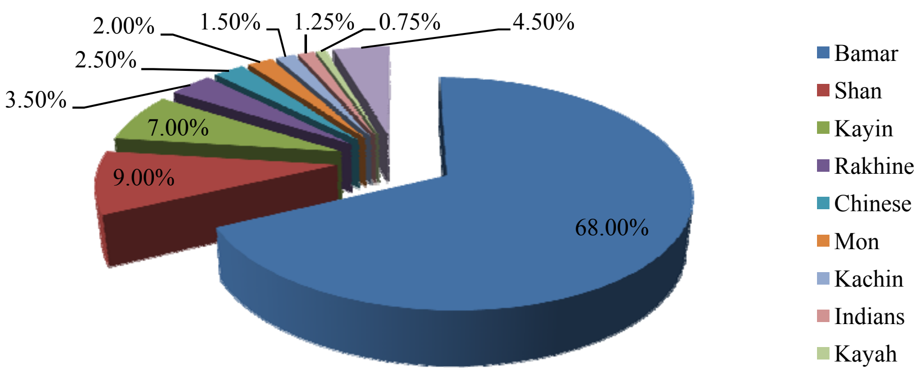
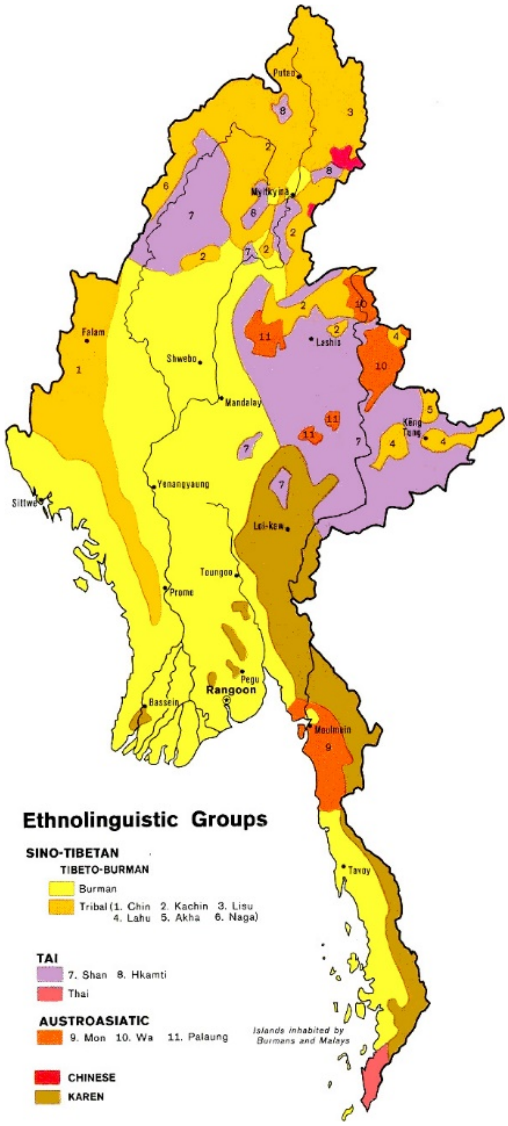


Figure 8.2.7 Ethnic Composition in Myanmar



Source: Statistics of University of Texas Libraries

Figure 8.2.8 Ethnic Groups in Myanmar

(9) Hazard and Public Health

Cyclone Nargis (May 2008), which resulted in approximately 135,000 missing or dead people five years ago, wiped out much of the equipment and livestock in Myanmar's vital southern rice bowl, and many indebted families have been unable to replace both. The price of beans, the country’s other key farm crop with sizable exports to India, fell drastically this year, and the lack of credit has left farmers unable to raise money for new planting.

Many kinds of diseases afflict the people in the country affecting public health such as malaria, diarrhea, tuberculosis, and human *immunodeficiency virus i*nfection and *acquired immune deficiency syndrome* (HIV/AIDS). The government has taken a number of new initiatives with respect to the development of community-based health care system and organizations, and increased cooperation with different United Nations (UN) agencies for upgrading the health standards. In order to prevent these diseases and take care of public health and welfare, lots of public and private clinics had been established. Mitigation measures have also been undertaken by providing education and campaign related to HIV/AIDS prevention to the local residents. Table 8.2.3 shows the number of health facilities.

Table 8.2.3 Number of Health Facilities

Health Facilities	1988-1989	2007-2008
Government Hospitals	631	839
Primary and Secondary Health Centers	64	86
Materfamilias and Child Health Centers	348	348
Rural Health Centers	1,337	1,473
School Health Team	80	80
Traditional Medicine Hospitals	2	14
Traditional Medicine Clinics	89	237

Source: Ministry of Health

8.2.2 NATURAL CONDITIONS

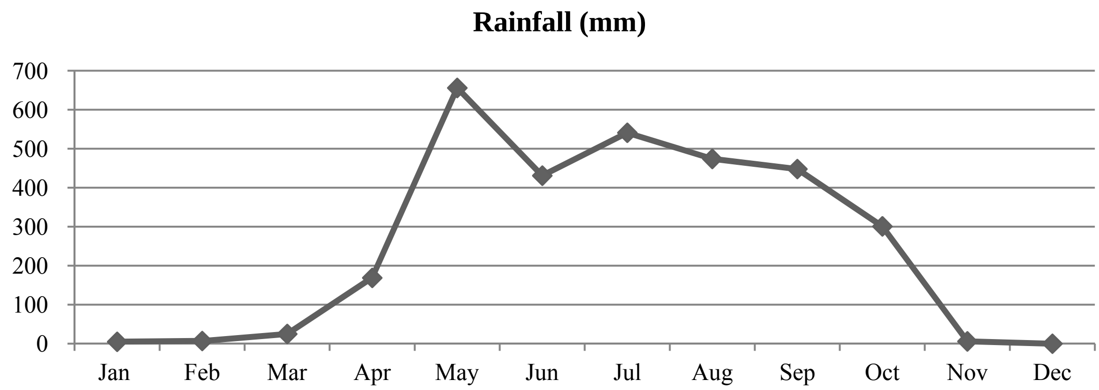
(1) Geology

The geological formation of the Ayeyarwady Delta is relatively new and originates from the Cenozoic era. Majority of the delta, including lower delta, is alluvial in origin from the Holocene by the sedimentation action of the Ayeyarwady River. However, the western central part of the delta, covering towns such as Patchein and Myaung Mya, is classified as Ayeyarwady Formation from the Miocene to the Pliocene.

Most of the lower delta areas are generally flat and the altitude is not more than 3 m. However, there are also some low ridges with deciduous tree from the Myaung Mya Township running downward to the south, for about 50 km to Laputta Township with numerous valleys intersecting Myaung Mya to Laputta.

(2) Climate

Myanmar is part of monsoon Asia with pronounced wet and dry seasons. However, there are three seasons recognized by the local people in Myanmar, i.e.: rainy season (from mid-May to mid-October); cold season (from mid-October to mid-February); and dry (hot/ summer) season (from mid-February to mid-May). The seasonal change in the project area follows this general pattern. The recorded mean maximum temperature is 35-37 ºC in March and April and the mean minimum temperature is 11-15 ºC in December and January. Humidity is between 60% and 100% throughout the year. The most highly evaporative months are from March to mid-May with high temperature without rain. The recorded mean annual rainfall (1990-2000) are 2,447 mm in Bogalay Township and 3,354 mm in Laputta Township, which tend to receive more rain than the Bogalay Township and whose annual fluctuation is also higher. Figure 8.2.9 shows the monthly rainfall.



Source: Statistics Year Book 2011

Figure 8.2.9 Monthly Rainfall

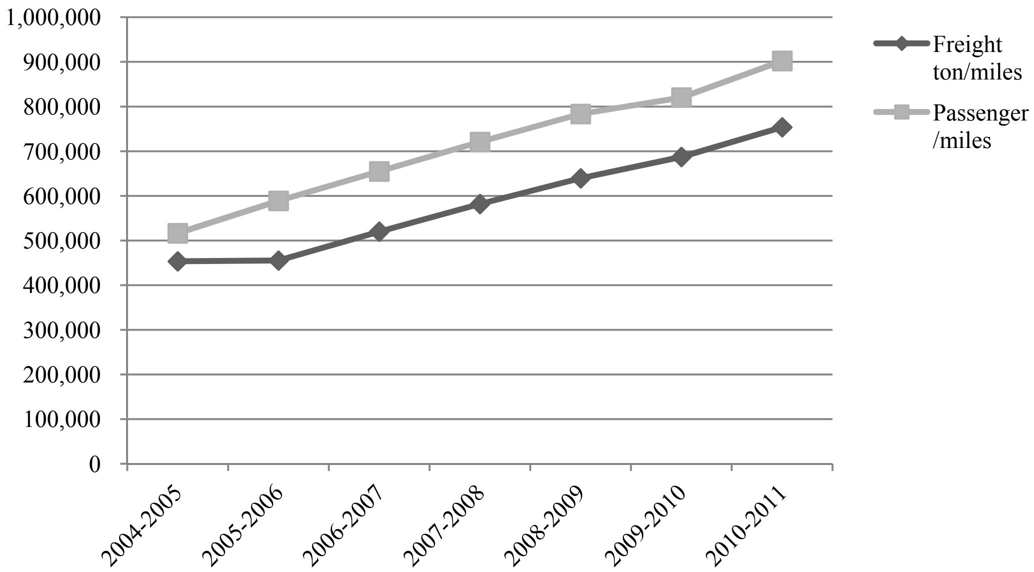
(3) Hydrology

The most densely populated part of the country is the valley of the Ayeyarwady River, which with its vast delta is one of the main rice-growing regions of the world. Mandalay, the country's second largest city, is on the Ayeyarwady in central Myanmar. The Ayeyarwady basin is inhabited by the Burmans, a Mongolic people who came down from Tibet by the 9th century and now represent nearly 70% of the mainly rural population. The valley is surrounded by a chain of mountains that stem from the east of Himalayas and spread out roughly in the shape of a giant horseshoe; the ranges and river valleys of the Chindwinn (a tributary of the Ayeyarwady) and of the Sittoung and the Thanlwin, or Salween (both to the east of Ayeyarwady), run from north to south.

(4) River and Creek

The delta area has large network of creeks, stream, and rivers, and is frequently flooded by tidal effects and/or rain during the rainy season. The land is intersected by rivers and creeks dividing it up into numerous islands. Basically, all of the rivers, creeks, and channels are branched from the Ayeyarwady River. Inland transportation is conducted using barge/cargo on the rivers. Figure 8.2.10 shows the data of freight and passenger for inland water transport.

The Yangon River is formed by the confluence of the Pegu and Myitmaka rivers and is a marine estuary that runs from Yangon emptying into the Gulf of Martaban of the Andaman Sea, which is 40 km southeast. It is the main access channel to Yangon and the channel is navigable by ocean-going ships and thus plays a critical role in the economy of Myanmar.



Source: Statistics Year Book 2011

Figure 8.2.10 Data of Freight and Passenger for Inland Water Transport

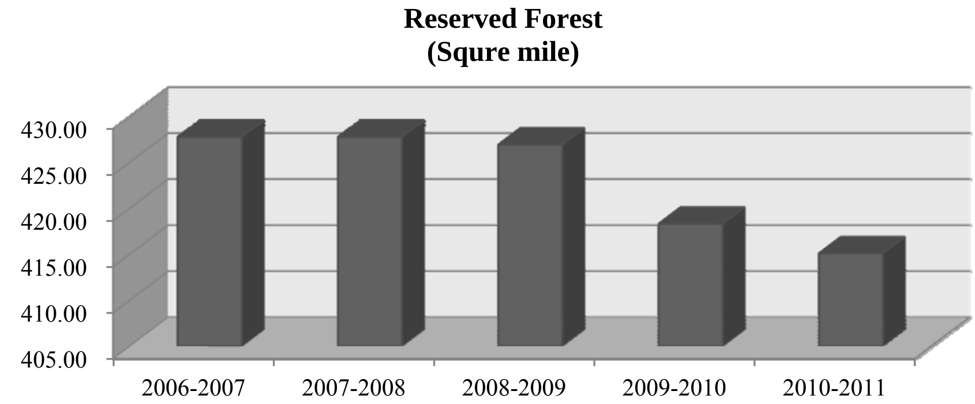
(5) Natural Resource

The country is rich in minerals. Petroleum is found east of Ayeyarwady in the dry zone. Tin and tungsten are mined in the east of Myanmar; the Mawchi mines in Kayah State are also rich in tungsten. In Shan State, northwest of Lashio, the Bawdwin mines, which are the sources of lead, silver, zinc, coal, copper, natural gas, and iron deposits, have also been found in Myanmar. Gems such as rubies and sapphires are found near Mogok.

(6) Forests

The most economically important forest resources are teak, hardwoods, and bamboo. Depending on the rainfall, temperature, and soil conditions, the distribution pattern of forests is uneven – less trees in the central dry zone, rich pristine forests in the northern part, and mangrove forests in the delta and coastal area. Exploitation of firewood, shifting cultivation, and human and agricultural encroachment have resulted in deforestation.

Deforestation for farming or illegal economic gain is the most persistent ecological effect of human encroachment. In 1985, about 1036 km^2 of the forest was lost through deforestation. By 1994, two-thirds of Myanmar's tropical forests had been eliminated. However, the nation still had the world's eighth largest mangrove area, totally approximately half of a million hectares. Figure 8.2.11 shows the data of reserved forest in Myanmar.



Source: Statistics Year Book 2011

Figure 8.2.11 Data of Reserved Forest

(7) Tidal Range

Tidal ranges vary from area to area. Topographical conditions affect the tidal level. In Yangon, the mean spring tide is wide at about 6.0 m as compared with other areas. Moreover, the volume of water brought about from rivers and creeks also affects tidal levels. During the rainy season, the level of water increases as the volume of rainwater increases thereby increasing the level of water in rivers/creeks and streams.

(8) Flora and Fauna

Approximately 300-500 species of mammals, 1,000 species of birds, 300-360 species of reptiles, and 180 species of fish inhabit Myanmar. In terms of plant life, there are about 7,000-9,000 species of plants growing in Myanmar. It is estimated that the total number of bio-species exceeds 20,000 in Myanmar, and of such, one-fourth are regarded as endemic species of Myanmar.

Endangered species in Myanmar include the tiger, Asian elephant, Malayan tapir, Sumatran rhinoceros, Fea's muntjac, river terrapin, estuarine crocodile, and four species of turtles (green sea, hawksbill, olive ridley, and leatherback). The Javan rhinoceros is extinct. Out of the total 300-500 species of mammals, 31 are endangered; of 1,000 bird species, 44 are endangered. Twenty reptiles out of 300-360 species are threatened along with one type of freshwater fish. Myanmar also has six threatened species of plants from a total of 7,000-9,000. Threatened species include the banteng, pink-headed duck, freshwater sawfish, Sumatran rhinoceros, Siamese crocodile, hawksbill turtle, gaur, and sun bear.

Coral reefs are mostly found in the southern coast and pearls are also cultured in this area. Oil and gas are exploited in offshore area as well. Marine transportation, disposal of sewage and industrial wastes are great concern for marine pollution.

(9) Important Wildlife

Important wildlife species can be identified as threatened species, which are ecologically and economically precious in the country. These species usually play a key role in any chain in their ecosystem. In addition, most tropical species are highly valued in biodiversity. However, there are no protected habitats in the proposed project site. The project site is Yangon City area and not located within an area of protected habitats of endangered species defined by the country's law and international treaties and conventions.

(10) Conditions of the Existing Port Area

Yangon City stretches from east to west along the Yangon River. South of the railway is the central district of Yangon. Many government buildings are situated in this area, especially near the river. Hinterland of Yangon City is at the southern side of the river which includes Dalla Township where there are villages with paddy fields and fruit and poultry farms, as well as a few industries such as ship repair yards. There are many ferry boats between Yangon City and the other side of the river. Yangon is also connected by waterway to Ayeyarwady and Bago divisions. The distance from Yangon Port to the sea at the mouth of the river down in the south is about 32 km.

8.2.3 POLLUTION CONTROL

(1) Pollution

Aside from the problems of underdevelopment and poverty, Myanmar is also confronted with several environmental problems arising from deforestation, loss of biological resource, land degradation due to wind and water erosion, urbanization, and waste management.

Waste management in particular has become a huge problem especially in Yangon City which has become too severe and still compounded by rapidly increasing waste and composition of waste due to the growth of population and changes in the consumption pattern and lifestyle of the local communities. Most families use plastic bags, baskets, and other containers for their wastes and these wastes are finally disposed into an open dumping type landfill site without segregation and treatment.

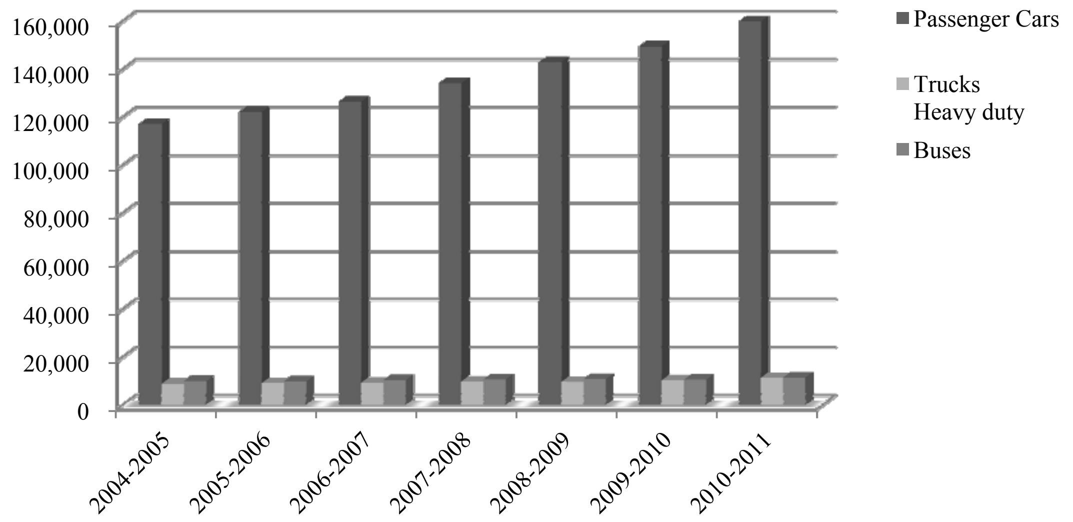
Waste management organizations of Yangon City are likewise severely constrained by the lack of resources to finance their services. Collection and transportation dominate the solid waste management cost in Yangon City. Funds are often lacking for the purchase of new equipment, purchase of landfill site and transport vehicles, and maintenance works.

Natural hazards like cyclones and earthquakes are few; and the frequency of occurrence is not very high. Also, the degree of air and water pollution caused by industry or agriculture at the present time is still minimal due to the low level of industrialization and relatively small amount of chemicals used in agriculture.

(2) Health and Environment

The National Health Plan has established four projects related to health and environment, namely: prevention and control of environmental health hazards, occupational health and safety, prevention and control of agricultural hazards, and air and water pollution control. Awareness on environmental health and issues such as impact of urbanization, air pollution, solid and hazardous waste disposal, traffic congestion, noise pollution is increasing and steps to confront these hazards are under active consideration.

Almost all vehicles running in the city are imported used vehicles/deteriorated vehicles; and air pollution results mainly from vehicle emission. Pollution checks are done at the time of vehicle registration and renewal. The Yangon City Development Committee (YCDC) manages to collect more than 80% of solid waste but some towns still face solid waste disposal problems. Figure 8.2.12 shows the data of registered motor vehicles by type.



Source: Statistics Year Book 2011

Figure 8.2.12 Registered Motor Vehicles by Type

8.2.4 LEGAL AND INSTITUTIONAL ASPECT

(1) Environmental Institution

In 1989, the Ministry of Foreign Affairs (MFA) began to assume authority over domestic environmental protection issues, while the Cabinet retained responsibility for international environmental matters. In 1990, a new body known as the National Commission for Environmental Affairs (NCEA) was initiated by the MFA to act as the central management agency for environmental matters. The NCEA's main missions are to ensure sustainable use of environmental resources and to promote environmentally sound practices in industry and in other economic activities. It formulates broad policies on natural resource management and prepares environmental legislation (standards and regulations) for pollution control, monitoring, and enforcement.

Presently, the MOECAF was established as the responsible organization for environmental management in the country according to the Environmental Conservation Law, which was promulgated in 2012.

(2) Environmental Regulation

There are no up-to-date laws for some of the most important aspects of environmental protection, such as the prevention of water pollution, air pollution, and industrial waste. Regarding pollution, Myanmar has no specific laws to govern air and water pollution. There is a general provision in Section 3 of the Public Health Law which empowers the Ministry of Health to carry out measures related to environmental health such as garbage disposal, use of water for drinking, protection of air from pollution and so on. However, detailed provisions do not exist to ensure more effective and comprehensive regulation of these matters.

The International Convention for the Prevention of Pollution by Ship (MARPOL 73/78) is a strong treaty which was signed but only partly entered into force. It has detailed regulations for preventing pollution of the marine environment by ship. It contains very specific guidelines on matters such as discharging oil from ships, storing oil on board, and dumping sewage. However, Myanmar has not yet accepted the Annexes III, IV, and V.

MARPOL 73/78 contains six annexes concerned with preventing different forms of marine pollution from ships, namely:

- Annex I — Oil
- Annex II — Noxious Liquid Substances carried in Bulk
- Annex III — Harmful Substances carried in Packaged Form
- Annex IV — Sewage
- Annex V — Garbage
- Annex VI — Air Pollution

(3) Administration of Environment

The current environmental laws in Myanmar are weak and enforcement is spread over many ministries. The following is a list of administrative competence in Myanmar:

Table 8.2.4 Administrative Competence in Myanmar

Ministry	Area of Competence
Ministry of Environmental Conservation and Forestry	Environmental management
Ministry of Livestock, Breeding and Fisheries	Marine and freshwater fisheries management
Ministry of National Planning and Economic Development	Industrial planning and foreign investment (with the Myanmar Investment Commission)
Ministry of Industry	Pollution from industrial activities (Directorate of Regional Industrial Coordination and Industrial Inspection)
Ministry of Agriculture and Irrigation	Environmental issues arising from agriculture
Ministry of Health	Health issues in relation to factories and vehicles (Department of Occupational Health, in collaboration with the Yangon and Mandalay City Development Committees)
Ministry of Road Transport	Vehicular emissions
Ministry of Labor	Health concerns of workers
City Development Committees of Yangon and Mandalay	Air pollution, waste disposal, general environmental issues in the cities of Yangon and Mandalay

(4) Awareness and Vision

In Myanmar, the environmental awareness is gradually rising. Presently, there is only a partial integration of environment into development, mainly in sectional ministries and departments. The main constraint in the integration of environment into development at the moment is the institutional factor. The NCEA, in collaboration with UN organizations, drafted the Myanmar Agenda 21, which contains programs and activities that will promote environmental protection and prevent environmental degradation. In addition, the Environmental Conservation Law for Protection and Improvement of the Environment in Myanmar was issued in 2012. Based on this law, details of environmental laws and rules are presently prepared by MOECAF (October 2014).

(5) Establishing of New Environmental Laws

One of the main problems of the existing environmental law is that there are no up-to-date laws that regulate pollution such as water and air quality, noise, and vibration. When the construction project commences at the site, there are no certain details of regulations for environmental impact assessment in order to examine the environmental impact of the project.

MOECAF is authorized as the responsible organization for environmental management in the country according to the new Environmental Conservation Law. This law consists of 14 chapters and includes an introduction of IEE and EIA system, environmental management plan (EMP), public consultation, and monitoring. Procedures and details of EIA/IEE system were formulated by MOECAF after the construction work of the jetty project was started. Figure 8.2.13 and Figure 8.2.14 show the procedures of EIA/IEE issued by MOECAF.

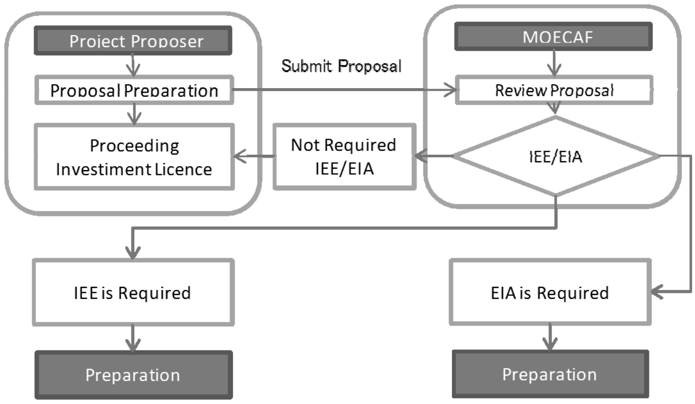


Figure 8.2.13 Procedure of EIA/IEE (1)

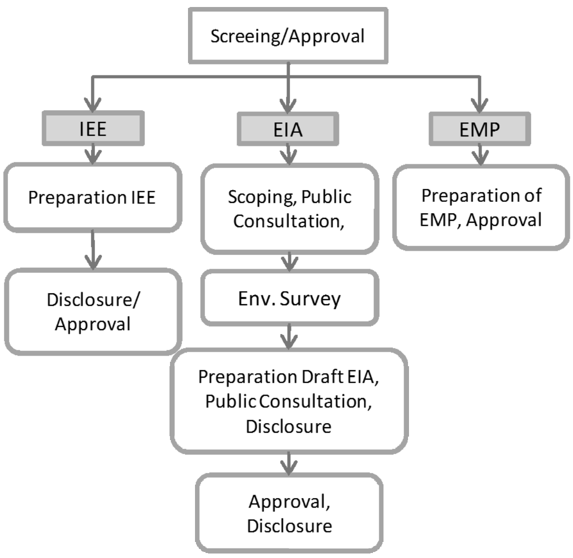


Figure 8.2.13 Procedure of EIA/IEE (2)

CHAPTER 9

CAPACITY DEVELOPMENT FOR SHIP CREW AND NAVIGATION

CHAPTER 9 CAPACITY DEVELOPMENT FOR SHIP CREW AND NAVIGATION

9.1 CAPACITY DEVELOPMENT OF SHIP CREW OF IWT SHIPS (STEP 1)

9.1.1 TRAINING SCHEME

(1) Purpose of the Training

Nautical instruments were equipped on two model ships of IWT ships before starting the training. The training and education consisting of basic course on safe navigation for IWT ship crew was performed by the JICA Project Team to educate potential IWT instructors first; and selected IWT instructors would perform training of IWT ship crew with assistance and supervision of the JICA Project Team.

(2) Principal Syllabus of the Training

Principal syllabus of the training is as follows:

1) To study outline of safe navigation.
2) To select two model ships and equip them with nautical instruments, and study operational procedures of these instruments.
3) To select the IWT instructors, to perform education of potential instructors, to perform training of the IWT ship crew, and to evaluate their performance.

The major subjects of training syllabus on safe navigation are as follows:

- ISM Code and BRM/BTM
- Rules and regulations for navigation and ship operation
- Navigation
- Ship operation
- Meteorology and river natural conditions
- Nautical instruments
- Normal operation and emergency operation
- Communication between IWT and ship, ship and ship, and ship and station

The nautical instruments used for training and equipped on board the two model ships are as listed below.

- Radar
- GPS
- Echo-Sounder
- Radio (HF)
- Radio (VHF)
- Anemometer
- Barometer

(3) Training Program

The training was broadly carried out in three stages so as to implement technical transfer as the main target according to the following schedule:

1) Stage 1: Preparation for Training (September 2009)

- To prepare educational materials and texts for the training.

- In Japan, procurement of nautical instruments.
- To select Japanese instructors (three instructors for preparing textbooks and other materials for training, materials for emergency case, safe operation and instructional book for nautical instruments).
- In Myanmar, selection of two model ships.
- To select 10-15 captain/officer trainees, including instructors for Stage 3, and to provide translators and educational rooms/facilities for implementation of the training.
- Translation of training curriculum and training text into Myanmar language.

2) Stage 2: Training of Instructors (October 2009)

To train and educate the assistant marine superintendent (AMS), captains, and helmsmen who are anticipated to become potential instructors for further training of captains and deck crews of IWT, during the period from October to November 2009.

3) Stage 3: Training of Seafarers and Crew/Evaluation of Training/Correction (November 2009)

To implement education and training of IWT crew by the IWT instructors who were trained in Stage 2, and to verify the conditions and evaluate the educational training carried out by Myanmar instructors selected by Japanese instructors. The advisable instructions may be proposed, if necessary.

Candidates of the Stage 2 training were selected from the officials or group leaders of crew engaged in the Marine Department of IWT who have the potential to become instructors of further training in Stage 3 for the training of IWT crew.

9.1.2 PROCUREMENT OF TRAINING MATERIALS AND EQUIPMENT

The following nautical instruments were procured for use in the safe navigation training of IWT ship crew:

	Name of Instrument	Outline Specifications	Quantity
1	Radar	• Distance range 0.125 to 36 miles • Own ship's position and waypoint display • 10.4 inch TFT color LCD display • Resolution 640 x 480 • Azimuth accuracy ±1°	2 units
2	GPS with Echo-Sounder	• Display 8 inch • Resolution 640 x 480 • VGA TFT LCD Color • Frequency 50/200 khz dual • Water depth range 500 m	2 units
3	Communication Equipment (HF)	• Frequency 1.8 Mhz to 30 Mhz • Channel : 300 channels • RF out pit 25 – 100 W • Power supply 28A 13.8 VDC	1 units
4	Communication Equipment (UHF/VHF)	Frequency range VHF 136 – 174 Mhz, UHF 350 – 400 Mhz/ 400 – 470 Mhz/ 450 – 512 Mhz • Power output 25 W/50 W (VHF), 50 W (UHF) • Channel spacing 12.5 khz/ 25 khz	1 unit
5	Transceiver	Frequency range VHF 136 – 174 Mhz, UHF 400 –512 Mhz • Memory channel 512	3 units
6	Anemometer	• Wind vane and anemometer register wind speed	2 units
7	Barometer	• Calibrated mercury, centimeters and millibars	2 units

Source: JICA Project Team

9.1.3 TRAINING SCHEDULE

(1) Training Place and Schedule

Training took place at the following two locations:

1) At the IWT Headquarters
2) On Model Ships

Training was performed following the schedule shown in Table 9.1.1.

Table 9.1.1 Location and Schedule of Training

Stage	Location of Training	
	At the IWT Headquarters	On Model Ships
Stage 2 Training of Instructors	9:00 a.m. – 4:00 p.m. Between 20 and 27 October 2009	9:00 a.m.– 4:00 p.m. Between 28 and 30 October 2009
Stage 3 Training of Ship Crew /Evaluation/Correction	9:00 a.m. – 4:00 p.m. Between 2 and 10 November 2009	9:00 a.m. – 4:00 p.m. Between 4 and 13 November 2009

Source: JICA Project Team

(2) Timetable of Training

The general training timetables of Stages 2 and 3 are shown in Tables 9.1.2 and 9.1.3, respectively.

Table 9.1.2 Training Schedule of Stage 2

No.	Date	Time	Contents	Instructor	Place	Instructor
1	Oct.20 (Tue)	AM	Opening Ceremony/Briefing	JICA,IWT	IWT Head Qr	Sakae*, Okubo, Kawaguchi
		PM	Orientation, ISM Code, Ship Management	JICA	IWT Head Qr	Sakae*, Okubo, Kawaguchi
2	21 (Wed)	AM	BRM	JICA	IWT Head Qr	Sakae*, Okubo, Kawaguchi
		PM	BRM	JICA	IWT Head Qr	Sakae, Kawaguchi*
3	22 (Thu)	AM	Meteorology and River natural condition	JICA	IWT Head Qr	Okubo*, Kawaguchi
		PM	Safe Navigation, Safe Operation	IWT	IWT Head Qr	Okubo*, Kawaguchi
4	23 (Fri)	AM	Safe Navigation, Safe Operation	IWT	IWT Head Qr	Okubo*, Kawaguchi
		PM	Rules and Regulations	JICA,IWT	IWT Head Qr	Okubo*, Kawaguchi
5	26 (Mon)	AM	Maneuvering for Berhing/Unberthing/River	JICA,Maker	IWT Head Qr	Okubo*, Kawaguchi
		PM	Maneuvering for Emergency	JICA,Maker	IWT Head Qr	Okubo*, Kawaguchi
6	27 (Tue)	AM	Nautical Instrument (General) GPS,Echo-Sounder	JICA,Maker	IWT Head Qr	Okubo, Kawaguchi*
		PM	Radar, Anemometer, Barometer	JICA,Maker	IWT Head Qr	Okubo, Kawaguchi*
7	28 (Wed)	AM	GPS, Echo-Sounder	JICA,Maker	Model Vessel	Sakae, Okubo, Kawaguchi*
		PM	GPS, Echo-Sounder	JICA,Maker	Model Vessel	Sakae, Okubo, Kawaguchi*
8	29 (Thu)	AM	Radar	JICA,Maker	Model Vessel	Sakae, Okubo, Kawaguchi*
		PM	Radar, Anemometer, Barometer	JICA,Maker	Model Vessel	Sakae, Okubo, Kawaguchi*
9	30 (Fri)	AM	VHF,HF	JICA,Maker	Model Vessel	Okubo, Kawaguchi*
		PM	Closing Ceremony	JICA,Maker	IWT Head Qr	Sakae*, Okubo, Kawaguchi

Source: JICA Project Team

Table 9.1.3 Training Schedule of Stage 3

No.	Date	Time	Contents	Instructor	Place	Remark
1	Nov.2 (Mon)	AM	Orientation	IWT	IWT Head Qr	Evaluation
		PM	Rule, Meteorology and River natural condition	IWT	IWT Head Qr	Evaluation
2	3 (Tue)	AM	Maneuvering for Berthing/Unberthing/River	IWT	IWT Head Qr	Evaluation
		PM	Maneuvering in Emergency	IWT	IWT Head Qr	Evaluation
3	4 (Wed)	AM	Nautical Instrument (General)GPS, Echo-Sounder	IWT	Model Vessel	Evaluation
		PM	GPS, Echo-Sounder	IWT	Model Vessel	Evaluation
4	5 (Thu)	AM	Radar, Anemometer, Barometer	IWT	Model Vessel	Evaluation
		PM	Radar, Anemometer, Barometer	IWT	Model Vessel	Evaluation
5	6 (Fri)	AM	VHF,HF	IWT	Model Vessel	Evaluation
		PM	VHF,HF , Closing	IWT	Model Vessel	Evaluation
6	9 (Mon)	AM	Orientation	IWT	IWT Head Qr	Evaluation
		PM	Rule, Meteorology and River natural condition	IWT	IWT Head Qr	Evaluation
7	10 (Tue)	AM	Maneuvering for Berthing/Unberthing/River	IWT	IWT Head Qr	Interim Report
		PM	Maneuvering in Emergency	IWT	IWT Head Qr	Interim Report
8	12 (Thu)	AM	Nautical Instrument (General)GPS, Echo-Sounder	IWT	Model Vessel	Interim Report
		PM	GPS, Echo-Sounder	IWT	Model Vessel	Interim Report
9	13 (Fri)	AM	Radar, Anemometer, Barometer	IWT	Model Vessel	Interim Report
		PM	Radar, Anemometer, Barometer	IWT	Model Vessel	Interim Report
10	14 (Sat)	AM	VHF,HF	IWT	Model Vessel	
		PM	VHF,HF , Closing	IWT	Model Vessel	

Source: JICA Project Team

9.1.4 DETAILS OF THE STAGE 2 TRAINING

The Stage 2 training kicked off in Ahlone Dockyard of IWT on 19 October 2009.

(1) Participants of Training

Fifteen participants were selected for the Stage 2 training by IWT. They were expected to become potential instructors in further stages of training for the education and capacity development of IWT crew. The positions in IWT of the participants are shown in Table 9.1.4 below.

Table 9.1.4 List of Participants of the Stage 2 Training

Position in IWT	Number of Participants
Assistant Marine Superintendent	3 persons
Fleet Officer	2 persons
Captain	9 persons
Helmsman	1 person
Total	**15 persons**

Source: JICA Project Team

(2) Details of Training Schedule

The Stage 2 training was carried out following the schedule shown in Table 9.1.5.

Table 9.1.5 Schedule of the Stage 2 Training

Date	Details of Training
19 Oct. (Mon) Morning	• Opening ceremony was held in Ahlone Dockyard Participants are as follows: U Soe Tint, Managing Director, IWT U Cho Than Maung, General Manager, MPA U Myint Swe, Marine Superintendent, IWT Mr. H. Yoshimura, 2nd Secretary, Embassy of Japan Mr. H. Miyamoto, Chief Representative, JICA Myanmar Office JICA Project Team Other parties concerned
Afternoon	• The JICA Project Team confirmed installation of the nautical and navigational instruments, e.g., radar, GPS, anemometer, barometer on board the two model ships.
20 Oct. (Tue) Morning	• Orientation was carried out by Capt. Y. Sakae. Contents of orientation: training curriculum (training of potential instructors) • The summary of "Safety Management System (SMS) and International Safety Management (ISM) Code" based on the distributed texts was explained by Capt. Y. Sakae. [Contents of lecture] 1. Background and necessity of the ISM code 2. Substandard ships 3. Objectives and scheme of the code 4. Background and necessity of SMS 5. What is SMS 6. Total quality management • The summary of "Bridge Resource Management (BRM) and Bridge Team Management (BTM)" based on the distributed texts was explained by Capt. Y. Sakae. [Contents of lecture] 1. Background and necessity of BRM and BTM 2. Format of course 3. Flow of BRM/BTM 4. Error chain 5. Human error 6. Heinrich's law and Bird's law 7. BTM/BRM correlation chart 8. Eight warning words
Afternoon	• The detailed BRM based on the distributed texts was explained by Capt. K. Kawaguchi. [Contents of the Lecture] 1. Principal signs of accidents 2. Necessity of voyage passage plan • The summary of "Rules and Regulations" based on the distributed texts was explained in principle by Capt. H. Okubo. [Contents of the Lecture] ✓ The reason for necessity of international standards on navigation safety ✓ What is the International Maritime Organization (IMO) ✓ What is the International Regulation for Preventing Collusions at Sea (COLREG)
21 Oct. (Wed) Morning	• The summary of "Passage Planning" based on the distributed texts was explained by Capt. K. Kawaguchi. [Contents of the Lecture] 1. Explanation based on the sample of actual voyage passage plan 2. Reply to participants' questions for making up these plan 3. IMO standard terms, which have been modified by the Japan Maritime Science (JMS) for clear and easy bridge communications

Date	Details of Training
Afternoon	• The summary of "IMO Structure and Standard of Training Certification and Watchkeeping (STCW) Convention" was orally explained, and "Safety Navigation" based on distributed texts was explained by Capt. H. Okubo. [Contents of the Lecture] 1. Explanation of the IMO structure in brief 2. Explanation of the STCW convention in brief 3. Reviewed the lights and shapes 4. The reason of necessity of collecting weather information 5. Principles of river navigation • The concept of "BRM/BTM" based on the distributed texts was explained by Capt. Y. Sakae. [Contents of the Lecture] 1. Flow of BRM/BTM 2. Error chain 3. Human error 4. Heinrich's law and Bird's law 5. BTM/BRM correlation chart 6. Eight warning words
22 Oct. (Thu) Morning	• The summary of "Navigation Safety" based on the distributed texts was explained by Capt. H. Okubo, and "Rules and Regulation" was reviewed by the Myanmar's participants. [Contents of the Lecture] 1. Weather conditions in river (by Capt. H. Okubo) 2. Navigation safety in river (by Capt. H. Okubo) 3. Signaling lights according to COLREG (by the Myanmar's participants)
Afternoon	• The summary of "Navigation Safety and Operation Safety" based on the distributed texts was explained by Capt. H. Okubo. [Contents of the Lecture] 1. IMO Standard Communication Phrases • The supplementary explanation of "BRM" was carried by Capt. Y. Sakae. [Contents of the Lecture] 1. SHELL Mode 2. Leadership grid (grid theory)
23 Oct. (Fri) Morning	• The summary of "Emergency Response" based on the distributed texts was explained by Capt. K. Kawaguchi. [Contents of the Lecture] 1. Main Engine Failure Emergency Response of Officer on Watch, Response of Master Emergency Response of Engineer on Watch, Response of Chief Engineer 2. Failure of Main Power Source (Blackout) Emergency Response of Officer on Watch, Response of Master Emergency Response of Engineer on Watch Response of Chief Engineer 3. Steering gear Emergency Response of Officer on Watch Emergency Response of Engineer on Watch, Command
Afternoon	• First of all, the summary of "Berthing and Un-berthing" was explained by Capt. Y. Sakae. And then, all Myanmar's participants had drawn up figures on berthing/un-berthing techniques according to their experiences. [Contents of lecture] 1. Typical techniques in the Port of Yangon 2. Drawing up the method of berthing by each participant • The summary of "Maneuvering in Emergency Situation" based on the distributed texts was explained by Capt. H. Okubo. [Contents of the Lecture] 1. Case 1 (Main Engine Failure) 2. Case 2 (Main Electric Power) 3. Case 3 (Steering Gear Failure) 4. Case 4 (Man Over Board)

Date	Details of Training
26 Oct. (Mon) Morning/Afternoon	• The summary of "Nautical Instruments" based on the distributed texts was explained by Capt. K. Kawaguchi. [Contents of the Lecture] 1. Radar 2. GPS 3. Echo-Sounder 4. Radio (VHF/HF) 5. Anemometer 6. Barometer
27 Oct. (Tue) Morning	• The summary of "Maneuvering Parameter Berthing at Yangon Port", "Natural Conditions of Yangon Division and Delta Area", and "Cyclone Disaster" based on distributed texts were explained by Capt. Y. Sakae.
Afternoon	• Explanation of handling and operation of nautical instruments, as shown above, was carried out by Fortune International Limited according to manufacturers' instructions.
28 Oct. (Wed) Morning/Afternoon	• Training of handling and operation of nautical instruments was carried out by the participants under the instruction of Fortune International Limited.
29 Oct. (Thu) Morning/Afternoon	• The training of handling and operation of nautical instruments was carried out by the participants under the instruction of Fortune International Limited.
30 Oct. (Fri) Morning/Afternoon	• The training of handling and operation of nautical instruments was carried out by the participants under the instruction of Fortune International Limited.
Afternoon	• For the closing session of Stage 2, the certificates of completion of the training program were presented from the Managing Director of Japan Marine Science Inc., Capt. Y. Sakae with the attendance of IWT General Manager U Maung Maung Lwin, and Marine Superintendent U Myint Swe.

Source: JICA Project Team

(1) Scenery of the Training

Photo 9.1.1 Lecture at the IWT Headquarters

Photo 9.1.2 Lecture and Discussion with IWT Seafarers at the IWT Headquarters

Photo 9.1.3 Explanation of Radar

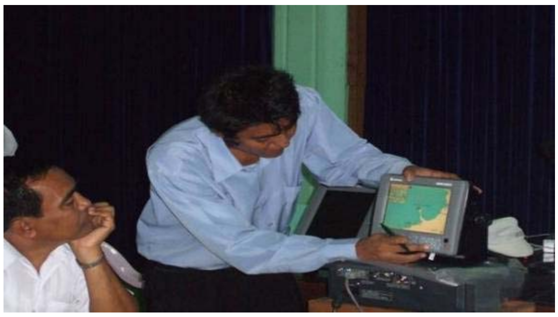


Photo 9.1.4 Explanation of GPS

Photo 9.1.5 Onboard Training at the Model Ship on Operation of Nautical Instruments

Photo 9.1.6 Onboard Training at the Model Ship on Operation of Nautical Instruments

Photo 9.1.7 Onboard Training at the Model Ship on Operation of Nautical Instruments

Photo 9.1.8 Onboard Training at the Model Ship on Operation of Nautical Instruments

Photo 9.1.9 Onboard Training at the Model Ship on Operation of Radar

Photo 9.1.10 Closing Ceremony of Stage 2

Source: JICA Project Team

9.1.5 DETAILS OF THE STAGE 3 TRAINING

(1) IWT Instructors and Participants

Among the trainees educated and trained during the Stage 2 training, four persons (one AMS, two fleet officers, and one captain) were selected as the instructors for the Stage 3 training.

Fifteen trainees were selected by IWT for the Stage 3 training. They are ten captains and five helmsmen.

(2) Details of Training

The Stage 3 training was carried out following the schedule shown in Table 9.1.6.

Table 9.1.6 Schedule of the Stage 3 Training

Date	Details of Training
2 Oct. (Mon) Morning	• Stage 3 of this program was started by the IWT instructors at the IWT Headquarters; and the orientation of the training was done by AMS U Aung Than Myang. [Contents of orientation] 1.Training curriculum • The summary of "BRM & BTM" based on the distributed texts was explained by AMS U Aung Than Myang. [Contents of orientation] 1. BRM 2. BTM 3. ISM Code
Afternoon	• The summary of safety navigation based on the distributed texts was explained by Fleet Officer U Aung Kyaw Soe. [Contents of orientation] 1. Passage planning • The method of safety navigation was explained by Fleet Officer U Aung Kyaw Soe. [Contents of orientation] 1. Rules and regulations according to COLREG
3 Nov. (Tue) Morning	• The summary of IMO standard terms based on the distributed texts was explained by AMS U Aung Than Myang. [Contents of orientation] 1. Standard onboard communication phrases • The summary of IMO standard terms based on the distributed texts was explained by AMS U Yan Lin Aung. [Contents of orientation] 1. IMO Standard Marine Communication Phrases (distress message, urgency Message, safety message, steering order, etc.)
Afternoon	• The summary of "Behavior in crisis situation" based on the distributed texts was explained by AMS U Aung Than Myang. [Contents of orientation] 1. Main Engine Failure 2. Failure of Main Power Source (Blackout) 3. Steering Gear Failure
4 Nov. (Wed) Morning	• The summary of safety navigation based on the distributed texts was explained by AMS U Aung Than Myang. [Contents of orientation] 1. Sound signal according to COLREG (supplement) • The summary of nautical instruments based on the distributed texts was explained by AMS U Aung Than Myang. [Contents of orientation] 1. Radar 2. GPS
Afternoon	• The summary of nautical instruments based on the distributed texts was explained by Fleet Officer U Aung Kyaw Soe [Contents of orientation]

Date	Details of Training
	1. Echo-Sounder 2. Radio (HF & VHF) • The summary of nautical instruments based on the distributed texts was explained by Fleet Officer U Yan Lin Aung [Contents of orientation] 1. Anemometer 2. Barometer
5 Nov. (Thu) Morning/Afternoon	• Training of handling and operation of nautical instruments was carried out by the participants under the instruction of Fortune International Limited.
6 Nov. (Fri) Morning/Afternoon	
9 Nov. (Mon) Morning/Afternoon	• The summary of safety navigation based on the distributed texts was explained by Fleet Officer U Aung Kyan Soe. [Contents of orientation] 1. BRM/BTM 2. ISM Code • The explanation of safety navigation was continued by AMS U Aung Than Myang. [Contents of orientation] 1. Rules and regulations according to COLREG 2. Passage Planning 3. Narrow Channels
10 Nov.(Tue) Morning/Afternoon	• The summary of "IMO" and "Behavior in crisis situation" based on the distributed texts was explained by Fleet Officer U Aung Kyan Soe and Fleet Officer U Moe Zet. [Contents of orientation] 1. IMO Standard Marine Communication Phrases (distress message, urgency message, safety message, steering order, etc.) 2. Main Engine Failure 3. Failure of Main Power Source (Blackout) 4. Steering Gear Failure 5. Cyclone
12 Nov. (Thu) Morning/Afternoon	• Training of handling and operation of nautical instruments was carried out by the participants under the instruction of Fortune International Limited.
13 Nov. (Fri) Morning/Afternoon	• Training of handling and operation of nautical instruments was carried out by the participants under the instruction of Fortune International Limited.
14 Nov. (Sat) Morning/Afternoon	• Training of handling and operation of nautical instruments was carried out by the participants under the instruction of Fortune International Limited.
Afternoon	• For the closing session for Stage 3, the certificates of completion of the training program were presented from the Managing Director of Japan Marine Science Inc., Capt. Y. Sakae with the attendance of IWT Marine Superintendent U Myint Swe.

Source: JICA Project Team

(2) Scene of the Training

Photo 9.1.11 Lecture in Stage 3 at the IWT Headquarters

Photo 9.1.12 IWT Instructor Teaches Navigation Safety to the Participants

Photo 9.1.13 Study of Nautical Instruments at the Model Ship

Photo 9.1.14 Study of Operation of Radar

Source: JICA Project Team

9.1.6 POST EVALUATION OF CAPACITY DEVELOPMENT TRAINING

The main objectives of this ship crew training project were to install various nautical instruments on two model ships and to enhance aspects of related safety issues by implementing education/training to IWT ship crew for support for safety navigation, including accurate handling/operation of the instruments, on the IWT fleet damaged by Cyclone Nargis.

The most important objectives of this project were to guide IWT seafarers on training measures and to develop potential instructors within IWT seafarers by using the education/training texts provided by the JICA instructors. The JICA Project Team recognized that JICA's objective could be best achieved through four weeks of continuous training.

The basic initiative of the JICA Project Team was for the trained IWT instructors to be able to conduct education/training for IWT ship crew on a regular basis in the future, and it was considered that support for these trainings is needed to continue once a month every year for a short period, for two to three years, taking into account the response of 100% of the participants to continue the training.

The JICA Project Team had realized that the same “ship crew training system” shall be established/introduced in Myanmar, taking account of the ship crew education programs performed in developed countries, i.e., their program shall not be only just once training but continuously implemented once every two years.

There are 280 ships of the IWT fleet, except for only two ships which have installed nautical instruments at this time, with no modern navigational instruments and communication systems on board and those ships carrying many passengers and cargos have navigated through the day by depending on obsolete systems/equipment and masters’ experiences. For such environmental conditions, the JICA Project Team is concerned that this may result into a considerable/alarming dangerous situation. Furthermore, the JICA Project Team considers the need to support continuous reinforcement on related safety by future assistance such as supplying devices from Japan.

In order to evaluate the effectiveness of the training, a questionnaire survey was performed to obtain difference of impression of trainees before Stage 2 and after Stage 3. Based on the questionnaire survey, post evaluation results of the training were summarized in the succeeding section.

Details of the questionnaire survey are presented in the appendix.

(1) Questionnaire Survey

1) Question 1: Training was Useful or Not

(Question)

- Do you think that this training course was useful with regard to navigation safety?

(Answer)

- Very useful
- Useful
- Not useful

All participants responded that the training is “very useful” both in Stage 2 and Stage 3.

Q-1	Very useful	Useful	Not useful	No answer	Total
A-1	15	0	0	0	15

2) Question 2: Selection of Preferable Subject

(Question)

- If participants respond as useful and very useful, please select three of the best subjects in the following table.

(Answer)

- N-1 ISM Code, BRM/BTM
- N-2 Rules and Regulations
- N-3-N-4 Navigation Safety (Passage Planning, IMO Standard Term)
- N-6 Navigation Safety (Behavior in Crisis Situations)

- N-7 Meteorology and River Natural Condition
- N-8-N-13 Nautical Instruments

(a) Stage 2

The subject of N-1 (ISM Code & BRM/BTM) received 15 points (34%), which is the most, followed by N-7 (Natural Condition) with 8 points (18%), N-2 (Rules and Regulations), N-3 and N-4 (Navigation Safety) and N-6 (Emergency) with 6 points (13%) each.

Item	N-1	N-2	N-3,4	N-6	N-7	N-8-13	Total
Answer	15	6	6	6	8	4	45
%	33.3	13.3	13.3	13.3	17.8	8.9	100.0

(b) Stage 3

The subject of N-1 (ISM Code & BRM/BTM) received 14 points (31%), which is the most, followed by N-8 to N-13 (Nautical Instruments) with 10 points (22%), N-3 and N-4 (Navigation Safety-Passenger Planning, IMO Standard Term) with 9 points (20%), N-2 (Rules and Regulations) with 6 points (14%), N-6 (Navigation Safety-Behavior in Crisis Situations) with 5 points (11%), and N-7 (Meteorology and River Natural Condition) with 1 point.

Item	N-1	N-2	N-3,4	N-6	N-7	N-8-13	Total
Answer	14	6	9	5	1	10	45
%	31.1	13.3	20.0	11.1	2.2	22.2	100.0

3) Question 3: Navigation Safety Training in the Future

(Question)

- Do you wish to continue the JICA training course by Japanese instructors every year?

(Answer)

- I wish to continue the JICA training course by Japanese instructors every year.
- I wish that this training should be carried out by Myanmar (IWT) instructors.
- No necessary training

Almost all the participants responded that this JICA training course should be continued in the future.

(a) Stage 2

Item	Continue JICA Training	IWT Internal Training	Not Necessary
Answer	15	5	0

(b) Stage 3

Item	Continue JICA Training	IWT Internal Training	Not Necessary
Answer	15	1	0

4) Question 4: Training in the Future (Additional Subjects)

If you need to continue this training course, please describe what other subjects you would like to add.

(a) Stage 2

Comments (e.g., your requirements of additional training)

- Does not require any additional training (three trainees)
- First aid work for requirements of life safety
- Firefighting exercises, including explanation of appliances at jetty, anchorage and underway
- Life-saving appliances including survival training
- Tasks to be taken step by step if a ship runs into a crisis situation including prevention for cyclone disaster and arrangements
- Damage control
- We especially considered that radar observation and GPS operation should be studied through the day on an actual underway ship as a practical proposition (two trainees)
- Cargo stowage plan for ship stability
- How to manage cyclone disaster prevention as in Japan's implementation plan and apply techniques to Myanmar

(b) Stage 3

- If another modern system would emerge, I want to ask you to arrange training in the same manner (two trainees)
- The requirements for prevention training of river control (two trainees)
- Firefighting and fire extinguisher, including handling/operation of appliances and prevention of fire (four trainees)
- Life-saving appliances and their handling/operation
- How to carry out maintenance of ship
- Team arrangement during fire and sinking caused by various reasons

5) Question 5: Please give any comments on the training, if any.

Comments given

(a) Stage 2

- This training has many advantages on prioritizing safety navigation (many trainees)
- Our ships have no modern navigational equipment, such as Global Maritime Distress and Safety System (GMDSS) radio, so we felt the need to install the same equipment on our ship for prevention from dangerous situations
- This training was too short so as to understand all the items; therefore, we need at least one month duration
- We hope to study from Japanese inland water ships in Japan with Myanmar instructors for at least two weeks duration, so as to obtain more understanding of the subject of this training

- Practical lecture on the model ship during navigation especially at night will be more suitable for trainees
- Room space in the model ship was very small for studying and practicing the installed nautical instruments for 15 trainees
- Operation training of nautical instruments should be carried out in a ship underway, which is better than in a moored ship for better understanding
- Translation sheets should be attached together with English texts
- Additional explanations are needed
- More lectures related to safety navigation using nautical instrument are needed in the future
- Request to consider providing food for the whole day for trainees coming from long distances

(b) Stage 3

- All of the lectures prepared by JICA were very good and perfect, and also satisfied with the study (15 trainees)
- I had learned well the rules and regulations on safety navigation provided by the IWT and Department of Maritime Administration, meantime I clearly understood the ISM code, BRM/BTM system and nautical instruments in addition to above knowledge, therefore I could teach systematically my crew on safety navigation and I believe that the IWT ships would be more safe in the future (two trainees)
- We, the IWT crew, would maintain safety navigation and could avoid accidents

(2) Results of Self-Evaluation on Fundamental Maritime Competence

The fundamental maritime competency and experience have been observed very differently among the participants.

For the self-evaluation on fundamental maritime competence, it was rated from level 1 to level 5 as defined below.

Level 1: It was not possible to understand at all
Level 2: It was possible to understand only a little
Level 3: It was possible to understand usually
Level 4: It was possible to understand comparatively well
Level 5: It was possible to understand very well

(a) Stage 2

The summary of the evaluation for this training (see Table 9.1.7 below) is as follows:

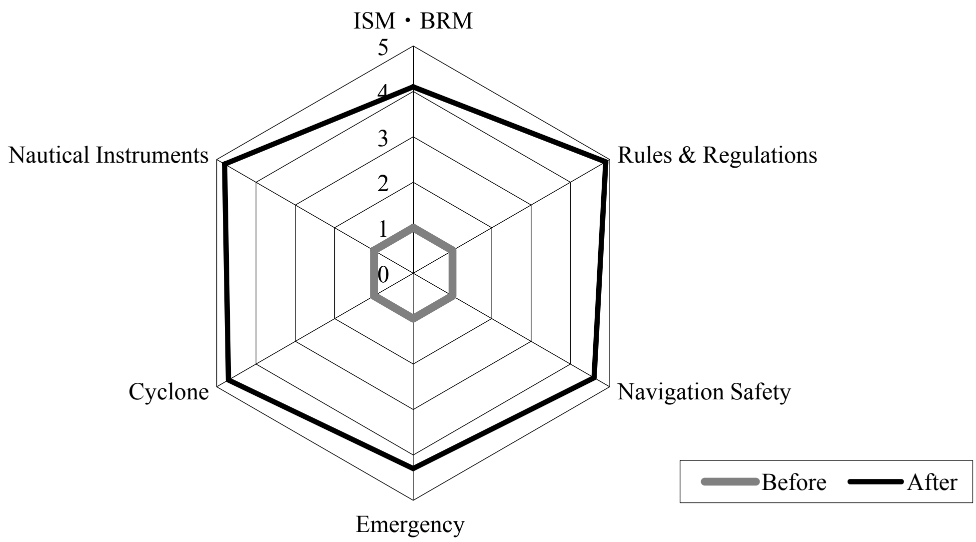
- According to the participants' self-evaluation, they had evaluated themselves with a high level of understanding, i.e., their self-evaluation had especially increased from level 1 to level 4.6 on average.
- The items of lectures were categorized into six groups for convenience, i.e.: N-1 (ISM Code, BRM/BTM), N-2 (Rules and Regulations), N-3 and N-4 (Navigation Safety) (Passage Planning, IMO Standard Term), N-6 (Navigation Safety) (Behavior in Crisis Situations), N-7 (Meteorology and River Natural Condition), and N-8 to N-13(Nautical Instruments).

- N-2 (Rules and Regulations) got the highest with 4.9 points, followed by N-8 to N-13 (Nautical Instruments) with 4.8 points. It was considered that this project was very fruitful in showing the responses, taking account of the main objective of this project which is familiarization for smooth operation of seven types of nautical instruments, such as radar and GPS, equipped on model ships for the first training program for IWT ship crew.
- Even setting this evaluation aside, it was evaluated that the attitude and degree of concentration of all the trainees during the period of this project as having excellent results together with their strong motivation on this objective.

Table 9.1.7 Summary of Self-Evaluation Sheet

No	Position	N-1	N-2	N-3,N-4	N-6	N-7	N-8 to N-13	**Total**	**Average**
		ISM, BRM	Rule	Navi. Safe	Emergency	Cyclone	N. Instruments		
1	AMS	4.0	5.0	5.0	4.0	4.0	4.7	**26.7**	**4.5**
2	Fleet Officer	4.0	5.0	4.5	4.0	4.0	4.0	**25.5**	**4.3**
3	Captain	4.0	5.0	4.5	5.0	5.0	5.0	**28.5**	**4.8**
4	Captain	4.0	5.0	4.5	4.0	5.0	4.5	**27.0**	**4.5**
5	Captain	4.0	5.0	4.5	4.0	5.0	4.3	**26.8**	**4.5**
6	AMS	5.0	5.0	5.0	5.0	5.0	5.0	**30.0**	**5.0**
7	Captain	4.0	5.0	4.5	4.0	5.0	5.0	**27.5**	**4.6**
8	Captain	4.0	5.0	4.5	4.0	4.0	5.0	**26.5**	**4.4**
9	Fleet Officer	4.0	5.0	4.0	4.0	5.0	4.8	**26.8**	**4.5**
10	Captain	4.0	4.0	4.5	5.0	5.0	5.0	**27.5**	**4.6**
11	AMS	4.0	5.0	5.0	5.0	5.0	5.0	**29.0**	**4.8**
12	Captain	4.0	5.0	5.0	5.0	4.0	5.0	**28.0**	**4.7**
13	Captain	4.0	5.0	5.0	4.0	5.0	4.7	**27.7**	**4.6**
14	Helmsman	4.0	5.0	4.5	4.0	4.0	4.7	**26.2**	**4.4**
15	Captain	4.0	5.0	4.5	4.0	5.0	5.0	**27.5**	**4.6**
Total		**61.0**	**74.0**	**69.5**	**65.0**	**70.0**	**71.7**	411.2	68.5
Average		**4.1**	**4.9**	**4.6**	**4.3**	**4.7**	**4.8**	27.4	4.6

Source: JICA Project Team



Source: JICA Project Team

Figure 9.1.1 Radar Chart of Self-Evaluation (Stage 2 Evaluation)

(b) Stage 3

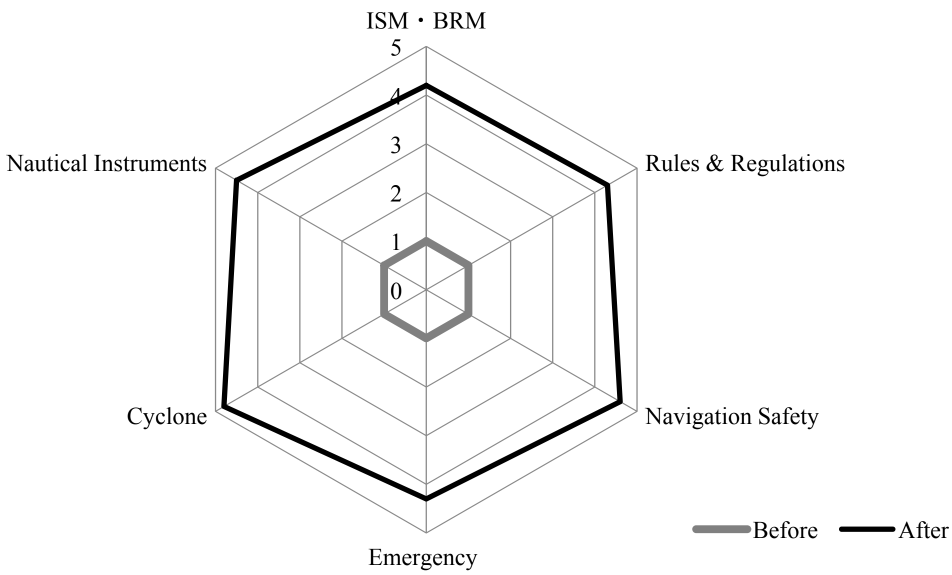
Adopting the same evaluation method for Stage 2, i.e., 15 participants evaluated themselves and then the JICA experts verified the results of the self-evaluation, the results are as follows:

- All of the 15 participants evaluated themselves as having a high level of understanding regarding all items from leve1 1 before starting the course.
- After completion of the course, all the levels of understanding of all participants sharply increased to 4.5 points against a full mark of 5. It was considered that such results should come from the challenging contents of the lectures; furthermore, it was considered that the lecture techniques of four IWT instructors trained during Stage 2 were quite skillful.
- In considering the level of understanding for each lecture item, N-7 (Cyclone) got 4.8 points, which is the highest, followed by N-3 and N-4 (Navigation Safety) with 4.6 points. It was assumed that this result was from their strong wish to make good use of cyclone measures through the review of Cyclone Nargis. In addition to the above, the JICA Project Team strongly felt high hopes to enhance safety in their old aged fleets through training on navigation safety
- All of the 15 participants seriously followed these introductions during the two-week training period. Therefore, the JICA instructors strongly felt that the IWT trainees have been wishing for this education and training

Table 9.1.8 Summary of Self-Evaluation Sheet

No	Position	N-1	N-2	N-3,N-4	N-6	N-7	N-8 to N-13	**Total**	**Average**
		ISM, BRM	Rule	Navi. Safe	Emergency	Cyclone	N. Instruments		
1	Captain	4.0	4.0	4.5	4.0	5.0	4.5	**26.0**	**4.3**
2	Captain	4.0	5.0	4.0	5.0	4.0	4.5	**26.5**	**4.4**
3	Captain	4.0	4.0	5.0	4.0	4.0	3.0	**24.0**	**4.0**
4	Captain	4.0	4.0	4.0	4.0	4.0	4.5	**24.5**	**4.1**
5	Captain	5.0	5.0	4.5	4.0	5.0	5.0	**28.5**	**4.8**
6	Captain	5.0	5.0	5.0	4.0	5.0	4.7	**28.7**	**4.8**
7	Captain	4.0	4.0	5.0	4.0	5.0	4.3	**26.3**	**4.4**
8	Captain	4.0	4.0	5.0	5.0	5.0	5.0	**28.0**	**4.7**
9	Helmsman	4.0	4.0	5.0	5.0	5.0	5.0	**28.0**	**4.7**
10	Captain	4.0	4.0	5.0	5.0	5.0	5.0	**28.0**	**4.7**
11	Helmsman	4.0	5.0	5.0	5.0	5.0	4.3	**28.3**	**4.7**
12	Helmsman	4.0	4.0	4.0	4.0	5.0	4.7	**25.7**	**4.3**
13	Helmsman	4.0	4.0	4.5	4.0	5.0	4.3	**25.8**	**4.3**
14	Captain	4.0	5.0	4.5	4.0	5.0	4.7	**27.2**	**4.5**
15	Helmsman	5.0	4.0	4.5	4.0	5.0	4.5	**27.0**	**4.5**
Total		**63.0**	**65.0**	**69.5**	**65.0**	**72.0**	**68.0**	**402.5**	**67.1**
Average		**4.2**	**4.3**	**4.6**	**4.3**	**4.8**	**4.5**	**26.7**	**4.5**

Source: JICA Project Team



Source: JICA Project Team

Figure 9.1.2 Radar Chart of Self-Evaluation (Stage 3 Evaluation)

(3) Key Issues and Measures（Summary of Stage 2 and Stage 3）

The JICA Project Team divided 30 ship crew members selected by IWT into two groups, and carried out their education and training continuously for two weeks (ten days) respectively. Recalling training duration of these four weeks, all trainees had appeared to try hard by making the best possible use of this first time program of IWT crew training. According to their self-evaluation after the completion of the course, all the trainees extremely showed high levels of understanding as compared before the start of the program. Furthermore, through the JICA Project Team's evaluation, it was recognized that such education and training program for crew members had been completed successfully in general.

However, some issues had been raised, such as materials, method of training by instructors, and training systems during the program. The JICA Project Team wishes to propose the following for the future IWT training system in relation to the above issues:

1) Materials

- Issues: JICA prepared the materials for this first program, but preparing such materials by IWT is premature. IWT has not only any sources of international maritime issues but also has no references for preparation of training materials by themselves, since they only manage inland water transportation. In addition to the above, it was felt that it is difficult to compile the training texts to meet their present skills.
- Measures: JICA provided maritime information and transferred the text preparation techniques in the short term (two to three years). JICA's assistance for new training text preparation is needed for this period. In the medium term (four years after), IWT should prepare the aforesaid text.

2) Navigational Instruments

- Issues: JICA provided and installed nautical instruments such as radar and GPS on two model ships for countermeasures against cyclones. In the meantime, this measure is not sufficient for this purpose, considering that the IWT owned and operated 280 self-propelled ships in total.
- Measures: The aforesaid instruments shall be installed on at least 28 ferry boats (10% of their fleet) in the future.

3) Method of Training

- Issues: The JICA Project Team pursued this program by making good use (exploiting) of text notes, PowerPoint presentations, and distributed documents. The most important issue observed is the promotion of IWT instructors. At this time, four IWT applicants are selected from 15 trainees as possible candidates for further Stage 2 who will provide training to the new trainees for Stage 3. However, their basic maritime knowledge/skills regarding the BRM, IMO, rules of traffic, safety navigation, nautical instruments, cargo handling, and fire fighting training were observed to be at a low level.
- Measures: JICA should support the promotion of instructors. Increasing the number of IWT instructors as a concrete measure shall be provided under the same manner at this time in the short term (later on two to three years). Furthermore, IWT shall promote about ten instructors and continue periodical training for safety navigation through their own training program in the medium term.

4) Education System of IWT

- Issues: At present, the biggest issue is the lack of crew training system in IWT. The responsibilities of IWT crews are very heavy with the safety of lives of 500 to 700 passengers and cargos onboard a ship every day, and the largest mission is maintenance of safety operation of their ships.

- Measures: Consideration and set up of a crew education system is especially necessary. The setup of a seafarer education system within IWT will be a burden for them; therefore, the guidance of JICA on this matter for IWT shall be needed. For example, in consideration of the education system, the issues regarding "when, where, who, to whom and contents of lecture" for providing safety navigation maintenance shall be resolved. On the other hand, there is an established good education system of seamen at the Department of Maritime Administration (DMA) under the same ministry. To make good use of facilities and resources of DMA for re-education of IWT seamen is the best way for further training of IWT's seamen. It is recommended for MOT to coordinate between two institutes for providing a good education system so as to secure safe navigation of IWT ships and to continue to provide good services with higher quality to their passengers.

9.2 CAPACITY DEVELOPMENT OF SHIP NAVIGATION SYSTEM (STEP 2)

9.2.1 TRAINING SCHEME

(1) Purpose of the Training

Prior to training, LED leading lights were installed on the three towers at the Monkey Point Channel. The purpose of training was to make MPA officers familiar with leading lights.

(2) Leading Light System at Monkey Point Channel

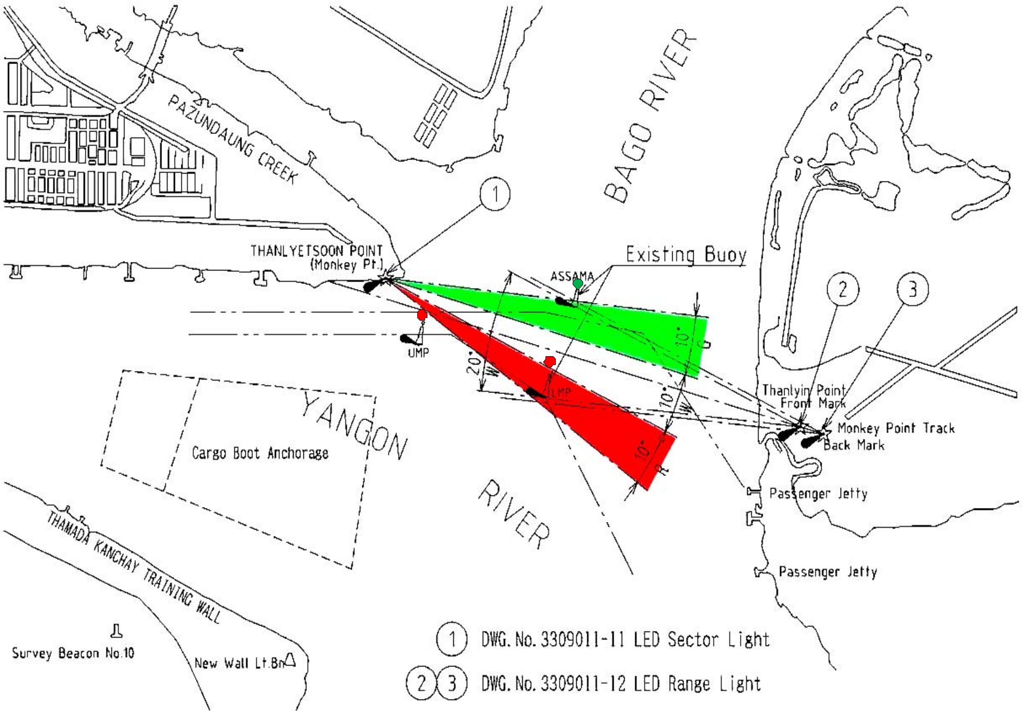
Based on the discussion between the JICA Project Team and the Marine Department of MPA, the leading lights were introduced as follows:

1) Monkey Point Tower (① in Figure 9.2.1)

- LED Sector Light
- Light Color: Green/White/Red
- Sector Angle: 10 degrees each, total of 30 degrees of horizontal angle
- Luminous Range: 5 nautical miles

2) Thanlyin Point Tower (② and ③ Figure 9.2.1)

- LED Range Light
- Light Color: White
- Sector Angle: 20 degrees of horizontal angle
- Luminous Range: 6 nautical miles
- Light Character: Isophase Light, 4 seconds (2 seconds on+2 seconds off)
- Synchronizing Front Light and Rear Light



Source: JICA Project Team

Figure 9.2.1 Leading Lights System at Monkey Point Channel


Photo 9.2.1 Monkey Point Channel

(3) Principal Syllabus of the Training

1) To study outline of safe navigation
2) To study navigation aids for narrow channel based on IALA
3) To furnish the lights on the three towers
4) To study how to use the above instruments

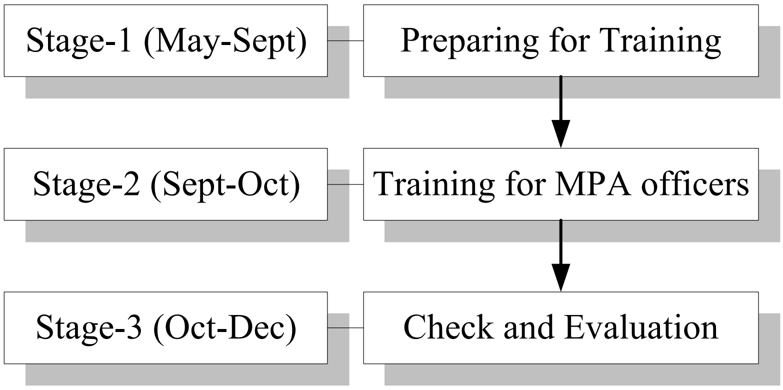
Major subjects of the training syllabus of safe navigation are as follows:

- Rules and regulations for navigation

- General instructions for navigation aids
- How to use sector lights and range lights
- Installation of lights at the three towers
- Operation and maintenance of the lights

(4) Training Program

The training program is implemented in three stages broadly in the following schedule with the main targets of technical transfer:



1) Stage 1 Preparing for Training:

(a) In Japan

- JICA Project Team
  Procurement of the lights, and preparation of educational materials and textbooks for the training.

(b) In Myanmar

- JICA Project Team
  Confirmation of conditions of the three light towers, which were restored by MPA;
  Confirmation of consignees for the leading lights;
- MPA
  Selection of MPA officers or engineers in order to install the lights on top of the tower;
  Selection of candidates of approximately ten MPA officers/engineers concerning installation, maintenance of new leading light system;
  Arrangement of interpreter and education room/facilities for training implementation; and
  Translation of training curriculum and training text to Myanmar language.

2) Stage 2 Training of MPA Officers:

- JICA Project Team
  Implementation of education and training for MPA officers by JICA instructors and maker.

- MPA
  Dispatch MPA officers/engineers to install the lights on top of the tower; and Arrangement of ship for JICA staff in order to regulate direction of the lights.

3) Stage 3 Check and Evaluation:

- JICA Project Team
  Check and evaluation of the results of training and navigation conditions after the restoration of the lights.

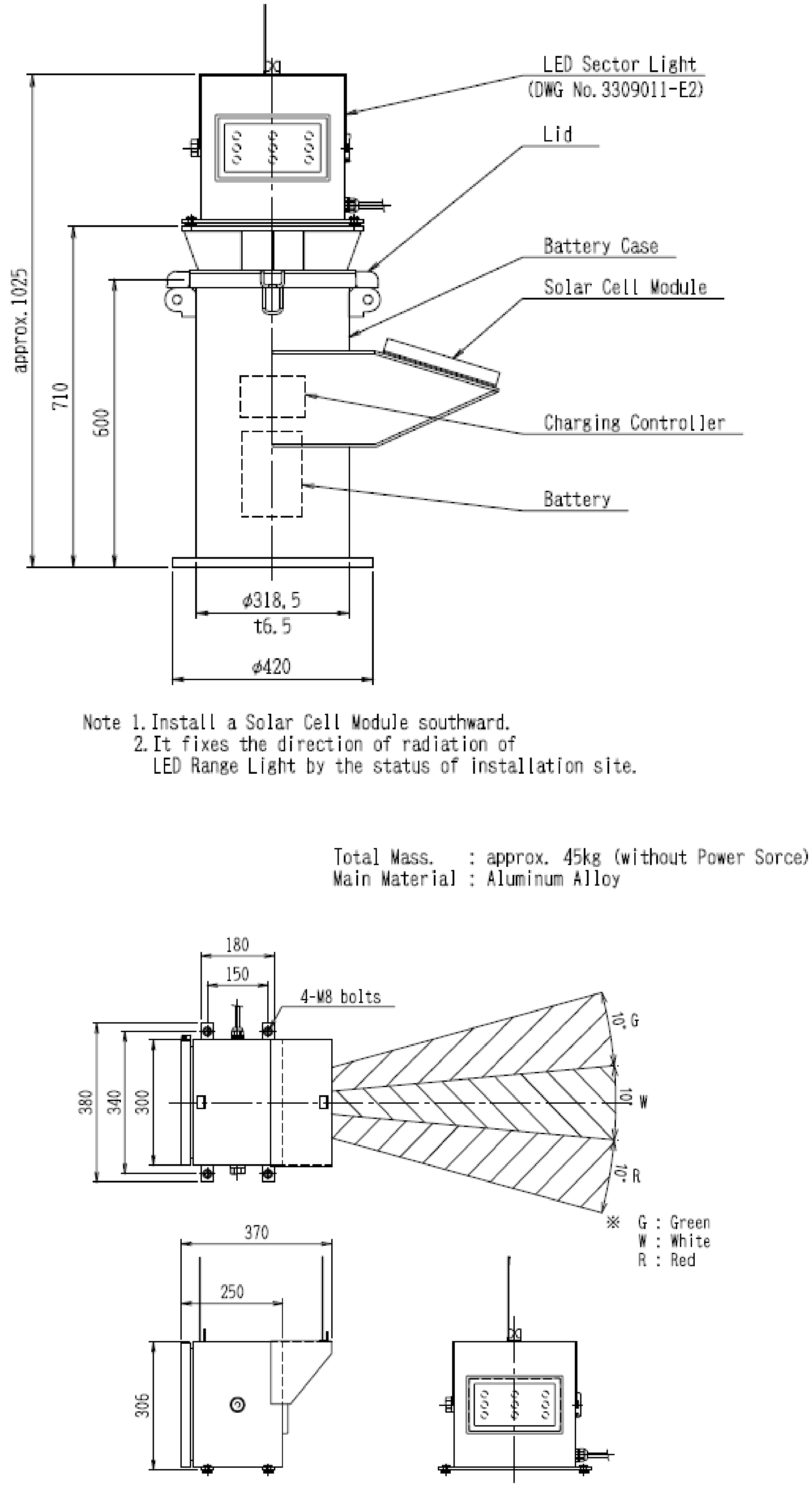
9.2.2 PROCUREMENT OF TRAINING MATERIALS AND EQUIPMENT

The following leading lights were procured for the safe navigation at the Monkey Point Channel:

No.	Name of Instruments	Outline Specification	Quantity
1	LED Sector Light with Battery Case	**Lighting Equipment** - Light Color: Green/White/Red - Light Source: High-power LED - Power Consumption: approx. 1.8 W - Input Voltage(nominal): 12 V DC - Sector Angle and Color: Total: 30 degrees (horizontal angle) - Green: 10 degrees - White: 10 degrees - Red: 10 degrees - Intensity: more than 150 cd (Each color, In Nighttime) - Luminous Range (T=0.74): more than 5 NM (each color, at nighttime) - Sun switch: Photodiode - Main Material: Casing; Stainless Steel Inside Unit; Aluminum Alloy - Overall Height: 306 mm - Total Mass: approx. 13 kg - Charging Controller: SVC14−5 A - Storage Battery: PWL12V38 - Charging Controller: SVC14−5 A - Storage Battery Type: PWL12V38 (Capacity; 12 V, 38 Ah) Quantity: 1 pc - Battery service period: 15 days - Mass: approx. 16 kg **Battery Case** - Overall height: 710 mm - Mass: approx. 32 kg	1 unit
2	LED Range Light with Battery Case	**Lighting Equipment** - Light Color: White - Light Source: High-power LED - Power Consumption: approx. 1.0 W - Input Voltage (nominal): 12 V DC - Sector Angle: 20 degrees - Light Character: Iso 4 sec (2.0 + 2.0) - Fixed Intensity: 170 cd - Luminous Range (T=0.74): 6.0 NM (nighttime) - Flasher: Microprocessor type - Sun switch: Photodiode - Main Material: Casing: Stainless Steel Inside Unit; Aluminum Alloy - Overall Height: 306 mm - Total Mass: approx. 13 kg **Power Source** - Solar Cell Module: ZK−36M53B (Output: 17.2 V, 5.3 W) Quantity: 1 pc - Charging Controller: SVC14−5 A	2 units

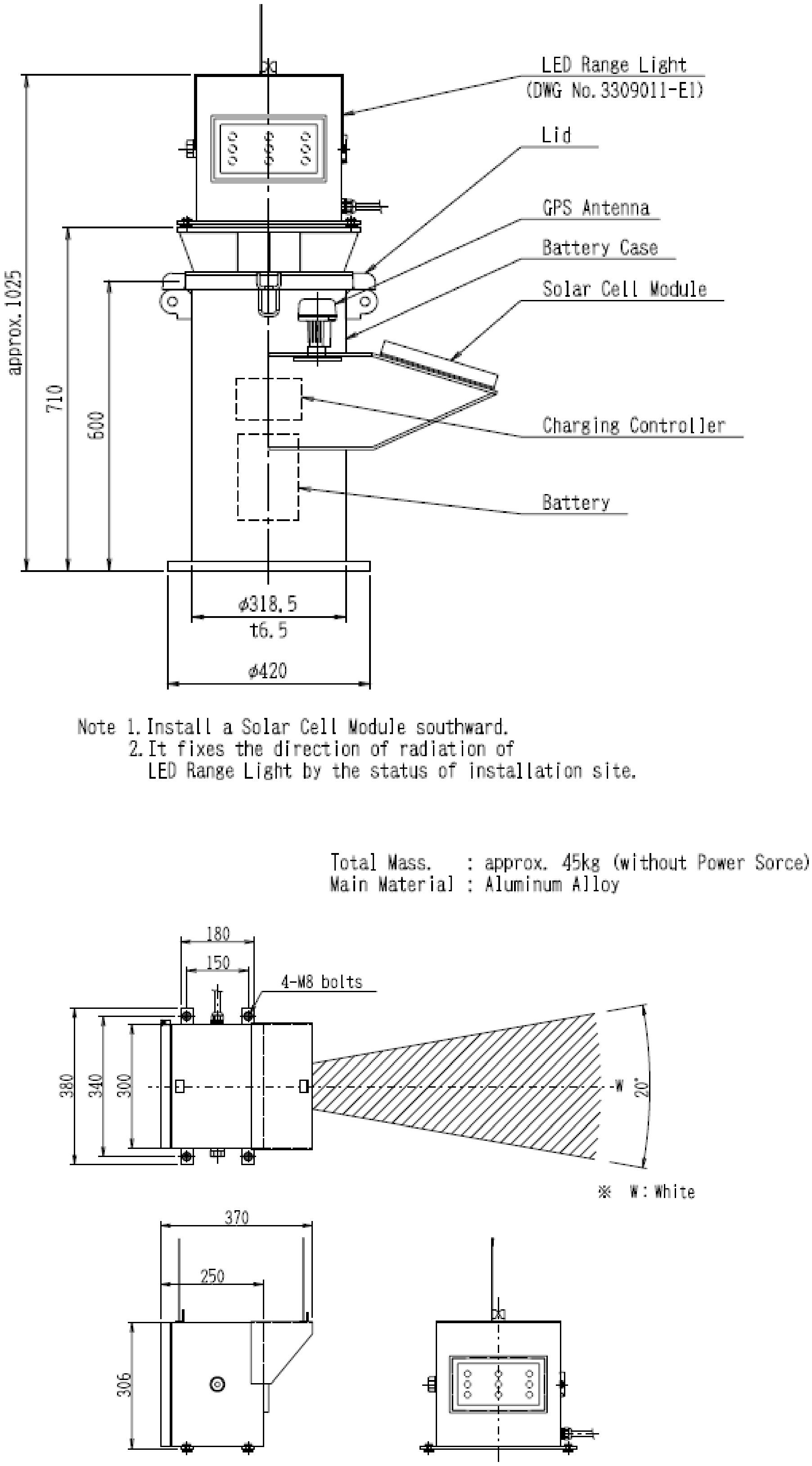
No.	Name of Instruments	Outline Specification	Quantity
		(Voltage controller for protection of overcharge) - Storage Battery: PWL12V24 (Capacity: 12 V, 24 Ah) Quantity: 1 pc - Battery Service Period: 15 days - Mass: approx. 13 kg **Accessories** - GPS Synchronizer: ZF-G3 and G Type Antenna **Battery Case** - Overall Height: 710 mm - Mass: approx. 32 kg	
3	Spare Parts	- 1 unit of LED Sector Light - 1 unit of LED Range Light - 1 piece of Solar Panel ZK-36M53B - 1 piece of Solar Panel ZK-36M130B - 1 piece of GPS Antenna - 3 pieces of Window with Frame - 3 pieces of Vent Filter - 3 pieces of Rubber Packing	

Source: JICA Project Team



Source: JICA Project Team

Figure 9.2.2 Drawing of Sector Light



Source: JICA Project Team

Figure 9.2.3 Drawing of Range Light

9.2.3 TRAINING SCHEDULE

(1) Training Place

The training took place at the following three locations:

1) At the MPA Office
2) At the site of leading light tower, and
3) On the MPA Ship

(2) Time Schedule

Schedule and training items for Stage 2 are shown below.

Date	Time	Contents	Instructor	Place	Remark
1 Oct. (Fri)	a.m.	Safe Navigation, Safe Operation	JICA Project Team	MPA Headquarters	Sakae, Tamatani
	p.m.	Safe Navigation, Safe Operation	JICA Project Team	MPA Headquarters	Sakae, Tamatani
5 Oct. (Tue)	a.m.	Leading Light and Sector Light General Instruction	JICA Project Team /Maker	MPA Headquarters	Sakae, Tamatani, Maker
	p.m.	Leading Light and Sector Light General Instruction	JICA Project Team /Maker	MPA Headquarters	Sakae, Tamatani, Maker
6 Oct. (Wed)	a.m.	Operation and maintenance Sector Light at Monkey Point	JICA Project Team /Maker	Tower/Ship	Sakae, Tamatani, Maker
	p.m.	Operation and maintenance Sector Light at Monkey Point	JICA Project Team /Maker	Tower/Ship	Sakae, Tamatani, Maker
7 Oct. (Thu)	a.m.	Operation and maintenance tor Range Light at Thanlyin Point	JICA Project Team /Maker	Tower/Ship	Sakae, Tamatani, Maker
	p.m.	Operation and maintenance Range Light at Thanlyin Point	JICA Project Team /Maker	Tower/Ship	Sakae, Tamatani, Maker
8 Oct. (Fri)	a.m.	Question and Answer Closing Ceremony	JICA Project Team /Maker	MPA Headquarters	Sakae, Tamatani, Maker

Source: JICA Project Team

9.2.4 DETAILS OF TRAINING

(1) Participants of Training

The total number of participants from MPA was 14. The position of participants in MPA is shown in Table 9.2.1 below.

Table 9.2.1 List of Participants from MPA

Position in MPA	Number of Participants
Harbour Master (Service)	1 person
Inspector of Lighthouse	1 person
Captain	3 persons
Chief Officer	1 person
Cadet (Engine)	4 persons
Cadet (Deck)	1 person
Divisional Engineer	1 person
Foreman	1 person
Deputy Manager of Port Management	1 person
Total	**14 persons**

Source: JICA Project Team

(2) Training Schedule and Location

The training schedule and location for the Stage 2 training are presented in Table 9.2.2.

Table 9.2.2 Training Schedule and Location

Contents of Training	Location of Training		
	At MPA Headquarters	At the site of tower	On MPA ship
1. Safe Navigation at Monkey Point Channel by Rehabilitation of Leading Lights System Education and Training by the JICA Instructors	10:00 a.m.–11:00 a.m. 1 October		
2. International Rules and Regulations IMO, COLREG Education and Training by the JICA Instructors	11:00 a.m.-12:00 noon 1 October		
3. ISM Code Education and Training by the JICA Instructors	1:00 p.m.-3:00 p.m. 1 October		
4. Passage Planning Education and Training by the JICA Instructors	3:00 p.m.-4:00 p.m. 1 October		
5. Open the imported case and Quantity/damage check of delivered products	10:00 a.m.-12:00 noon 4 October		
6. NAVGUIDE Aids to Navigation Manual 2010 Edition IALA Education and Training by the JICA Instructors and maker	10:00 a.m.-12:00 noon 5 October		
7. Instruction Manual of LED Sector Light, Range Light and Battery Case How to use the lights Education and Training by the JICA Instructors and maker	1:00 p.m.-2:30 p.m. 5 October		
8. Install LED Sector Light at Monkey Point How to install and maintain the lights Education and Training by the JICA Instructors and maker		9:00 p.m.-7:00 p.m. 6 October	5:30 p.m.-7:00 p.m. 6 October

Contents of Training	Location of Training		
	At MPA Headquarters	At the site of tower	On MPA ship
9. Install LED Ranger Light at Thanlyin Point How to install and maintain the lights Education and Training by the JICA Instructors and maker		9:00 p.m.-7:00 p.m. 7 October	5:30 p.m.-7:00 p.m. 7 October
10. Closing Ceremony of the Training Course	10:00 a.m.-11:00 a.m. 8 October		
11. Inspection and delivery of spare parts to MPA	1:30 p.m.-2:00 p.m. 11 October		
12. Check and Evaluation of the Training Course	9:00 a.m.-5:00 p.m. 12-18 Oct.		

Source: JICA Project Team

(3) Details of Training

Details of the training are shown in Table 9.2.3.

Table 9.2.3 Details of Training

Date	Details of Training
1 Oct. (Fri) Morning	Orientation was carried out by Capt. Y. Sakae. Introduce lecturer, contents of orientation; Training curriculum The summary of "Safe Navigation at Monkey Point Channel by Rehabilitation of Leading Light System" based on the distributed texts was explained by Capt. Y. Sakae. [Contents of lecture] Cyclone disaster Cyclone damage at Thanlyin Point Rear Tower Lighting system at Monkey Point Channel The summary of "International Rules and Regulations IMO, COLREG" based on the distributed text was explained by Capt. J. Tamatani. The summary of "ISM Code" based on the distributed text was explained by Capt. Y. Sakae. [Contents of lecture] Background and the necessity of the ISM code Substandard ships Objectives and scheme of the code Background and the necessity of the SMS What is the SMS Total quality management
1 Oct. (Fri) Afternoon	The summary of "Passage Planning" based on the distributed texts was explained by Capt. J. Tamatani. [Contents of lecture] Responsibility for passage planning Passage appraisal Passage planning Bridge notebook Executing and monitoring the plan Evaluation and improvement Reply to participants' question for making up these plan The summary of "BRM & BTM" based on the distributed texts was explained by Capt. Y. Sakae. [Contents of lecture] Background and the necessity of BRM & BTM Flow of BRM/BTM Error chain

Date	Details of Training
	Human error Heinrich's law and Bird's law Eight warning words
4 Oct.(Mon) Morning/Afternoon	Quantity and damage check were carried out by the JICA Project Team and MPA for delivered products at the MPA Headquarters and found all products in good order.
5 Oct.(Tue) Morning	The summary of "NAVGUIDE Aids to Navigation Manual 2010 Edition IALA" based on the distributed texts was explained by maker Mr. Ono. [Contents of lecture] IALA Navguide 2010 Visual Aids to Navigation Signal Color Geographical Range Light Characters Night Operations Day Operations Automatic Identification System Maritime Buoyage System
5 Oct.(Tue) Afternoon	The summary of "Instruction Manual of Sector Light and Range Light" based on the distributed texts was explained by maker Mr. Ono. LED Sector Light with Power Source LED Range Light with Power Source and Synchronizer Specifications Outline and Constructions Handling Operation Wiring Maintenance and Inspection
6 Oct.(Wed) Daytime Nighttime	Installation and maintenance lecture on sector light with power source at Monkey Point Confirmation of proper operation and adjustment of sector light at Monkey Point after sunset
7th Oct.(Thu) Daytime Nighttime	Installation and Maintenance Lecture of Range Light with Power Source and Synchronizer at Thanlyin Point Confirmation of proper operation and adjustment of light of Range Light at Thanlyin Point after sunset
8 Oct. (Fri)	Closing ceremony
11 Oct. (Mon)	Visual check and operation check of spare parts
12 Oct. (Tue)	Site survey of Yangon Port
15 Oct. (Fri)	Site check at Monkey Point

Source: JICA Project Team

(4) Scene of the Training

Photo 9.2.2 Lecture at the MPA Headquarters

Photo 9.2.3 Lecture and Discussion with MPA Captains and Cadets

Photo 9.2.4 LED Sector Light for Monkey Point and Range Lights for Thanlyin Point

Photo 9.2.5 Instruction on Practical Assembly of the LED Lights

Photo 9.2.6 Instruction on Practical Assembly of the LED Lights

Photo 9.2.7 Instruction on Practical Assembly of the LED Lights

Photo 9.2.8 Departure at Monkey Point

Photo 9.2.9 Preparatory Work for Sector Light Installation at Monkey Point.

Photo 9.2.10 Installation Work of Sector Light at Monkey Point

Photo 9.2.11 Trainees Check Alignment of Sector Light

Photo 9.2.12 JICA and ODA Sticker Logo at the Instrument

Photo 9.2.13 Preparatory Work of Rear Leading Light at Thanlyin Point

Photo 9.2.14 Lifting Up the Leading Light at Front Tower at Thanlyin Point

Photo 9.2.15 Installation Work of the Front Tower Leading Light at Thanlyin Point

Photo 9.2.16 Installation Work for the Rear Tower at Thanlyin Point

Photo 9.2.17 JICA Project Team and MPA Trainee after Installation of the Front Tower at Thanlyin Point

Photo 9.2.18 Monkey Point Sector Light Properly Working at Nighttime

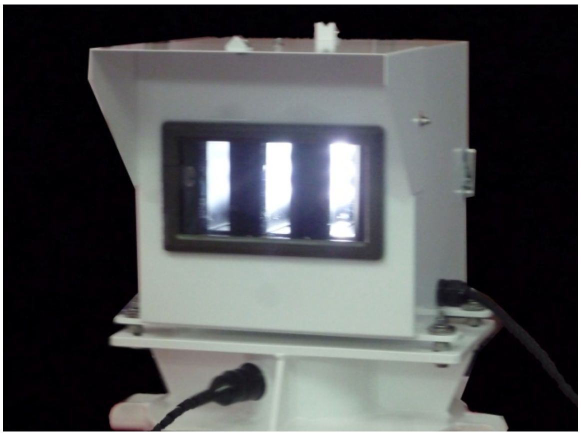


Photo 9.2.19 Thanlyin Point Leading Light Properly Working at Nighttime

Photo 9.2.20 Handover of Completion Certificate from the JICA Project Team to Trainees

Photo 9.2.21 Closing Ceremony of the Training Course

Source: JICA Project Team

9.2.5 POST EVALUATION OF CAPACITY DEVELOPMENT TRAINING

In order to evaluate the effectiveness of the training, which is similar to the one carried out at IWT last year, questionnaire and self-evaluation surveys were performed to obtain the impression of each trainee about the improvement of his knowledge after the training course.

Based on both questionnaire survey and self-evaluation survey, the post evaluation results of training are summarized in the succeeding section.

(1) Questionnaire Survey

1) Question 1: Training was Useful or Not

(Question)

- Do you think that this training course was useful with regard to navigation safety?

(Answer)

- Very useful
- Useful
- Not useful

All participants responded that the training was “very useful”.

Q-1	Very useful	Useful	Not useful	No answer	Total
A-1	5	9	0	0	14

2) Question 2: Selection of Preferable Subject

(Question)

- If participants responded “useful” and “very useful”, please select three of the best subjects in the following table.

(Answer)

- N-1 Safe Navigation at Monkey Point Channel by Rehabilitation of Leading Lights System
- N-2 International Rules and Regulations IMO, COLREG
- N-3 ISM Code
- N-4 Passage Planning
- N-5 NAVGUIDE Aids to Navigation Manual 2010 Edition IALA
- N-6 Instruction Manual of LED Sector Light, Range Light and Battery Case

The subject of N-1 received 11 points (28%), which is the most, followed by N-2 with 9 points (23%), N-3 with 6 points, N-5 and N-6 with 5 points each, and N-4 with 3 points.

Item	N-1	N-2	N-3	N-4	N-5	N-6	Total
Answer	11	9	6	3	5	5	39
%	28.2	23.1	15.4	7.7	12.8	12.8	100

3) Question 3: Selection of Preferable Subject

(Question)

- Do you wish to continue rehabilitation of navigation aids and the JICA training course?

(Answer)

- I wish to continue rehabilitation of navigation aids and the JICA training course. 13 participants (93%)
- Not necessary 1 participant (7%)

4) Question 4: Training in the Future (Additional Subjects)

(Question)

- In case this training course would continue, do you have any request to study other additional subjects?

(Answer) Comments replied

- Due to the limited time, all of the lectures are very short. The subject is enough but next time JICA should present a wider coverage on this subject.
- In the next training, the training period should be longer and more detailed information on the subjects should be provided.
- This training course is useful for navigation safety, lecture, and arrangement. The training on navigation safety training is enough.
- Life safety on the Yangon River.
- Enough for us.
- All subjects in this training course are very useful.
- This training course is useful for navigation safety.

- There is no need for any additional subject. This training course is useful for navigation and enough for us.
- This training course is useful for navigation safety.
- Coastal lighthouse system
- Automatic identification system (AIS) is a subject that I want to study in further trainings. AIS is widely used in many ports around the world as an effective tool for ensuring maritime safety and security. Introduction of AIS will be beneficial to MPA and ships calling at Yangon Port.

5) Question 5: Please give any comments on the training, if any.

(Answer) Comments replied

- This training course is very good for any trainer. We gained a lot of knowledge and skills. The outcome of this training course is not only for our trainers but also for Myanma Port Authority to improve aids in their navigation system.
- This training course is a very good idea and teaches a lot of knowledge and skills.
- The training is very useful for my country.
- Very good for us.
- This training is very useful for all of us. I think this training should be known to other departments such as DMA and the fisheries department.
- In this training course, we studied about the following:
  - Safe navigation
  - COLREG
  - ISM code
  - Passage planning
  - Navigation aid to Navigation Manual 2010 edition IALA
  - LED sector light, range and battery case.
  - This training course is very useful for us. Thank you very much.
- This training course is a very good idea.
- The training course is a very good idea and provides a lot of experience and knowledge. I am so glad to learn from this navigation safety training course.
- This training course is a very good idea.
- I would like to express many thanks to JICA. We received knowledge from this navigation safety course.
- I would like to have more training on save navigation aids. Now, I get a lot of knowledge on safety navigation. After installation of leading lights and sector lights, we will be more safe. Thank you very much for this training.
- I would like to express my gratitude to JICA’s kind technical assistance, training and equipment.

(2) Results of Self-Evaluation on Fundamental Maritime Competence

The fundamental maritime competency and experience have been observed to be so different among the participants.

For the self-evaluation on fundamental maritime competence, it was rated from level 1 to level 5 as defined below.

Level 1: It was not possible to understand at all
Level 2: It was possible to understand only a little
Level 3: It was possible to understand usually
Level 4: It was possible to understand comparatively well
Level 5: It was possible to understand very well

The summary of the evaluation for this training (see Table 9.2.4 below) is as follows:

- The items of lectures were categorized into six groups from N-1 to N-6 for convenience.
- According to the participants' self-evaluation, they had evaluated themselves with a high level of understanding, i.e., their self-evaluation had especially increased from level 1 to level 4.0 on the average.
- The reason for the low level (4.0 on average) is due to two participants belonging to the Civil Engineering Department who are not familiar with navigation safety regarding their duty work.
- N-1 (Safe Navigation at Monkey Point Channel by Rehabilitation of Leading Lights System) got the highest with 4.5 points, and followed by N-2 (International Rules and Regulations IMO, COLREG) with 4.2 points.
- Even putting this evaluation aside, it was evaluated that the attitude and degree of concentration of all of trainees during the period of this project as having excellent results together with their strong motivations on this objective.

Table 9.2.4 Summary of Self-evaluation Sheet

No	Position	N-1	N-2	N-3	N-4	N-5	N-6	**Total**	Average
		L. Light	IMO	ISM	P Planning	IALA	LED		
1	Harbour Mastr	5.0	4.0	3.0	4.0	3.0	3.0	**22.0**	3.7
2	Inspector	3.0	4.0	3.0	4.0	4.0	4.0	**22.0**	3.7
3	Captain	5.0	5.0	4.0	4.0	4.0	3.0	**25.0**	4.2
4	Captain	5.0	5.0	5.0	5.0	5.0	4.0	**29.0**	4.8
5	Captain	5.0	5.0	5.0	4.0	4.0	4.0	**27.0**	4.5
6	Officer	4.0	4.0	4.0	3.0	3.0	4.0	**22.0**	3.7
7	Cadet	4.0	3.0	3.0	4.0	5.0	5.0	**24.0**	4.0
8	Cadet	4.0	5.0	4.0	4.0	5.0	4.0	**26.0**	4.3
9	Cadet	5.0	4.0	4.0	4.0	4.0	3.0	**24.0**	4.0
10	Cadet	5.0	5.0	4.0	4.0	4.0	3.0	**25.0**	4.2
11	Cadet	5.0	5.0	4.0	4.0	4.0	3.0	**25.0**	4.2
12	Engineer	4.0	2.0	2.0	2.0	3.0	4.0	**17.0**	2.8
13	Foreman	4.0	3.0	3.0	4.0	3.0	4.0	**21.0**	3.5
Total		**58.0**	**54.0**	**48.0**	**50.0**	**51.0**	**48.0**	**309.0**	**51.5**
Average		4.5	4.2	3.7	3.8	3.9	3.7	**23.8**	4.0

Remark: N-1: Safe Navigation at Monkey Point Channel by Rehabilitation of Leading Lights System
N-2: International Rules and Regulations IMO, COLREG
N-3: ISM Code
N-4: Passage Planning
N-5: NAVGUIDE Aids to Navigation Manual 2010 Edition IALA
N-6: Instruction Manual of LED Sector Light, Range Light and Battery Case

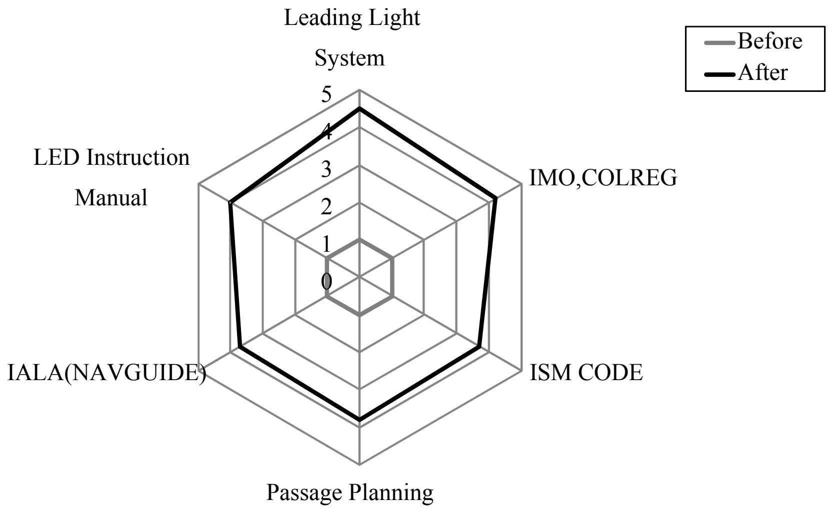


Figure 9.2.4 Radar Chart of Self-Evaluation

(3) Summary

Eleven pilots and captains who have duties directly related to this training and two engineers who are in charge of installation and maintenance of navigational aids (total of 13 trainees) were selected by MPA, and participated in the six-day training from 1st-8th October 2010.

The subjects of the training are as follows:

- Important points on safe navigation
- International Association of Lighthouse Authorities (IALA) rules, including leading lights
- Efficient way to use leading lights at Monkey Point

All the trainees were very keen on the lecture and practice. One trainee joined in the middle of the training and a total of 14 trainees replied to the questionnaire, and it proved that the training was beneficial. Regarding the contents, most of the participants answered that it was good to learn the current situations and trends of international treaties or international standards related to safe navigation.

Furthermore, participants indicated strong interest to study about AIS. According to SOLAS regulation, to activate AIS, construction of shore station for exchanging information between ships and shore station is necessary. It would be necessary to have a training course on AIS and to construct the shore station.

In addition, 13 of the trainees mentioned in the questionnaires that they wanted to have similar and continuous JICA training in the future.

Although the training was short, the knowledge and techniques of all the trainees have increased with respect to the six items according to the analysis of the self-assessment. In turn, the training was considered very beneficial for them.

(4) Handover Ceremony for Leading Lights for Navigation Aids

Both the Handover Ceremony for Leading Lights for Navigation Aids and the Closing Ceremony of the Capacity Development on Ships and Metal Structure (Phase II) was held in the Dalla Dockyard on 25 November 2010. The outline of the ceremony is as follows:

1) Principal Attendees:

- IWT: Managing Director and General Manager
- MPA: General Manager and Harbour Master
- Embassy of Japan: Second Secretary
- JICA: Chief Representative, Co-Team Leader of the Project

2) Principal Agenda:

- Speech; Managing Director of IWT, Chief Representative of JICA Myanmar Office
- Handover of Leading Lights for Navigation Aids, welding equipment and related documents to MPA and IWT by JICA.
- Presenting certificates to the trainees
- Observation of leading lights, welding equipment, and cradle.

Photo 9.2.22 Handover of Leading Lights Documents to MPA from JICA

Photo 9.2.23 Handover of Welding Equipment Documents to MPA from JICA

Photo 9.2.24 Exhibition of Leading Lights' Pictures and Spare Parts

Photo 9.2.25 Exhibition of Welding Equipment

Photo 9.2.26 Newly-built Cradle by JICA in the Dalla Dockyard

Photo 9.2.27 Newly-built Cradle by JICA in the Dalla Dockyard

Source: JICA Project Team

9.3 CAPACITY DEVELOPMENT OF SHIP CREW OF IWT SHIPS (STEP 3)

9.3.1 TRAINING SCHEME

(1) Background of the Training

Nautical instruments (GPS and echo-sounder) were handed over to IWT, and installed on the two model ships of IWT during the training. Training and education on the basics of safe navigation for IWT ship crew were performed by the JICA Project Team. Most of the syllabus for the training was the same as that of the Step 1 Training in 2009.

The purpose of equipment handover and installation was to get annual data on time, location, and depth of the route of ships because the bathymetric survey at the hazards points of DWIR does not cover the overall routes of inland transport. In addition, a navigation route map has not been prepared yet. The observation data will show annual depth variations (between dry and rainy seasons) of the routes and will help in preparation of future navigation route maps.

(2) Purpose of the Training

Major purpose of the training are listed below.

1) To study outline of safe navigation.
2) To select two model ships and equip them with nautical instruments, and study the operational procedures of these instruments.
3) To select IWT instructors, to perform education of the potential instructors, to perform training of IWT ship crew, and to evaluate their performance.

(3) Subjects in the Training Syllabus

Major subjects in the training syllabus of safe navigation are as follows:

- ISM Code;
- Navigation Safety Planning (COLREG);
- Navigation Safety Planning (Seaman-Ship Duty of Navigator);

- Passage Planning;
- Bridge Resource Management (BRM) / Bridge Team Management (BTM);
- Nautical Instruments (GPS); and
- Nautical Instruments (Echo-Sounder).

(4) Training Program

The training was carried out in the following three stages:

1) Stage 1: Preparation of Training

- To prepare educational materials and texts for the training.
- To procure the nautical instruments (in Japan).
- To select Japanese instructors (one instructor to prepare navigation textbooks and other materials for training).
- To select two model ships (in Myanmar).
- To select ten captains/officer trainees, and to provide translators and educational rooms/facilities for implementation of the training.

2) Stage 2: Installation of Echo-Sounder and Training of Instructors

- To install the echo-sounder with GPS on IWT ferries.
- To train and educate the AMS, captains and helmsmen who are anticipated to become instructors for training of captains and deck crews of IWT.

3) Stage 3: Evaluation of Training/Correction

- To verify the condition and evaluate the education training carried out by the Japanese instructor.

Candidates of the Step 3 training were selected from the officials or group leaders of crew engaged in the Marine Department of IWT who have the potential to become instructors of further training of IWT crew.

9.3.2 PROCUREMENT OF TRAINING MATERIALS AND EQUIPMENT

The nautical instruments listed in Table 9.3.1 were procured for use in the safe navigation training of IWT ship crew.

Table 9.3.1 Procurement of Training Materials and Equipment

	Name of Instruments	Outline Specification	Quantity
1	GPS with Echo-Sounder (Automatic recording type)	• Display 7 inch wide • Resolution 800 x 480 pixels (WVGA) • TFT LCD Color • Frequency 50/200 khz • Water depth Display range 5-1,200 m, Shift 0-1,200 m	2 units

Source: JICA Project Team

9.3.3 TRAINING SCHEDULE

(1) Training Place and Schedule

Training took place at the two following locations:

1) At the IWT Headquarters
2) On Model Ships

Training was performed following the schedule shown in Table 9.3.2.

Table 9.3.2 Location and Schedule of Training

Stage	Location of Training	
	At the IWT Training Center	On Model Vessels
Step 2 Training of Instructors	15 Dec. 2014 10:00 a.m. – 4:00 p.m.	16 Dec. 2014 4:00 p.m. – 6:00 p.m.

Source: JICA Project Team

(2) Timetable of Training

The training timetable of Step 3 is shown in Table 9.3.3.

Table 9.3.3 Timetable of Training

No.	Date	Time	Contents	Instructor	Place
1	15th Dec. 2014	AM	Safe Navigation, ISM Code, COLREG, seam an-Ship, Passage Planning, BRM/BTM, Nautical Instruments (GPS, Echo-Sounder)	JICA	IWT Head Or
		PM	Nautical Instruments (GPS, Echo-Sounder)	JICA, Suppler	IWT Head Qr
2	16th Dec. 2014	AM	Install Nautical Instruments to IWT Vessel	JICA, Suppler	IWT Ferry
		PM	Nautical Instruments (GPS, Echo-Sounder)	JICA, Suppler	IWT Ferry

9.3.4 DETAILS OF STEP 3 TRAINING

The Step 3 training kicked off at the IWT Headquarters on 15 December 2014.

(1) Participants of Training

A total of ten participants were selected for the Step 3 training by IWT. They were expected to become instructors in the further stages of training for the education and capacity development of IWT crew. The positions in IWT of the participants are shown in Table 9.3.4 below.

Table 9.3.4 List of Participants of the Step 3 Training

Position in IWT	Number of Participants
Assistant Marine Superintendent	3 persons
Fleet Officer	2 persons
Captain	4 persons
Helmsman	1 person
Total	**10 persons**

Source: JICA Project Team

(2) Details of Training Schedule

The Step 2 training was carried out following the schedule shown in Table 9.3.5.

Table 9.3.5 Schedule of the Step 3 Training

Date	Details of Training
15 Dec. (Mon) Morning	• Orientation was carried out by Capt. Y. Sakae. Contents of orientation; Training curriculum (training of potential instructor) • The summary of "Safe Navigation, ISM Code, Navigation Safety Planning, BRM/BTM and Nautical Instruments" based on the distributed texts was explained by Capt. Y. Sakae. [Contents of lecture] 1. Safe Navigation 2. ISM Code (International Safety Management) ✓ Background and the necessity of the ISM code ✓ Substandard ships ✓ Objectives and scheme of the code ✓ Background and the necessity of SMS ✓ What is SMS ✓ Total quality management 3. Navigation Safety Planning ✓ The reason of necessity of international standard for navigation safety ✓ What is the International Maritime Organization (IMO) ✓ What is the International Regulation for Preventing Collusions at Sea (COLREG) ✓ Seaman-ship duty of navigator ✓ Passage planning 4. Bridge Resource Management (BRM) and Bridge Team Management (BTM) ✓ Background and necessity of BRM and BTM ✓ Format of course ✓ Flow of BRM/BTM ✓ Error chain ✓ Human error ✓ Heinrich's law and Bird's law ✓ BTM/BRM correlation chart ✓ Eight warning words 5. Nautical Instruments ✓GPS (theory) ✓Echo-sounder (theory)
Afternoon	• Explanation of handling/operation of nautical instruments abovementioned was carried out by Sea Technology International Limited according to Manufacturer's Instructions
16 Dec. (Tue) Afternoon	• Onboard Training at the Model Ship on Operation of Nautical Instruments Explanation of handling/operation of nautical instruments were carried out by Sea Technology International Limited. • Trial of Nautical Instruments (GPS and Echo-Sounder) Firstly the nautical instruments were installed temporarily to IWT vessel "TIDA" by Sea Technology International Limited, and then testing of instruments was carried out under the supervision of IWT participants and the JICA Project Team. Instrument testing was finished successfully.

Source: JICA Project Team

(3) Training Scene

Photo 9.3.1 Japanese Captain's Lecture at the IWT Headquarters

Photo 9.3.2 Japanese Captain's Lecture at the IWT Headquarters

Photo 9.3.3 Discussion with IWT Participants

Photo 9.3.4 Explanation of GPS and Echo-Sounder

Photo 9.3.5 Explanation of the Processing of Instruments

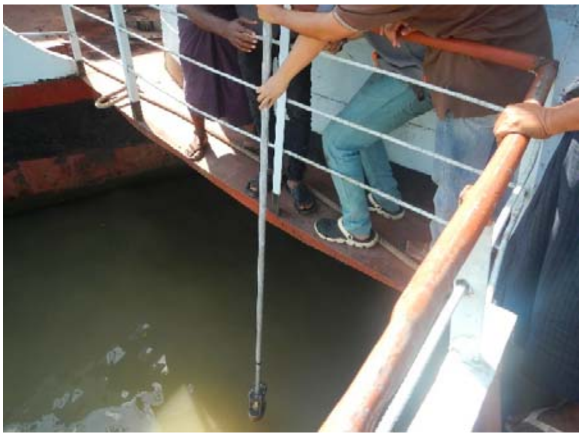


Photo 9.3.6 Installation of Instruments Onboard

Photo 9.3.7 Installation of Echo-Sounder Display Unit in the Navigation Bridge

Photo 9.3.8 Onboard Training at the Model Ship, Study on Operation of Echo-Sounder

Photo 9.3.9 Onboard Training at the Model Ship, Study on Operation of Nautical Instruments

Photo 9.3.10 Closing Ceremony of the Step 3 Training

Source: JICA Project Team

(4) Results of Self-Evaluation of the Step 2 Training

The JICA Project Team has adopted only the self-evaluation of ten participants. The self-evaluation method was the same as the previous training evaluation method in 2009.

1) Rating Method

Self-assessment was carried out on two aspects of the evaluation. One is safe navigation lecture in the IWT classroom, and the other is handling, operation, and maintenance lecture on board. The degree of understanding was rated in five levels, as follows:

Level 1: It was not possible to understand at all
Level 2: It was possible to understand only a little
Level 3: It was possible to understand usually
Level 4: It was possible to understand comparatively well
Level 5: It was possible to understand very well

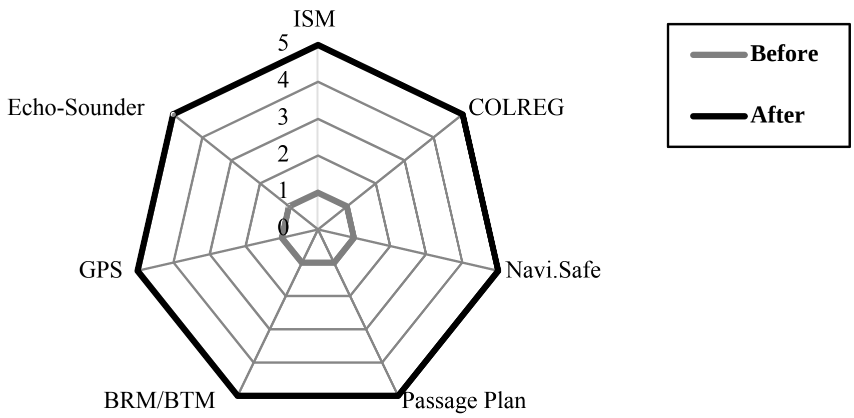
2) Safe Navigation Lecture in the IWT Classroom

The summary of the evaluation for this training is as follows:

- According to the participants' self-evaluation, they evaluated themselves as having a high level of understanding. Their self-evaluation had remarkably increased from level 1 to level 5 on average. This means that all participants fully understood the lecture.
- The JICA Project Team also recognized the good attitude and high concentration of all the trainees during the lecture.

Table 9.3.6 Summary of the Self-Evaluation Sheet

Sr. No.	Position	N-1	N-2	N-3	N-4	N-5	N-6	N-7	Total	Average
		ISM Code	COLLEG	Navi. Safe	Passage	BRM/MTM	GPS	Sounder		
1	AMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	35.0	5.0
2	AMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	35.0	5.0
3	AMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	35.0	5.0
4	Fleet Officer	5.0	5.0	5.0	5.0	5.0	5.0	5.0	35.0	5.0
5	Fleet Officer	5.0	5.0	5.0	5.0	5.0	5.0	5.0	35.0	5.0
6	Captain	5.0	5.0	5.0	5.0	5.0	5.0	5.0	35.0	5.0
7	Captain	5.0	5.0	5.0	5.0	5.0	5.0	5.0	35.0	5.0
8	Captain	5.0	5.0	5.0	5.0	5.0	5.0	5.0	35.0	5.0
9	Captain	5.0	5.0	5.0	5.0	5.0	5.0	5.0	35.0	5.0
10	Captain	5.0	5.0	5.0	5.0	5.0	5.0	5.0	35.0	5.0
Total		50.0	50.0	50.0	50.0	50.0	50.0	50.0	350.0	50.0
Average		5.0	5.0	5.0	5.0	5.0	5.0	5.0	35.0	5.0



Source: JICA Project Team

Figure 9.3.1 Radar Chart of Self-Evaluation (Step 2 Evaluation)

3) Onboard Lecture

The summary of the evaluation of this training is described below.

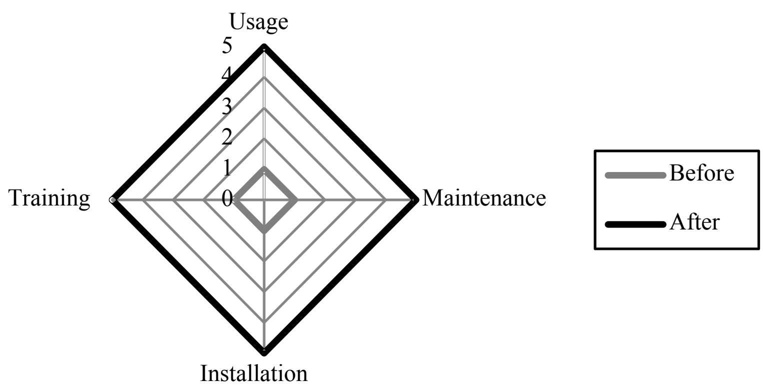
- There are four evaluation items for this onboard training, as follows:
  - How to use (usage),
  - Maintenance,

- Installation of nautical instruments, and
- Training of crew.

➢ According to the self-evaluation, the participants evaluated themselves as having a high level of understanding. Their self-evaluation remarkably increased from level 1 to level 5 on average.

Table 9.3.7 Summary of the Self-Evaluation Sheet

Sr. No.	Position	N-1	N-2	N-3	N-4	Total	Average
		ISM Code	COLLEG	Navi. Safe	Passage		
1	AMS	5.0	5.0	5.0	5.0	20.0	5.0
2	AMS	5.0	5.0	5.0	5.0	20.0	5.0
3	AMS	5.0	5.0	5.0	5.0	20.0	5.0
4	Fleet Officer	5.0	5.0	5.0	5.0	20.0	5.0
5	Fleet Officer	5.0	5.0	5.0	5.0	20.0	5.0
6	Captain	5.0	5.0	5.0	5.0	20.0	5.0
7	Captain	5.0	5.0	5.0	5.0	20.0	5.0
8	Captain	5.0	5.0	5.0	5.0	20.0	5.0
9	Captain	5.0	5.0	5.0	5.0	20.0	5.0
10	Helmsman	5.0	5.0	5.0	5.0	20.0	5.0
Total		50.0	50.0	50.0	50.0	200.0	50.0
Average		5.0	5.0	5.0	5.0	20.0	5.0



Source: JICA Project Team

Figure 9.3.2 Radar Chart of Self-Evaluation (Step 2 Evaluation)

4) Summary

According to the participants' self-evaluation, they evaluated themselves as having a high level of understanding. This means that all participants perfectly understood the lecture.

The JICA Project Team recognized that the education and training program undertaken by these crew members had been successfully completed.

CHAPTER 10

CAPACITY DEVELOPMENT FOR REPAIRING SHIPS AND METAL STRUCTURES

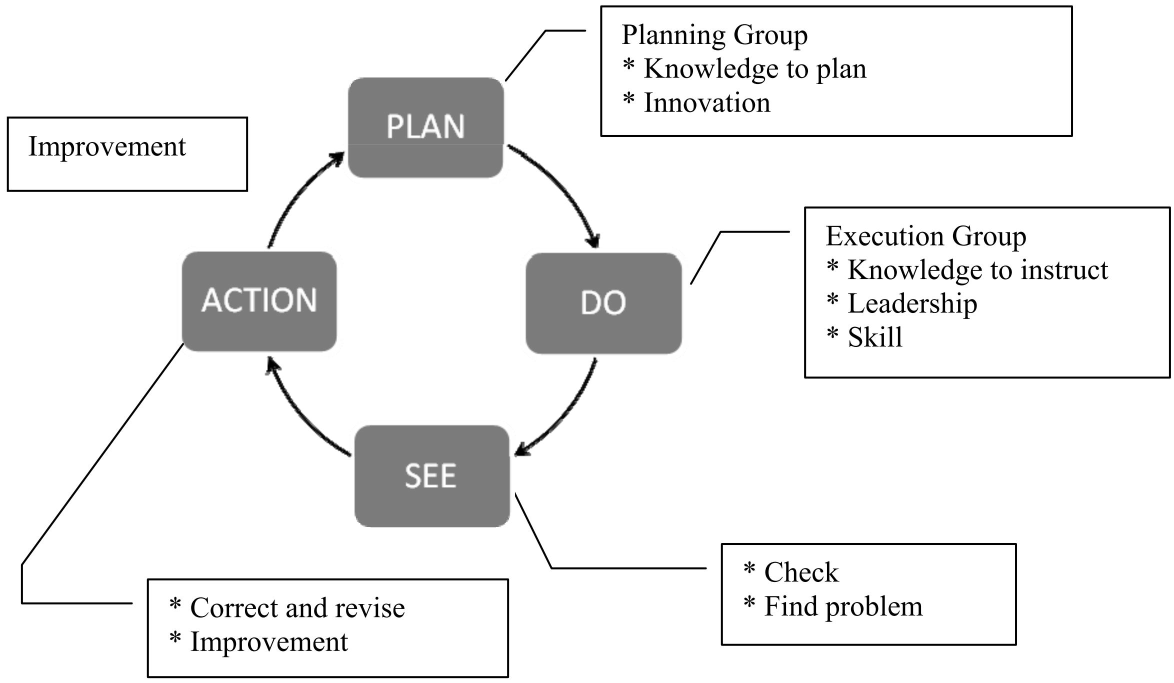
CHAPTER 10 CAPACITY DEVELOPMENT FOR REPAIRING SHIPS AND METAL STRUCTURES

10.1 CAPACITY DEVELOPMENT FOR REPAIRING SHIPS AND METAL STRUCTURES (STEP 1)

10.1.1 TRAINING SCHEME

(1) Purpose of the Training

The impact of cyclone Nargis caused reverse damages to many of the IWT ships. The urgent repair of the damaged ships resulted in a critical overload situation of IWT dockyard facilities. The many additional repair works, which have no alloted time, caused problems by postponing and delaying the scheduled normal maintenance and repairs.



Notes: Items marked * have a close relation with this training

Source: JICA Project Team

Figure 10.1.1 Principal Job Cycle and Relation with This Training

Where:

"PLAN": The planning group must have knowledge and ability to conduct planning and innovation.

"DO": The execution group must have knowledge to instruct workers, take leadership, and have sufficient skills and techniques.

"SEE": The planning group should check the process for the plan to be rightly executed, and the execution group should check if its procedure is rightly executed through its instruction. And these groups should be able to find any problems.

"ACTION": The planning group and execution group should take necessary action to correct, revise, and improve if problems are found. These groups must have strong will to correct and revise, and the ability for improvement.

During the course of the training, this basic concept of management cycle was taken into consideration.

Bearing in mind the above concept and targets to be achieved, the following scheme, schedule, and curriculum were prepared.

(2) Principal Syllabus of the Training

This program was implemented broadly in two stages. In order to achieve the targets of technical transfer and capacity development of counterpart personnel effectively, and also to achieve sustainable education and training system of MPA and IWT technicians in the future, phase-wise training plan was introduced. Main targets of each phase are as follows:

- Step 1 Training Scheme:
  To train and educate potential instructors of welding group leaders for further training of welding technicians of IWT and MPA in their groups.
- Step 2 Training Scheme:
  To develop the capacity of technicians through intensive training by the respective instructors who qualified in Step 1 Training Scheme scheduled in the forthcoming year.

Step 1 Training Scheme was further subdivided into three training program modules and implemented between September and November 2009. Targeted trainees were selected from management officials/engineers and skilled technicians/group leaders of dockyards. The details of Step 2 Training Scheme are discussed in the following sub-section.

In the Step 1 Training Scheme, Program Modules 1 and 2A were prepared for all candidates, while Program Module 2B was designed for skilled technicians/group leaders who shall be the potential training instructors for the Step 2 Training Scheme.

- Program Module 1 (1 week):
  Lecture was performed in Ayar Auditorium of IWT Ahlone Dockyard to provide basic knowledge, international regulation and standards as well as management skills needed for operating a dockyard.
- Attendees of this Program Module 1 were management officials/engineers who are policy makers of each organization and skilled technicians/group leaders of IWT and MPA who had been trained as the potential instructors for the Step 2 Training Scheme.
- Program Module 2A (1 week):
  Half-day basic practical training for engineers and group leaders was performed in Dalla and Ahlone dockyards.
  - Morning session in Dalla, and
  - Afternoon session in Ahlone.
- Similar to Program Module 1, attendees of this Program Module 2A were management officials/engineers who are the policy makers of each organization and skilled technicians/group leaders of IWT and MPA who will be trained as the potential instructors for the Step 2 Training Scheme.
- Program Module 2B (2 weeks):
  Advanced practical training for group leaders was performed. Attendees of this Program Module 2B were skilled technicians/group leaders of IWT and MPA who have been trained as potential instructors for Step 2 Training Scheme.

10.1.2 PROCUREMENT OF TRAINING MATERIALS AND EQUIPMENT

The equipment listed in Table 10.1.1 were procured for the training for capacity development of welding skills. The 15 sets of main training equipment were procured to cater to one batch of trainees targeted at one time (eight from Dalla IWT Dockyard, four from Ahlone IWT Dockyard, and three from MPA Dockyard).

Table 10.1.1 Training Equipment Procured

No.	Name of Equipment	Specification	Quantity
1	DC Arc Welding Machine	*Input: 380 V/3P, 50/60 hz *Output: 80-500 A	15 sets
2	Semi-Auto Portable Gas Cutting Machine	*Input: 200/220 V,50/60 hz *Cutting Thickness: 6-50 mm *Cutting Speed: 100-1,000 mm/min. *Bevel Angle: 0-45 degrees	15 sets
3	Manual Gas Cutting Torch	*For Plate Thickness:6-25 mm	15 sets
4	Electric Portable Grinder	*Input: 200/220 V, 50/60 hz *Abrasive Disc Diameter: 125 mm	15 sets

Source: JICA Project Team

Three sets of standard tools for teaching welding skills were prepared for inspecting the degree of welding skill, and checking the size, dimension, and appropriateness of the welding performed. After the training, one set of these tools were provided and kept for each of the dockyards (one for Dalla Dockyard, one for Ahlone Dockyard, and another for MPA Dockyard).

Training consumables such as steel plates, LPG gas, grinder discs, and welding electrode were prepared by the JICA Project Team.

10.1.3 TRAINING SCHEDULE

(1) Training Venue and Schedule

The training has taken place mainly at two locations, namely:

1) Dalla Dockyard, and
2) Ahlone Dockyard

Trainees of MPA were invited to receive training in Ahlone Dockyard. The schedule of the training is shown in Table 10.1.2.

Table 10.1.2 Location and Schedule of Training

Stage	Location of Training	
	Dalla Dockyard	Ahlone Dockyard
Program Module 1 Guidance and General Lecture	9:00 a.m. – 4:00 p.m. at Ayar Auditorium of IWT Ahlone Dockyard Between 20 and 26 October 2009 Training of management officials/engineers/group leaders of IWT and MPA to educate potential instructors for Step 2 and future education plan by themselves	
Program Module 2A Basic Practical Training	Morning Session (8:00 a.m. – 11:00 a.m.) Between 28 October and 3 November 2009 Training for 8 officials and 8 technicians of Dalla Dockyard, IWT	Afternoon Session (1:00 p.m. – 4:00 p.m.) Between 28 October and 3 November 2009 Training for 7 officials and 7 technicians of Ahlone Dockyard, IWT and MPA
Program Module 2B Advanced Practical Training	Morning Session (8:00 a.m.– 11:00 a.m.) Between 4 and 17 November 2009 Training for 8 officials and 8 technicians of Dalla Dockyard, IWT	Afternoon Session (1:00 p.m. – 4:00 p.m.) Between 4 and 17 November 2009 Training for 7 officials and 7 technicians of Ahlone Dockyard, IWT and MPA

Source: JICA Project Team

Wrap-up of training was held at Ayar Auditorium of IWT Ahlone Dockyard on 18 November 2009.

(2) Timetable of Training

General training timetable of Program Modules 1, 2A, and 2B are shown in Table 10.1.3 below.

Table 10.1.3 Training Schedule of Program Module 1

Date	Time	Contents
Oct. 20(Tue)	9 a.m. - 4 p.m. Ahlone Dockyard	Orientation Start Lecture * Introduction of welding for shipbuilding and ship repairing
Oct. 21(Wed)		* Arc welding method and welding machine * Steel material and welding material
Oct. 22(Thu)		* Welding procedure * Inspection and non-destructive test
Oct. 23(Fri)		* Principle of gas cutting * DVD of welding practice
Oct. 26(Mon)		* TIG, MAG, various kinds of welding method * DVD of welding practice

Source: JICA Project Team

Table 10.1.4 Training Schedule of Program Module 2A

Date	Time	Contents
Oct. 28(Wed)	AM: Dalla PM: Ahlone	* Non-experienced: bead on plate * Skilled: flat butt weld/instruction of non-experienced
Oct. 29(Thu)		* Non-experienced: flat fillet * Skilled: flat butt and vertical butt welding
Oct. 30(Fri)		* Non-experienced: flat fillet welding * Skilled: test of flat butt and vertical butt welding
Nov. 2(Mon)		* Non-experienced: flat butt welding * Skilled: vertical butt welding
Nov. 3(Thu)		* Non-experienced: test of flat butt welding * Skilled: test of vertical butt welding

Source: JICA Project Team

Table 10.1.5 Training Schedule of Program Module 2B

Date	Time	Contents
Nov. 4(Wed)	AM: Dalla PM: Ahlone	* Test of vertical butt welding
Nov. 5(Thu)		* Horizontal butt welding
Nov. 6(Fri)		* Horizontal butt welding
Nov. 9(Mon)		* Horizontal butt welding
Nov. 10(Tue)		* Test of horizontal butt welding
Nov. 12(Thu)		* Overhead butt welding
Nov. 13(Fri)		* Test of overhead butt welding
Nov. 16(Mon)		* Penetration welding, flat and vertical
Nov. 17(Tue)		* Penetration welding, flat and vertical

Source: JICA Project Team

10.1.4 POST EVALUATION OF CAPACITY DEVELOPMENT TRAINING

In order to verify the effectiveness of the training, the JICA experts provided two kinds of questionnaires and performed practical tests to the trainees as post evaluation of the training.

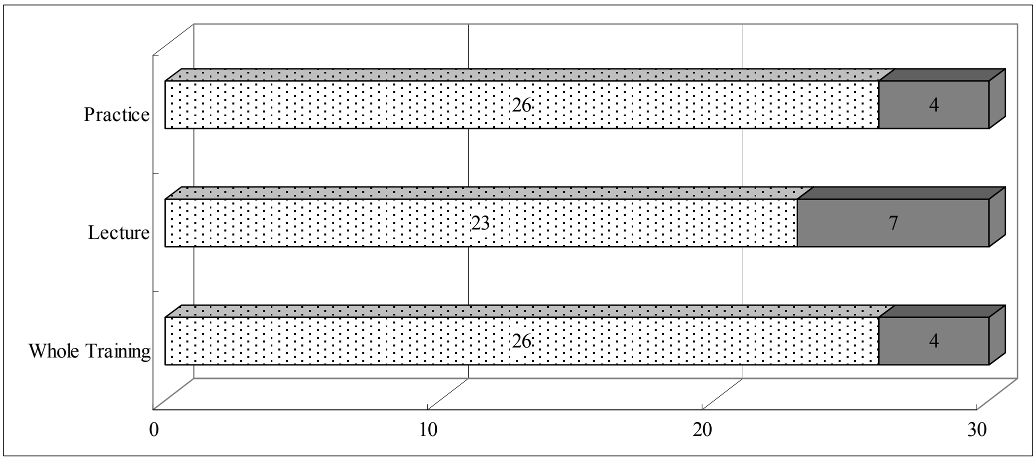
The evaluation points covered the following points:

1) General question,
2) Knowledge question, and
3) Practical welding test.

These questions were given to 30 trainees and the practical welding tests were performed for 15 trainees, who are skilled technicians.

(1) General Question in Attending the Training

To the general questions on attending the training, 30 trainees responded to the queries and the results are shown in Figure 10.1.2. As to the question if "whole training" is useful or not, most of the trainees replied "very useful". And for the same questions for "lecture" and "practice", most of them also replied "very useful" to their work and for instructing workers.



No. of Trainees	Whole Training	Lecture	Practice
Very useful	26	23	26
Useful	4	7	4
Not Useful	0	0	0

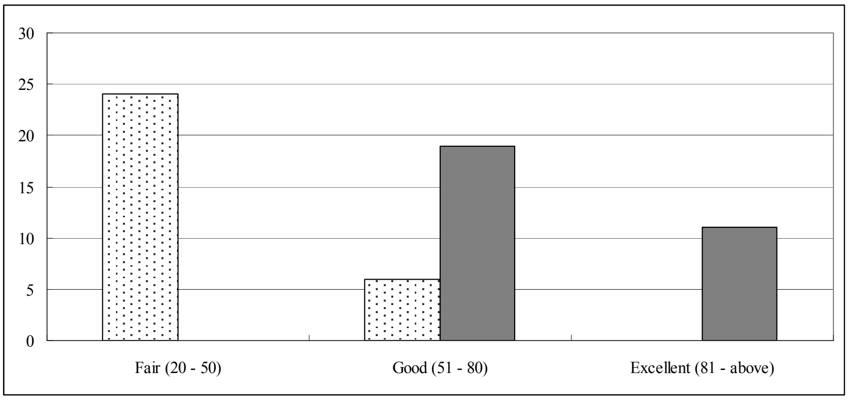
Source: JICA Project Team

Figure 10.1.2 Responses from Trainees for General Question

(2) Question on Understanding and Knowledge of Welding

Twenty questions on the understanding and knowledge of welding technology were asked. The result of the answers to the questions on understanding and knowledge of welding is summarized in the following Figure 10.1.3.

Questionnaire survey was performed two times, i.e., the first time before and the second time after the Module 1 training. Full mark is equivalent to 100 points in this questionnaire. The total score for each time is shown in Figure 10.1.3. In the first session, no one achieved an excellent score of more than 81, but 11 trainees achieved excellent level in the second session of the questionnaire survey.



No. of Trainees	Fair (20 - 50)	Good (51 - 80)	Excellent (81 - above)
First Test	24	6	0
Second Test	0	19	11

Source: JICA Project Team

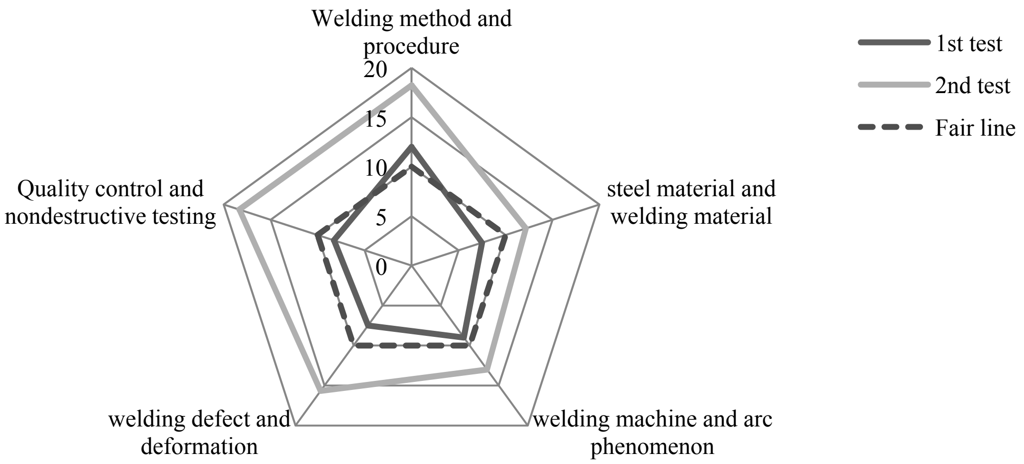
Figure 10.1.3 Total Score of Understanding Level

The questions on the understanding and knowledge of welding are broadly composed of the following five categories:

a. Welding method and welding procedure,
b. Steel material and welding material, as well as their characteristics,
c. Welding machine and electric arc phenomenon,
d. Weld defect and deformation, and countermeasures, and
e. Quality control and nondestructive test.

Among the five categories, categories d) and e) achieved high scores. The scores on categories b) and c) were comparatively low.

The chart of balance score diagram in Figure 10.1.4 reveals the weakness and strength of the trainees' technical knowledge.



Source: JICA Project Team

Figure 10.1.4 Diagonal Chart of Understanding Level Classified by Five Categories

(3) Practical Test

Practical tests were performed to evaluate the achievement of technical skill through visual inspection of welded and bended steel test piece. During the course of Program Modules 2A and 2B, practical tests have been carried out one time for officials/engineers and four times/positions for skilled/group leaders.

Table 10.1.6 Practical Tests Performed

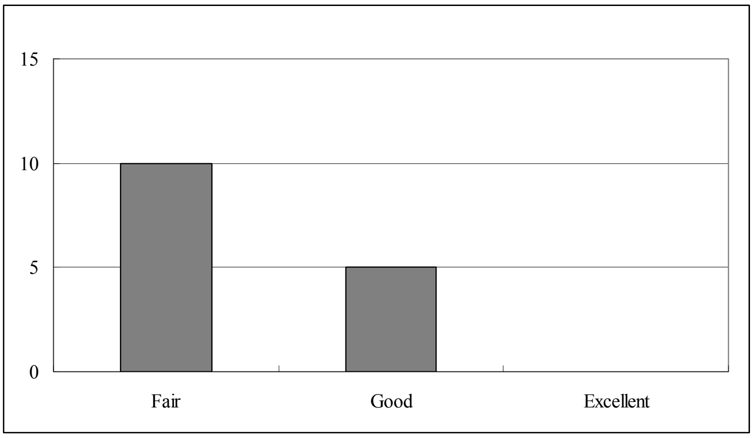
	Test for Welding Position	Targeted Trainees
(1) During Module 2A	1. Flat position	15 Officials/Engineers
	2. Flat position	15 Skilled/Group Leaders
(2) During Module 2B	1. Vertical Position	15 Skilled/Group Leaders
	2. Horizontal Position	15 Skilled/Group Leaders
	3. Overhead Position	15 Skilled/Group Leaders

Source: JICA Project Team

Evaluation of practical welding test was performed on the following three aspects:

1) Bead appearance: Straightness of welding bead,
   - Height of welding bead (lower than 3 mm is desirable)
   - Width of welding bead
     (less than 3 times electrode diameter is desirable)
   - Undercut (less than 0.5 mm is desirable)
   - Overlap (bead flank angle less than 90º is desirable)
2) Penetration condition: Judged by backing strip burned pattern.
3) Bend test: Face bend, root bend (Side bend in case of thick plate).

Figure 10.1.5 shows the result of the practical test performed for the officials/engineers. All members got the passing grade of more than "fair" and five of the 15 members got a "good" rating.

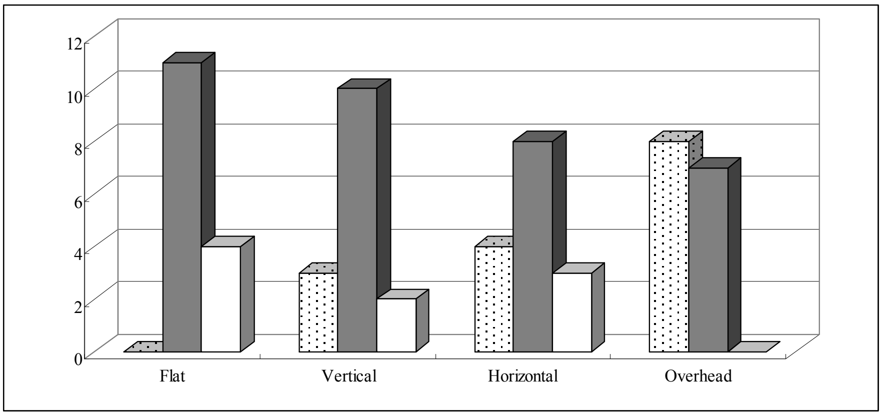


No. of participants	Fair	Good	Excellent
Flat Position	10	5	0

Source: JICA Project Team

Figure 10.1.5 Practical Welding Test Result for Officials/Engineers

For the skilled/group leader training, tests were carried out for four kinds of positions, i.e.: flat, vertical, horizontal, and overhead. Some of the trainees were not good at vertical welding in the beginning of the training, but all trainees passed each test finally. Test results are shown in Figure 10.1.6.



No. of Participants	Flat	Vertical	Horizontal	Overhead
Fair (5 - 5)	0	3	4	8
Good (7 - 8)	11	10	8	7
Excellent	4	2	3	0

Source: JICA Project Team

Figure 10.1.6 Practical Welding Test Results of Skilled/Group Leaders

10.2 CAPACITY DEVELOPMENT FOR REPAIRING SHIPS AND METAL STRUCTURES (STEP 2)

10.2.1 TRAINING SCHEME

(1) Purpose of the Training

Through the Step 1 Training Scheme, 15 management officials/engineers and 15 skilled technicians/group leaders of IWT and MPA were trained and educated as future welding instructors to materialize sustainable education system in their organizations.

In the Step 2 Training Scheme, these 30 instructors who had been educated in Step 1 gave the training to their workers in each dockyard for planning and executing the practical training by themselves.

Finally, the steel cradle was constructed by the trainees trained under the Step 2 Training Scheme as a practical training of welding skill.

(2) Principal Syllabus of the Training

Step 2 Training Scheme was subdivided into two trainings, namely, Program Module 3 and Program Module 4.

Program Module 3 was the welding training by the instructors who had received the training under the Step 1 Training Scheme. Program Module 3 was further subdivided into Program Modules 3A and 3B. Program Module 3A was designed for planning of the training and for preparation of the instruction material. Program Module 3B was prepared for the practical training.

Program Module 4 was the practical lesson by constructing the steel cradle with the trainees. Program Module 4 was further subdivided into Program Modules 4A and 4B. Program Module 4A was prepared to provide lectures on cradle construction planning, scheduling, construction method, welding method, painting method, and safety precaution during construction of the cradle to IWT and MPA instructors and officials at the meeting room of Dalla Dockyard. Program Module 4B was prepared to execute the cradle construction and welding at the dockyard by the trainees trained in the Step 2 Training Scheme in Dalla Dockyard.

- Program Module 3A (Two weeks):
  Planning of training was performed in IWT meeting room for planning of the training schedule, casting of instructors, and selection of trainees. Instruction material was translated to Myanmar Language from English and the translation work was given and allotted to each instructor as homework which is requested to be done within two months.
- Program Module 3B (Half day for two weeks for 1st Group and full day for one week for 2nd Group):
  The practical training was executed to five groups, each consisting of 15 trainees, by the instructors trained under the Step 1 Training Scheme. Training places were Dalla Dockyard and Ahlone Dockyard. For the 1st Group, the training period was half day for two weeks in order for the JICA expert to attend the training at two centers. For the 2nd Group, the training period was full day for one week and the JICA expert alternately visited the two training centers and guided the instructors.
- Program Module 4A (Two weeks):
  The steel cradle construction was prepared as the objective lesson under the Step 2 Training Scheme. The JICA expert explained the planning, scheduling, production method, welding method, painting method, and safety precaution during construction of the cradle to the management officials/engineers in IWT and MPA. In the Dalla Dockyard, the JICA expert explained the details of the design and construction planning, and discussed the scheduling, preparation of facility, improvement of the slipway rail condition, and necessary materials to the management officials/engineers.
- Program Module 4B (Six months):
  The steel cradles were constructed by the instructors and trainees trained in the Step 1 and Step 2 Training Scheme. Construction of cradles was performed by the trainees with the leadership of the group leaders under the instruction of the JICA expert.

10.2.2 PROCUREMENT OF TRAINING MATERIALS AND EQUIPMENT

For the Program Module 3, training consumables such as steel plates, LPG gas, and welding electrodes were prepared by the JICA Project Team.

For the Program Module 4, i.e., steel cradle construction, the air compressor equipment, consumables such as steel plates, I shaped steel beam, cast iron wheel, LPG gas, and welding electrodes, and other miscellaneous consumables were prepared.

10.2.3 TRAINING SCHEDULE

(1) Training Venue and Schedule

Training has taken place mainly at three locations, namely:

1) IWT meeting room
2) Dalla Dockyard
3) Ahlone Dockyard

Trainees of MPA were invited to receive training at Ahlone Training Center. Training was performed based on the schedule in Table 10.2.1.

Table 10.2.1 Location and Schedule of Training

Stage		Location and Schedule
Program Module 3A Welding Training Planning and Preparation	Period: Place: Member:	Between 15 and 29 March 2010 Homework for the instructors (translation of training text) until end of May 2010 IWT meeting room Instructors trained in Step 1 Training Scheme consisting of 15 officials/engineers and 15 group leaders of IWT and MPA JICA expert and staff
Program Module 3B Welding Training Practice in Training Center	Period: Practice: Place: Member: Trainees:	Between 29 July and 8 Aug. 2010 1st Batch : Between 9 and 20 Aug. 2010 2nd Batch : Between 23. and 27 Aug. 2010 3rd Batch : Between 30 Aug. and 3 Sept. 2010 4th Batch : Between 6 and 10 Sept. 2010 5th Batch : Between 13 and 17 Sept. 2010 Training Center in Dalla Dockyard Training Center in Ahlone Dockyard 15 officials/engineers and 15 group leaders of IWT and MPA Total of 72 trainees attended composed of: Dalla Dockyard: 8 persons x 3 groups / 7 persons x 1 group 6 persons x 1 group Ahlone Dockyard: 4 persons x 5 groups Theinbyu Dockyard: 1 person x 5 groups Satsan Dockyard: 1 person x 5 groups Angyi Dockyard: 1 person x 5 groups JICA expert had fully attended to Group 1 and alternately attended to Groups 2, 3, and 4 in order to support the instructors.
Program Module 4A Cradle Construction Planning by Lecture	Period: Place: Member:	Between 15 and 29 March 2010 IWT meeting room of Dalla Dockyard 15 officials/engineers and 15 group leaders of IWT and MPA JICA expert explained the cradle construction methods, drawings, construction schedule, and safety precautions.
Program Module 4B Cradle Construction at Dockyard	Period: Place: Member:	Between June 2010 and November 2010 Dalla Dockyard and meeting room for short lecture Officials/engineers and group leaders in Dalla Trainees who were trained in Step 2 Training Scheme JICA expert instructed the cradle construction method, parts control, painting methods, cradle construction schedule, and safety precaution during the course of the cradle construction.

Source: JICA Project Team

(2) Timetable of Training

The general training timetables of Program Modules 3A, 3B, 4A, and 4B are shown in the following Table 10.2.2.

Table 10.2.2 Training Schedule of Program Module 3

Program Module	Date	Contents
Program Module 3A	18-19 Mar. and 25-26 Mar.	Of the instructors trained in Step 1 Training Scheme, 15 officials/engineers and 15 group leaders conducted the Step 2 training planning, scheduling, listing of trainees, and casting of instructors. Text of instruction materials was confirmed. Translation into Myanmar Language was assigned to each instructor as homework until end of May.
Program Module 3B (Preparation)	4-5 Aug.	Plan and schedule of Step 2 Training Scheme were confirmed by the instructors trained in Step 1 Training Scheme in IWT meeting room. Training was rehearsed following the Step 2 Training Scheme order with instructors and the JICA expert.
(Practice) 1st Batch 2nd Batch 3rd Batch 4th Batch 5th Batch	9-20 Aug. 23-7 Aug. 30-3 Sept. 6-10 Sept. 13-17 Sept.	1.Place ,Time, Trainee and Instructor ・Dalla (a.m.): 8 trainees (Dalla) and 4 instructors (Dalla) ・Ahlone (p.m.): 7 trainees (Ahlone: 4 persons, MPA: 3 persons) and 4 instructors (Ahlone: 2 persons, MPA: 2 persons) 2. Curriculum ・Lecture and DVD ・Practice of bead on plate welding ・Flat butt welding and fillet welding ・Vertical butt welding and fillet welding ・Horizontal butt welding and fillet welding ・Evaluation by welding bead appearance ・Evaluation by bend test (For non-experienced worker, this curriculum was executed up to flat butt and fillet welding.) 3. The JICA expert fully attended to the 1st Group, and alternately attended to the 2nd, 3rd, and 4th groups. 4. The trainees in Dalla Dockyard had continued welding to construct the steel cradle as an objective lesson after having finished the Step 2 Training Scheme.

Source: JICA Project Team

Table 10.2.3 Training Schedule of Program Module 4

Program Module	Date	Contents
Program Module 4A	20-26 Mar.	The JICA expert explained and instructed how to plan regarding the construction of the steel cradle as an objective lesson to the IWT & MPA instructors trained under Step 1 Training Scheme. In Dalla Dockyard, the detailed plan to construct the steel cradle was discussed. 1. Instruction of how to conduct planning ・Production method ・Scheduling for construction ・Welding procedure ・Painting procedure ・Facilities ・Inspection and measurement of accuracy 2. Explanation of production drawing
Program Module 4B	May 2010 July 2010 July 2010 Aug. 2010 Sept. 2010 Oct. 2010 Nov. 2010	1. Production of wheel units of the cradle 2. NC and gas cutting of steel plate in Dalla Dockyard 3. Preparation of construction 4. Preparation of assembly floor 5. Sub-assembly 6. Welding 7. Preparation of fitting wheel units 8. Painting 9. Fitting wheel units 10. Grand assembly 11. Painting (Final coat) 12. Operation test

Source: JICA Project Team

(3) Participants of Training

Among the 30 candidate instructors trained during Step 1 Training Scheme, 19 instructors were selected for the Program Module 3B as shown in Table 10.2.4.

Table 10.2.4 List of Instructors for Program Module 3B

	Current Working Dockyard	Instructors by Position (person)
IWT	Dalla Dockyard	Assist. Engineer: 6 Assist. In-charge: 1 Grade-3: 1 Foreman: 1
	Ahlone Dockyard	Foremen: 2 Assist. Engineer: 1 Grade-3: 1
MPA	Satsan Dockyard	Deputy Manager: 1 In-charge, Grade 1: 1
	Theinbyu Dockyard	Assist. Engineer: 1 In-Charge, Grade 2: 1
	Angyi Dockyard	Assist. Engineer: 1 In-charge, Grade 3: 1
Total		**19 persons**

Source: JICA Project Team

(4) Trainee List for Program Module 3B

The number of trainees and their attendance ratio are summarized in Table 10.2.5 below.

Table 10.2.5 Number and Attendance Ratio of Trainees in Program Module 3B

	Current Working Place	1st Batch	2nd Batch	3rd Batch	4th Batch	5th Batch
IWT	Dalla Dockyard	8 (100%)	8 (100%)	7 (100%)	8 (90%)	6 (95%)
	Ahlone Dockyard	4 (97%)	4 (100%)	4 (100%)	4 (100%)	4 (100%)
MPA	Angyi Dockyard	1 (100%)	1 (100%)	1 (100%)	1 (100%)	1 (100%)
	Theinbyu Dockyard	1 (100%)	1 (100%)	1 (100%)	1 (100%)	1 (90%)
	Satsan Dockyard	1 (100%)	1 (100%)	1 (100%)	1 (100%)	1 (90%)
Total		**15**	**15**	**14**	**15**	**13**
Grand Total		**72 persons**				

Note: Figure in parenthesis is attendance ratio.

Source: JICA Project Team

(5) Training Details of Cradle Construction in Program Module 4

Table 10.2.6 List of Participants for the Cradle Construction

	Planning (Module 4A)		Practical Training (Module 4B)	
	Management Officials/Engineers	Technicians /Group Leaders	Trainees Trained in the Training Center	Others
IWT	8	8	11	25
MPA	3	-	-	-

Source: JICA Project Team

Details of Program Module 4 are elaborated below.

1) Basic Idea of the Design and Construction of Cradles

The following are the three major points in the cradle construction training:

- To give practical welding conditions to the trainee as much as possible, the cradles were designed to be built-up with steel plate having thickness of 10 to 18 mm.
- To give the new concept of wheel unit, oil-less bush system was applied on the wheel shaft construction.
- To realize easy application of the painting, and high anti-corrosion efficiency, Nippon E marine 400 was adopted.

2) Technical Explanations

The general explanation of the function of cradles, design concept and conditions of the cradle, and conceptual ideas of the wheel units were given to the concerned staff in the middle of May 2010, and followed by precise explanations of each drawing until the end of May in Dalla Dockyard. The more practical and precise explanations on how to fabricate and sub-assemble and assemble on the slipway, and prepare, apply paint, and fit wheel units and wood blocks were done at every necessary occasion in the course of the cradle construction.

3) Steel Fabrication

All steel plates were supplied to Dalla Dockyard by the end of May, and steel piece cutting by CNC cutting machine started in the beginning of June. It was the trainees' first experience to cut such thick steel plate using CNC cutting machine, and they did not know what kerf is. They cut the steel pieces 3 mm shorter than the drawings. But this problem was rectified through the instruction of the JICA expert.

There were more than 800 steel pieces from bigger size to smaller ones. However, Dalla staff successfully checked all pieces according to the check lists prepared by the JICA expert. It was admirable that there were no missing piece and lacking materials in Dalla Dockyard.

The cutting of all steel pieces was completed by the end of August.

4) Wheel Unit

The JICA expert could get trial product of wheel unit from a foundry company in Myanmar in the beginning of June and was satisfied with the product quality. Then 112 wheel units were ordered. The oil-less bushes were adopted in the wheel unit, and consequently the weight of the new wheel unit could be reduced to almost half of the old one. About 112 wheel units were delivered to Dalla Dockyard by the end of September. Fitting of wheel units had been carried out when the A and B girders were transported on each slip way and set upside down posture.

5) Sub-assembly Work

Sub-assembly work for A and B girders of the cradle started in the beginning of August. No sooner than the start of the assembly work, the JICA expert found out the poorness of the construction base. The JICA expert instructed the Dalla staffs about the importance of fine construction base to carry out high quality sub-assembly work effectively and safely. Dalla staffs understood the situation and they arranged new construction base inside of the factory. Four A girders and eight B girders were sub-assembled successfully according to the subassembly method prepared by the JICA Project Team with minimum deformation on the newly installed construction base in the factory in the beginning of October.

6) Surface Preparation and Paint Application

The paint (Epoxy type Nippon E Marine 400) meets both requirements, namely, anti-corrosion and for over-coating of the steel and easy handling. Prior to the application of paint, the JICA expert instructed how to do the surface preparation, how to prepare, handle, and keep the paint, and how to observe the safety precautions. The first coat of painting on each girder was carried out inside of the sub-assembly factory, and touching up on the welded portion and second coat were carried out on the slipway. The final paint works for No. 1 cradle were delayed for more than ten days because the rainy season continued until the end of October.

7) Grand Assembly Work

Wheel unit fittings on A and B girders of No. 1 cradle were completed on the No. 11 slipway, and those girders turned to normal position. It was in the beginning of October when the datum line on No. 11 slipway had been decided and one A girder and two B girders for No. 1 cradle were set to the grand assembly position. I type steel shape, gusset, and bracing installation followed.

The main welding works for one cradle according to the welding sequence continued for about ten days by skillful welders and trainees trained in Program Module 3. The grand assembly works of another three cradles followed and were completed in the middle of November. Eighty-four wood blocks were installed on the cradle after the final coating with Nippon E Marine 400. The grand assembly works on the slipway were often affected by much rain and high tide, but the Dalla staffs and workers gave their best effort to catch up with the construction schedule. The JICA Project Team admires and respects such Dalla staffs' attitude.

8) Cradle Operation

All four cradle operations were confirmed successfully from topside to bottomside of the slipways, but some parts of rail condition need to be readjusted and improved.

9) Rail Conditions on the Slipway

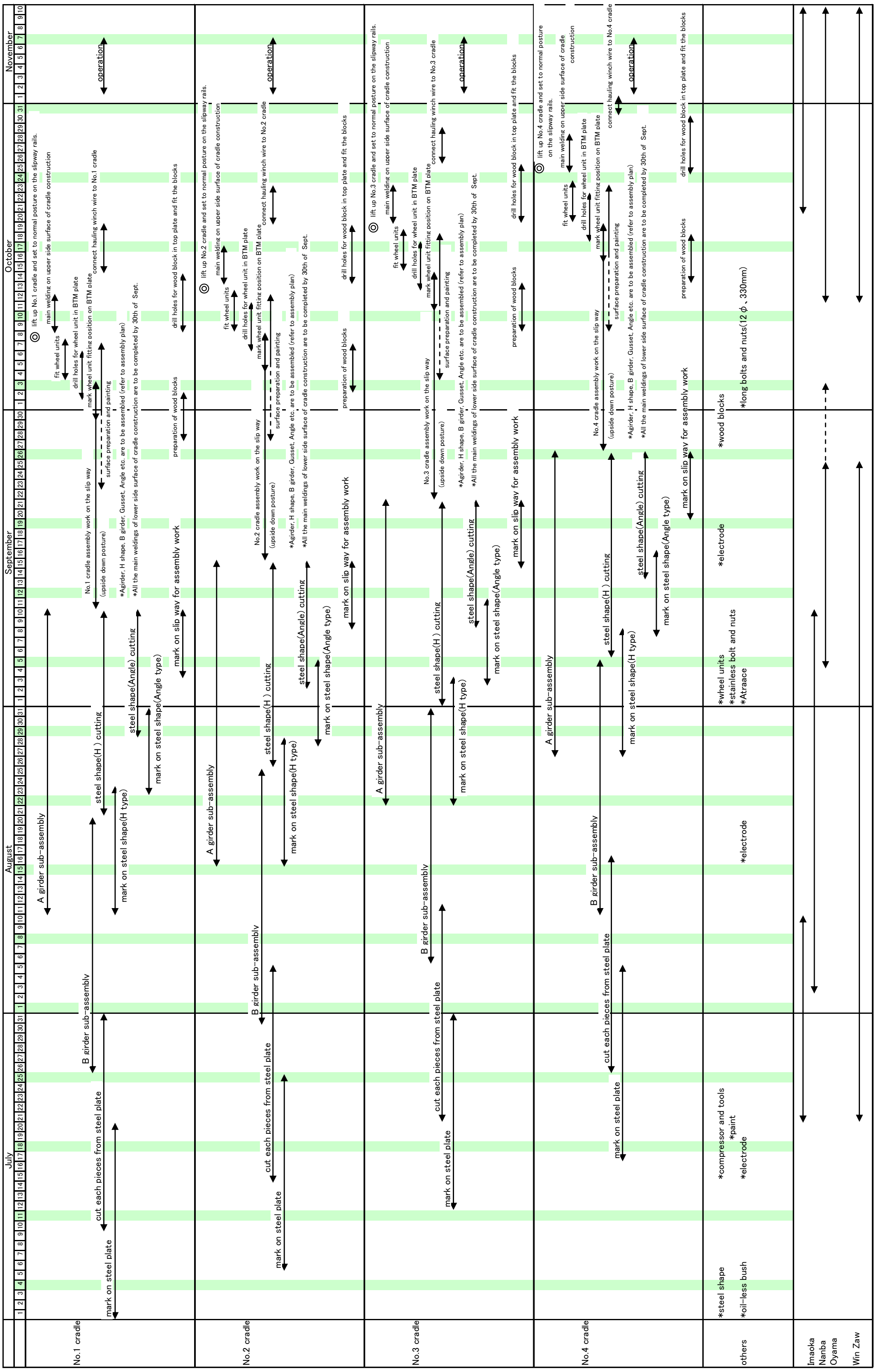
The rail conditions of all slipways were very bad, and the Dalla staff could not decide where each rail of each slipway should be finally installed correctly.

There are 16 rails on four slipways, and all these rails should be installed in parallel and the rail height of each point of the slipway should be equal to operate four cradles simultaneously under the loaded condition.

Dalla Dockyard should confirm that the 16 rails have been installed in parallel, and have same height at each point of the slipway and if not, the rails should be readjusted before using the four cradles under loaded condition. The rail conditions are quite important not only for the cradles but also for the ship's hull constructions loaded on the cradles. Bad rail conditions will possibly lead to damage of hull construction and cradles.

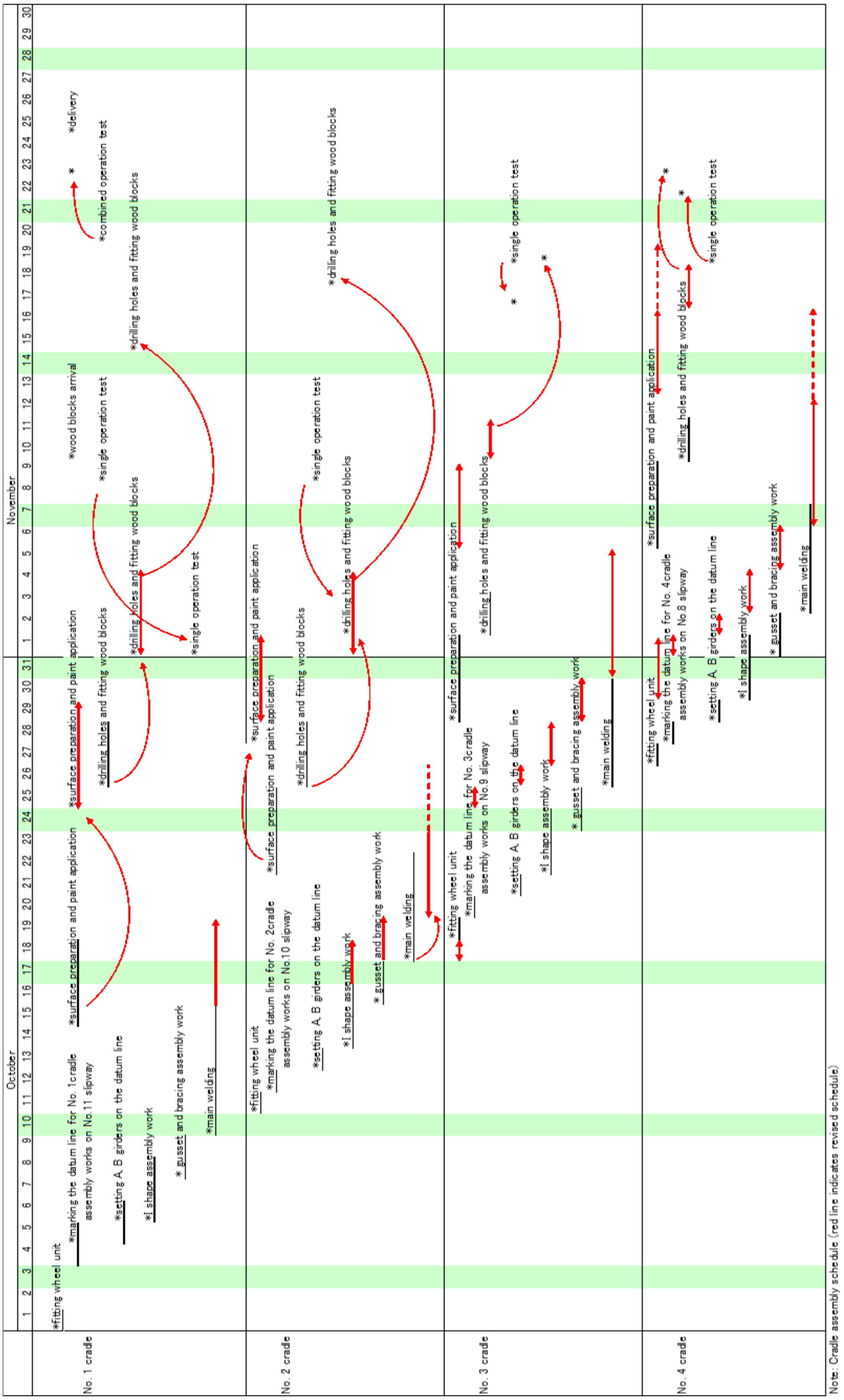
(6) Cradle Construction Schedule

Cradle construction schedule (from the start of steel fabrication work to operation of the cradles) and grand assembly schedule of four cradles are shown in Figures 10.2.1 and 10.2.2.



Source: JICA Project Team

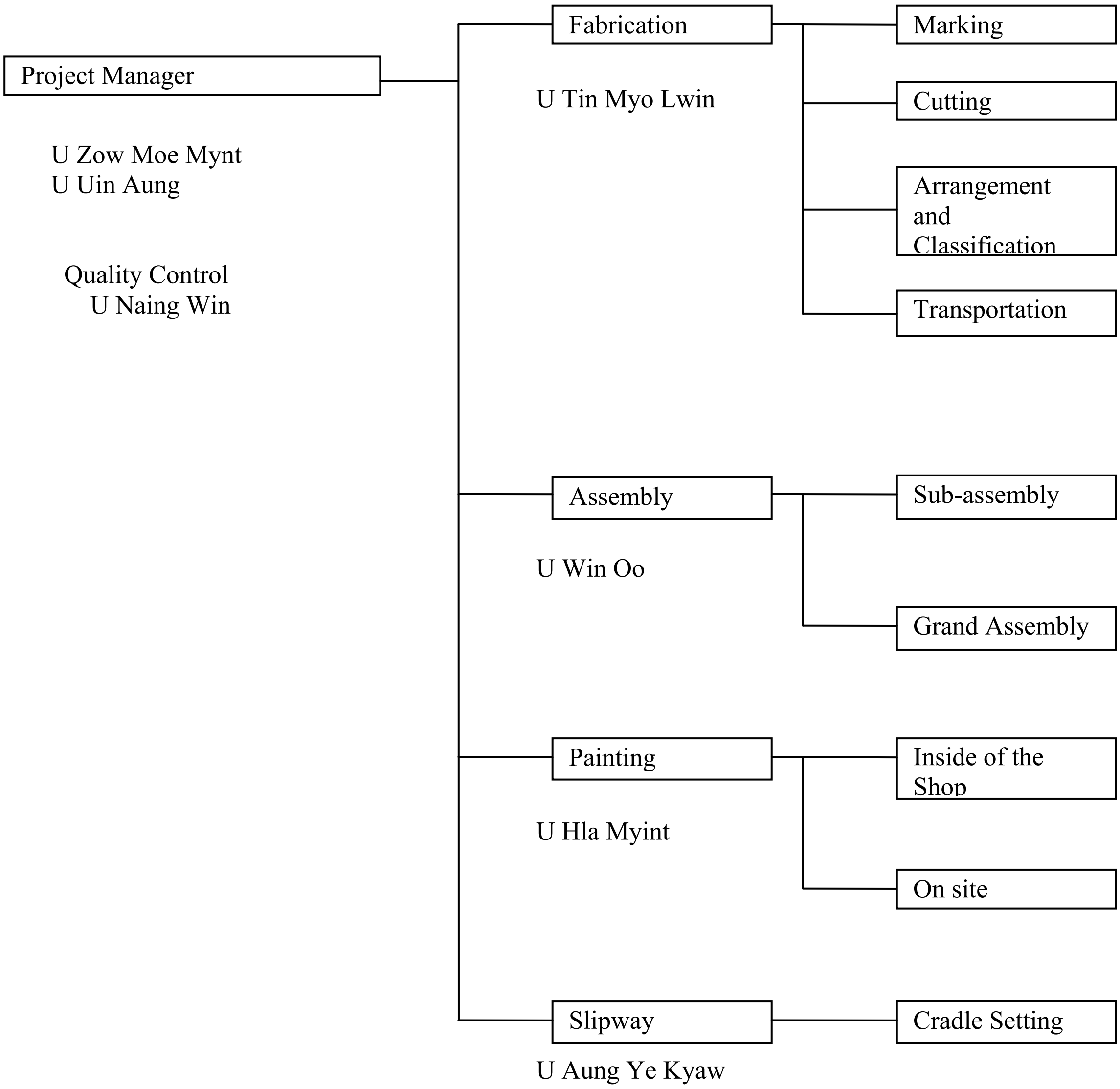
Figure 10.2.1 Cradle Construction Schedule



Source: JICA Project Team

Figure 10.2.2 Grand Assembly Schedule

(7) Organization of Cradle Construction in Dalla Dockyard



10.2.4 POST EVALUATION OF CAPACITY DEVELOPMENT TRAINING

Welding training under Step 2 Training Scheme was executed by the instructors who received education and training during Step 1 Training Scheme.

(1) Preparation and Execution by Instructors

The training textbook was translated into Myanmar Language for use in the further training planned to be performed for the sustainable capacity development of their technicians. Training of 72 technicians was executed by the instructors.

(2) Training Results

The attendance ratio of trainees was very high as shown in Table 10.2.7 and the average attendance ratio was as high as 98%. It shows the trainees' seriousness and the highest concern to obtain special technology and skill. Both experienced and inexperienced persons achieved certain skill as shown in the table below. Several persons got excellent grades. The situation in which some officers tried to participate in the training and to acquire the technology is appreciable.

The training results were evaluated and the technical capability and training attitude were evaluated by five levels, i.e.: 5: Excellent, 4: Good, 3: Enough, 2: Not Sufficient, and 1: Not Good.

Table 10.2.7 Post Evaluation Results of Training

Evaluation Point	Evaluation				
	Excellent or Very Good	Good	Enough	Not Sufficient	Not Good
Status of Skill	6 (6%)	30 (24%)	33 (70%)	0	0
Status of Attitude	13 (15%)	41 (53%)	16 (32%)	0	0
Total Result of Training	15 (6%)	29 (46%)	27 (48%)	0	0

Source: JICA Project Team

(3) Evaluation of Cradle Construction

Quality of cradle construction was evaluated in terms of the following three major points:

- Distance between cradle center and wheel center
- Welding skill and painting method
- Major dimensions of constructed cradle

1) Distance Between Cradle Center to Port and Starboard Wheel Center

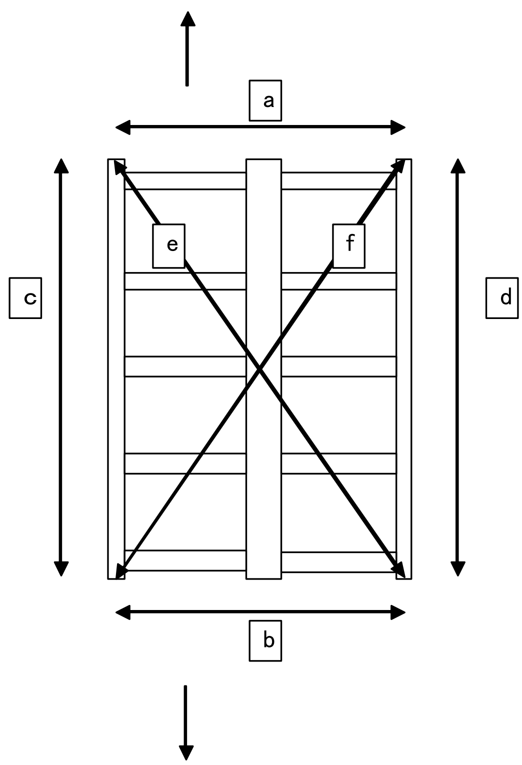
Cradle No.	Position	Port Side			Starboard Side			Evaluation
		Planned Value	Measured Value	Diff.	Planned Value	Measured Value	Diff.	
No. 1 Cradle Unit	Before	4195	4199	-4	4295	4288	7	Good
	After	4195	4193	2	4295	4288	7	Good
No. 2 Cradle Unit	Before	4515	4515	0	4545	4540	5	Good
	After	4515	4514	1	4545	4542	3	Good
No. 3 Cradle Unit	Before	4525	4529	-4	4515	4515	0	Good
	After	4525	4525	0	4515	4510	5	Good
No. 4 Cradle Unit	Before	4510	4512	-2	4530	4534	-4	Good
	After	4510	4513	-3	4530	4534	-4	Good

2) Welding and Painting

	Welding	Painting	
		Surface Preparation	Paint Application
No. 1 Cradle Unit	Good	Good	Good
No. 2 Cradle Unit	Good	Good	Good
No. 3 Cradle Unit	Good	Good	Good
No. 4 Cradle Unit	Good	Good	Good

3) Dimensions of Major Parts of No. 1 to No. 4 Cradles (All values are measured on the top plate of cradles in mm)

	a	b	c	d	e	f
No. 1 Cradle Unit	8,500	8,468	10,303	10,301	13,328	13,380
No. 2 Cradle Unit	9,049	9,050	10,311	10,311	13,714	13,728
No. 3 Cradle Unit	9,041	9,033	10,310	10,312	13,701	13,729
No. 4 Cradle Unit	9,029	9,027	10,313	10,312	13,692	13,715



Source: JICA Project Team

Figure 10.2.3 Dimension of Cradles

In constructing the cradle, major construction method was changed. In order to avoid difficult overhead welding and fixing wheels at precise position, the cradle units are normally manufactured upside down. Then, lifting crane will be used to place the cradle into final position and assemble the wheels. Due to the lack of lifting facilities, the cradle was manufactured and assembled into position from the beginning.

Dalla Dockyard staffs and workers fully understood the construction procedure and its difficulties, but the trainees did their best to meet the permissible tolerance.

It is quite important to carry out main welding precisely according to the welding sequence to minimize the cradle structure deformations and maintain the cradle size as it was designed. The trainees kept the welding sequence so strictly, and consequently, all cradle wheel units center line spans were kept within the permissible tolerance of ±5 mm. Thus, it can be said that their skill was developed more than expected and that the total evaluation of their skill was judged as achieving acceptable level.

10.3 CAPACITY DEVELOPMENT FOR REPAIRING SHIPS AND METAL STRUCTURES (STEP 3)

10.3.1 TRAINING SCHEME

(1) Purpose of the Training

The purposes of the Step 3 Training Scheme are to master the CO_2 arc welding as a progressive technology to improve the speed of ship repairing and shipbuilding and to study the testing and inspection to improve the quality of ships. CO_2 arc welding is the welding method using CO_2 welding machine. The speed of the welding is about 2 to 3 times of normal hand arc welding. IWT had long planned to deploy CO_2 welding machine to improve the welding efficiency, but was vain due to lack of technology.

In this Step 3 Training Scheme, 12 management officials/engineers and 20 skilled technicians/group leaders of IWT studied the theories of CO_2 arc welding and testing and inspection method, and underwent practical training on CO_2 arc welding and penetrant testing (PT).

(2) Principal Syllabus of the Training

Step 3 Training Scheme is subdivided into two trainings, namely, Program Module 5 and Program Module 6.

Program Module 5 is the CO_2 arc welding training and is further subdivided into Modules 5A and 5B.

Module 5A is the study of the theory of CO_2 arc welding and its application to shipbuilding. Module 5B is the practical training of CO_2 arc welding.

Program Module 6 involves the study of the theory of the testing and inspection method and the practical training of PT. It is further subdivided into Modules 6A and 6B.

Module 6A was conducted for 12 management officials/engineers and four group leaders with lectures on the details of testing and inspection theory and the practical training of PT for five days.

Module 6B was conducted for 16 skilled technicians with lectures on the outline of the testing and inspection method and the practical training of PT for two days.

- Program Module 5A (to three groups with total of 32 trainees for two days)
  The lecture on the theory of CO_2 arc welding and its application to shipbuilding was carried out for three groups each having 11, 12, and 9 trainees, respectively for two days.
- Program Module 5B (to eight groups with total of 32 trainees for five days at half day)
  The practical training of CO_2 arc welding was carried out for eight groups with four trainees each for five days at half day (a.m. or p.m.)
  The training room was constructed temporarily at the next door of the Ayeyar Auditorium of Ahlone Dockyard.
- Program Module 6A (to two groups with total of 16 trainees for five days)
  The detailed lecture on the theory of testing and inspection method was conducted for two groups each having 8 management officials/engineers/group leaders for five days in order to study the theory in detail including the practical training of PT.
- Program Module 6B (to two groups with total of 16 trainees for two days)
  The lecture on the theory of testing and inspection method was conducted for two groups with eight skilled technicians each in order to study the outline of testing and inspection method including the practical training of PT.

(3) Target of the Training

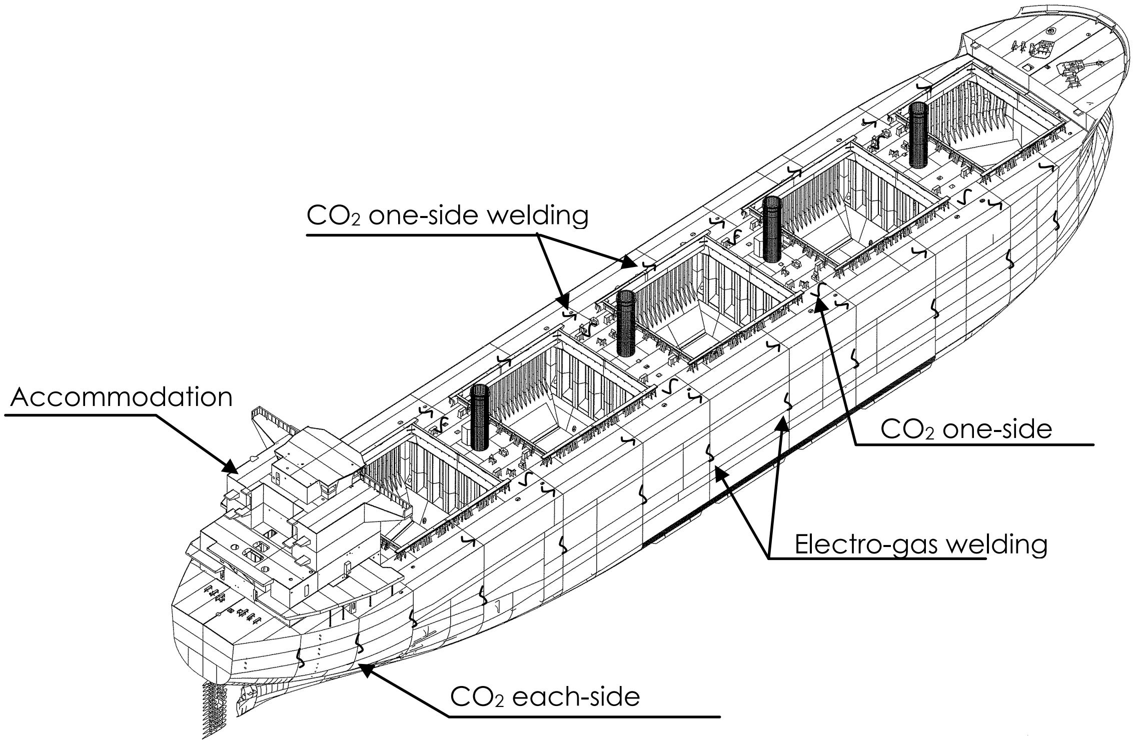
The target of the training is to obtain the ability of shipbuilding and repairing at international standards by introducing the present welding methods which are classified into typical welding methods as follows:

1) Typical Welding Method in Shipbuilding

(a) Typical Welding Method at the Erection Stage

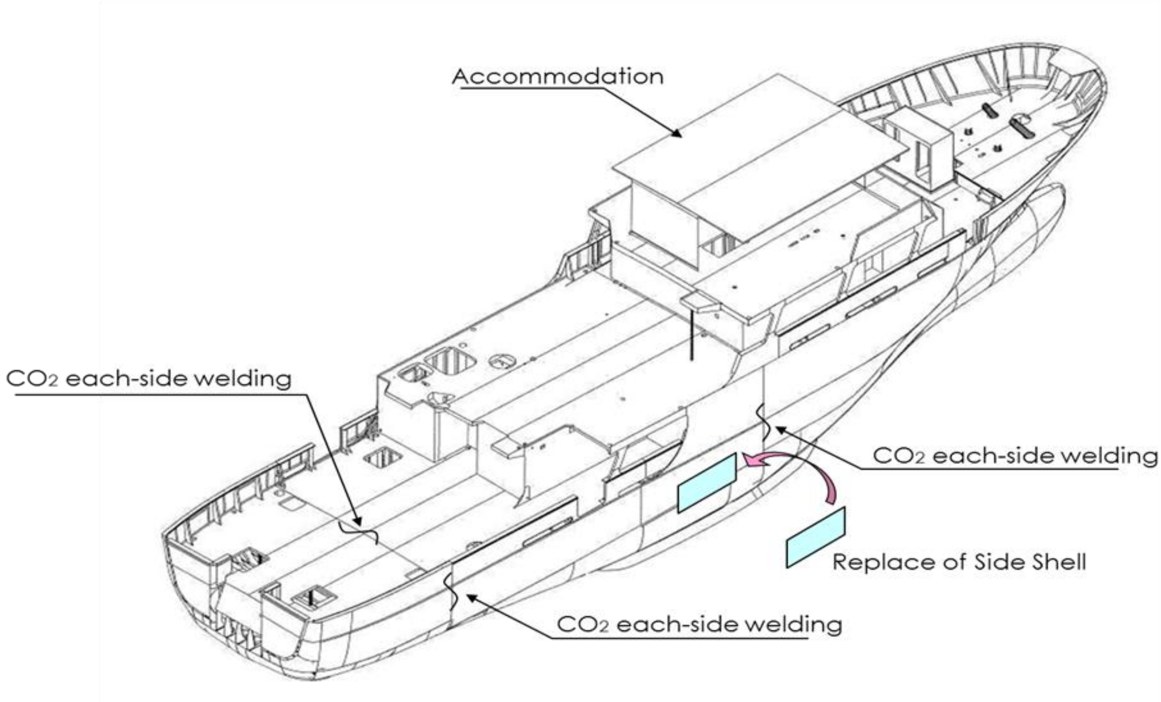
Place/Location	Welding Method	
	Skin Plate	Internal Member
0.6 Midship Side Shell x Side Shell	Electro-gas (Vertical)	❖ MAG one-side (Flat) (Vertical) (Horizontal) MAG each-side (All Position) SMAW (All Position)
Bottom Shell x Bottom Shell	MAG one-side (Flat)	
Upper Deck x Upper Deck	MAG one-side (Flat)	
Trans. BHD x Trans. BHD	MAG one-side (Vertical)	
Aft and Fore Part General	MAG one-side (F, V, H) MAG each-side (All Position) SMAW (All Position)	
❖CO_2 Welding is one of metal active gas (MAG) welding methods		

Source: JICA Project Team



Source: Mitsui Zosen Training Program

Figure 10.3.1 Typical Welding Method at the Erection Stage

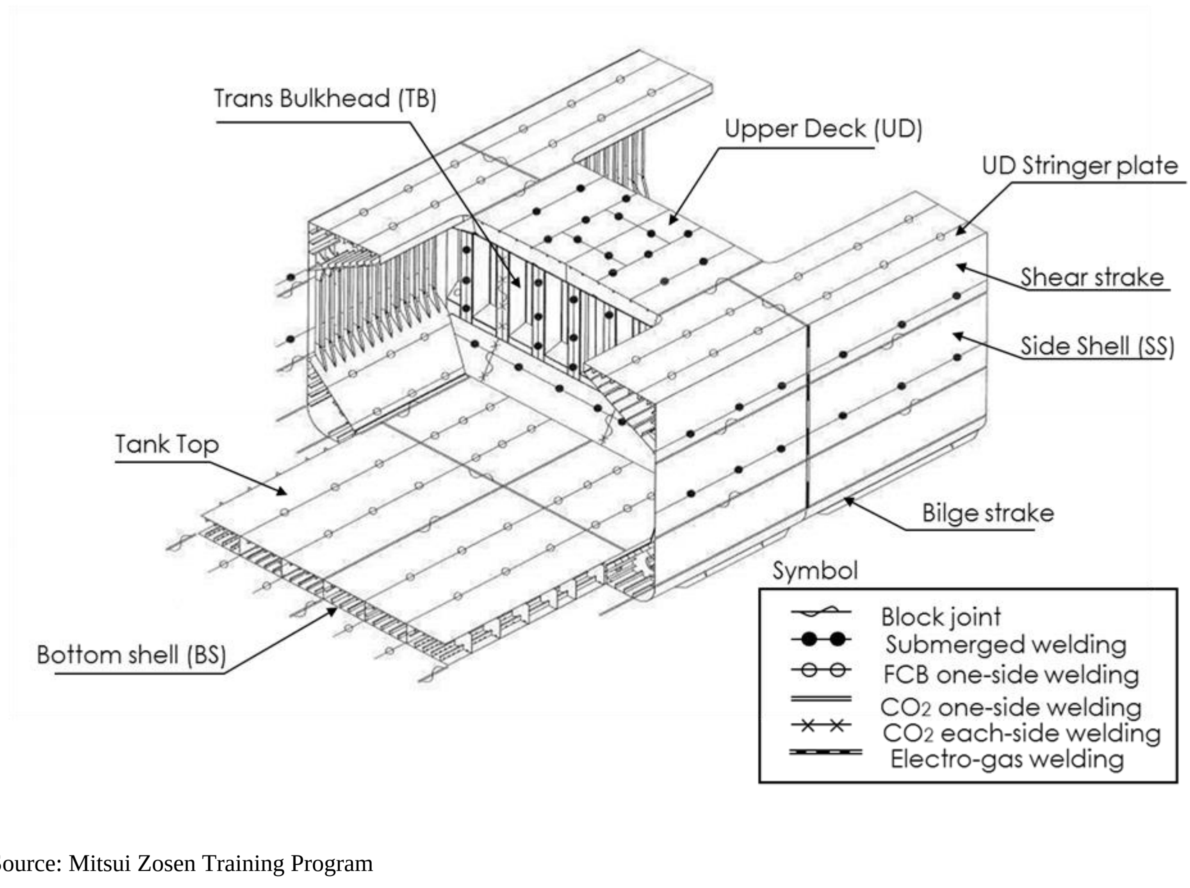


Source: Mitsui Zosen Training Program

Figure 10.3.2 Midship Section and Welding Method (General)

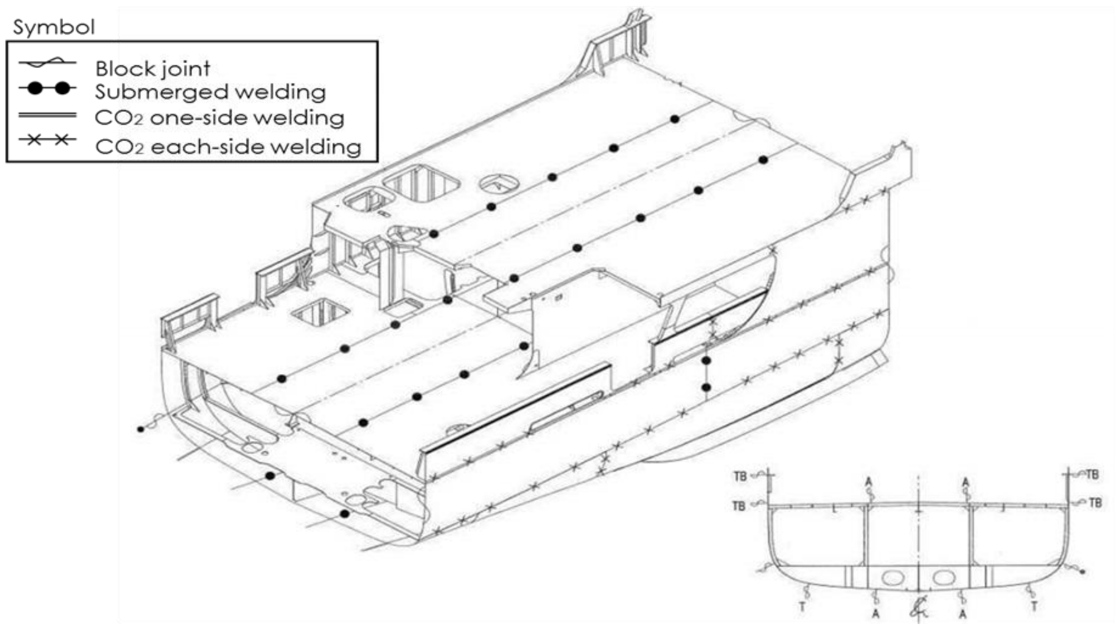
(b) Typical Welding Method at the Assembly Stage

Place and Construction	Welding Method
Plate Joint State Skin Plate x Skin Plate (Parallel Plate)	SAW One-Side Welding FCB or RF Multi Electrodes
(Curbed Part)	SAW Each-Side MAG One-Side MAG Each-Side
Assembly Stage Skin Plate x Long. Member	Line Welding Multi Electrodes MAG Automatic Fillet
Skin Plate x Inter. Member x Trans. Member	MAG Semi-Automatic Simplified MAG Automatic Fillet
Trans. Member x Long. Member	MAG Welding (All Position) SMAW (All Position)



Source: Mitsui Zosen Training Program

Figure 10.3.3 Midship Section and Welding Method (Bulk Carrier)



Source: Mitsui Zosen Training Program

Figure 10.3.4 Midship Section and Welding Method (General)

10.3.2 PROCUREMENT OF TRAINING MATERIALS AND EQUIPMENT

For Program Module 5, the training consumables such as steel plates, CO_2 welding wire, and LPG gas were prepared by the JICA Project Team as listed in Table 10.3.1.

Table 10.3.1 List of Steel Plates, CO_2 Welding Wire and LPG Gas

Item Name	Quantity	Unit
Solid Wire (KOBELCO) (1.2 mm dia.), 20 kg/coil	10	coil
Liner (WIM/Malaysia)	2	piece
Contact Tip (WIM/ Malaysia)	7	piece
Solid Wire (WELDRO) (1.2 mm dia.), 15 kg/coil	10	coil
Nozzle (WIM/ Malaysia)	4	piece
Steel plate (300x300x8 mm)	320	piece
Steel plate (350x30x6 mm)	640	piece
350 Gas Nozzle (Panasonic)	4	piece
350 Tip Holder (Panasonic)	2	piece
350 Orifice (Panasonic)	4	piece
350 Nozzle Insulator (Panasonic)	4	piece
MIG Contact Tip (1.2 mm dia.) (Panasonic)	20	piece
(8M)MIG Contact Tip (1.2 mm dia.) (Malaysia)	13	piece
Flux Cored Wire (WELDRO) (1.2 mm dia.), 15 kg/coil	10	coil
Oxygen	240	kg
Propane Gas	52	kg
Carbon Dioxide Gas	260	kg
Propane Cutting Nozzle	2	piece
Grinder Disc	25	piece
Waste	1.5	kg

Source: JICA Project Team

For Program Modules 5 and 6, safety shoes and goods and materials for PT were prepared by the JICA Project Team as shown in Table 10.3.2.

Table 10.3.2 List of Safety Goods for CO_2 Arc Welding and Goods for Inspection

No.	Name of Instrument	Quantity	Unit	Remarks
1	Safety Helmet	35	piece	Safety appliances
2	Protective Glasses	35	piece	Safety appliances
3	Anti-dust Mask	35	piece	Safety appliances
4	Micron Filter	400	piece	Safety appliances
5	Earplug	35	pair	Safety appliances
6	Safety Shoes	35	pair	Safety appliances
7	Shoes Cover	35	pair	Safety appliances
8	Hood for Welding	35	piece	Safety appliances
9	Apron for Welding	35	piece	Safety appliances
10	Arm Cover for Welding	35	pair	Safety appliances
11	Leather Glove	35	pair	Safety appliances
12	Hand Shield	20	piece	Shading from welding light
13	Colored Glass	100	piece	For hand shield
14	Clear Glass	400	piece	For hand shield
15	Chipping Hammer	10	piece	Welding tools
16	Wire Brush	20	piece	Welding tools
17	Plier	4	piece	Welding tools
18	Monkey Wrench	4	piece	Welding tools
19	Hexagonal Wrench	4	piece	Welding tools
20	Screwdriver	4	piece	Welding tools
21	Small Bottle Container（Jet Oiler）	12	piece	Inspection tools
22	Brush (15 mm width)	12	piece	Inspection tools
23	Brush (50 mm width)	12	piece	Inspection tools
24	Small Can	6	can	Inspection tools

Source: JICA Project Team

Table 10.3.3 List of Penetrant Testing Materials

Item Name	Quantity	Unit
Penetrant (FAW-6)	6	can
Cleaner (FR-S)	12	can
Developer (FD-S)	60	can

Source: JICA Project Team

10.3.3 TRAINING SCHEDULE

(1) Training Venue and Schedule

Training has taken place at the Ayeyar Auditorium and training room in Ahlone Dockyard. Training was performed in accordance with the schedule shown in Table 10.3.4.

Table 10.3.4 Location and Schedule of Training

Stage	Location and Schedule
Module 5A CO_2 Arc Welding Lecture on the theory of CO_2 arc welding and its application to the shipbuilding	Period: Between 28 September and 5 October 2012 1st Batch (11 persons): 28 Sept. and 1 Oct. 2012 2nd Batch(12 persons): 2 Oct. and 3 Oct. 2012 3rd Batch (9 persons): 4 Oct. and 5 Oct. 2012 Place: Ayeyar Auditorium in Ahlone Dockyard Trainees: 12 officials/engineers and 20 group leaders/skilled technicians of Dalla Dockyard and Ahlone Dockyard in IWT. Instructor: JICA expert and staff
Module 5B CO_2 Arc Welding Practical Training	Period: Between 9 October and 6 November 2012 1st Batch: Between 9 Oct. and 15 Oct. 2012 in the morning 2nd Batch: Between 9 Oct. and 15 Oct. 2012 in the afternoon 3rd Batch : Between 16 Oct. and 22 Oct. 2012 in the morning 4th Batch: Between 16 Oct. and 22 Oct. 2012 in the afternoon 5th Batch: Between 23 Oct. and 29 Oct. 2012 in the morning 6th Batch: Between 23 Oct. and 29 Oct. 2012 in the afternoon 7th Batch: Between 31 Oct. and 5 Nov. 2012 in the morning 8th Batch: Between 31 Oct. and 5 Nov. 2012 in the afternoon (4 persons each batch) Place: Training Room in Ahlone Dockyard Training Center in Ahlone Dockyard Trainees: 12 officials/engineers and 20 group leaders/skilled technicians of Dalla Dockyard and Ahlone Dockyard in IWT Instructor: JICA expert and staff
Module 6A Testing and Inspection Method Lecture and Practice for Officials/ Engineers/Group Leaders	Period: Between 7 and 20 November 2012 1st Batch (8 persons): Between 7 and 13 Nov. 2012 2nd Batch (8 persons): Between 14 and 20 Nov. 2012 Place: Ayeyar Auditorium in Ahlone Dockyard Trainees: 12 officials/engineers and four group leaders of Dalla Dockyard and Ahlone Dockyard in IWT Instructor: JICA expert and staff
Module 6B Testing and Inspection Method Lecture and Practice for Group Leaders/ Skilled Technicians	Period: Between 21 and 29 Nov. 2012 1st Batch (6 persons): 21 and 22 Nov. 2012 2nd Batch (6 persons): 23 and 26 Nov. 2012 3rd Batch (6 persons): 27 and 29 Nov. 2012 Place: Ayeyar auditorium in Ahlone Dockyard Trainees: 18 group leaders/skilled technicians of Dalla Dockyard and Ahlone Dockyard in IWT Instructor: JICA expert and staff

Source: JICA Project Team

(2) Timetable of Training

The general training timetable of Module 5A, Module 5B, Module 6A, and Module 6B are shown in the following Table 10.3.5.

Table 10.3.5 Training Schedule of Module 5

Module	Date	Contents	Instructor
Module 5A	Year 2012	Lecture on CO_2 arc welding	Mr. Imaoka
	28 Sept.	1. Welding in shipbuilding	
1st Batch	-1 Oct.	Application of CO_2 arc welding in shipbuilding	
		2. Principle and characteristics of CO_2 arc welding	
	2 Oct.	3. CO_2 welding machine and equipment	
2nd Batch	-3 Oct.	4. Steel material and CO_2 welding wire	
		5. Welding procedure and weld defects	
	4 Oct.	6. Quality and inspection	
3rd Batch	-5 Oct.	7. Safety hazards and countermeasure	
		8. DVD of CO_2 arc welding	
Module 5B	Year 2012	Practical training of CO_2 arc welding	Mr. Yasuo Namba
1st Batch	9 Oct. -15 Oct. (a.m.)	1. How to wear safety goods, safety helmet, safety shoes, anti-dust mask, apron for welding, and hood for welding.	
2nd Batch	9 Oct. (p.m.)		
3rd Batch	16 Oct. -22 Oct. (a.m.)	2. How to handle CO_2 welding machine. Connection of power cable, connection of CO_2 gas hose, setting of wire feeding device and CO_2 welding wire	
4th Batch	16 Oct. -22 Oct. (p.m.)		
5th Batch	23 Oct. - 29 Oct. (a.m.)	3. Welding practice 1) Welding of bead on plate 2) Flat position welding	
6th Batch	23 Oct. - 29 Oct. (p.m.)	3) Vertical welding 4) Horizontal welding 5) Overhead fillet welding	
7th Batch	31 Oct. -6 Oct. (a.m.)	4. Examination Flat position welding Vertical welding	
8th Batch	31 Oct. -6 Oct. (p.m.)		

Source: JICA Project Team

Table 10.3.6 Training Schedule of Module 6

Module	Date	Contents	Instructor
Module 6A 1st Batch 2nd Batch	Year 2012 7-13 Nov. 14-20 Nov.	Lecture on testing and inspection method and practice of penetrant testing (PT) for officials/ engineers/ group leaders 1. Outline of Testing and Inspection 2. Instruction of Nondestructive Test 3. Instruction and Details of Radiographic Test 4. Instruction and Details of Ultrasonic Test 5. Instruction and Details of Magnetic Particle Test 6. Instruction of Penetrant Test 7. Practice of Penetrant Test	Mr. Toshitaka Namba
Module 6B 1st Batch 2nd Batch 3rd Batch	Year 2012 21-22 Nov. 23-26 Nov. 27-29 Nov.	Lecture on testing and inspection method and practice of penetrant testing (PT) for group leaders/skilled technicians 1. Outline of Testing and Inspection 2. Instruction of Nondestructive Test 3. Instruction of PT 4. Practice of PT	Mr. Toshitaka Namba

Source: JICA Project Team

10.3.4 DETAILS OF TRAINING

The Step 3 Training Scheme was implemented throughout the Step 1 and Step 2 processes.

(1) Participants of Training

The Step 3 Training Scheme was planned for 12 management officials/engineers and 20 skilled technicians/group leaders who were nominated from Dalla Dockyard and Ahlone Dockyard of IWT.

Table 10.3.7 List of Trainees

Affiliation	Dockyard	Name	Position
IWT	Dalla Dockyard	U Myo Aung Thein U Tin Maung Wai U Hla Myint U Naing Win U Aung Ye Kyaw U Myo Win Thein U Htain Lin Maung U Than Lwin U Shwe Win U Soe Myint U Ohn Thein U Tint Lwin U Win Tun U Than Soe U Win Ko Tun U Zay Yar Win U Naing Win Tun U Zar Ni Win U Aye Thein	Assist. Engineer Assist. Engineer Assist. Engineer Assist. Engineer Assist. Engineer Assist. Engineer Assist. Engineer In-charge In-charge In-charge In-charge In-charge In-charge In-charge 1st Grade 1st Grade 1st Grade 1st Grade 2nd Grade

Affiliation	Dockyard	Name	Position
	Ahlone Dockyard	U Ye Zaw U Tin Myo Lwin U Kyaw Shwe Oo U Win Zaw Tun U Kyaw Thu Win U Aye San U Thein Aung U Shwe Tun U Hla Win U Zayar Lwin U Hla Win Naing U Kyi Soe U Zaw Min Oo	Assist. Engineer Assist. Engineer Assist. Engineer Assist. Engineer Assist. Engineer In-charge Assist. In-charge Assist. In-charge Assist. In-charge Assist. In-charge Assist. In-charge Assist. In-charge Assist. In-charge 2nd Grade

Source: JICA Project Team

(2) Number of Trainees

Table 10.3.8 Number of Trainees in Step 3 Training Scheme

Module		5A			5B								6A		6B		
Batch		1b	2b	3b	1b	2b	3b	4b	5b	6b	7b	8b	1b	2b	1b	2b	3b
Dalla Dock	Officer/ Engineer	3	2	2	2		1	1	1	1	1	1	4	3			
	Group Leader/ Skilled Technician	3	4	5	2		3		2		3	2	1	3	3	2	3
Ahlone Dock	Officer/ Engineer	1	2	2		1		1	1	1		1	3	2			
	Group Leader/ Skilled Technician	4	4			3		3		2					3	3	2
Total of Batch		11	12	9	4	4	4	4	4	4	4	4	8	8	6	5	5
Total of Module		**32**			**32**								**16**		**16**		

Source: JICA Project Team

(3) Details of Training Program of Each Module

1) Details of Training Program of Module 5A

"Lecture on CO_2 Arc Welding"

(a) Course Period and Number of Trainees

Item	Contents	
Course Period	2 days x 3 batches	Morning (9:00 a.m.-12:00 noon) Afternoon (1:00 p.m.-4:00 p.m.)
Number of Trainees	1st Batch (11 persons) 2nd Batch(12 persons) 3rd Batch (10 persons) Total	28 September and 1 October 2012 2 and 3 October 2012 4 and 5 October 2012 32 persons
Instructor	JICA Expert	(Mr. Yu Imaoka)

(b) Contents of Lecture

Schedule		Contents of Lecture
1st Day	9:00 a.m.-12:00 noon.	1. Application of CO_2 arc welding to shipbuilding 2. Principle and characteristics of semi-automatic welding 3. CO_2 welding machine and equipment
	1:00 p.m.-4:00 p.m.	4. Treatment of CO_2 welding machine and prevention of welding disaster 5. Steel material and welding material
2nd Day	9:00 a.m.-12:00 noon	6. Welding procedure 7. Outline of testing and inspection of welds 8. DVD of CO_2 arc welding
	1:00 p.m.-4:00 p.m.	Question and Questionnaire

<Photos of Training>

Photo 10.3.1 Ayeryar Room for Educational Room in Ahlone Dock

Photo 10.3.2 Opening of Step 3 Training Scheme with Attendance of the Commander and GM

Photo 10.3.3 Lecture on CO_2 Arc Welding

Photo 10.3.4 Training Scenery

Source: JICA Project Team

2) Details of Training Program of Module 5B

"Practical Training of CO_2 Arc Welding"

(a) Course Period and Number of Trainees

Item	Contents	
Course Period	5 days x 8 batch	Morning group (9:00 a.m.-12:00 noon) Afternoon group (1:00 p.m.-4:00 p.m.)
Number of Trainees	1st Batch (4 persons)	Between 9 and 15 October 2012, morning
	2nd Batch(4 persons)	Between 9 and 15 October 2012, afternoon
	3rd Batch (4 persons)	Between 16 and 22 October 2012, morning
	4th Batch(4 persons)	Between 16 and 22 October 2012, afternoon
	5th Batch (4 persons)	Between 23 and 29 October 2012, morning
	6th Batch (4 persons)	Between 23 and 29 October 2012, afternoon
	7th Batch (4 persons)	Between 31 October and 6 November 2012, morning
	8th Batch (4 persons)	Between 31 October and 6 November 2012, afternoon
	Total:	32 persons
Instructor	JICA Expert	(Mr. Yasuo Namba)

<Contents of Practical Training>

Schedule		Contents of Practice
1st Day	Morning group (9:00 a.m.-12:00 noon)	1. Handling of CO_2 welding machine 2. Bead on plate 3. Horizontal fillet welding 4. Flat butt welding
	Afternoon group (1:00 p.m.-4:00 p.m.)	- do -
2nd Day	Morning group (9:00 a.m.-12:00 noon)	5. Vertical downward fillet welding 6. Vertical upward fillet welding
	Afternoon group (1:00 p.m.-4:00 p.m.)	- do -
3rd Day	Morning group (9:00 a.m.-12:00 noon)	7. Vertical butt welding
	Afternoon group (1:00 p.m.-4:00 p.m.)	- do –
4th Day	Morning group (9:00 a.m.-12:00 noon)	8. Horizontal butt welding 9. Overhead fillet welding
	Afternoon group (1:00 p.m.-4:00 p.m.)	- do –
5th Day	Morning group (9:00 a.m.-12:00 noon)	10. Final test by flat position and/or vertical position 11. Evaluation
	Afternoon group (1:00 p.m.-4:00 p.m.)	- do –

(b) Photos of Training

Photo 10.3.5 How to Wear the Safety Wear and Goods

Photo 10.3.6 Completion of Safe Wear

Photo 10.3.7 CO_2 Welding Machines Prepared by JICA

Photo 10.3.8 Training of Cable Connection and Handling of Machines

Photo 10.3.9 Flat Position Welding

Photo 10.3.10 Vertical Welding

Photo 10.3.11 Horizontal Welding

Photo 10.3.12 Overhead Fillet Welding

Photo 10.3.13 Not Good Example of Flat Position Butt Welding Bead

Photo 10.3.14 Good Example of Flat Position Butt Welding Bead

Photo 10.3.15 Not Good Example of Vertical Butt Welding Bead

Photo 10.3.16 Good Example of Vertical Butt Welding

Photo 10.3.17 Good Example of Flat Position Butt Welding Bead

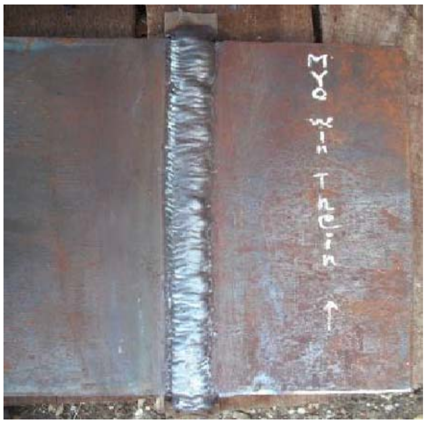


Photo 10.3.18 Good Example of Vertical Butt Welding Bead

Source: JICA Project Team

3) Details of Training Program of Module 6A

"Testing and Inspection, Lecture and Practice for Officials/ Engineers"

(a) Course Period and Number of Trainees

Item	Contents	
Course Period	5 days x 2 batches	Morning (9:00 a.m. -12:00 noon) Afternoon (1:00 p.m. -4:00 p.m.)
Number of Trainees	1st Batch (8 persons) 2nd Batch (8 persons) Total:	Between 7 and 13 November 2012 Between 14 and 20 November 2012 16 persons
Instructor	JICA Expert	(Mr. Toshitaka Namba)

(b) Contents of Lecture and Practice

Schedule		Contents of Lecture and Practice
1st Day	9:00 a.m.-12:00 noon	1. Outline of testing and inspection
	1:00 p.m.-4:00 p.m.	2. Introduction of nondestructive testing
2nd Day	9:00 a.m. -12:00 noon	3. Introduction and details of radiographic testing
	1:00 p.m.-4:00 p.m.	4. Introduction and detail of ultrasonic testing
3rd Day	9:00 a.m.-12:00 noon	5. Introduction of magnetic particle testing
	1:00 p.m.-4:00 p.m.	- do -
4th Day	9:00 a.m. -12:00 noon	6. Introduction of penetrant testing
	1:00 p.m.-4:00 p.m.	- do -
5th Day	9:00 a.m. -12:00 noon	7. Practice of penetrant testing
	1:00 p.m.-4:00 p.m.	Question and questionnaire

4) Details of Training Program of Module 6B

"Testing and Inspection, Lecture and Practice for Group Leaders/ Skilled technicians"

(a) Course Period and Number of Trainees

Item	Contents	
Course Period	2 days x 3 batches	Morning (9:00 a.m.-12:00 noon) Afternoon (1:00 p.m.-4:00 p.m.)
Number of Trainees	1st Batch (6 persons) 2nd Batch (5 persons) 3rd Batch (5 persons) Total:	21st and 22nd November 2012 23rd and 26th November 2012 27th and 29th November 2012 16 persons
Instructor	JICA Expert	(Mr. Toshitaka Namba)

(b) Contents of Lecture and Practice

Schedule		Contents of Lecture and Practice
1st Day	9:00 a.m.-12:00 noon	1. Outline of testing and inspection
	1:00 p.m.-3:00 p.m.	2. Introduction of nondestructive testing
2nd Day	9:00 a.m.-12:00 noon	3. Introduction of penetrant testing and practice
	1:00 p.m.-3:00 p.m.	Question and questionnaire

(c) Photos of Training

Photo 10.3.19 Lecture on Testing and Inspection 1

Photo 10.3.20 Lecture on Testing and Inspection 2

Photo 10.3.21 Practical Training Scenery

Photo 10.3.22 Penetrant Process of PT

Photo 10.3.23 Developing Process of PT

Photo 10.3.24 Result of Penetrant Testing

Photo 10.3.25 Practical Penetrant Testing Applied to the Ship

Photo 10.3.26 Explanation of Radiographic Testing

Source: JICA Project Team

10.3.5 POST EVALUATION OF CAPACITY DEVELOPMENT TRAINING

The Step 3 Training Scheme was planned systematically with Step 1 and Step 2.

In order to evaluate the level of acquired knowledge, some examinations were executed on the "Lecture on CO_2 Arc Welding" and "Testing and Inspection" modules.

About the practical training of CO_2 arc welding, it was the first-time experience for almost all the trainees. Finally, the improvement of technical skill was evaluated through welding test at flat position and vertical position.

On the whole, all trainees had studied seriously and indicated a remarkable improvement, which will enable these trainees to take leadership and contribute to develop the industry in Myanmar.

(1) Training Results of Module 5A "Lecture on CO_2 Arc Welding"

The attendance ratio of trainees as shown in Table 10.3.9 was 100%. It indicates the trainees' seriousness and great concern to master the technology.

Before and after the lecture, some examinations were executed in order to measure the level of knowledge acquisition.

- Category 1: Knowledge regarding "welding method" like CO_2 arc welding and other welding methods including the current welding method to be applied in shipbuilding.
- Category 2: Knowledge regarding "welding machine" of CO_2 arc welding and equipment.
- Category 3: Knowledge regarding "steel material and welding material".
- Category 4: Knowledge regarding "welding procedure".
- Category 5: Knowledge regarding "welding defects and evaluation".

Table 10.3.9 Training Attendance Sheet

Sr.	Name	Position	Age	Attendance Ratio (%)				Assignment
				5A	5B	6A	6B	
				5 Days	5 Days	2 Days	2 Days	
1	U Myo Aung Thein	Assist. Engineer	36	100	100	80		Dalla Dockyard
2	U Tin Maung Wai	Assist. Engineer	35	100	100	100		Dalla Dockyard
3	U Tin Myo Lwin	Assist. Engineer	29	100	60	100		Dalla Dockyard
4	U Ohn Thein	In-charge	49	100	100	100		Dalla Dockyard
5	U Naing Win	Assist. Engineer	28	100	100	100		Dalla Dockyard
6	U Myo Win Thein	Assist. Engineer	27	100	100	100		Dalla Dockyard
7	U Than Lwin	In-charge	53	100	100	100		Dalla Dockyard
8	U Shwe Win	In-charge	44	100	100	100		Dalla Dockyard
9	U Ye Zaw	Assist. Engineer	32	100	100	20		Ahlone Dockyard
10	U Aung Ye Kyaw	Assist. Engineer	27	100	100	100		Dalla Dockyard
11	U Win Zaw Tun	Assist. Engineer	27	100	100	100		Ahlone Dockyard
12	U Htain Lin Maung	Assist. Engineer	31	100	100	100		Dalla Dockyard
13	U Kyaw Thu Win	Assist. Engineer	27	100	100	80		Ahlone Dockyard
14	U Kyaw Shwe Oo	Assist. Engineer	27	100	100	100		Ahlone Dockyard
15	U Hla Myint	Assist. Engineer	53	100	100	100		Dalla Dockyard
16	U Tint Lwin	In-charge	43	100	100	100		Dalla Dockyard
17	U Win Ko Tun	1st Grade	32	100	100		100	Dalla Dockyard
18	U Soe Myint	In-charge	35	100	100		100	Dalla Dockyard
19	U Aye Thein	2nd Grade	34	100	100		100	Ahlone Dockyard
20	U Thein Aung	Assist. In-charge	39	100	100		100	Ahlone Dockyard
21	U Shwe Tun	Assist. In-charge	25	100	100		100	Ahlone Dockyard
22	U Zaw Min Oo	2nd Grade	34	100	100		100	Ahlone Dockyard
23	U Naing Win Tun	1st Grade	35	100	100		100	Dalla Dockyard
24	U Zar Ni Win	1st Grade	34	100	100		100	Dalla Dockyard
25	U Kyi Soe	Assist. In-charge	25	100	80		50	Ahlone Dockyard
26	U Hla Win	Assist. In-charge	23	100	100		100	Ahlone Dockyard
27	U Zayar Lwin	Assist. In-charge	35	100	100		100	Ahlone Dockyard
28	U Win Tun	In-charge	34	100	100		100	Dalla Dockyard
29	U Than Soe	In-charge	45	100	100		100	Dalla Dockyard
30	U Zay Yar Win	1st Grade	34	100	100		100	Dalla Dockyard
31	U Aye San	In-charge	50	100	100		100	Ahlone Dockyard
32	U Hla Win Naing	Assist. In-charge	23	100	100		100	Ahlone Dockyard

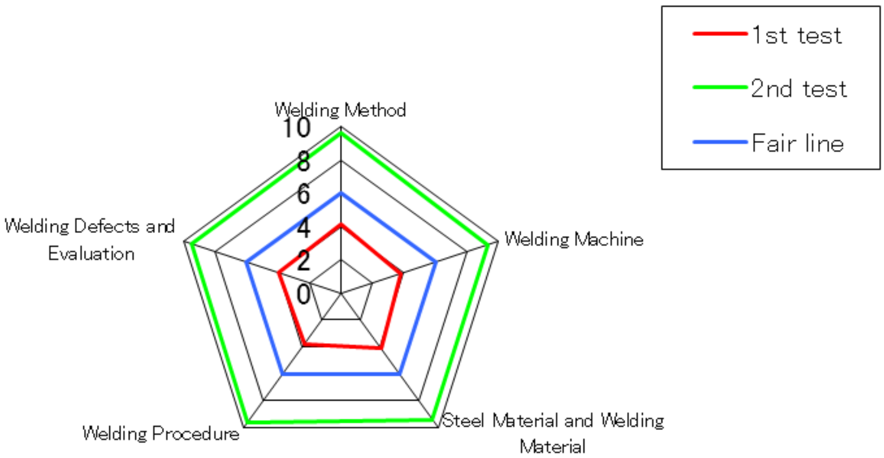
Source: JICA Project Team

Table 10.3.10 Comprehensive Test Results of CO_2 Arc Welding and General

Group	Name	Before or After	Score					
			1st Categ.	2nd Categ.	3rd Categ.	4th Categ.	5th Categ.	Total
1st Batch	U Myo Aung Thein	Before	8	8	8	6	6	36
		After	10	10	10	10	10	50
	U Tin Maung Wai	Before	6	4	6	8	2	26
		After	9	9	9	9	9	45
	U Hla Myint	Before	8	6	6	8	10	38
		After	9	9	9	9	10	46
	U Than Lwin	Before	0	2	6	4	6	18
		After	8	8	8	9	8	41
	U Shwe Win	Before	6	8	4	4	4	26
		After	9	8	9	9	8	43
	U Ye Zaw	Before	6	4	6	6	2	24
		After	9	9	9	8	8	43
	U Soe Myint	Before	6	6	6	8	4	24
		After	9	9	9	9	8	44
	U Aye San	Before	2	0	0	0	2	4
		After	8	8	8	8	7	39
	U Thein Aung	Before	6	6	6	8	4	30
		After	9	9	8	9	9	44
	U Shwe Tun	Before	6	4	10	6	10	36
		After	9	8	10	9	10	46
	U Zaw Min Oo	Before	6	4	6	10	4	30
		After	9	9	9	10	9	46
2nd Batch	U Naing Win	Before	4	8	4	0	6	22
		After	10	10	10	10	10	50
	U Aung Ye Kyaw	Before	4	4	4	0	2	14
		After	10	10	10	10	10	50
	U Ohn Thein	Before	0	2	0	0	2	4
		After	10	6	8	10	10	44
	U Tin Myo Lwin	Before	4	0	4	2	6	18
		After	10	10	10	10	10	50
	U Kyaw Shwe Oo	Before	4	4	4	6	6	24
		After	10	10	10	10	10	50
	U Win Tun	Before	6	4	0	0	0	10
		After	10	10	10	10	10	50
	U Win Ko Tun	Before	4	4	0	4	6	18
		After	10	8	10	10	10	48
	U Aye Thein	Before	2	4	2	2	2	12
		After	10	8	8	10	10	46
	U Hla Win	Before	6	2	4	6	6	24
		After	10	10	10	10	8	48
	U Zayar Lwin	Before	2	2	0	0	0	4
		After	10	10	10	8	10	48
	U Hla Win Naing	Before	4	0	6	6	4	20
		After	10	10	10	10	10	50
	U Kyi Soe	Before	4	4	4	2	4	18
		After	10	10	10	10	10	50

Group	Name	Before or After	Score					
			1st Categ.	2nd Categ.	3rd Categ.	4th Categ.	5th Categ.	Total
3rd Batch	U Myo Win Thein	Before	2	4	4	6	4	20
		After	10	10	10	10	10	50
	U Tint Lwin	Before	6	2	4	6	2	20
		After	10	10	10	10	10	50
	U Kyaw Thu Win	Before	4	6	6	2	6	24
		After	10	10	10	10	10	50
	U Win Zaw Tun	Before	4	2	6	6	0	18
		After	10	10	10	10	10	50
	U Htain Lin Maung	Before	4	2	4	2	6	18
		After	10	10	10	10	10	50
	U Zay Yar Win	Before	6	4	0	2	0	12
		After	10	10	10	10	10	50
	U Naing Win Tun	Before	4	6	6	0	6	22
		After	10	10	10	10	10	50
	U Zaw Ni Win	Before	2	2	4	4	2	14
		After	10	10	10	10	10	50
	U Than Soe	Before	2	4	4	0	4	14
		After	10	10	8	10	10	48
Total (Average)		**Before**	**4.1**	**3.8**	**4.1**	**3.8**	**4.0**	**19.8**
		After	**9.6**	**9.3**	**9.4**	**9.6**	**9.5**	**47.4**

Source: JICA Project Team



Source: JICA Project Team

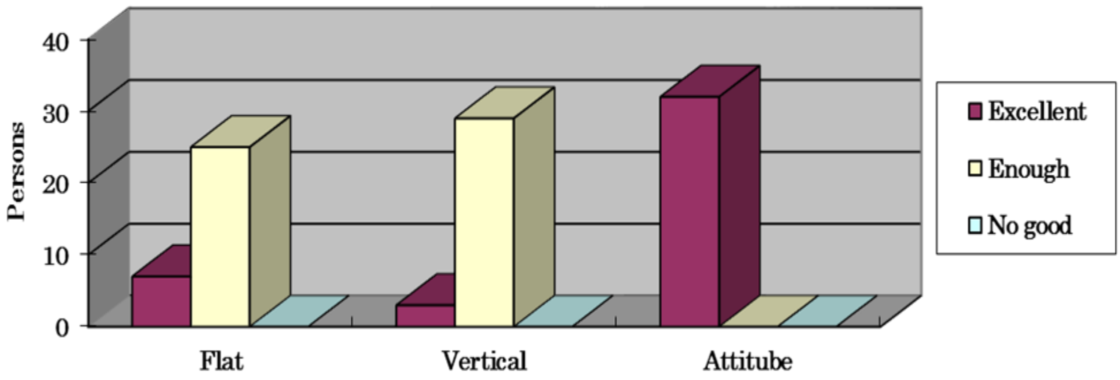
(2) Practical Training Results of Module 5B "Practical Training of CO_2 Arc Welding"

- Trainees learned from wearing the safety goods, handling of welding machine to practical welding of flat position butt welding, vertical butt welding, horizontal butt welding, and overhead fillet welding.
- For the final test, flat position butt welding and vertical butt welding were executed.
- Examination was evaluated by three levels, namely: "Excellent", "Enough", and "Not Good".
- Four persons for flat position and three persons for vertical butt welding were evaluated as "Excellent". They were appreciated as they could get good results in a very short period.

Table 10.3.11 Practical Training Results of CO_2 Arc Welding

Group	Name	Dockyard	Position	Evaluation		
				Flat Position	Vertical Position	Attitude
1 B	U Myo Aung Thein	Dalla	Assist. Engineer	Enough	Enough	Excellent
	U Tin Maung Wai	Dalla	Assist. Engineer	Enough	Enough	Excellent
	U Ohn Thein	Dalla	In-charge	Enough	Enough	Excellent
	U Win Ko Tun	Dalla	1st Grade	Excellent	Excellent	Excellent
2 B	U Ye Zaw	Ahlone	Assist. Engineer	Enough	Enough	Excellent
	U Thein Aung	Ahlone	Assist. In-charge	Enough	Enough	Excellent
	U Shwe Tun	Ahlone	Assist. In-charge	Excellent	Excellent	Excellent
	U Zaw Min Oo	Ahlone	2nd Grade	Enough	Enough	Excellent
3 B	U Naing Win	Dalla	Assist. Engineer	Enough	Enough	Excellent
	U Shwe Win	Dalla	In-charge	Enough	Enough	Excellent
	U Soe Myint	Dalla	In-charge	Enough	Enough	Excellent
	U Aye Thein	Dalla	2nd Grade	Enough	Enough	Excellent
4 B	U Kyaw Shwe Oo	Ahlone	Assist. Engineer	Enough	Enough	Excellent
	U Kyi Soe	Ahlone	Assist. In-charge	Enough	Enough	Excellent
	U Hla Win	Ahlone	Assist. In-charge	Enough	Enough	Excellent
	U Zayar Lwin	Ahlone	Assist. In-charge	Excellent	Enough	Excellent
5 B	U Myo Win Thein	Dalla	Assist. Engineer	Enough	Enough	Excellent
	U Tin Myo Lwin	Ahlone	Assist. Engineer	Enough	Enough	Excellent
	U Nain Win Tun	Dalla	1st Grade	Enough	Enough	Excellent
	U Zar Ni Win	Dalla	1st Grade	Excellent	Enough	Excellent
6 B	U Win Zaw Tun	Ahlone	Assist. Engineer	Enough	Enough	Excellent
	U Htain LinMaung	Dalla	Assist. Engineer	Excellent	Enough	Excellent
	U Aye San	Ahlone	In-charge	Enough	Enough	Excellent
	U Hla Win Naing	Ahlone	Assist. In-charge	Enough	Enough	Excellent
7 B	U Hla Myint	Dalla	Assist. Engineer	Enough	Enough	Excellent
	U Than Lwin	Dalla	In-charge	Enough	Enough	Excellent
	U Win Tun	Dalla	In-charge	Excellent	Excellent	Excellent
	U Than Soe	Dalla	Chargen	Enough	Enough	Excellent
8 B	U Kyaw Thu Win	Ahlone	Assist. Engineer	Enough	Enough	Excellent
	U Aung Ye Kyaw	Dalla	Assist. Engineer	Enough	Enough	Excellent
	U Tint Lwin	Dalla	In-charge	Enough	Enough	Excellent
	U Zay Yar Win	Dalla	1st Grade	Excellent	Enough	Excellent

Note: Practical training results will be evaluated by three levels as “Excellent”, “Enough” and “Not Good” for about three items, namely: “Flat position butt welding”, “Vertical butt welding”, and “Training attitude”.



	Flat Position Butt Welding	Vertical Position Butt Welding	Attitude
Not Good	0	0	0
Enough	25	29	0
Excellent	7	3	32

Figure 10.3.5 Practical Training Results of CO_2 Arc Welding

(3) Training Results of Module 6A and Module B Testing and Inspection

The attendance ratio of trainees was 100%. It indicates the trainees' seriousness and their great concern to master technology.

Before and after the lecture, some examinations regarding basic knowledge were executed in order to confirm the knowledge acquisition.

- Category 1: Knowledge regarding "nondestructive testing (NDT) generally" like visual checking and other NDT methods
- Category 2: Knowledge regarding "radiographic testing (RT)"
- Category 3: Knowledge regarding "ultrasonic testing (UT)"
- Category 4: Knowledge regarding "penetrant testing (PT)"
- Category 5: Knowledge regarding "magnetic particle testing"

The 1st examination score of about 40% showed that the management officials/engineers and group leaders/ skilled technicians had no substantial knowledge about non-destructive testing because almost all participants had never seen the equipment.

However, the results of the 2nd examination, wherein the score became nearly 100%, showed that their knowledge improved considerably.

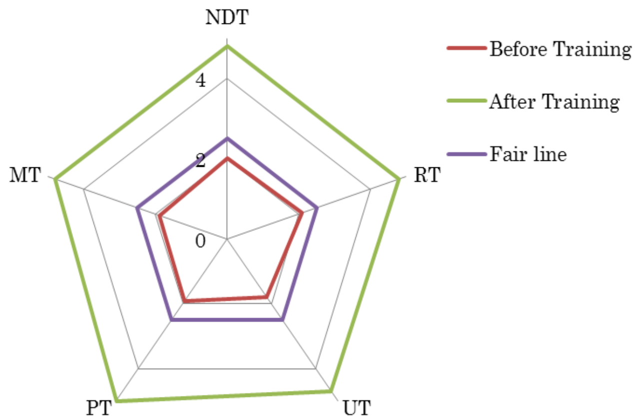
As the questionnaires used in these examinations are just regarding basic knowledge, the trainees have still many things to learn.

Taking this training opportunity, the trainees are expected to study more until they are challenged to get an international or Japanese NDT qualification in the near future.

Table 10.3.12 Comprehensive Test Results of Testing and Inspection (6A)

Group 1st and 2nd Batch (Engineer)								
Before Training								
No.	**Name**	**NDT (5/5)**	**RT (5/5)**	**UT (5/5)**	**PT (5/5)**	**MT (5/5)**	**Total (25/25)**	**Mark (100/100)**
1	MYO AUNG THEIN	2	4	2	2	4	14	56
2	TIN MAUNG WAI	2	3	1	1	1	8	32
3	TIN MYO LWIN	2	0	1	3	2	8	32
4	OHN THEIN	2	2	1	1	2	8	32
5	YE ZAW	3	1	1	1	0	6	24
6	AUNGYE KYAW	1	1	2	1	2	7	28
7	WIN ZAW TUN	2	2	2	2	4	12	48
8	HTAIN LIN MAUNG	3	3	0	3	0	9	36
9	NAING WIN	4	2	3	4	2	15	60
10	MYO WIN THEIN	2	4	3	1	0	10	40
11	THAN LWIN	2	1	0	2	2	7	28
12	SHWE WIN	2	2	2	1	1	8	32
13	KYAW THU WIN	2	0	3	2	3	10	40
14	KYAW SHWE OO	1	3	3	2	3	12	48
15	HLA MYINT	0	4	2	2	2	10	40
16	TINT LWIN	2	2	3	3	2	12	48
	AVERAGE	**2.0**	**2.1**	**1.8**	**1.9**	**1.9**	**9.8**	**39.0**
After Training								
1	MYO AUNG THEIN	5	5	5	5	5	25	100
2	TIN MAUNG WAI	5	5	5	5	5	25	100
3	TIN MYO LWIN	5	5	5	5	5	25	100
4	OHN THEIN	5	5	5	5	5	25	100
5	YE ZAW	-	-	-	-	-	-	-
6	AUNGYE KYAW	5	5	5	5	5	25	100
7	WIN ZAW TUN	5	5	5	5	5	25	100
8	HTAIN LIN MAUNG	5	5	5	5	5	25	100
9	NAING WIN	5	5	5	5	5	25	100
10	MYO WIN THEIN	5	5	5	5	5	25	100
11	THAN LWIN	4	3	4	5	5	21	84
12	SHWE WIN	5	5	5	5	4	24	96
13	KYAW THU WIN	5	5	5	5	5	25	100
14	KYAW SHWE OO	4	5	4	5	5	23	92
15	HLA MYINT	4	4	2	5	4	19	76
16	TINT LWIN	5	5	5	5	4	24	96
	AVERAGE	**4.8**	**4.8**	**4.7**	**5.0**	**4.8**	**22.6**	**90.3**

Source: JICA Project Team



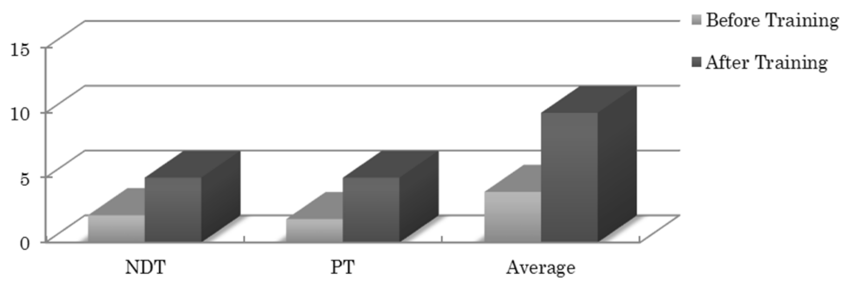
Source: JICA Project Team

Figure 10.3.6 Practical Training Results for Testing and Inspection of Module 6A

Table 10.3.13 Comprehensive Test Results of Testing and Inspection (6B)

Group 3rd, 4th, and 5th Batch (Worker)					
Before Training					
No.	**Name**	**NDT (5/5)**	**PT (5/5)**	**Total (10/10)**	**Mark (100/100)**
1	WIN KO TUN	1	0	1	10
2	SOE MYINT	1	2	3	30
3	AYE THEIN	1	1	2	20
4	THEIN AUNG	3	3	6	60
5	SHWE TUN	2	4	6	60
6	ZAW MIN OO	2	0	2	60
7	NAING WIN TUN	1	1	2	20
8	ZAR NI WIN	2	2	4	40
9	HLA WIN NAING	4	2	6	60
10	HLA WIN	4	2	6	60
11	ZAY YAR LWIN	3	2	5	50
12	WIN TUN	2	2	4	40
13	THAN SOE	0	1	1	10
14	ZAY YAR WIN	5	2	7	70
15	AYE SAN	0	0	0	0
16	KYI SOE	3	3	6	60
AVERAGE		**2.1**	**1.8**	**3.8**	**40.6**
After Training					
1	WIN KO TUN	5	5	25	100
2	SOE MYINT	5	5	25	100
3	AYE THEIN	5	5	25	100
4	THEIN AUNG	5	5	25	100
5	SHWE TUN	5	5	25	100
6	ZAW MIN OO	5	5	25	100
7	NAING WIN TUN	5	5	25	100
8	ZAR NI WIN	5	5	25	100
9	HLA WIN NAING	5	5	25	100
10	HLA WIN	5	5	25	100
11	ZAY YAR LWIN	5	5	25	100
12	WIN TUN	5	5	25	100
13	THAN SOE	5	5	25	100
14	ZAY YAR WIN	5	5	25	100
15	AYE SAN	5	5	25	100
16	KYI SOE	5	5	25	100
AVERAGE		**5.0**	**5.0**	**25.0**	**100.0**

Source: JICA Project Team



Source: JICA Project Team

Figure 10.3.7 Practical Training Results for Testing and Inspection of Module 6B

Table 10.3.14 Practical Training Results of Penetrant Testing

No.	Name	Evaluation		
		TP No.1	TP No.2	Attitude
Group 1 (Engineer) 6A 1st Batch				DATE: 13/11/2012
1	Myo Aung Thein	Enough	Enough	Excellent
2	Tin Maung Wai	Enough	Enough	Excellent
3	Tin Myo Lwin	Enough	Enough	Excellent
4	Ohn Thein	Enough	Enough	Excellent
5	Ye Zaw	-----	-----	-----
6	Aung Ye Kyaw	Enough	Enough	Excellent
7	Win Zaw Tun	Excellent	Excellent	Excellent
8	Htain Lin Maung	Excellent	Excellent	Excellent
Group 2 (Engineer) 6A 2nd Batch				DATE: 20/11/2012
1	Naing Win	Excellent	Excellent	Excellent
2	Myo Win Thein	Enough	Enough	Excellent
3	Than Lwin	Enough	Enough	Excellent
4	Shwe Win	Enough	Enough	Excellent
5	Kyaw Thu Win	Enough	Enough	Excellent
6	Kyaw Shwe Oo	Enough	Enough	Excellent
7	Hla Myint	Enough	Enough	Excellent
8	Tint Lwin	Enough	Enough	Excellent
Group 3 (Worker) 6B 1st Batch				DATE: 22/11/2012
1	Win Ko Tun	Enough	Enough	Excellent
2	Soe Myint	Enough	Enough	Excellent
3	Aye Thein	Enough	Enough	Excellent
4	Thein Aung	Excellent	Excellent	Excellent
5	Zaw Min Oo	Enough	Enough	Excellent
Group 3 (Worker) 6B 2nd Batch				DATE: 26/11/2012
1	Naing Win Tun	Enough	Enough	Excellent
2	Zar Ni Win	Excellent	Excellent	Excellent
3	Hla Win Naing	Enough	Enough	Excellent
4	Shwe Tun	Enough	Enough	Excellent
5	Hla Win	Enough	Enough	Excellent
6	Zay Yar Lwin	Enough	Enough	Excellent
Group 3 (Worker) 6B 3rd Batch				DATE: 29/11/2012
1	Win Tun	Enough	Enough	Excellent
2	Than Soe	Enough	Enough	Excellent
3	Zay Yar Win	Excellent	Excellent	Excellent
4	Aye San	Enough	Enough	Excellent
5	Kyi Soe	Excellent	Excellent	Excellent

Source: JICA Project Team

(4) Proposal

All trainees have seriously received training through Steps 1, 2, and 3, and they have strong intention to master the technology. But until now, they were having difficulties to get the chance to see the current technology and there are so many items which need to be studied.

The following will be proposed in view of "safety", "quality", and "efficiency":

First point is the dispatch of trainees to Japan for the following purposes:

a. Managing officers will visit the Japanese shipyards and the surrounding companies and see the current technology and working systems.
b. Engineers and management officials will visit the Japanese shipyards and the surrounding companies to learn the shipbuilding process, design systems, production systems, production standards, and shipbuilding rules and standards.

Second point is the evolution of training by the following theme:

a. Submerged arc welding and other popular welding methods in shipbuilding;
b. Radiographic testing and ultrasonic testing;
c. Painting; and
d. Ship construction method.

Third point is the renovation of facilities.

a. Planning of improvement of material transportation system in shipyard;
b. Renovation of shops such as repairing and maintenance of overhead cranes and machines; and
c. Improvement of working procedure and introduction of current working tools such as air tools.

10.4 CAPACITY DEVELOPMENT FOR REPAIRING SHIPS AND METAL STRUCTURES (STEP 4)

10.4.1 TRAINING SCHEME

(1) Purpose of the Training

Among the pilot projects, the construction of pontoon in Dalla Shipyard was decided on 31 March 2013 by the steering committee as part of the technical transfer.

IWT's pontoons and sponsons are brought on shore every two years for maintenance. The works such as replacement of steel plate of pontoon are conducted during this maintenance, and IWT must spend huge expenses every year for the maintenance works. Therefore, it was decided to introduce the common technology of Japan to IWT in this project for the purpose of reducing the annual maintenance costs. Furthermore, this will enable the previous trainings of [Capacity Development for Repairing Ships and Metal Structure] to be put into practice. The technologies included in this training can be applied to shipbuilding.

(2) Brief of Training

In Step 4, construction management methods such as construction plan, schedule preparation, and staff assignment were introduced as an extension of previous training. Besides, some important technologies for IWT were introduced in this phase.

There are three important issues for IWT due to lack of experiences before.

The first issue is knowledge of mold loft which is an interface of design and construction site. Production standards such as shape of weld joint, shape of crossover of weld line and small slot for air tight/water tight (full penetration welding) are necessary for controlling quality. It is very important to assure safety and quality to be acceptable by international standards. For this purpose, detailed technical standards should be set and then information should be put in mold loft for each stage of foldout marking, cutting, assembling, welding, and general assembly. However, to come up with these kinds of technical standards of production, it requires appropriate time and huge works. Therefore, these parts were conducted in Japan and then put into NC data and drawing list.

The second issue is the preparation of construction plan. First, construction principle will be decided based on the condition of work space and capacity of facilities. Then, the place to build-up pontoon and the launching method will be decided. Afterward, the working method of the next implementation step will be decided. In this training, the capacities of the existing truck cranes were 20 t and 25 t and so the largest weight of one block was set at 20 t. However, during initial time, the cranes were broken and so it was decided to repair them before use. During the fabrication stage, NC cutting machine would be basically used. However, it had to be changed to list marking when the machine is broken. It was decided to use shot blasting and primer paint for steel plate and shape steel. A small temporary blast workshop was built at an empty land within the dockyard for blasting work.

Working instruction is made based on the abovementioned basic principle. In this working instruction, overall procedures until completion, block division, built-up order of block, and joint geometry will be described. The articles which needed to be improved with care will be described in the instruction and these will be reflected in the mold loft. In this pontoon construction, there were some ingenious attempts. For example, in the built-up stage, bench and jig are made ingeniously to prevent the welding strain during built-up work of web and face. In the built-up work, efficiency improvement was done by applying panel method in which lounge was attached to steel plate preliminarily. To improve workability for joining panels, reversal of blocks, and combination of blocks, bench was set on building slip. Safety, quality control, and efficiency matters were devised in the production procedure and this information is put in the mold loft. However, this is the first experience for IWT and so at that time, this production procedure was prepared in Japan and compiled as a textbook. Moreover, to be able for the managers, engineers, foremen, and workers of IWT to understand the models of block, panel, and frame works were made using cardboards. Then, the method of block fabrication and method of block reversal by crane were explained by using these models.

The third issue is schedule preparation. The main schedule, which included the design period, delivery date of main machines and materials, and construction period, was prepared after contract date and the terms of works were decided. Then, the master schedule which can cover the overall works was made after the main schedule was decided. The schedules of each stage and each block were described. Then, the schedule of each stage and plan of staff assignment were made based on this master schedule. However, the scheduling of works cannot be made without understanding the overall works and so this document was also prepared in Japan.

On-the-job training of construction method, schedule management, and quality control was carried out based on the abovementioned production procedure and master schedule.

Table 10.4.1 Contents of Instruction

No.	Instruction Theme		Detail	Remark
	Article	Contents		
1	Construction principle	Apply block method	Workplace and bench	Area of workplace at each stage, form of bench
			Check up the facility	Power of crane
		Schedule	Manpower and ability	
2	Production procedure	Block division	Power of crane, size of materials	6 blocks for one pontoon
		Built-up procedure	From making panel to built-up block describe in working instruction	Applying mass production method
		Loading procedure	Loading procedure of block	Define no. 4 as origin block
		Accuracy standard	Measurement method of shrink	Put into NC data
3	Schedule preparation	Master schedule	Overall schedule and loading schedule	Schedule of milestone and quantity of work
		Schedule at each stage	Cutting, built-up (small & large), rigging schedule	Leveling of construction work and planning of manpower assignment
4	Working schedule (hull)	Manufacture	NC marking/ cutting	Making NC data
			Manual cutting	List drawing
		Built-up block	Built-up trans frame	Strain countermeasure
			Making panel	Instruction of work streamlined method
			Combination of blocks	Built-up the block with deck in bottom condition; reverse after welding
		Loading	Loading procedure	Reverse and loading by using 2 cranes
			Air tightness test	Check complete condition of welding by soapy water
			Quality check	Apply JSQS
			Installation of anode	30 years durability
5	Working schedule (rigging, painting)	Rigging	Making concrete steel mold for fender and fence	Safety measure
		Painting	Shot blasting and painting primer	Check-up workplace and facility
			Painting block	Finishing of interior surface by block
			Clear coat	

Source: JICA Project Team

(3) General Description of Introduced Technology

In this project, new technologies for IWT were introduced for accuracy enhancement, construction speed, and reducing interval of maintenance work.

Introduced Technology	Present Condition of IWT	Content of Implementation	Advantage/ Effect
Blasting	Conduct painting without blasting	Exert pressure upon steel surface to get fine roughened surface	Adhesion improvement of paint = Improvement of durability
Block method	Built-up from bottom to top at the same place	Construct small, medium and large block and then build into a structure	Increase indoor work = Workability is good without being affected by weather condition Improve construction speed =workability is improved because parallel work can be done =because of increase of indoor work and increase of downward direction welding
Air tightness test	Only visual check	Check air leak by sending air pressure into pontoon	Work accuracy is improved =can check air leak
Electrolytic protection	None	Installed anode	Decrease erosion and corrosion of steel plate by installation of anode with durability of 30 years
Marine paint	Land paint	Marine paint	Jetty site is at the brackish water area and therefore land paint is not suitable.
Concrete coat	Ordinary paint only	Coated by 15 cm thickness	High turbidity and high current speed cause large negative impact. Coating by concrete will reduce negative impact drastically.
Bond with sponson	Bond with sponson and chain	Fully-bonded pontoon with sponson	Repeated tension and shock cause damage to bond part of the structures. The damages will be reduced by applying fully-bond structure.
Detailed work plan schedule	Only draft work plan	Conduct by daily work schedule	Clear work schedule Confirmation of working efficiency

(4) Details of Introduced Technology

1) Block Division and Naming

Block division was decided based on the power of crane, capacity of workshop, size of steel plate, structure of pontoon (position of transverse bulkhead), safety, and efficiency. At this time, the weight of block was set at 20 t based upon the power of crane. Then, length of one block was set as 6 m and one pontoon was divided into six blocks because the length of steel plate was 6 m.

The pontoon is composed of several parts and so it is very important to name these parts. It is very important to give the name with regularity to understand the installation direction using the name of the parts. The regularity of naming was considered to be applicable also to shipbuilding. Upstream side of pontoon and downstream side of pontoon (except joint parts) are symmetrical and so the upstream side of pontoon was named as port side and downstream side of pontoon was named as starboard side. One pontoon is divided into six blocks and the blocks of upstream side pontoon were named Nos. 1 to 6 from the downstream to the upstream direction. As for sponson, it was named as SPUP for the port side and SPUS for the starboard side.

Next, the upper surface of pontoon was named as UD (Upper Deck), S (Side Shell) for the side surface and BS (Bottom Shell) for the bottom surface. Then, the description of F (For) and A (Aft) for length direction, I (In) and O (Out) for width direction, U (Upper) and L (Low) for vertical direction was decided. Next, it was decided to call L (Longitudinal) for longitudinal direction and T (Transverse) for transverse direction.

2) Production Procedure

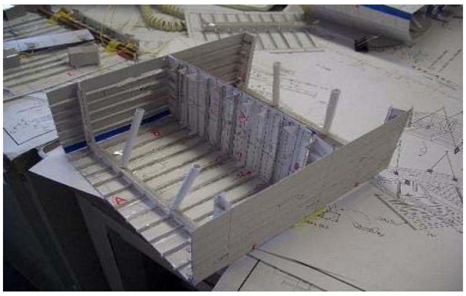
The production procedure describes the work procedure and method, and this is a very important article for safety, quality, and efficiency. In this procedure, examples were made with easy description of built-up method of block such as construction method to prevent strain during built-up work of web/ face with transverse member, and built-up procedure of parts and reverse methods.

3) Mold Loft

Mold loft was prepared based on block division and work instruction. In this drawing, detailed drawing of joint part of frame member was described. Since drawings will differ with the shape of joint, several kinds of working standards are necessary. In case of shipbuilding, lots of standards for mold loft are necessary. Although it is necessary to instruct mold loft to IWT, preparation of the NC data and list drawing for the pontoon was made in Japan. Cutting data was prepared according to nesting.

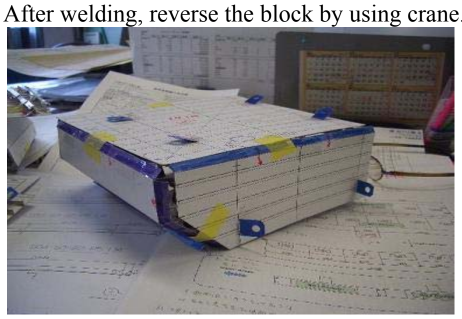
4) Explanation of Block Method Using Model

The following are explanations of the block method carried out by the JICA expert using the models:



Model of block of pontoon main body.
Set the deck to bottom condition and fitted transverse bulkhead and outer panel.
After welding, reverse the block by using crane.

Model of each block.
Sponson at front side.
Built-up with inversion condition and deck is at the bottom.



Completion of sponson.
Suspending ring is attached for loading and reverse.

Explanation of block method and drawing by the JICA expert.

Explanation of reverse method of block by the JICA expert.

Simulation of block reverse work by the IWT engineer.

Source: JICA Project Team

Photo 10.4.1 Explanation of Block Method by Model

5) Painting Procedure

The JICA expert prepared the procedure of painting and then instructed it to IWT (reference in the attachment). Selection of paint and pretreatment are very important for painting works. At this time, shot blasting and primer painting were done in the dockyard. For efficiency and quality control, block painting was applied. To prevent corrosion during construction work, touch-up operation of primer was done at the welded part. For awareness of the importance of pretreatment and influence of corrosion prevention with different paint, test pieces were prepared and the tests were carried out by test pieces. Comparison items in the tests are described below. Test pieces were soused into river water from the pier of the dockyard.

a. Influence of the existence of surface treatment.
b. Influence of the existence of primer.
c. Influence of the existence of the second coating.
d. Influence of the difference of paint materials.
e. Comparison of rust generation in brackish-water region (water surface and under 1 m water depth).
f. With a mill scale.

Source: JICA Project Team

Photo 10.4.2 Test Piece

6) Air Tightness Test Procedure of Pontoon

In order to confirm the air tightness inside the floating structure like pontoon, air leak should be confirmed by pressurizing the inside of the floating structure.

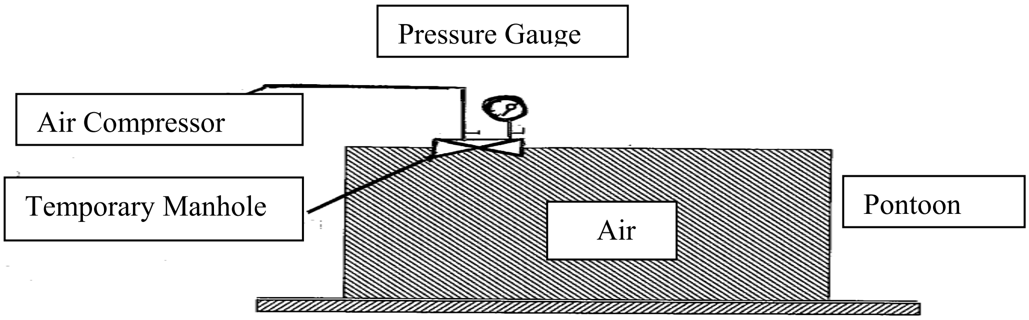
The confirmation method is as follows:

1st: Check the operation condition of the pressure gauge. Inject air into pontoon and pressurize gradually.

2nd: Air pressure will be pressurized until 4.0 kPa (= 4.0/98.0665 kgf/cm^2). This condition will be kept up to 30 minutes and the change of pressure will be checked visually.

3rd: Decrease in pressure shows the possibility of air leak. The situation will be confirmed by injection of the “soapsuds” to the welding bead and the attachment of manhole. The soapsuds are made by mixing water with liquid detergent or melted soap with water.

4th: If the pressure does not change during the 30 minutes, it can be deemed that there is no air leak problem.



Source: JICA Project Team

Figure 10.4.1 Basic Concept of Air Pressurizing

Scene of Air Pressurizing Test

Pressure Gauge

Source: JICA Project Team

Photo 10.4.3 Implementation of Air Tightness Test

7) Implementation

Pontoon construction was implemented based on the abovementioned procedure (Items 2 to 6). The JICA expert and manager, engineer, and foreman of IWT understood each of their works and the pontoons were constructed smoothly. The procedure of implementation can be explained as below.

Two truck cranes were repaired and now can reverse until 20 t block. Workability improved dramatically compared with the previous method.

Workability improved after introduction of forklift. Steel plate was carried by 10 or 20 people until now. Heavy load such as steel plate can be moved easily now and so workability was improved.

Source: JICA Project Team

Photo 10.4.4 Heavy Machine

Marking/ cutting is done by NC machine based on NC data. Change to manual marking and manual cutting when machine is failed (data is prepared by the JICA expert)

Straight cut for small part, old share machine was used.

Source: JICA Project Team

Photo 10.4.5 Fabrication Stage

Built-up frame member was used in transverse of frame. Special device was necessary because welding distortion could occur easily. The works were implemented on bench.

Point to keep time schedule is how to build panel of steel plate and assemble them effectively and smoothly. Schedule of panel fabrication was prepared in particular to maintain effort and to follow time schedule.

Source: JICA Project Team

Photo 10.4.6 Small Size Built-up Stage

Bottom Construction. Lounge frame was built according to production procedure.

Welding works at bottom construction.

Side shell and trans-bulkhead are fitted to upper deck. Block was in inverted condition at this stage.

Temporary fitting of side shell to upper deck.

Trans-bulkhead and side shell of both sides were loaded to upper deck.

To keep accuracy, built-up block and bench are important. Built-up works were done according to the instruction.

Source: JICA Project Team

Photo 10.4.7 Large Size Built-up Stage

Flipping reverse work by using 2 cranes.

Combine the block on bench.
Weld 4 panels of UD(1) + TB(1) + SS(2) and then inverted and loaded to bottom shell construction.

Cross sectional shape after welding of the panels of BC+TB+SS+UD.
The works were done according to construction method and instruction.

Blocks were loaded in order.
One pontoon is composed of 6 blocks and 1 sponson.

Sponson was fitted to pontoon main body.
Although complicated shape, built-up can be done with good accuracy.

After completion of main body, necessary rigging was installed.
This work was also carried out and completed according to production procedure.

Fender strike boards and stud bolts for concrete casting were fitted

Source: JICA Project Team

Photo 10.4.8 Loading Stage


Temporary blasting place was built at a space in dockyard


Blasting work with emitted dust


After painting primer
Completed with good accuracy. Device of IWT was recognized. The photo shows the steel plate being hung-up by IWT idea


Primer painting with brush after blasting
Workshop of blasting and painting is necessary in the future


Touch-up by painting after welding
Effect of corrosion protection is large.


Clear coat inside of the pontoon.
Repair of welding part by painting primer

Source: JICA Project Team

Photo 10.4.9 Painting Works

(5) Safety Instruction during Pontoon Construction

Safety instruction was carried out during the pontoon construction as shown in Table 10.4.2.

Table 10.4.2 Contents of Safety Instruction During Pontoon Construction

Instruction Matter	Remark
Do not touch the block. Fit the rope when block is moved.	Instruct and implement at building slip
Prevention measure for collapse. Fit the tripping to the block which can easily fall down.	Instruct and implement at building slip
Do not enter under the hanging block. Evacuate at 45 degree direction. Evacuate with the distance equal to the height of block.	Instruct at building slip
To use glove when working at each workshop.	Supply cotton glove (8 dozens), leather glove (1 dozen)
To use mask and glass at grinder work.	Supply 50 masks
To use safety belt when working at high places (over 2 m).	Stretch a rope on deck. Supply 12 safety belts. Instruct and implement at building slip
To switch off during break time.	Instruct and implement at building slip
To use ear piece in noisy work.	Supply 25 ear pieces.
Move up and down the ladder using 3 touches (means grip firmly and do not hold anything in hand).	Instruct at building slip
To be careful not to fall in manhole, construction borehole	Implement at building slip
Do cleaning at each construction stage	Instruct and implement at building slip
Make curing at bare electrical cable	Implement at building slip. Supply insulating tape
To use rope when lifting and dropping materials and instruments from high place. Do not throw.	Instruct and implement at building slip
Do not put the materials and instruments at dangerous high place.	Instruct and implement at building slip
To pave steel plate for preventing settlement when the lag is put on ground.	Instruct and implement in rigging
To use fan at confined area	Implement some part at building slip
To use safety belt on scaffold works	Implement some part at building slip
To use grounding wire at machine	Instruct and implement at building slip
To use specified suspending ring	Suspending ring was made during pontoon construction. Hand over the list of adopted types of jig.
Not to clamp up cut remaining materials	Instructed in fabrication works but IWT did not work according to instruction.

Source: JICA Project Team

(6) Work Responsibility Among JICA Project Team, IWT and Contractor

	Scope of Work
JICA Project Team	● Soil investigation, design of related facility such as steel jetty ● Design (basic design, detailed design) ● Drawing up of plans and working instruction ● Making of marking and cutting diagram of steel plate ● Order of materials such as steel plate and consumable goods ● Dispatch of technical instruction expert ● Technical supervision for design ● Instruction of final adjustment of ballast
IWT	● Preparation of fabrication yard ● Acceptance of materials ● Shot blasting and primer coating of steel plate ● Procurement of worker (labor fee for outside workers is prepared by JICA) ● Marking of cut of small parts ● Fabrication and welding of pontoon ● Installation of equipment ● Painting ● Making of steel formwork ● Support of launching
Contractor (JFE)	● Procurement of materials ● Casting of concrete coating ● Casting of ballast concrete ● Launching of pontoon ● Procurement and installation of anchor and chain ● Fixing of steel jetty

10.4.2 PROCUREMENT OF TRAINING MATERIALS AND EQUIPMENT

Major materials and consumable materials which were provided to IWT by JFE (the contractor for the pilot project construction) in this training were described in Table 10.4.3 from the beginning of February. Total procurement cost was about JPY 80 million.

Table 10.4.3 List of Major Materials and Consumable Materials

Category	Item	Details
Material	Mild Steel	Plate, Pipe, Flat bar, Angle, H beam
	Stainless Steel	Plate, Pipe, Flat bar, Angle,
	Marine Paint	Primer
	Anode	30 years durability
Consumable Materials	Welding Rod	For mild steel and stainless steel
	Gas	CO_2, Oxygen, Propane gas

Source: JICA Project Team

10.4.3 TRAINING SCHEDULE

(1) General Schedule

Basic design started in October 2013 and the bidding documents were distributed on 13 December 2013. Then, the detailed design was continuously conducted. After the contract in January 2014, steel plate was ordered sequentially and the deliveries of materials started from 1 February 2014. In February 2014 manufacturing of body parts started, and assembling of small, medium, and large blocks followed. From July 2014, installation of accessories started. From August 2014, JFE started the construction works related to concrete casting concurrently. In September 2014, IWT finished the fabrication work of pontoon and then, its installation work was done in October 2014.

In this technical transfer, eight experts were dispatched. Their main task and the dispatch period are described in the following Table 10.4.4 .

Table 10.4.4 Main Task of Each Expert

Name	Position	Main Task
Kazuhisa Iwami	Team Leader	Overall construction schedule control
Kentaro Kimura	Document and Procurement Expert	Order of materials, reporting work, discussion with counterpart
Yu Imaoka	Shipyard Operation Expert	Schedule control of technical transfer, reporting work
Yoshiaki Mitsumori	Pontoon Designer	Design in home country and technical supervision for design at local site
Susumu Nogami	Metal Structure Expert	Drawing up of working instruction, cutting plan, site supervision of construction
Kazuhisa Matsusaka	Ship Construction Expert	Site supervision of construction
Yasuo Namba	Inspection Expert	Instruction of welding at site and assistance to site supervision of construction
Yu Sanya	Paint Specialist	Instruction of painting at site

Source: JICA Project Team

(2) Building Schedule

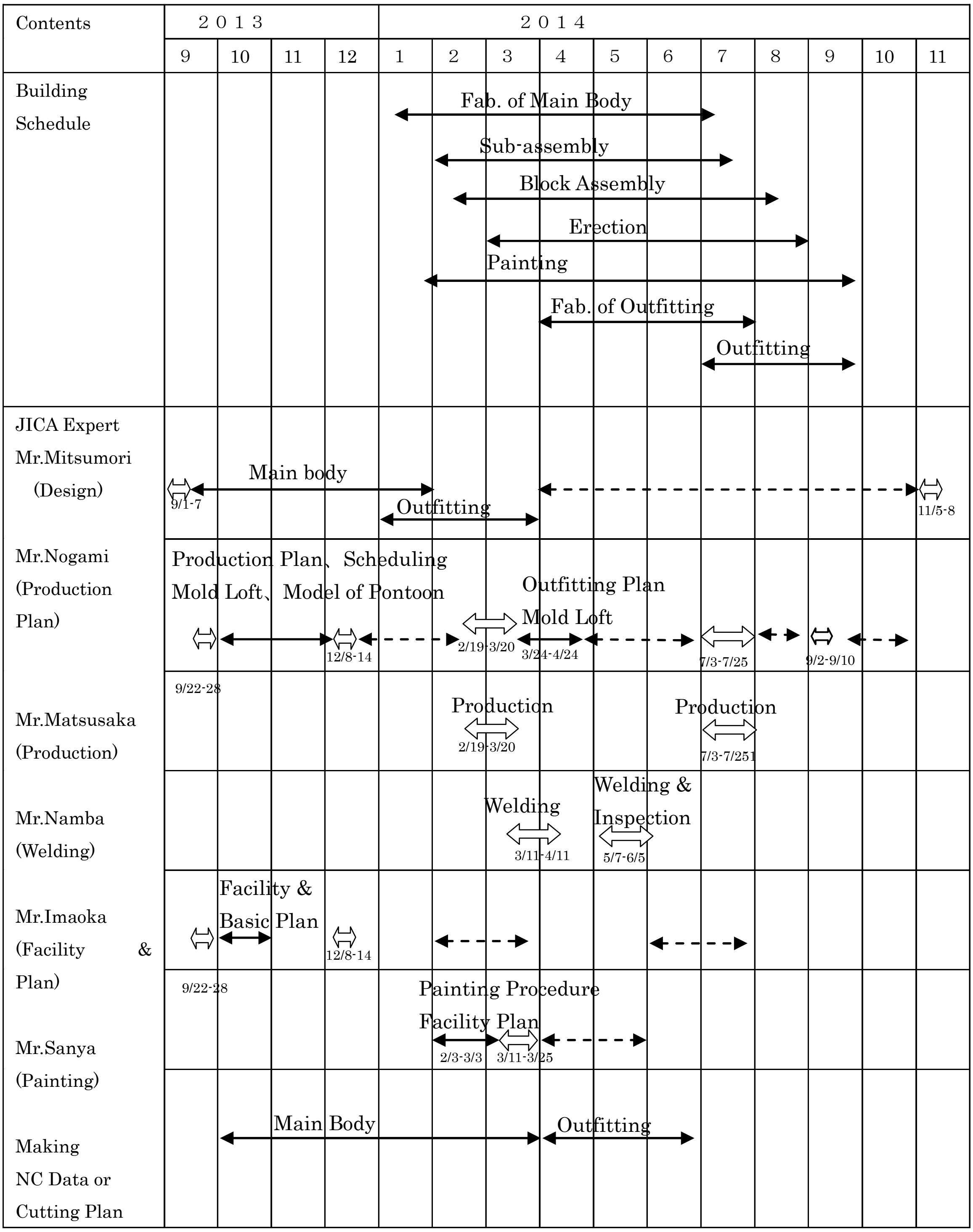
The most suitable method of pontoon construction was studied by the JICA expert and then the production procedure including working procedure was made. Technical documents were not available at IWT and therefore, the JICA expert prepared the mold loft, NC data, and also the list drawing in case the NC machine is unavailable.

Block method had been implemented in the fabrication of cradle in the last two years. However, the size was big and the structure was also different in this pontoon construction. To make IWT side understand the structure of the pontoon, models for the composition of frame, structure of block, built-up method of block, and reverse method of panels by two cranes, were made using cardboards. Moreover, the construction method was explained using the models.

Design works started from September 2013 after the field study. Design works of main body was finished in January 2014. Then, outfitting was finished in March 2014. However, revision and back-up works of production were carried out until completion.

The construction schedule and the responsibility of each JICA expert are described in Table 10.4.5.

Table 10.4.5 Building Schedule and Activity of JICA Project Team



Notes： Instruction in Myanmar by JICA Expert
Work in Japan by JICA Expert
Back-up in Japan

Source: JICA Project Team

10.4.4 EVALUATION OF CAPACITY DEVELOPMENT TRAINING

Construction of pontoon in IWT has an important meaning because block method is a new construction method for IWT and then it becomes a practice following the previous trainings. This is a great effort for IWT to build this scale of pontoon with international standard within a short time using very limited facilities. For minimum essential facilities, existing faulty machines were repaired. The basic plan of pontoon construction was explained to IWT officer. Some facilities and consumable items which could not be prepared by IWT were arranged by the JICA Project Team.

In IWT, all staffs follow the instruction of executive officers such as general manager, deputy general manager, and manager. Engineers and workers work hard and IWT can be recognized as a good organization. However, this is the first time for IWT and so progress was delayed sometimes. Therefore, the JICA experts were dispatched at an appropriate time to instruct them during on-the-job-training. Even though the experts were not in Myanmar, they supported IWT from Japan.

(1) Achievement

This pontoon construction had very beneficial effect not only for technical ability (skill of workers, increase of capacity of facility, skill on production technology) but also management capacity. Capacity development through this training can be described as follows:

- Principle of block method was explained by using a model which was prepared as a part of training. The level of understanding of relevant IWT officers about the method of reverse block by using two cranes also increased.
- As for the capacity of facility, the repair of two faulty cranes and introduction of forklift led to huge benefits for increasing the efficiency.
- In Step 1, the block method was already explained. During this time, members at IWT site became aware of the advantages of the block method because of their practical works through this training. However, some issues related to crane such as insufficient hanging load and number of machine and weakness of crane at operation place should be solved to apply this block method in IWT. Therefore, enhancement of machines and facilities is necessary for efficiency and high quality in IWT.
- IWT has not conducted air tightness test until now and so inspection related to air leakage cannot be done. It causes poor verification for quality control. In this technical transfer, air leak test was introduced and so the awareness of IWT related to quality management (the importance of checking of air leakage and part of welding) was improved.
- The different levels of skills between workers who gained technical instruction and those who did not gain were recognized. The achievement of welding training was applied at the site.
- In this training, the method of pontoon construction and procedure of block fabrication were learned through production procedure. There was no common awareness of work progress until now and it was dependent on the speculation and experience of the engineer. However, in this training, specific skills (efficiency), awareness of deadline, efficient use of yard, clarification of delay work, and awareness of critical path became clear through the detailed work schedule and these lead to the common awareness of work progress by all engineers.
- As for quality management, IWT has not enough knowledge of quality standard and not enough understanding of the troubleshooting method. However, IWT passively followed the error correction method, and increasing the skill on the error correction technique was recognized.
- Officers of IWT planned the organization and staff assignment under the instruction of the JICA expert. Topdown command was established.
- Safety awareness was improved through technical instruction of safety management. Before this instruction, very few people used safety equipment. However, the use of safety equipment and checking of electrical leak were improved through this technical transfer.

- In this training, the head, deputy head, and managers of Dalla Dockyard took leadership and pontoon construction works were carried out under their strong responsibilities. Under their leadership, the IWT staffs carried out the construction works smoothly according to the production procedure. Furthermore, all of the IWT engineers, foremen, and technicians were earnest and hardworking, and their growth and development will be promising in the future.

(2) Challenges for the Future

IWT gained a big achievement through this pontoon construction. However, some challenges also remained and these are described below together with their countermeasures. Besides, the techniques cannot be mastered during a short time and so skills enhancement and capacity development of facility are still necessary in the future.

1) Skills Improvement for the Mold Loft Technique

Improving the skills on techniques for detailed design such as drawings and standards of welding joint part, treatment method of intersection of welding joint, form of joint part of steel plate and shape steel, making bending template of steel plate, and drawing of reverse curve of steel plate is necessary to satisfy international standards of ship classification.

2) Skills Improvement for Production Technology of Fabrication and Construction Method

Enhancement of skills on construction method and making the production procedure is also necessary. For this purpose, preparation of master schedule and detailed understanding of construction are necessary

3) Improvement of Knowledge of Quality Standards and Introduction of Minimum Testing Equipment

Practical training of penetrant test was conducted in the last two years. At this time, air tightness test was carried out. To build a class ship in the future, x-ray permeation testing and ultrasonic inspection would be necessary as a minimum level. Thereafter, recovery method when trouble occurs and understanding of JSQS are necessary to control quality.

4) Strengthening of Facility

As verified during the pontoon construction, lifting equipment is very important for workability. The repair of 20 t truck crane and inspection and repair of OHC of workshop are necessary. Moreover, strengthening of facility whenever necessary and improvement of production capacity are important. Besides, introduction of pneumatic tools and hydraulic machines whenever required are also important.

CHAPTER 11

STUDY ON DISASTER RISK MANGEMENT

CHAPTER 11 STUDY ON DISASTER RISK MANGEMENT

11.1 BACKGROUND AND OBJECTIVE OF THE STUDY

Cyclone Nargis struck Myanmar in 2008 and inflicted catastrophic damage. Thereafter, it has been raised to attention the realization of disaster risk management in Myanmar.

Japan has been investing in the field of disaster prevention for many years. After a series of disasters caused by earthquakes and typhoons in the late 1940s to the 1950s, the Japanese government carried out a series of institutional reforms and increased investment on disaster prevention.

From 1959 then, the death toll or missing people after a disaster significantly decreased.

In 1995, the Hanshin Awaji Earthquake caused enormous damage. More than 6,000 people were killed or went missing due to collapsed houses. After this disaster the Japanese government reviewed, and strengthened the seismic criteria to build earthquake-resistant structures.

In 2011, the Tohoku earthquake and tsunami resulted in about 20,000 people killed or missing. Though the collapsed houses caused by the earthquake were minimal, the tsunami exceeded the expected height in the stricken areas, and the stricken areas were severely damaged.

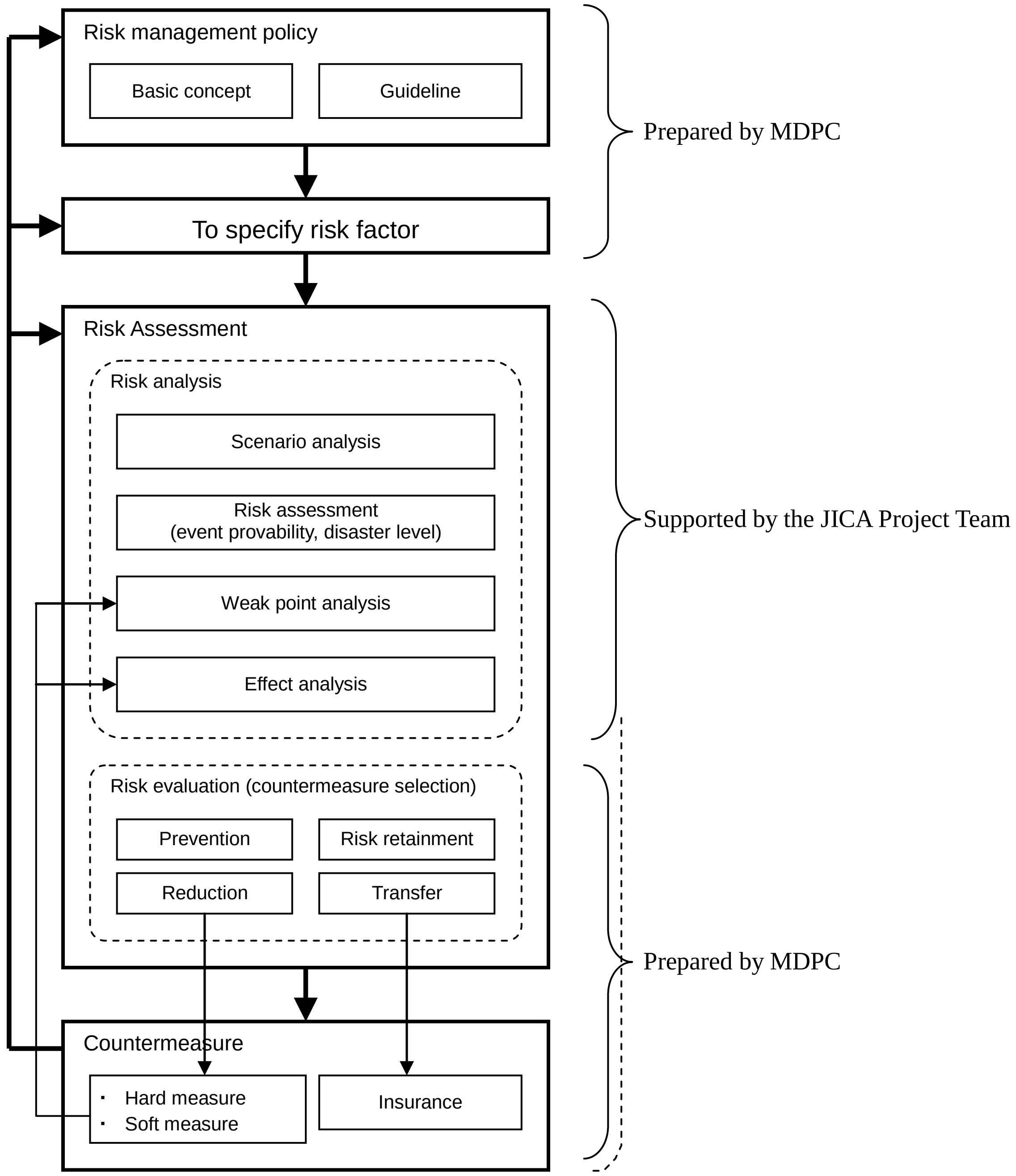
Based on this experience, the importance of preparedness against an unexpected scale of disaster has been re-recognized.

The Central Disaster Prevention Council was held in Myanmar, and each ministry prepared the disaster risk management system after Cyclone Nargis.

The Ministry of Transportation formed the Maritime Disaster Prevention Committee (MDPC) chaired by MPA, and the Maritime Disaster Prevention Programme was prepared. IWT also prepared the Maritime Disaster Prevention Programme for Inland Waterway. The Maritime Disaster Prevention Implementation Plan and the Maritime Disaster Prevention Handbook were prepared, and evacuation drills are being done twice a year.

The abovementioned programme and plan covered risk management policies, specification of risk factors, risk evaluation, and countermeasures of the risk management system, as shown in Figure 11.1.1. The tasks of the JICA Project Team were to assist with risk assessment, and to define countermeasures for enhancement of the risk management system.

The risk evaluation and countermeasure had been included in the maritime disaster prevention programme, although some parts of them have been studied by JICA Project Team.



Source: JICA Project Team

Figure 11.1.1 Tasks of the JICA Project Team for Preparation of the Risk Management System

This chapter describes the general idea of risk management in Section 11.2, the disaster prevention programme and plan in Myanmar in Section 11.3, risk assessment and countermeasures against cyclones and tsunamis in Yangon Port and the delta area in Sections 11.4 to 11.8, and the recommendations and suggestions in Section 11.9. The components of risk assessment are shown in Table 11.1.1.

Table 11.1.1 Components of Risk Assessment

<table>
<tr><th>Study Area</th><th>Type of Hazard</th><th>Content</th><th>Section in the Report</th></tr>
<tr><td rowspan="6">Yangon Port</td><td rowspan="3">Cyclone and storm surge</td><td>Analysis of hazard magnitude and probability (cyclone and storm surge)</td><td>11.4</td></tr>
<tr><td>Analysis of damage on building, human, ship</td><td>11.5</td></tr>
<tr><td>Study of countermeasures (evacuation anchorage, evacuation of ship)</td><td>11.6</td></tr>
<tr><td rowspan="3">Tsunami</td><td>Analysis of hazard magnitude</td><td rowspan="3">11.7</td></tr>
<tr><td>Analysis of damage to building, human</td></tr>
<tr><td>Study of countermeasures (hazard map)</td></tr>
<tr><td rowspan="2">Delta area</td><td>Cyclone and storm surge</td><td>Analysis of hazard magnitude and probability (cyclone and storm surge)</td><td rowspan="2">11.8</td></tr>
<tr><td>Tsunami</td><td>Analysis of hazard magnitude and probability</td></tr>
</table>

Source: JICA Project Team

11.2 DISASTER RISK AND CRISIS MANAGEMENT

11.2.1 PROCESS OF PREPARING DISASTER PREVENTION PROGRAM/GUIDELINE

The disaster prevention program/guideline, including the hard and soft components, is prepared through the following process:

(1) Data Collection of Disaster Records and Forecast

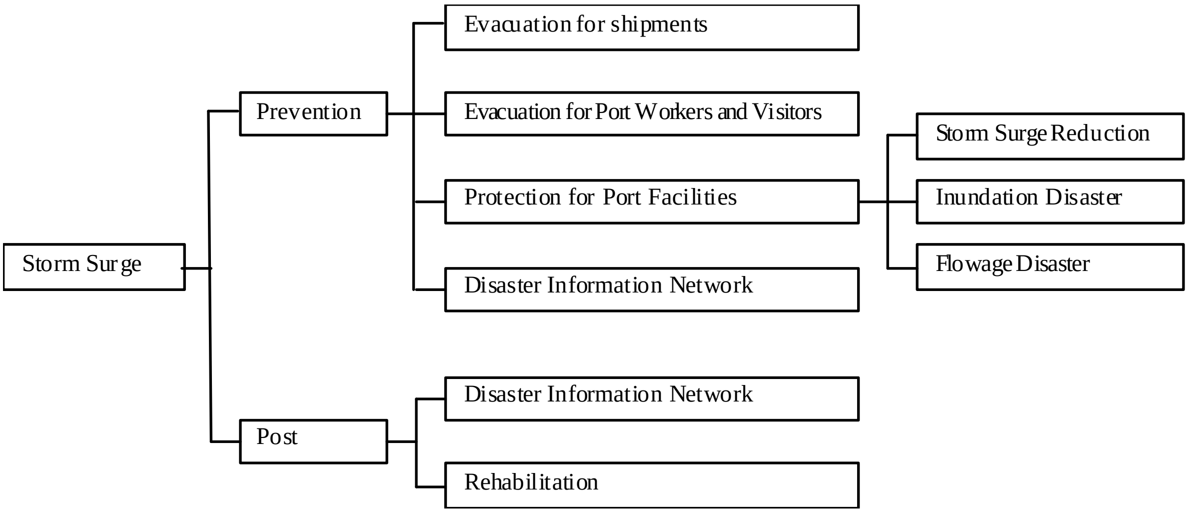
With collected data on disaster conditions due to cyclones, the causes of damage to port facilities are analyzed. From the results of the analysis of damage caused by each factor of storm surge carried out in the course of preparing the hazard map, the relation between the scale of damage and countermeasures are identified. The procedure for disaster prediction and hazard map preparation is as follows:

1) Meteorological prediction
2) Wave prediction
3) Storm surge prediction
4) Inundation assumption
5) Estimation of damages
6) Hazard map preparation

(2) Selection of Hard and Soft Measures

While analyzing the scale of damage, the necessary hard components (e.g., restoration and reinforcement of port facilities) and soft components (e.g., information and communication system, command and control procedures, and emergency recovery methods) are considered.

The measures against storm surge, which are aimed at preventing or reducing the effects of future disasters, will be based on the following structure.



Source: JICA Project Team

Figure 11.2.1 Structure of Disaster Prevention Plan and Program

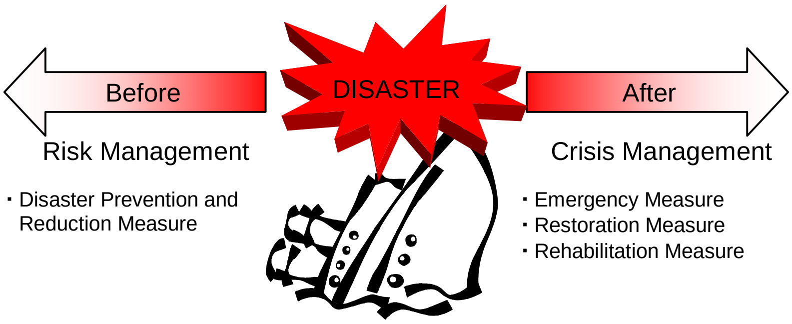
The disaster prevention program/guideline is prepared in consideration of the following matters as potential items:

1) Existing conditions related to disaster,
2) Prediction of disaster scale and its effect,
3) Information and communication system for disaster,
4) Disaster prevention measures and strengthening of port facilities,
5) Evacuation and rescue plans,
6) Urgent checklist of port facilities after a disaster,
7) Designation of alternative facilities to secure port operations after occurrence of a disaster,
8) Urgent restoration plan for damaged areas,
9) Full-scale disaster recovery plan,
10) Ensuring stock availability of materials and equipment required for urgent restoration works,
11) Education and training on disaster prevention, and
12) Participation of volunteers and citizens on restoration works.

11.2.2 DISASTER RISK AND CRISIS MANAGEMENT

(1) Risk and Crisis Management

A disaster prevention plan and program comprises risk management before a disaster occurs, and crisis management after disaster. Risk management involves disaster prevention and reduction measures, while crisis management involves emergency, restoration, and rehabilitation measures.



Source: JICA Project Team

Figure 11.2.2 Risk Management and Crisis Management

1) Risk Management

A risk management system is as follows:

(a) Risk management policy

Basic concept of risk management, purpose, and guideline are formulated.

(b) Specification of risk factor

The risk factor such as natural disaster and accident is specified.

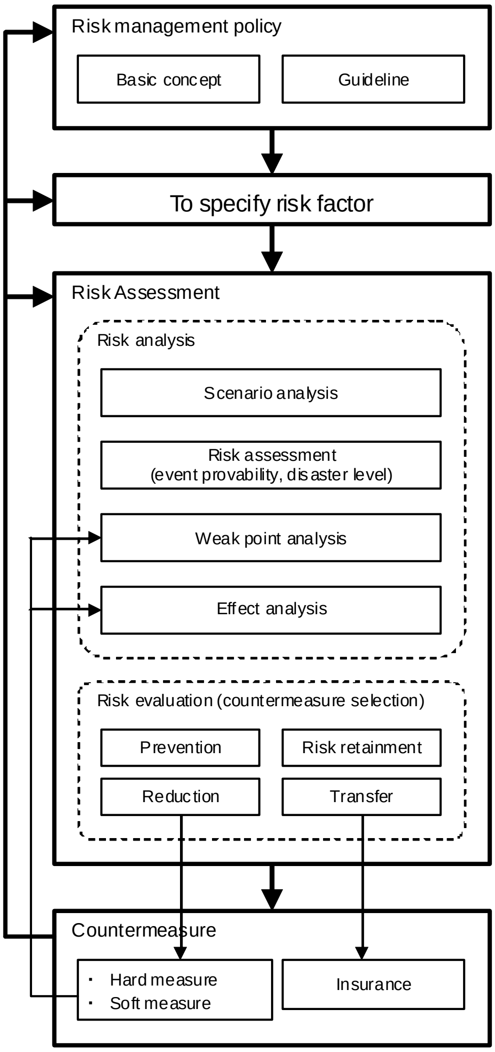
(c) Risk assessment

The disaster scenario is analyzed, and the risk is assessed by simulation or prior occurrence. Measures are selected in consideration of event probability, disaster level, cost, among others. The measures are finalized by weak point and effects analysis.

Countermeasure concepts consist of disaster prevention, risk retention, reduction, and transfer. Countermeasure as disaster risk retention is selected in case of an unavoidable disaster occurs. The risk can be transferred by taking out insurance.

(d) Countermeasure

Countermeasures comprise hard and soft measures. It is necessary that comprehensive perspective for the most suitable countermeasure has to be selected considering economic and safety evaluation.

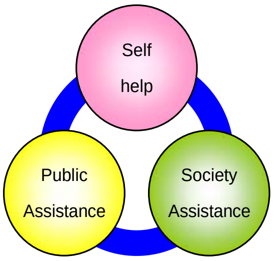


Source: JICA Project Team

Figure 11.2.3 Risk Management System

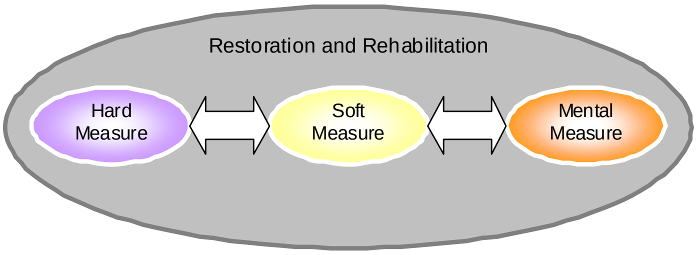
2) Crisis Management

The share of "self-help" is high, but "society assistance" is also prospective in the recovery stage. It is necessary for hard measures such as reconstruction of important structures, and soft measures such as mental care by "public assistance", as soon as possible in the restoration and rehabilitation stage.



Source: JICA Project Team

Figure 11.2.4 Self-Help, Society Assistance, and Public Assistance



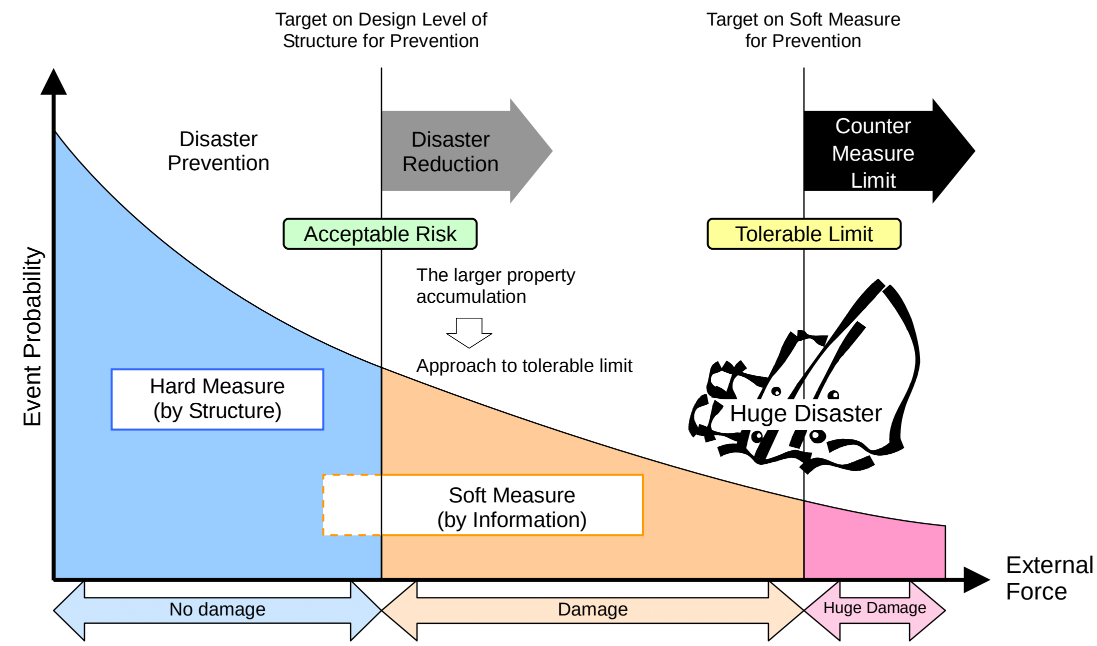
Source: JICA Project Team

Figure 11.2.5 Linkage of Measures in the Restoration and Rehabilitation Stage

(2) Disaster Prevention and Reduction

Disaster prevention approach was considered as a major component of countermeasures previously, but disaster reduction approach is highlighted as another component recently. Disaster prevention measures consist of construction and improvement of hard structures, while disaster reduction involves mainly soft measures. Hard measures necessitates a big amount of cost and long time, and huge damage occurs in case the design level limits of a structure are surpassed. On the other hand, disaster reduction by soft measures such as hazard mapping and drills necessitate a small amount of cost as compared with hard measures'.

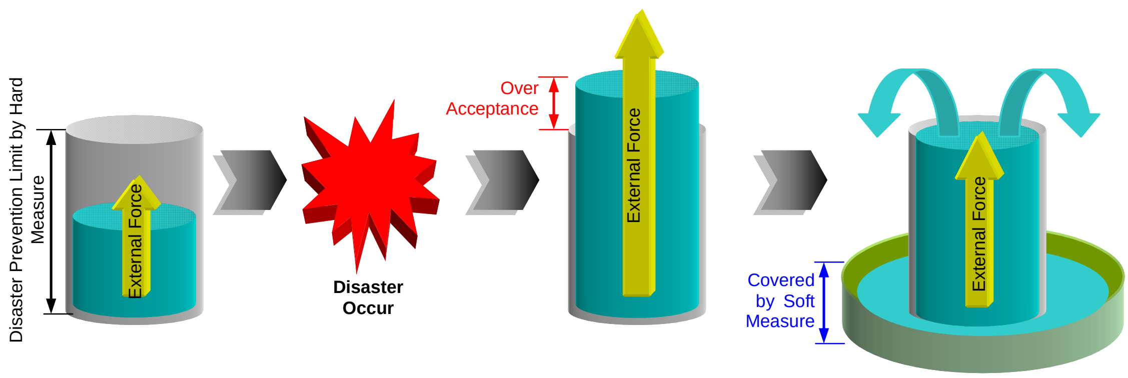
Disaster prevention up to the protection target on design level of structures is covered by hard measures basically. In the case of overprotection, protection of properties by hard structures are problematic in view of economic efficiency, therefore soft measures are important. Soft measures are beneficial before a structure is completed or in case a structure's protection is not functioning. But hard measures are indispensable to maintain reliable safety, and it is necessary to have sustainable construction and maintenance of structures. The target of design level of a structure is changed depending on its damage risks and importance. Damage risks are high in areas where there are accumulated properties and high density of population.



Source: JICA Project Team

Figure 11.2.6 Disaster Prevention and Reduction by Hard and Soft Measures

Linkage of hard and soft measures is necessary for disaster reduction. It is important to upgrade the protection level by hard measure, such as appropriate and effective structure construction and rehabilitation, and disaster reduction by soft measure, such as preparation of hazard map, damage estimation by simulation, and evacuation drills.

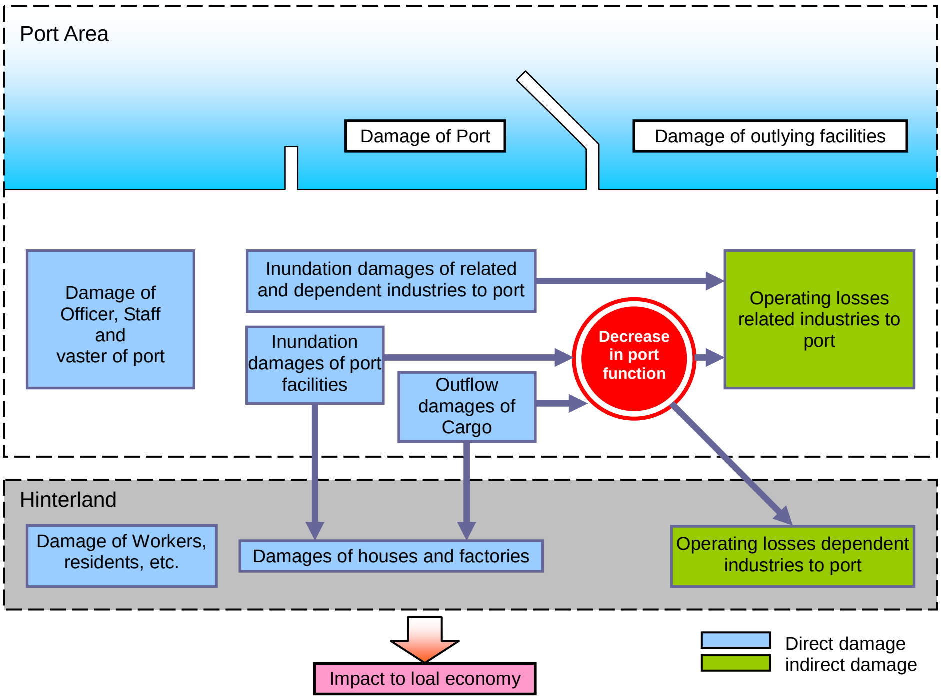


Source: JICA Project Team

Figure 11.2.7 Image of Linkage of Hard and Soft Measures

(3) Disaster and Countermeasures at the Port Area

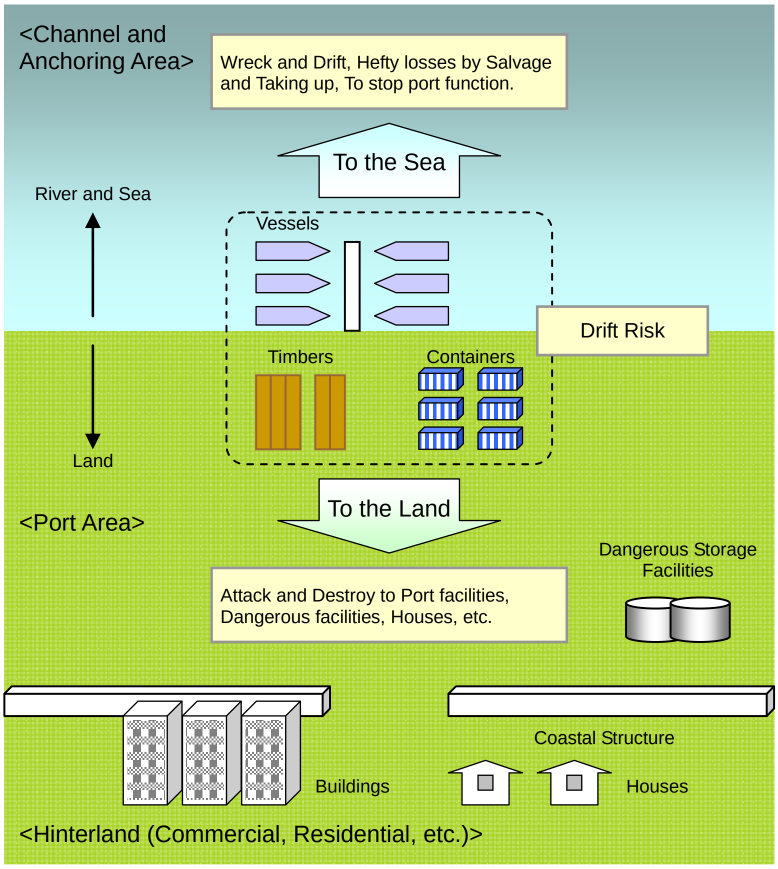
Transportation systems such as ports and roads are blocked by inundation in the short term, and blocking of traffic and navigation occurs due to scattering and floating wreckage over the medium term. The damage and decrease in function of the transportation system would impact transportation of injured people, aid delivery, and other recovery works at the time of emergency. They impact restoration and rehabilitation in the medium term too. It is important to prevent or decrease the time of paralysis of the transportation system in order to develop a highly-resilient system.



Source: JICA Project Team

Figure 11.2.8 Image of Disaster Impact by Storm Surge at the Port Area

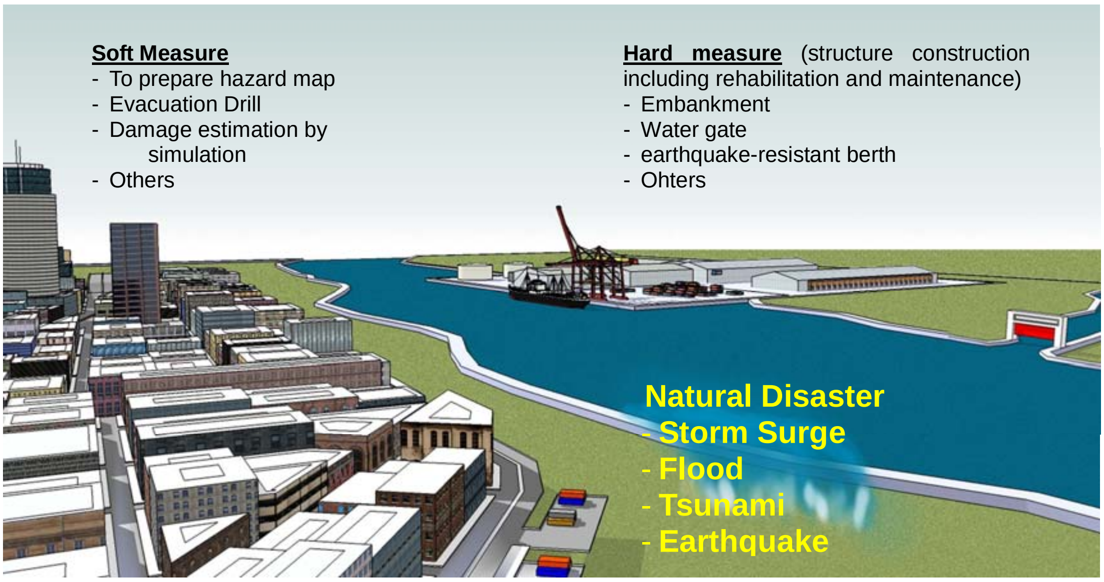
As previously mentioned, port disaster does not only include inundation damage, but also damage by floating wreckages such as containers, timber, ships. Containers, timber, ships have a high possibility of floating at the port area. In case the land area is inundated and wreckages hit the land, they may cause damage on port facilities, houses and hazardous-materials site, and so on. On the other hand, in case of wreckages floating into the river and sea, they may be adrift and sink in front of a berth, channel, or anchorage. They may cause not only a huge cost for their recovery, but also stop port operation until safety is confirmed and operation is secured.



Source: JICA Project Team

Figure 11.2.9 Damage from Floating Wreckage

Hard measures include protection by structures such as embankment, breakwater, earthquake-resistant berth, and water gate. They include maintenance and rehabilitation. Soft measures include evacuation drills, hazard map preparation, damage estimation by simulation, and improvement of organization.

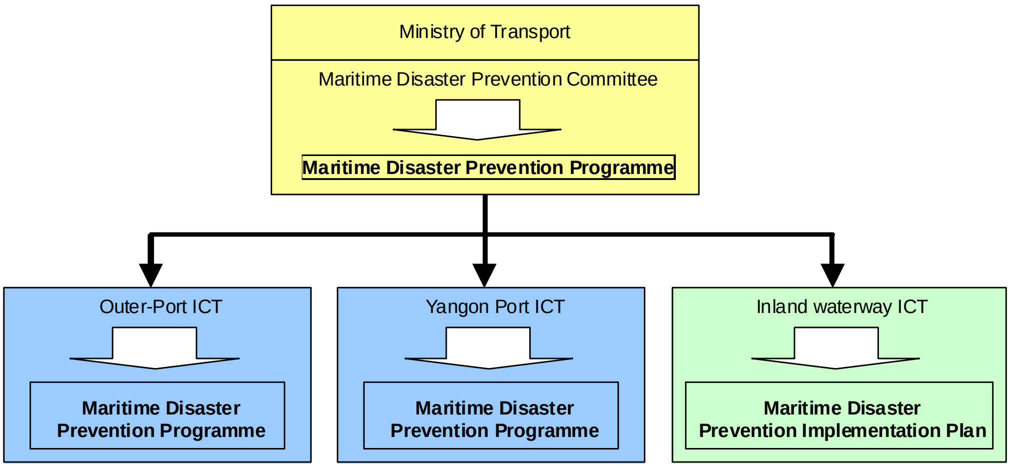


Source: JICA Project Team

Figure 11.2.10 Disaster Prevention Measures in Waterfront

11.3 MARITIME DISASTER PREVENTION PROGRAMME AND PLAN IN MYANMAR

The Maritime Disaster Prevention Plan has been prepared by the Maritime Disaster Prevention Committee (MDPC), established under MOT, after Cyclone Nargis hit Myanmar. MDPC does not consist of only MPA and IWT but also other maritime organizations (DMC, Navy, etc.). MDPC has three Inspection and Control Teams (ICTs), namely, Yangon Port ICT and Outer-port ICT managed by MPA, and Delta Region ICT managed by IWT. The Yangon Port ICT and Outer-port ICT use the Maritime Disaster Prevention Programme prepared by MDPC. The Delta Region ICT uses the Maritime Disaster Implementation Plan, which was prepared by IWT as a sub-document of MDPC's Maritime Disaster Prevention Programme. The relationship of the organizations, programmes, and plans are illustrated in Figure 11.3.1.



Source: JICA Project Team

Figure 11.3.1 Maritime Disaster Prevention Organization and Programme and Plan in MOT

11.3.1 MARITIME DISASTER PREVENTION PROGRAMME

(1) Responsibilities

U Thein Htay, the Managing Director of Myanma Port Authority, holds the post of the chairman of MDPC and is responsible for making a plan for submission of the Maritime Pertinence of Natural Disaster Prevention Program[1], and for creating the committee of Maritime Pertinence of Natural Disaster Prevention Program under the responsibility of MOT.

(2) Aim

Cyclone Nargis struck the coastal area of Myanmar from 2 to 3 May 2008, and resulted in human loss, injured people, and damage to properties. Affected cities/towns include seven in the delta region, and three in Yangon Division. The cost of damage in the territory of MPA was estimated at MMK 4,463.916 million, caused by sinking and stranded ships, damage to pontoons and buoys, and blocking of channels. Therefore, the Maritime Pertinence of Natural Disaster Prevention Program is to be carried out in the future.

[1] Maritime Disaster Prevention Programme is expressed as Maritime Pertinence of Natural Disaster Prevention Program in the documents of MPA.

(3) Actual Conditions and Setup of Evacuation Anchorage

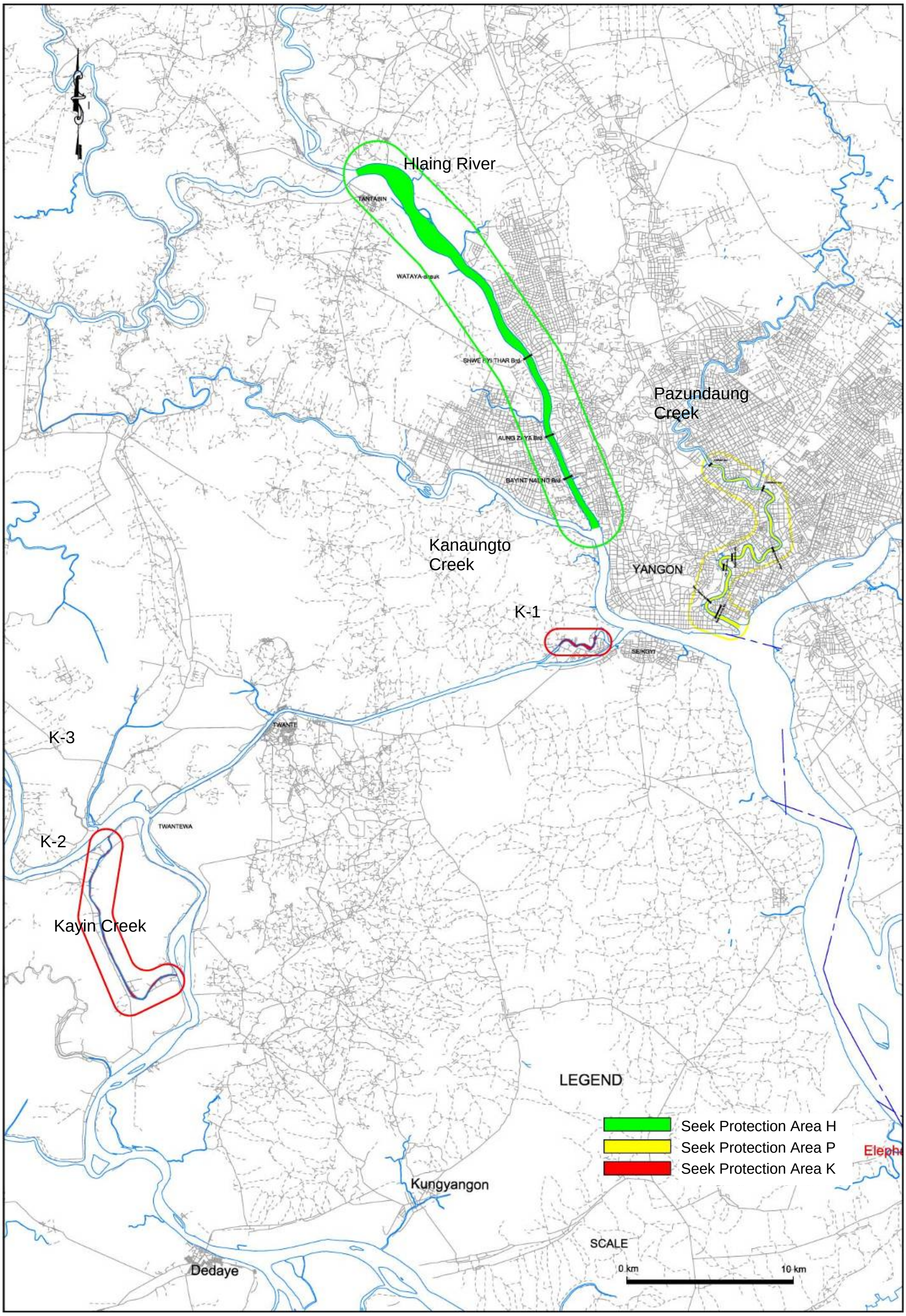
Actual conditions and situation of evacuation anchorages[2] have been studied, as follows:

1) Maritime natural disasters and cyclones in Myanmar
2) Yangon Port's territory and current situation
3) Situation of ships driving from and berthing in Yangon Port
4) Extra jetties' territory and current situation
5) Situation of ships driving from and berthing at extra jetties
6) Current situation of jetties and jetties' territory in the delta region
7) Situation of ships driving from and berthing at jetties in the delta region
8) Issues on weather warnings

The evacuation anchorages for ships have been selected to protect small ships going to the coast and ships going to inland channels, and to prevent blocking of ocean liner channels of Yangon Port and damage to jetty bridges. The evacuation anchorages are listed below and illustrated in Figure 11.3.2.

(H1)-(H-6)	Inside of the Hlaing River Seek Protection Area
(K1)	Inside of the Kanaungto Creek Seek Protection Area
(K2)	Kayin Creek, inside of the Toe River Seek Protection Area
(K3)	Nearby Sarphyusu Village Seek Protection Area
(P1)-(P6)	Inside of the Pazundaung Creek Seek Protection Area

[2] An evacuation anchorage is expressed as Seek Protection Area in the documents of MPA.



Source: JICA Project Team

Figure 11.3.2 Evacuation Anchorage

(4) Maritime Disaster Prevention Programme

The Maritime Disaster Prevention Programme was studied. Five stages were set as disaster risk levels for cyclone, and the actions in each stage were studied.

1) Yellow Stage

This emergency situation will be announced when a tropical storm has developed in the vicinity of the Andaman Sea and Bay of Bengal. Ships must stay alert.

2) Orange Stage

This emergency situation will be announced when the tropical storm is heading toward the coastal area of Myanmar. Ships must have sufficient crew on board and engines on standby.

3) Red Stage

This emergency situation will be announced when the tropical storm is approaching Myanmar’s coast and due arrival at the port is within ten hours. Ships are to be in all respects ready to take action in order to move toward the open sea or to sheltered areas allotted for ships of their class and size as directed by ICTs and Patrol Teams (PTs).

4) Brown Stage

This emergency situation will be announced when the tropical storm passes the port area. Ships are tightly secured at their location and withstand the storm by using their engines and helms as necessary.

5) Green Stage

This emergency situation will be announced when the tropical storm has receded. This is the normal stage, where ships return to their original berths as supervised by ICTs, PTs, and wharf supervisors.

11.3.2 MARITIME DISASTER PREVENTION IMPLEMENTATION PLAN FOR INLAND WATERWAY

(1) Aim and Objectives

With the forceful storms occurring in Bay of Bengal, IWT has to prepare the Disaster Prevention Implementation Plan for IWT crafts and buildings to prevent their destruction, and to educate the staff and passengers safety mind in Ayeyarwady Division, Yangon Division, Mon State, and Rakhine State.

(2) Procedure

IWT will carry out the following:

(a) To specify and nominate the protected territory in case of storm.
(b) To differentiate and specify the ships for each protected territory.
(c) To specify the consumption fuel of ships for administration movement.
(d) To differentiate and specify the ship staff.
(e) To provide the ship’s administrative facilities (such as life jacket, and Manila rope).

(3) Distribute and Specify the Management Facilities for Ships

In preparation for storms in advance, IWT has to arrange life jackets for each staff of the IWT ships, and also to provide life buoys, life rafts, boats equipped with outboard motor (e.g., speedboat), search lights, torchlights, raincoats, waterproof plastic helmets, and other requirements. IWT has to replace the fenders to reduce damage to ships by collision. Besides, steel wire for ships, nylon ropes, and Manila ropes need to be supplied sufficiently. If other navigational facilities are required, the Marine Department has to request to the headquarters.

11.4 ANALYSIS OF CYCLONE AND STORM SURGE IN YANGON PORT

Storm surge simulation was conducted to estimate the damage to Yangon Port, which is one of the basic data for the Maritime Disaster Prevention Program. Several cases of cyclones including Cyclone Nargis were considered for the simulation.

11.4.1 STUDY OF CYCLONES IN MYANMAR

(1) Collection of Meteorology Data

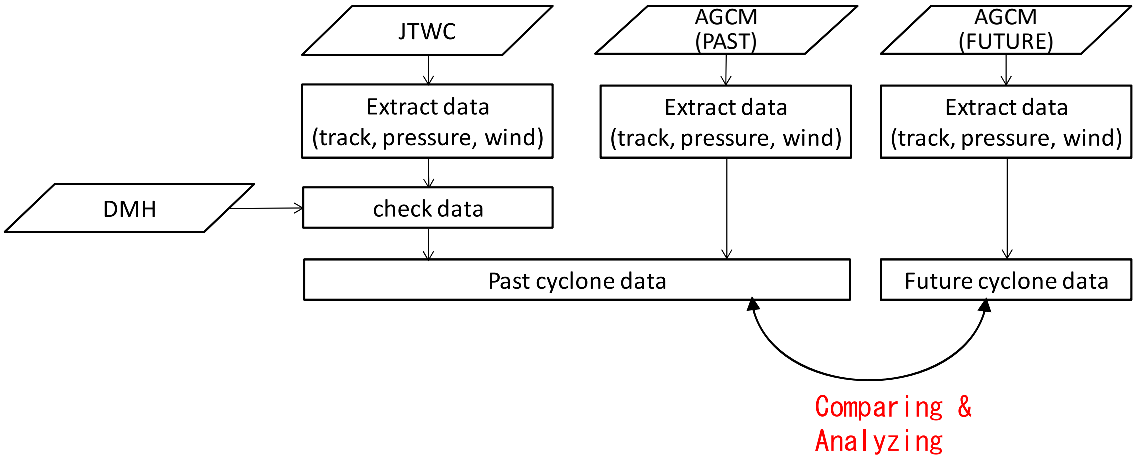
In order to study the characteristics of cyclones in Bengal Bay and the cyclone conditions around Myanmar, meteorological data such observation data, cyclone track data, and analyzed data were collected. Table 11.4.1 shows the contents of the collected meteorological data. Figure 11.4.1 shows a brief flowchart of the procedure for analyzing meteorological data. Past cyclone records were collected from the Joint Typhoon Warning Center (JTWC). Numerical simulation data on the present and future climates were collected from the Meteorological Research Institute of Japan and the Japan Meteorological Agency. The past cyclone data (records and numerical simulation outputs) and the future cyclone data (numerical simulation outputs) were compared and analyzed.

Table 11.4.1 Contents of Collected Meteorological Data

Meteorology Data	Contents	Data Sources
Ground Observation Data	Ground meteorology observation by DMH Rainfall (monthly) Temperature (maximum, minimum, monthly mean) Sea level pressure (monthly mean) Wind velocity(maximum, minimum, monthly mean)	DMH
Cyclone Track Data	Cyclone tracks data (position of center, central pressure, wind velocity) in 1945-2009 (JTWC) (see Figure 11.4.2) in 1991-2008 (RSMC) (see Figure 11.4.2)	JTWC RSMC
Numerical Simulation Data (AGCM)	Numerical simulation data of weather conditions (sea level pressure, wind velocity, and temperature) in the resolution of 20 km mesh in the period of 1979-2003 and 2015-2039	MRI/JMA

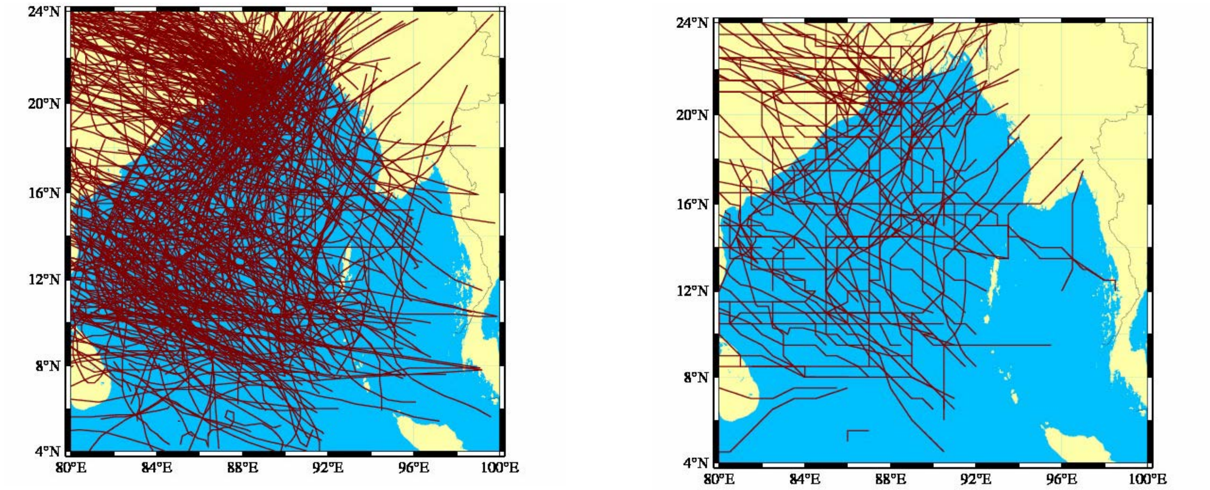
Note:
DMH: Department of Meteorology and Hydrology
JTWC: Joint Typhoon Warning Center
RSMC: Regional Specialized Meteorological Center
NCEP: National Center for Environmental Protection
MRI/JMA: Meteorological Research Institute / Japan Meteorological Agency
AGCM: Atmospheric Global Climate Model

Source: JICA Project Team



Source: JICA Project Team

Figure 11.4.1 Procedure for Meteorological Analysis



JTWC (1945-2009) RSMC (1991-2008)

Source: JTWC and RSMC

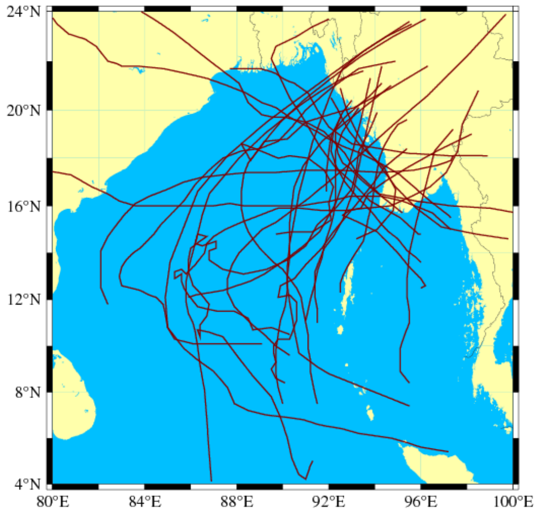
Figure 11.4.2 All Cyclone Tracks

(2) Analysis of Historical Cyclone Record

1) Extraction of Cyclones Landed around Myanmar

The typical cyclones that landed around Myanmar were picked up by using past cyclone tracks. For picking up a cyclone, the cyclones passed in the radius of 500 km in Yangon were picked up by using JTWC track data. Figure 11.4.3 and Table 11.4.2 show the cyclones landed in Myanmar for 65 years. The cyclone track data such as the center position and sea level pressure recorded by JTWC can be provided from 2000 onwards. Before 2000, the available data are only on the position of cyclone tracks by JTWC.

The cyclone track data by RSMC provides sea level pressure and the center position of cyclone. However, the center positions of these track data are not good in accuracy as shown in Figure 11.4.2. Therefore, the data of RSMC was not applied for the extraction of cyclones.



Source: JTWC

Figure 11.4.3 Tracks of Cyclones Landed around Myanmar from 1945 to 2009

Table 11.4.2 List of Cyclones Landed around Myanmar from 1945 to 2009

Year	Date	Remarks
1948	15/5/1948, 5/10/1948	
1962	23/5/1962	
1963	8/9/1963, 4/10/1963	
1964	6/5/1964	
1967	14/5/1967	
1968	6/5/1968	Cyclone Sittwe
1975	4/5/1975	Cyclone Pathein
1976	29/4/1976	
1978	14/5/1978	
1982	30/4/1982	Cyclone Gwa
1983	18/10/1983	
1988	14/11/1988	
1990	13/12/1990	
1992	15/5/1992, 21/9/1992, 14/10/1992	
1994	26/4/1994	Cyclone Maungdaw
1995	12/9/1995, 18/11/1995	
1996	1/5/1996, 1/11/1996	
2002	9/5/2002	
2003	9/5/2003	
2004	14/5/2004	
2006	24/4/2006	Cyclone Mala
2008	25/4/2008	Cyclone Nargis
2009	9/11/2009	

Source: JTWC

2) Characteristics of Cyclone

By using the cyclone track data from both JTWC and RSMC, the sea level pressure, wind velocity, and landing duration of the selected cyclones were extracted, as shown in Table 11.4.3. From this table, it can be observed that Cyclones Mala and Nargis were extreme cyclones. Especially, the duration of stay of Cyclone Nargis in Myanmar was very long. Thus, it can be concluded that Cyclone Nargis is almost the worst cyclone in terms of route, pressure, wind, and landing duration.

Table 11.4.3 Pressure, Wind Velocity, and Landing Time of Typical Cyclones

Year	Minimum Pressure (hPa)	Maximum Wind (m/s)	Landing Duration (hour)	Remarks
1992	994	17.5	6	
1994	940	57.5	5	
1995	978	32.5	3	
1996	1000	15.0	3	
2002	997	17.5	12	
2003	991	22.5	6	
2004	976	32.5	12	
2006	**922**	**60.0**	18	Cyclone Mala
2008	**937**	**57.5**	**36**	Cyclone Nargis

Source: JTWC, RSMC

(3) Analysis of Numerical Simulation Outputs of Cyclones in the Present and Near Future

1) Extraction of Cyclones from AGCM

The AGCM by MRI/JMA provides numerical simulation outputs of present and near future climate considering climate change. The datasets are provided in the format of 20 km mesh point. In order to analyze the characteristics of cyclones, it is necessary to extract data related to cyclones from vast amounts of data by using the devised algorithm, which is described in the next sub-clause.

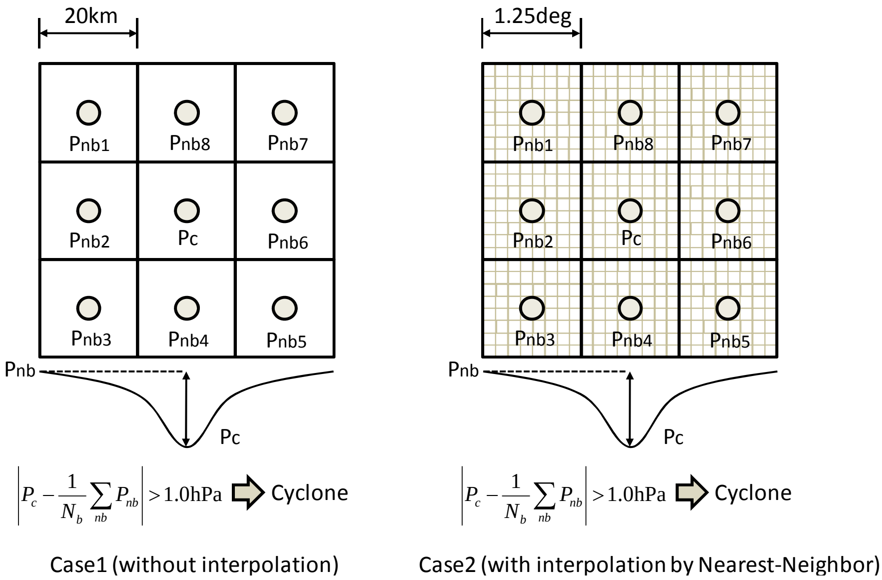
2) Algorithm for Extraction of Cyclones

The procedure for extraction of cyclones is based on the comparison of sea level pressure between the target mesh point and the surrounding mesh points. The difference between the target mesh value and the surrounding mesh value is defined as the gradient, or the rate at which the sea level pressure changes between each mesh point. In order to check the number and the characteristics of cyclones, the two kinds of definitions to pick out cyclones were applied.

Figure 11.4.4 shows the procedure for extracting low pressure areas from the mesh point data. The point "Pc" is the target point for the extraction, and "Pnb" is the point to be compared with "Pc". If "Pc" is 1 hPa smaller than the average of "Pnb", "Pc" is defined as a low pressure area.

The left figure (Case 1) shows the case without interpolation and this procedure can extract wide range of low pressures. Almost all of cyclones can be extracted.

The right figure (Case 2) shows the case with interpolation by the nearest neighbor method. Points "Pc" and "Pnb" are defined as the interpolation values around 8 x 8 points. In this case, a narrow range of low pressures or extreme cyclones can be extracted.



Source: JICA Project Team

Figure 11.4.4 Procedure of Extraction of Cyclones

3) Comparison of Cyclones in the Present and Near Future

Table 11.4.4 shows the results of the total number of picked out cyclones and center pressure. From this table, it can be seen that the number of present cyclones in Case 1 is more than near future cyclones. However, the number of present cyclones in Case 2 is less than near future cyclones. The minimum and mean pressure of the near future cyclone is lower than the present cyclones. From here onwards, the near future cyclones can be predicted to be of more extreme conditions.

Table 11.4.4 Results of Picked Out Cyclones from AGCM

		Number of Cyclones in Bengal Bay	Minimum Center Pressure (hPa)	Mean Center Pressure (hPa)
Present Cyclones (1979-2003)	Case 1 (w/o interpolation)	57	983.1	1002.6
	Case 2 (with interpolation)	8	980.8	991.0
Near Future Cyclones (2015-2039)	Case 1 (w/o interpolation)	46	962.7	1001.2
	Case 2 (with interpolation)	13	945.8	980.9

Source: JICA Project Team

(4) Number of Cyclones in Myanmar

The number of cyclones in Myanmar and Bay of Bengal was counted from the data of JTWC and MRI/JMA as tabulated in Table 11.4.5. The average number of cyclones formed in Bay of Bengal is 4.5 per year, and 10% of the cyclones make landing around Myanmar. The proportion of cyclones landing in Myanmar would not change in the near future (approximately 10%). However, it is noted that extreme cyclones would increase in the near future as described in the previous sub-clause.

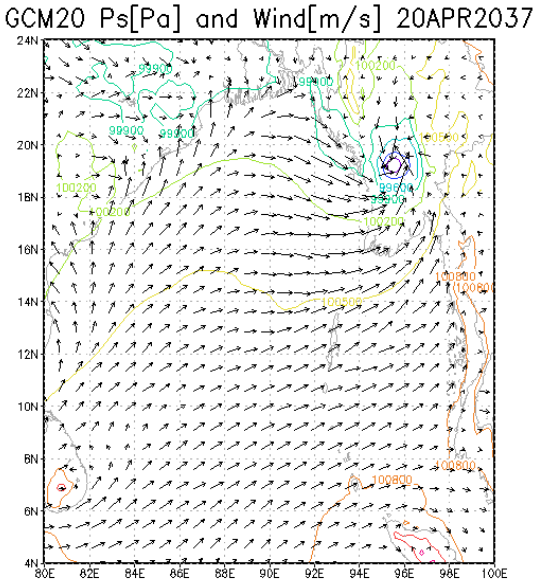
Table 11.4.5 Number of Picked Out Cyclones from JTWC and AGCM

	Total Number of Cyclones in Bay of Bengal (A)	Total Number of Cyclones Landed around Myanmar (B)	Average Number of Cyclones in Bay of Bengal per Year	Proportion (B/A)
JTWC 1945-2009 (65 years)	290	29	4.5	10.0%
MRI/JMA 1979-2003 (25 years)	57	5	2.3	8.8%
MRI/JMA 2015-2039 (25 years)	46	4	1.8	8.7%

Source: JICA Project Team

(5) Assumption of Extreme Cyclone

The near future cyclones will become stronger than the present ones according to the AGCM numerical experiment. In the near future, a cyclone that is more extreme than Nargis may land in Myanmar. Figure 11.4.5 shows the typical near future cyclone by AGCM. The strongest cyclone in the near future can be assumed using the severe case of the AGCM results.



Source: JMA/MRI

Figure 11.4.5 Typical Near Future Cyclone

11.4.2 STORM SURGE SIMULATION IN YANGON PORT

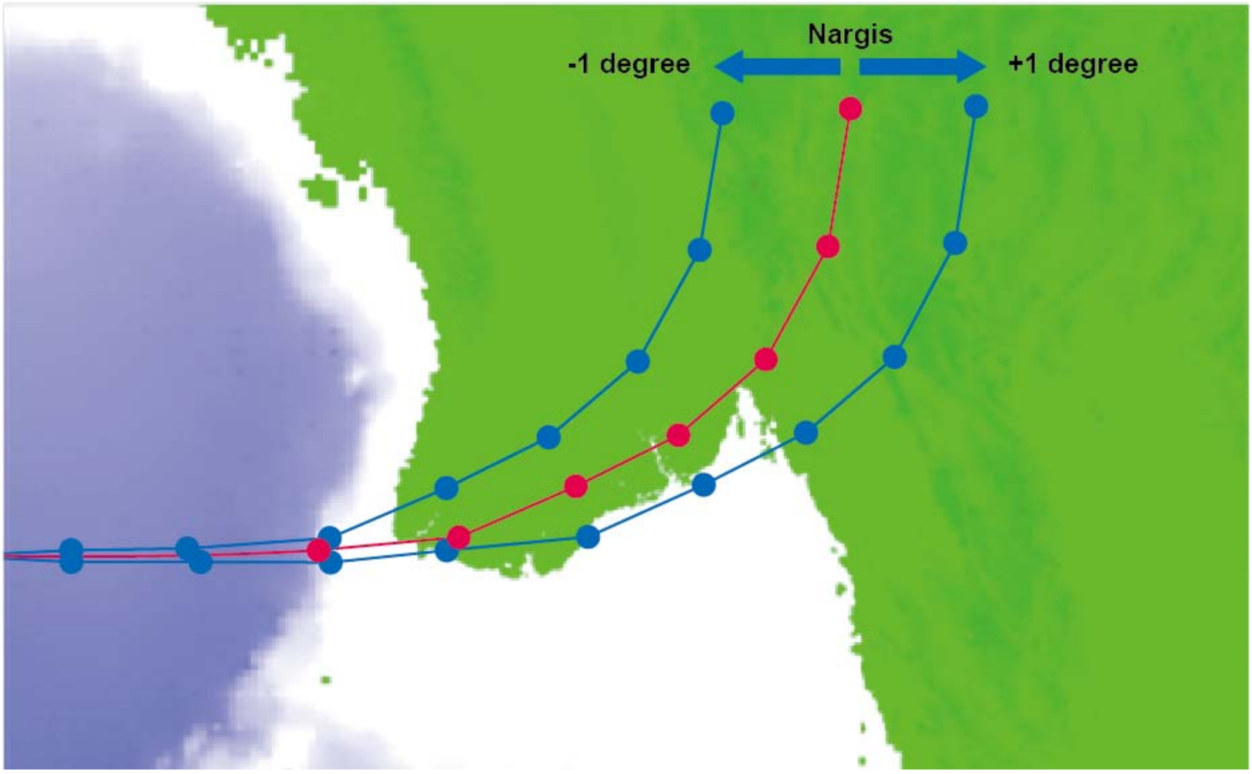
(1) Simulation Case

Cyclone Nargis had the most extreme conditions among cyclones that hit Myanmar in the past. According to the prediction results of near future cyclones by AGCM, there is a possibility that the same scale of cyclone will hit Myanmar. To analyze the target cyclones, it is necessary to arrange the cyclone conditions such as atmospheric pressure and cyclone route. Table 11.4.6 shows the target cyclone conditions including the present and near future cyclones. The assumed strongest cyclone was defined by using the most severe result.

Table 11.4.6 Simulation Case

Case No.	Cyclone
1	Cyclone Nargis tracks
2	Cyclone Nargis tracks + 1 degree
3	Cyclone Nargis tracks - 1 degree
4	2004 Cyclone
5	2006 Cyclone Mala
6	Assumed strongest cyclone in the future (simulated pressure by AGCM and track of Cyclone Nargis + 1 degree)

Source: JICA Project Team



Source: JICA Project Team

Figure 11.4.6 Cyclone Tracks

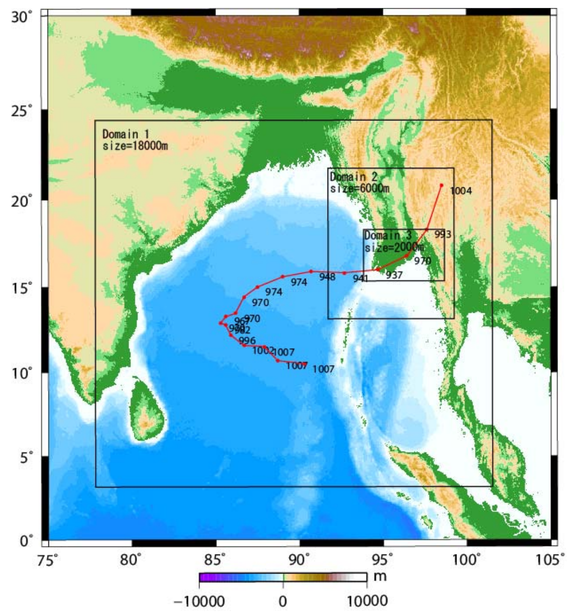
(2) Computational Domain for Storm Surge Simulation

In order to cover the track of cyclone, domain of the calculation is defined as shown in Figure 11.4.7. Moreover, in order to investigate the storm surge situation in detail, from the river mouth of the Yangon River to the coastal line of Yangon Port, the six step nesting model was applied for the analytical domains. The calculation domain for storm surge simulation and tracks of Cyclone Nargis is shown in Figure 11.4.7. Details of the calculation mesh of each domain are shown in Table 11.4.7.

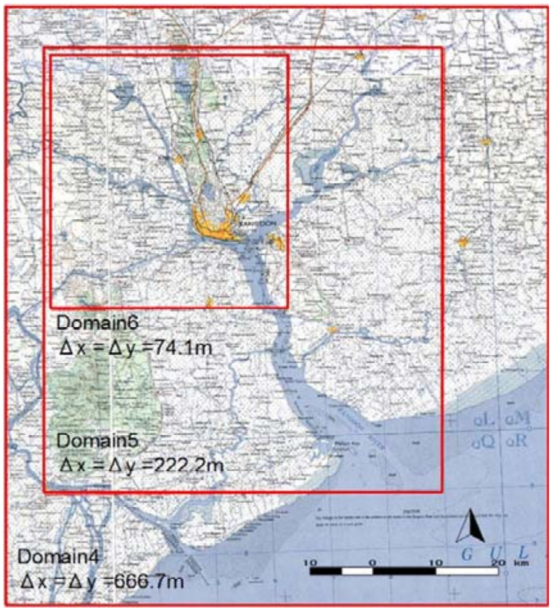
Table 11.4.7 Details of Calculation Mesh

Domain No.	Domain Area	Mesh Size (m)	Number of Mesh (horizontal x vertical)
1	Bay of Bengal	18,000	170 x 150
2	Andaman Sea	6,000	180 x 180
3	Around coastal line of Myanmar	2,000	270 x 210
4	Around coastal line and the Yangon River	666.7	120 x 132
5	Around the Yangon River	222.2	285 x 321
6	Around Yangon Port	74.07	510 x 555

Source: JICA Project Team



Domain 1-3



Domain 4-6

Source: JICA Project Team

Figure 11.4.7 Calculation Domain for Storm Surge Simulation

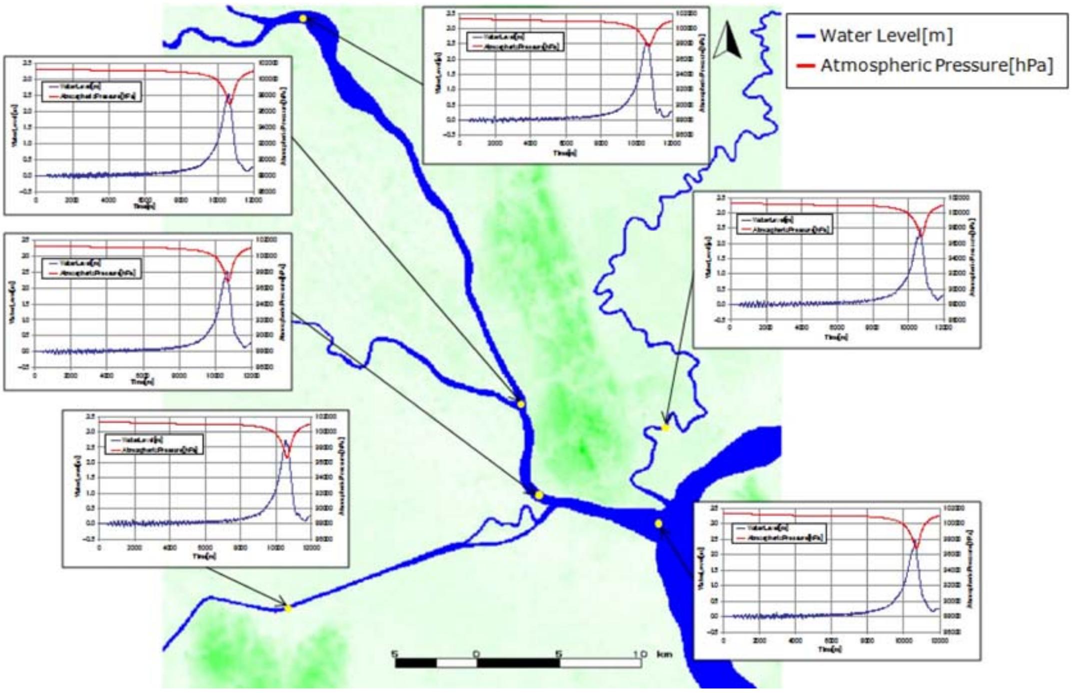
(3) Simulation Results

1) Time Series of Water Level

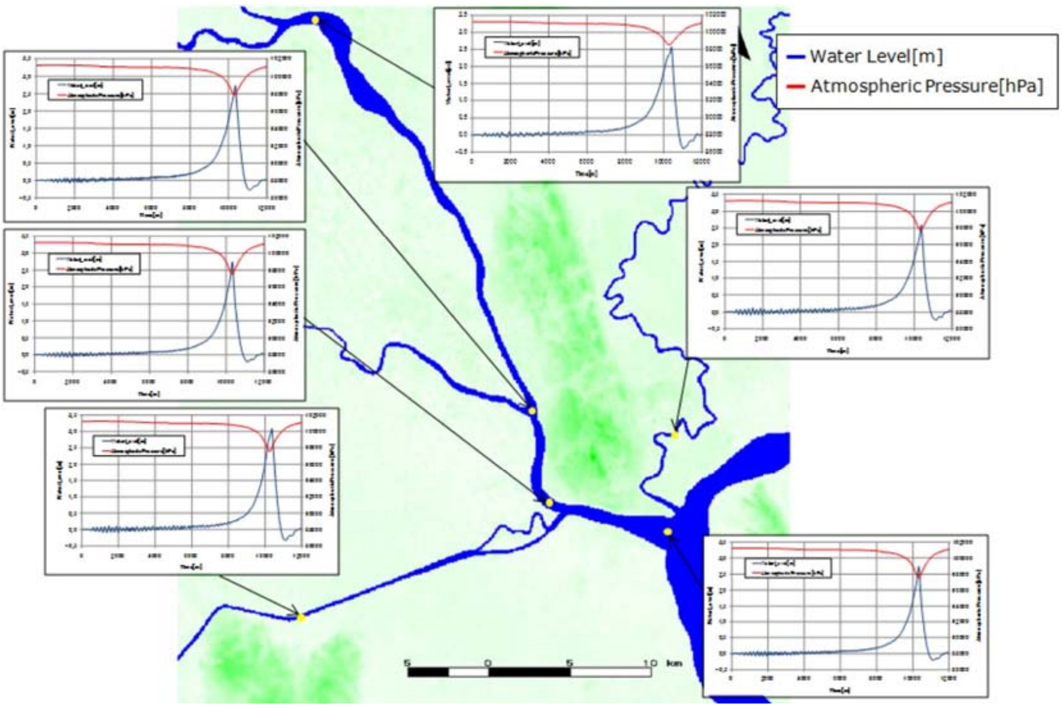
For each case, the time series of storm surge deviation and atmospheric pressure at the typical six points of the Yangon River are shown in Figure 11.4.8 to Figure 11.4.9. From these figures, it can be seen that the case of Cyclone Nargis +1 degree has the severest result. From this, the assumed strongest cyclone was determined using the results of the Cyclone Nargis +1 degree case. Figure 11.4.10 shows the time series of storm surge deviation of the Yangon Port area of all cases including the case of the assumed strongest cyclone. During the peak time of the storm surge, water level will rise about 3.0 m in the Yangon Port area. In the case of the assumed strongest cyclone, the storm surge deviation was predicted about 3.0 m in the Yangon area. During astronomical high tide levels, the water level reaches 9.0 m, as shown in Figure 11.4.11.

2) Storm Surge Deviation of Assumed Strongest Cyclone

Figure 11.4.12 shows the time series and maximum storm surge deviation in the case of the assumed strongest cyclone. The storm surge deviation was predicted about 3.0 m in the Yangon area. From this figure, it can be seen that upstream areas of Twante Canal and the Hlaing River are higher than in other areas.



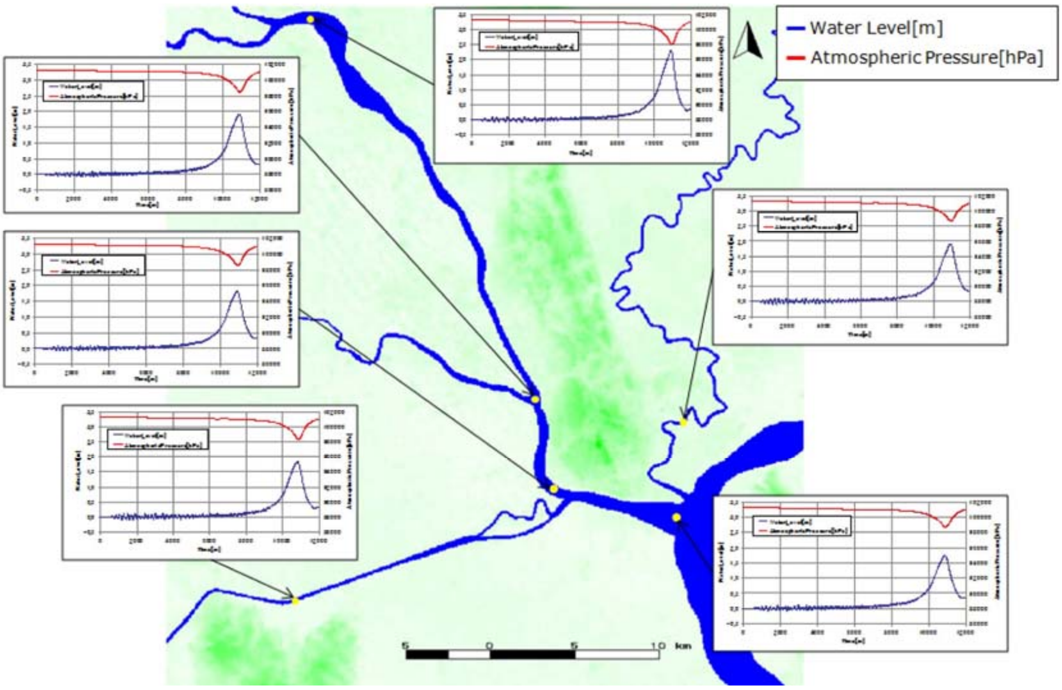
Time Series of Storm Surge Height (Case 1: Nargis)



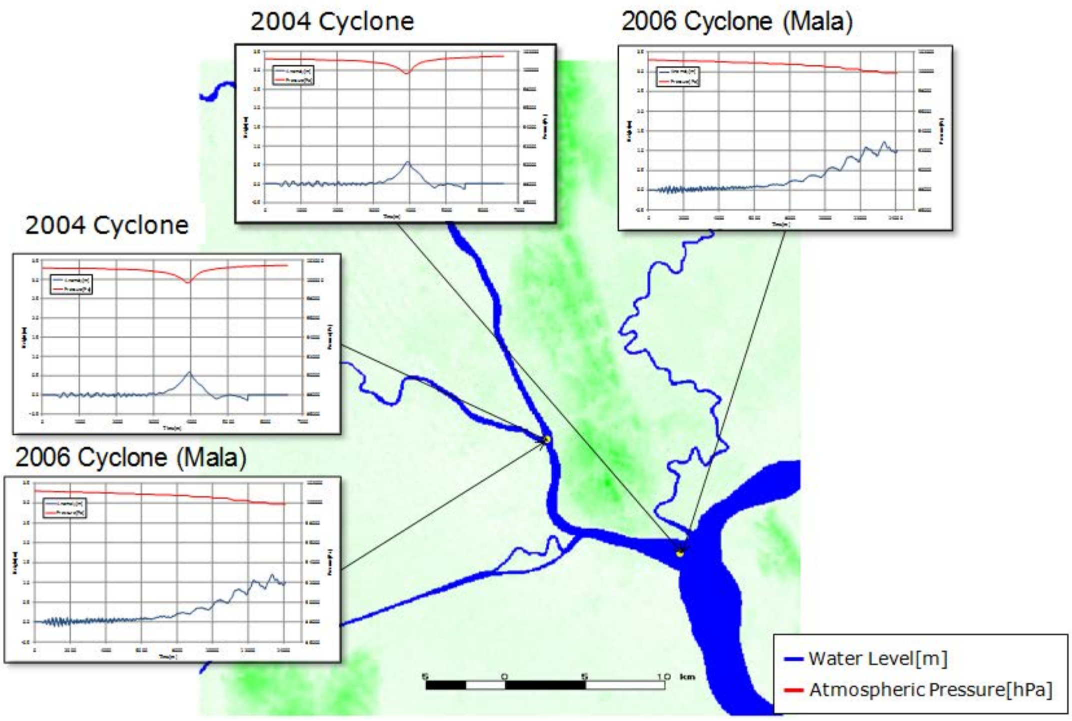
Time Series of Storm Surge Height (Case 2: Nargis +1 degree)

Source: JICA Project Team

Figure 11.4.8 Time Series of Water Level and Atmospheric Pressure (1/2)



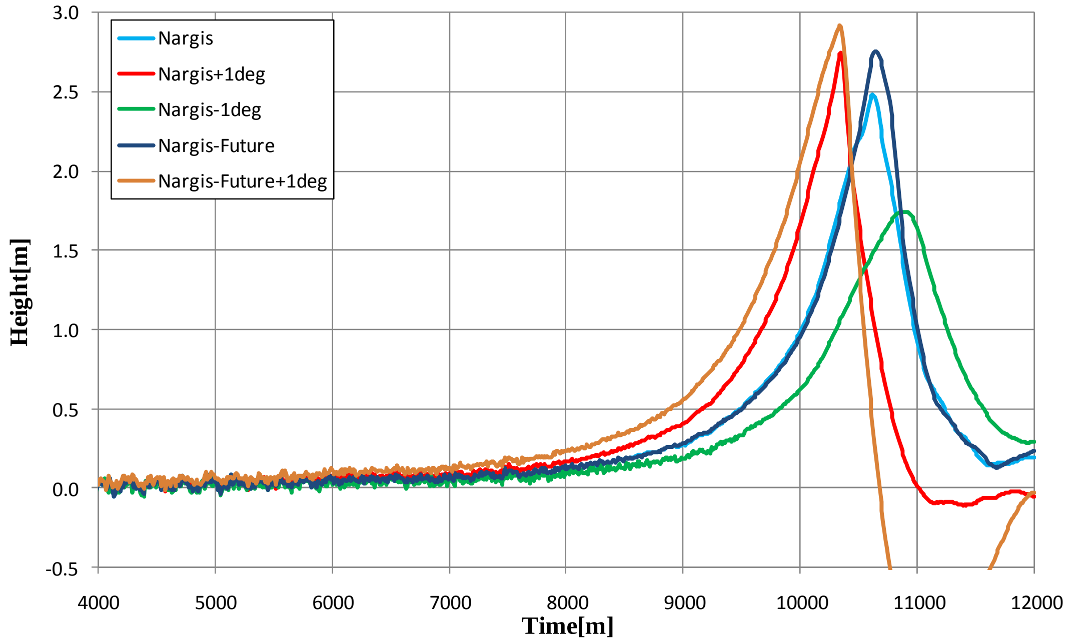
Time Series of Storm Surge Height (Case 3: Nargis -1 degree)



Time Series of Storm Surge Height (Case 4: 2004 Cyclone, Case 5: 2006 Cyclone)

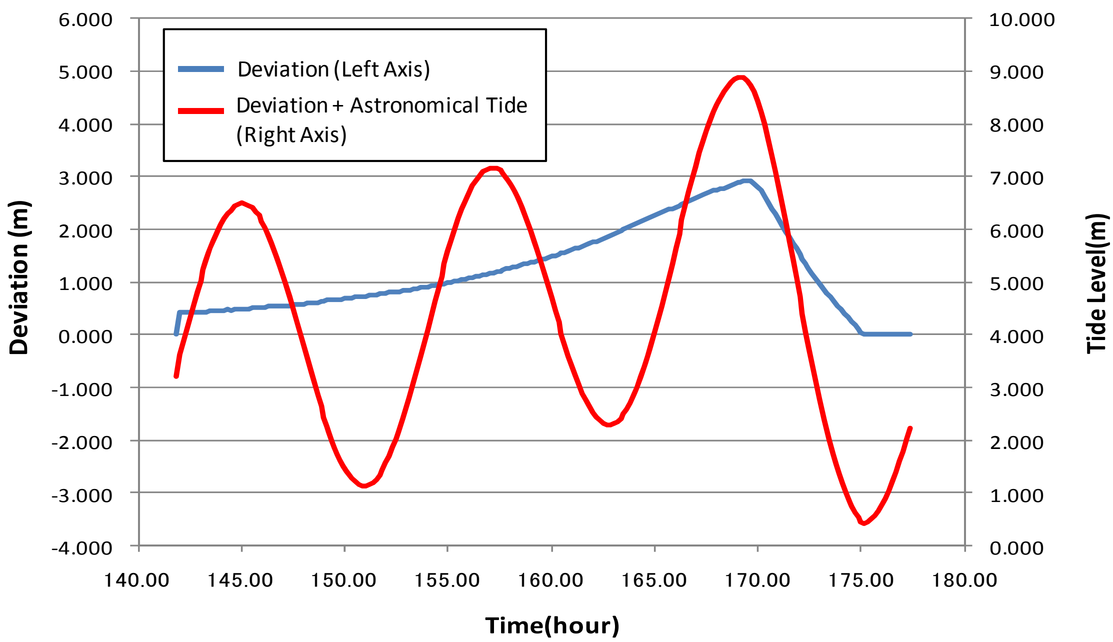
Source: JICA Project Team

Figure 11.4.9 Time Series of Water Level and Atmospheric Pressure (2/2)



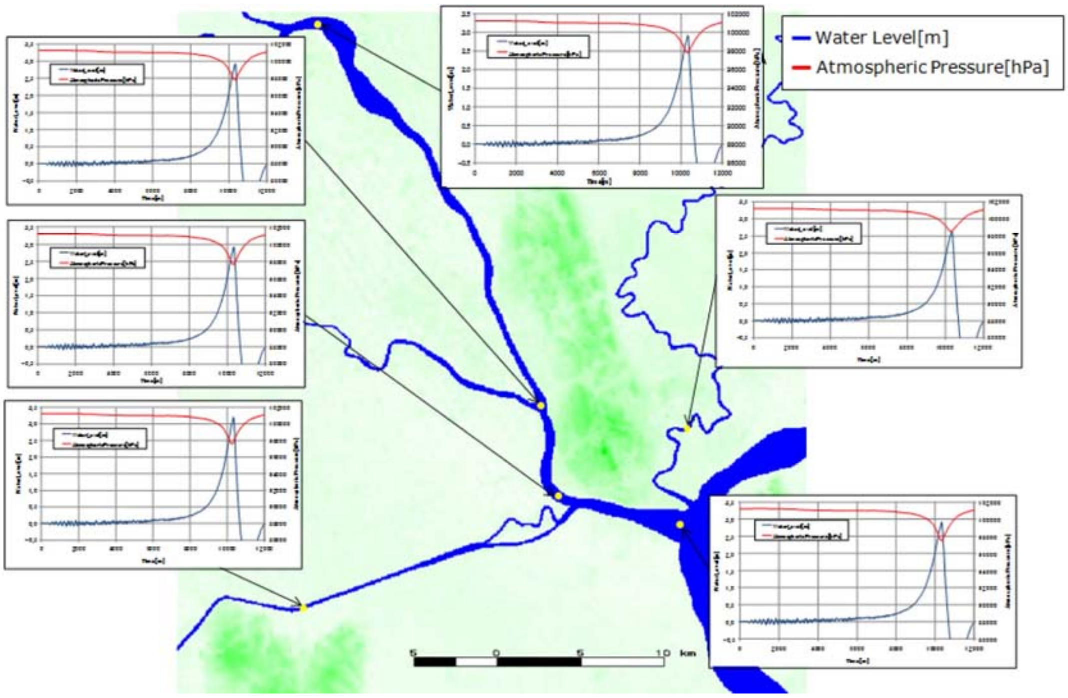
Source: JICA Project Team

Figure 11.4.10 Time Series of Storm Surge Deviation (All Cases)

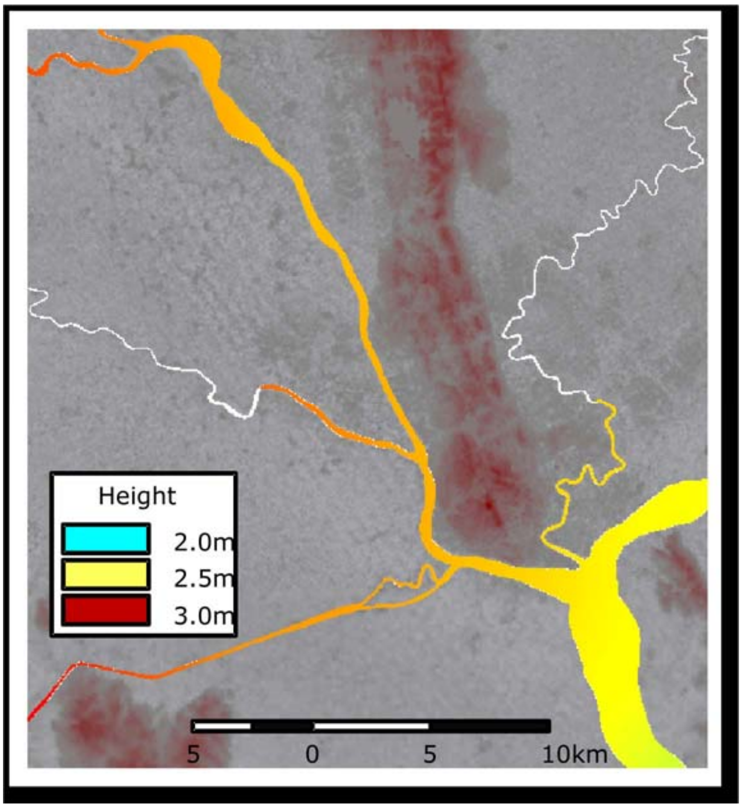


Source: JICA Project Team

Figure 11.4.11 Deviation and Astronomical Tide of Assumed Strongest Cyclone



Time Series of Strom Surge Height (Case 6: Assumed Strongest Cyclone)



Source: JICA Project Team

Figure 11.4.12 Storm Surge Deviation of the Assumed Strongest Cyclone

3) Verification

In order to verify the calculation results in the case of Cyclone Nargis, the simulated water level and observed trace of Cyclone Nargis were compared. During Cyclone Nargis, water level was recorded at 70 cm above the highest astronomical tide level, as shown in Figure 11.4.13. In most of the area, the water levels of the Hlaing River, Pazundaung Creek, and Twante Canal were raised by Cyclone Nargis. These observed data are consistent with the calculated results.

Source: JICA Project Team

Figure 11.4.13 Cyclone Nargis Water Level by Field Survey

(4) Characteristics of Cyclones and Storm Surges in the Future

1) Characteristics of Cyclones

The numerical simulations by MRI/JMA indicated that atmospheric pressures of cyclones in the future will be lower than today due to rising sea temperatures, so the scale of cyclones would be more extreme. Consequently, the external forces of storm surges, which are atmospheric pressure and wind, would be more extreme.

2) Characteristics of Storm Surges

In order to compare the present and future storm surges, several cases of simulation were carried out. From the results, the characteristics of storm surge around Yangon Port were obtained as follows:

- In case of Cyclone Nargis +1 degree east, the storm surge deviation is larger than Cyclone Nargis. The JICA Project Team assumed this cyclone track as the most severe case.
- The storm surge deviation was predicted about 3.0 m in the Yangon area in case of the assumed strongest cyclone.
- According to the simulation of the assumed strongest cyclone, which is 1 degree east from the Cyclone Nargis track and applied future distribution of atmospheric pressure, the water level rises even in the upstream of the Yangon River. The water level also rises in the branches of the Yangon River.

3) Recommendations for Countermeasures

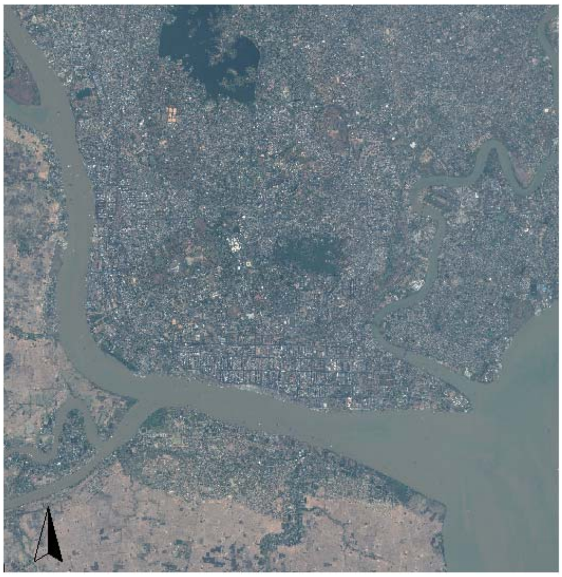
- In the future, the scale of storm surge would be larger than Cyclone Nargis. In such a case, port facilities will be seriously damaged by inundation. It is necessary to consider countermeasures against inundation caused by storm surges.
- In Ayeyarwady Division, the storm surge height is high. It is necessary to study the characteristics of storm surges and damage estimation. It is also necessary to study disaster prevention (e.g., storm surge warning system) and countermeasure plans (e.g., cyclone shelter) in Ayeyarwady.

11.5 ANALYSIS OF DAMAGE BY CYCLONE AND STORM SURGE IN YANGON PORT

11.5.1 SIMULATION OF SHIP DRIFTING

(1) Collection of Satellite Imagery

The satellite imagery was collected to grasp locations of ships around Yangon Port. The basic specifications of the satellite imagery and the imagery itself are shown in Figure 11.5.1.

Product Name	QuickBird	
Domain	Upper left coordinate: - North latitude 16.8457º - East longitude 96.1020º	
	Lower right coordinate: - North latitude 16.7346º - East longitude 96.2153º	
Ground Resolution	60 cm	
Shot Date	22 June 2010	

Source: JICA Project Team

Figure 11.5.1 Satellite Photo around Yangon Port

(2) Simulation Model

In order to estimate the position of ships drifted by storm surge, numerical simulation was applied with the results of storm surge simulation. This numerical simulation model assumes that a ship is a particle, and the particle is drifted by water flow. The basic equation is expressed by using the characteristics of ship object and velocity obtained by the storm surge simulation.

$$\rho_t V \frac{d\mathbf{u}_t}{dt} = \rho V \frac{d\mathbf{u}}{dt} + \rho\left(C_M - 1\right)V\left(\frac{d\mathbf{u}}{dt} - \frac{d\mathbf{u}_t}{dt}\right) - \frac{1}{2}\rho C_D \mathbf{A}\left(\mathbf{u}_t - \mathbf{u}\right)\left|\mathbf{u}_t - \mathbf{u}\right|$$

u is the velocity and ut is the velocity of the object. A is the projected area of ship, and CM and CD are the mass and drag coefficient, respectively. The velocity and the position of the object can be calculated using finite difference scheme, as follows:

$$\mathbf{u}_{t,j}^{k+1} = \frac{1}{1+\mu}\left[(1-\mu)\mathbf{u}_{t,j}^{k-1} + 2\Delta t\alpha\left(\frac{d\mathbf{u}}{dt}\right)_j^k + 2\mu\mathbf{u}_j^k\right]$$

$$\mathbf{X}_j^{k+1} = \mathbf{X}_j^k + \Delta t\mathbf{u}_{t,j}^k + \sqrt{24\kappa\Delta t}\left(\xi_j^k - \frac{1}{2}\right)$$

The coefficient of the object can be calculated by experimental formula.

$$\mu = \beta\Delta t C_D \frac{\mathbf{A}}{V}\left|\mathbf{u}_t - \mathbf{u}\right|, \quad \alpha = \frac{C_M}{\rho_t/\rho + C_M - 1}, \beta = \frac{1}{2(\rho_t/\rho + C_M - 1)}$$

$$C_D = \left[0.91 + 32.5R_e^{-1/2}\right]^2 + 0.1F_\gamma^{0.25}$$

$$C_M = 1.78$$

(3) Simulation Conditions

The simulation conditions of drifting ships are shown in Table 11.5.1. In this study, mooring of ships was not considered to estimate damage in the worst case.

Table 11.5.1 Simulation Condition of Drifting Ships

Item	Condition
Drifting object	Ship
Drift starting	Water depth > 1.5 m
Drift stopping	Water depth < 1.5 m
Mooring	Not considered
Initial position of ships	Identified by the satellite image
Flow velocity	Outputs of storm simulation, the case of assumed strongest cyclone

Source: JICA Project Team

(4) Definition of Ship Damages

The damage of ships are classified into the following: 1) collision, 2) sinking, and 3) stranding. In the simulation, the damage of ships was defined as shown in Table 11.5.2.

Table 11.5.2 Definition of Ship Damage

Phenomena	Definition
Collision	Distance between objects is zero.
Sinking	Ship repeats collisions.
Stranding	Ship is drifted into the land.

Source: JICA Project Team

(5) Simulation Results and Damage Estimation

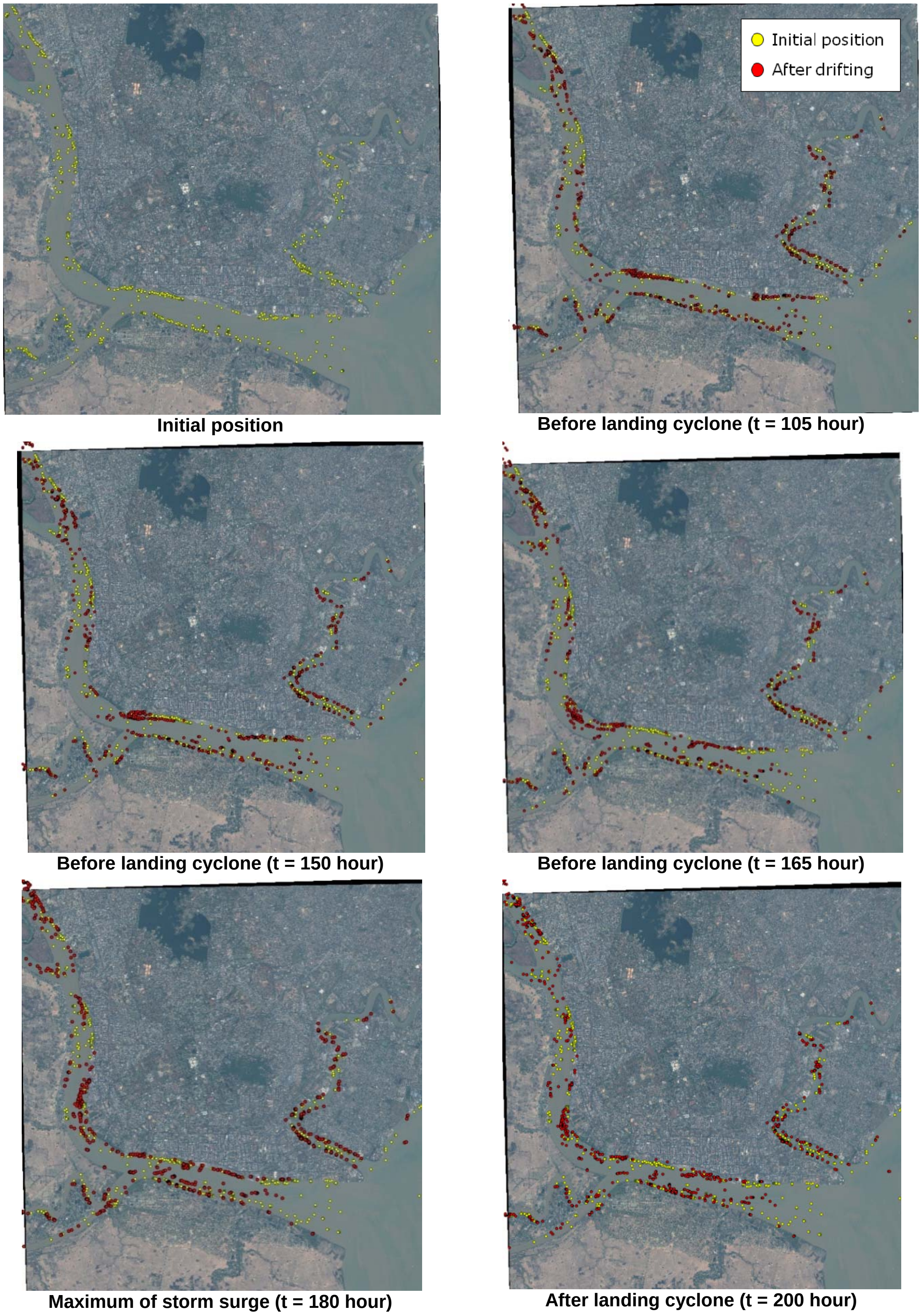
Figure 11.5.2 shows the results of drifting ships in time series, and the summary of simulation outputs is shown in Table 11.5.3. The water flowed to the upstream of rivers by storm surge, and almost all ships were drifted to the upstream. Approximately 40% of ships were stranded, and about 20% were sunk. Most of the accidents occurred in Yangon Port and the upstream of the Hlaing River.

In this simulation, the effects of cyclone winds were not considered due to difficulty of simulation. If the effects of winds were considered, the estimated damage would be worse.

Table 11.5.3 Summary of Ship Drift Simulation Output

Phenomena	Damaged Ships/Total (Percentage)	Descriptions
Collision (between ships)	642/949 (68%)	In almost the entire area, there were many collisions, especially in the main Yangon Port.
Collision (between ship and embankment)	105/949 (11%)	There were a lot of collisions in the main Yangon Port.
Sinking	211/949 (22%)	There was a lot of sinking in the main Yangon Port area and upstream of the Hlaing River. There were a few sunk ships in Pazundaung Creek.
Stranding	351/949 (37%)	In almost the entire area excluding Pazundaung Creek, there were many stranded ships.

Source: JICA Project Team



Source: JICA Project Team

Figure 11.5.2 Simulation Results of Drifting Ships

11.5.2 EFFECTS OF THE WIND

Breaking of mooring ropes results in drifting of ships. The mechanism of rope breaks was studied as follows:

Figure 11.5.3 shows the connection between wind velocity and drag force. Drag force increases in proportion to the square of wind velocity.

	Type 1	Type 2	Type 3	Type 4
Length	70 m	40 m	30 m	20 m
Width	12 m	10 m	8 m	5 m
Draft	5 m	1.7 m	2 m	1.8 m

Source: JICA Project Team

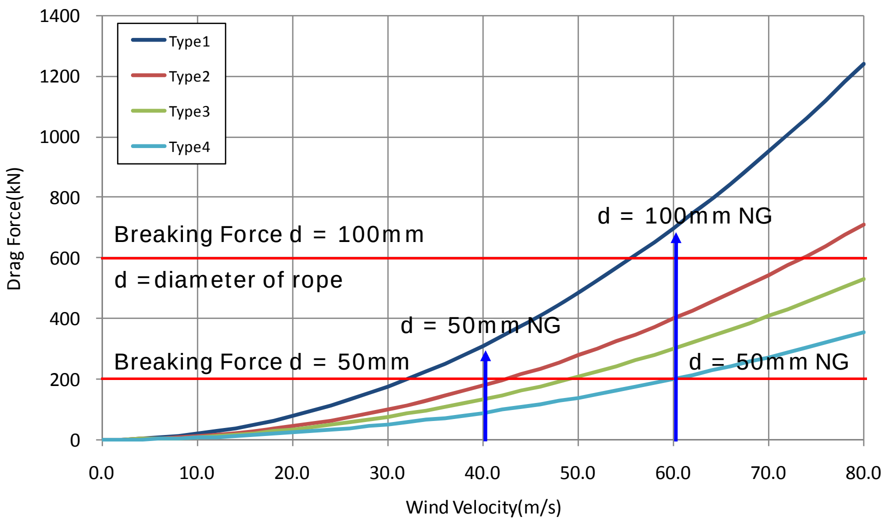
Figure 11.5.3 Dimensions of Ships

Drag force of the wind can be expressed in the following formula:

$$F_{Wk} = \frac{1}{2}\rho_a C_{DW} A_W U_{Wk}{}^2$$

Source: JICA Project Team

Figure 11.5.4 shows the connection between wind velocity and drag force. The drag force increases in proportion to the square of wind velocity. The effect of strong wind is dominant. In case that wind velocity is more than 40 m/s, mooring ropes may break. Impulse force by wind will occur by local wind velocity. From this, it is necessary to improve the mooring system (e.g., mooring position, specifications of mooring ropes)



Source: JICA Project Team

Figure 11.5.4 Graph of Wind Velocity and Drag Force

11.5.3 STUDY OF HUMAN LOSS AND DAMAGE TO STRUCTURES

(1) Methodology

1) Damage Rate of Building

The damage of buildings by storm surge was estimated based on the manual in Japan, as shown in Table 11.5.4. The damage rates of buildings are defined as the function of 1) slope of the ground, and 2) inundation depth.

Table 11.5.4 Building Damage Rate

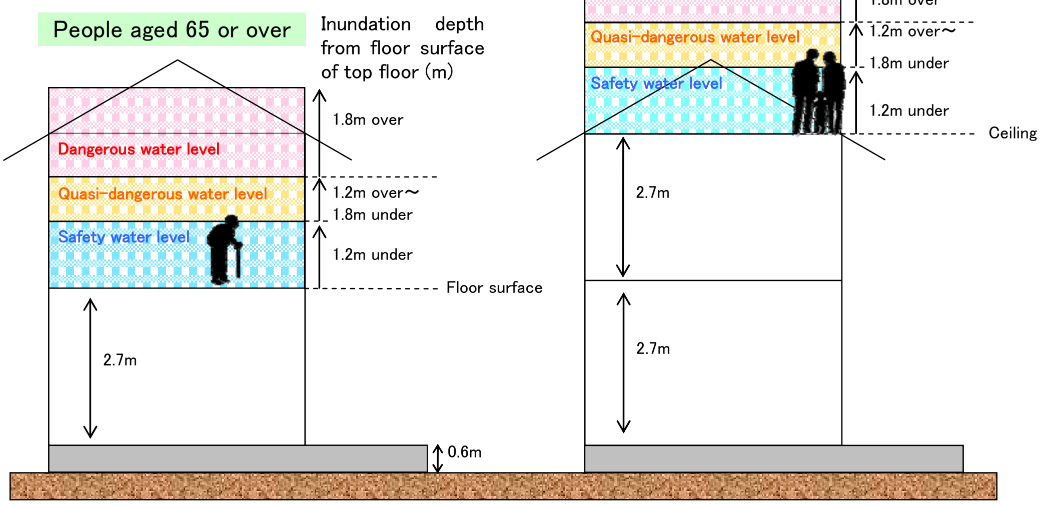
Slope \ Inundation Depth	Under Floor	Above Floor Level				
		50 cm under	50 –99	100 –199	200 –299	300 cm over
A group	0.032	0.092	0.119	0.266	0.580	0.834
B group	0.044	0.126	0.176	0.343	0.647	0.870
C group	0.050	0.144	0.205	0.382	0.681	0.888

A: 1/1000 under, B: 1/1000 - 1/500, C: 1/500 over
Source: The manual for economic evaluation of flood control projects (draft), MLIT, Japan

2) Rate of Human Loss

The rate of mortality by storm surges was estimated based on the report from the National Disaster Prevention Council, Japan. The expert panel of the council studied death tolls in large-scale inundation events with the model developed by the US Army Corps of Engineers, in which inundation depths were categorized into three levels of 1) dangerous water level, 2) quasi-dangerous water level, and 3) safety water level, as shown in Figure 11.5.5.

	Mortality rate
Dangerous water level	91.75%
Quasi-dangerous water level	12.00%
Safety water level	0.023%

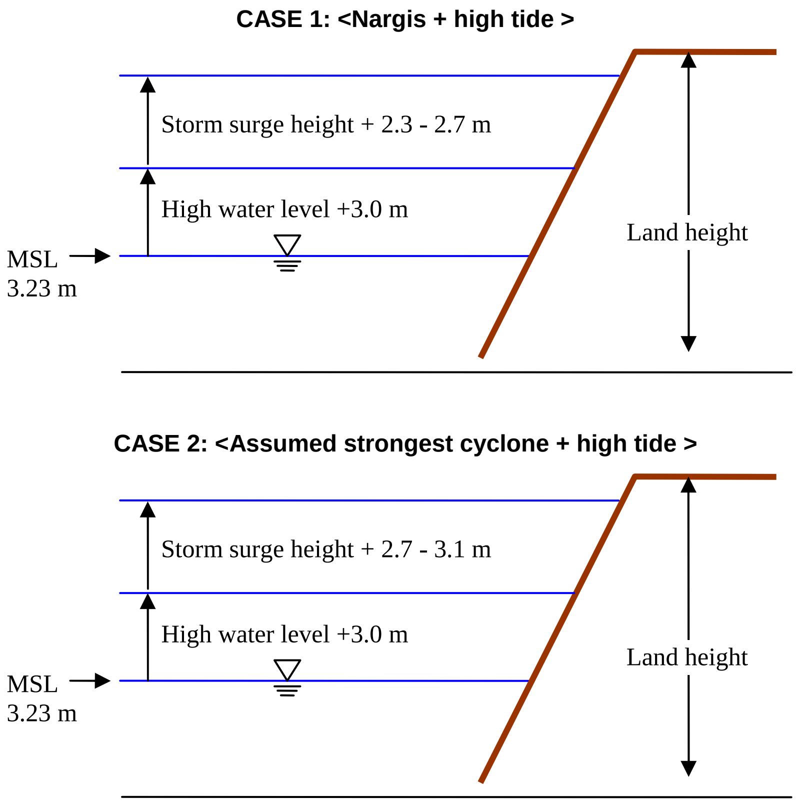


Source: National Disaster Prevention Council, Japan

Figure 11.5.5 Method of Mortality Rate Estimation

(2) Simulation Case of Storm Surge

The two cases of storm surge simulation were conducted, as illustrated in Figure 11.5.6. In Case 1, the high tide height (+3.0 m) and the storm surge height of Cyclone Nargis (from +2.3 m to +2.7 m) were added to the mean sea level (+3.23 m). In Case 2, the high tide height (+3.0 m) and the storm surge height of the assumed strongest cyclone (from +2.7 m to +3.1 m) were added to the mean sea level (+3.23 m).



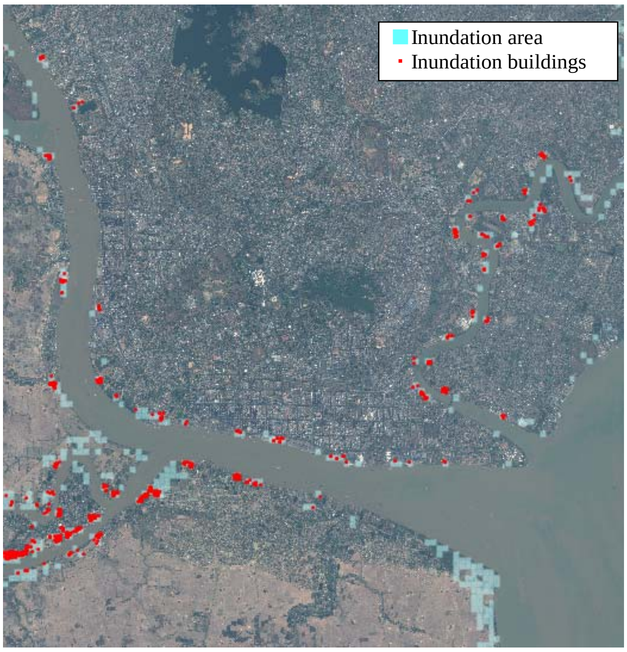
Source: JICA Project Team

Figure 11.5.6 Storm Surge Simulation Case

(3) Result of Damage Estimation

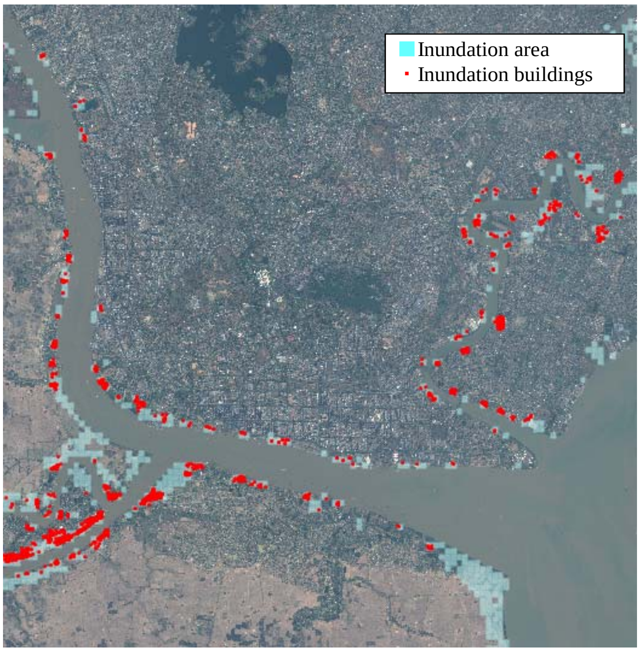
1) Building Inundation in Yangon Port

Inundated buildings in Yangon Port are shown in Figure 11.5.7 and Figure 11.5.8. The number of inundated buildings is 273 in Case 1, and 848 in Case 2.



Source: JICA Project Team

Figure 11.5.7 Inundated Building in Yangon Port (Case 1)



Source: JICA Project Team

Figure 11.5.8 Inundated Building in Yangon Port (Case 2)

2) Damage Rate of Building

The inundated buildings were counted and classified into four categories based on inundation depth, as shown in Table 11.5.4, and corresponding damage rates are shown as well. The slope of the ground was adopted under Group A (under 1/1000), and the results of classification are shown in Table 11.5.5. Due to the accuracy of elevation data, which is based on the Shuttle Radar Topography Mission (SRTM), inundation depth of less than 50 cm and 50-99 cm cannot be distinguished. Therefore, if the simulated inundation depth of a building is equal to 1 m or less, the inundation depth of the building is assumed under the 50-99 cm class.

Damage rate at less than 200 cm of inundation depth is relatively low, at about 30%. If the inundation depth exceeds 200 cm, the damage rate sharply increases, at about 60%. In Case 2, it was simulated that more than 56 buildings (over 300 cm) would be highly damaged.

The applied damage rate in this study is derived from data from Japan. However, buildings in Myanmar are weaker than buildings in Japan because of difference of building materials. Buildings in Myanmar are mostly made of bamboo or corrugated iron sheets, as shown in Figure 11.5.9. Therefore, the damage rates shown in Table 11.5.5 might be underestimated, and even in Case 1, most of inundated buildings might be highly damaged.

Table 11.5.5 Number of Inundated Buildings Classified into Four Inundation Ranges and Corresponding Building Damage Rate

	Inundation Depth				
	Less than 50 cm	50–99 cm	100–199 cm	200–299 cm	Over 300 cm
Damage rate	Not applied in this study	11.9%	26.6%	58.0%	83.4%
Case 1		217 buildings (217)	50 buildings (267)	4 buildings (271)	2 buildings (273)
Case 2		575 buildings (575)	217 buildings (792)	50 buildings (842)	6 buildings (848)

Note: Accumulated number of inundated buildings is shown in parentheses.
Example: 50+217=267, in Case 1, less than 200 cm.

Source: JICA Project Team

Source: JICA Project Team

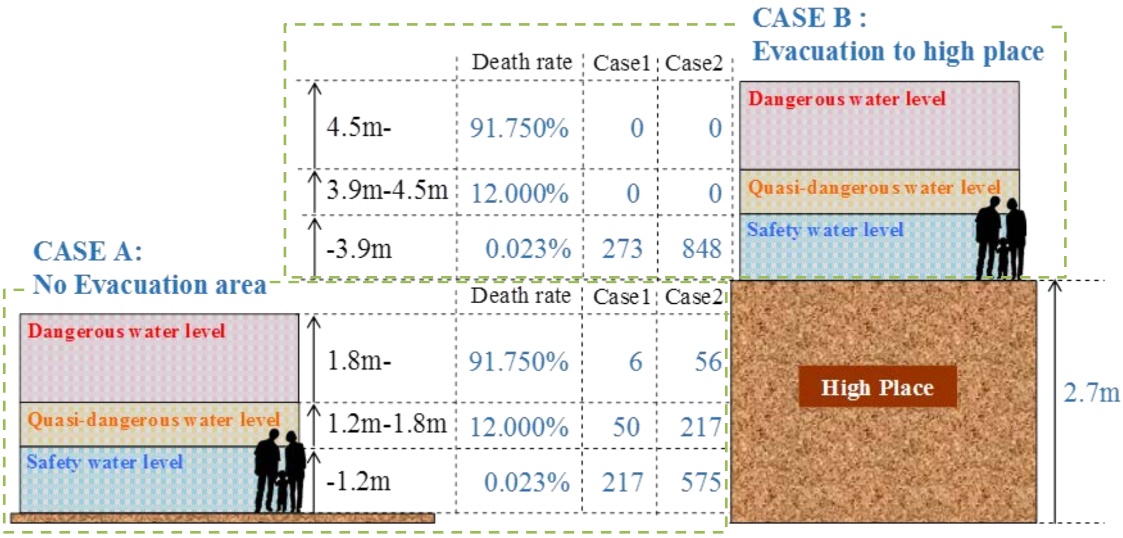
Figure 11.5.9 Bamboo or Corrugated Iron Sheet Houses

3) Rate of Human Loss

The rate of human loss was estimated based on Figure 11.5.5. The inundated buildings in Case 1 and Case 2 were counted and classified into three categories based on inundation depth, as shown in Figure 11.5.10, and corresponding death rates are shown as well.

Case A: Six buildings in Case 1 and 56 buildings in Case 2 were at inundation depth of equal to or more than 1.8 m, at which rate of human loss was more than 90%.

Case B: As described previously, most of the buildings in Myanmar are easily destroyed by storm surges, and the upper floor of such buildings is not suitable for evacuation. If evacuation areas are designated on higher ground, the mortality rate will be reduced. In Case B, the ground level is assumed to be elevated at 2.7 m, and the inundation depth is decreased to the category with minimum human loss.



Source: JICA Project Team

Figure 11.5.10 Number of Inundated Buildings Classified into Three Inundation Ranges and Corresponding Death Rate

4) Damage to Yangon Port Facilities

The following damage to facilities in Yangon Port is expected in case of storm surge:

(a) Damage to Pontoon

Pontoons may drift away because of the water level rise as high as 3 m and the high speed of current.

(b) Drift and Outflow of Container

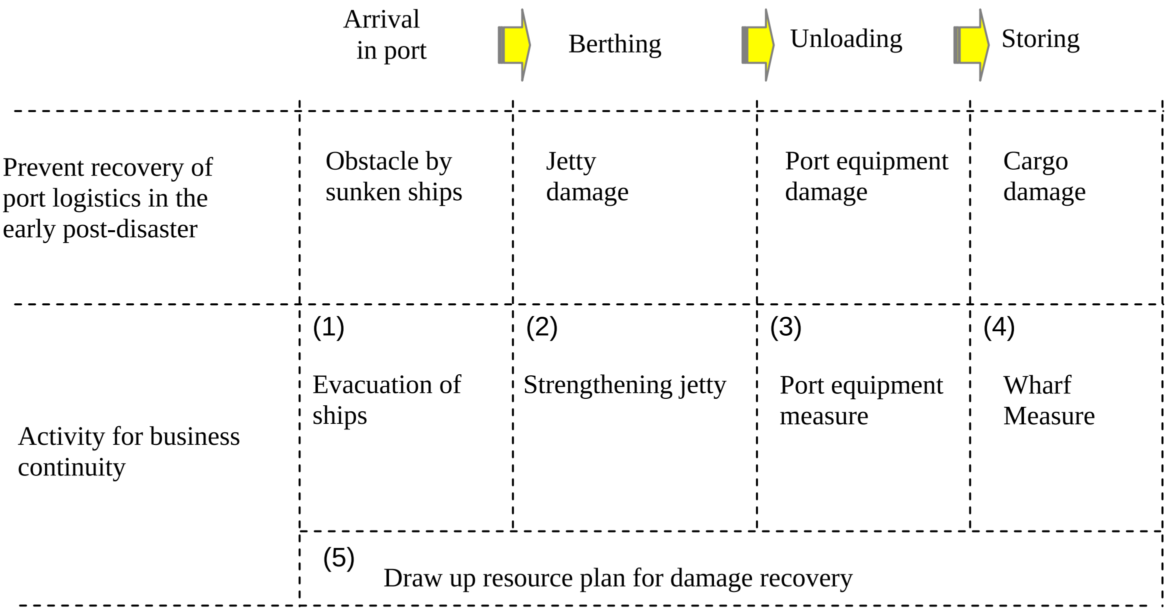
There is a possibility of drifting and washing away of containers by inundation if empty containers are stockpiled in only one tier.

(c) Damage to Cargo and Equipment

There is a possibility of damage to cargo and port equipment such as forklifts kept in the warehouse, caused by inundation.

(4) Business Continuity Plan

To minimize damage to port facilities, it is necessary to build a system to respond smoothly to the occurrence of disaster. For example, it is necessary to consider the following: (1) evacuation of ships, (2) strengthening of jetty, (3) port equipment measures, and (4) wharf measures in Yangon Port.



Source: JICA Project Team

Figure 11.5.11 Activities for Business Continuity

11.6 STUDY OF COUNTERMEASURES AGAINST CYCLONES AND STORM SURGES IN YANGON PORT

11.6.1 SAFETY ASSESSMENT OF EVACUATION ANCHORAGE IN YANGON PORT

(1) Ship Position

The present locations of ships were surveyed.

1) Ship Survey

Ships moored at the jetties of Yangon Port were investigated through interview survey, in which the JICA Project Team asked about the following items:

- Jetty Name
- Ship Number
- Ship Name
- Length, Width, Depth
- Weight (ton)

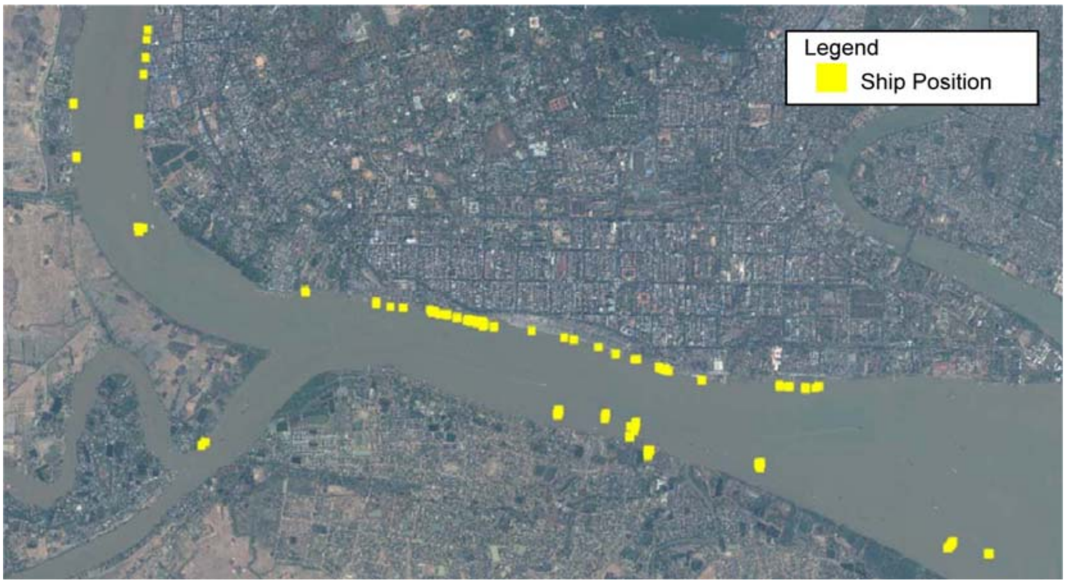
- Mooring Rope (Type, Number)
- Affiliation

Source: JICA Project Team

Figure 11.6.1 Ship Survey

2) Database of Ship Position

A database on the locations of ships was made from the ship survey and IWT ship data.



Source: JICA Project Team

Figure 11.6.2 Location of Ships Identified from Field Survey and IWT Data

(2) Evacuation Anchorage

The JICA Project Team surveyed the conditions of the evacuation anchorages of ships which were designated in the Maritime Disaster Prevention Plan of MPA.

1) Evacuation Anchorage in the Hlaing River (from H-1 to H-6)

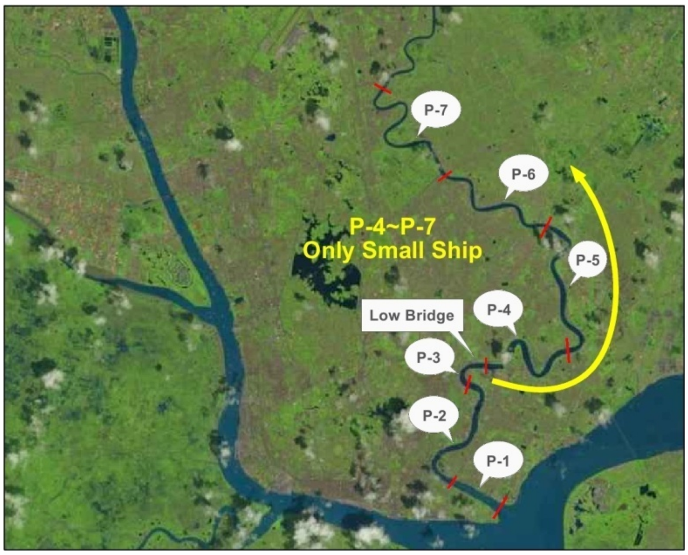
The evacuation anchorage in the Hlaing River is shown in Figure 11.6.3.

Background image: Satellite image of Landsat-8
Source: JICA Project Team

Figure 11.6.3 Evacuation Anchorage in the Hlaing River

2) Evacuation Anchorage in Pazundaung Creek (from P-1 to P-7)

The evacuation anchorage in Pazundaung Creek is shown in Figure 11.6.4.



Background image: Satellite image of Landsat-8
Source: JICA Project Team

Figure 11.6.4 Evacuation Anchorage in Pazundaung Creek

3) Evacuation Anchorage from K-1 to K-3

The evacuation anchorage from K-1 to K-3 is shown in Figure 11.6.5.

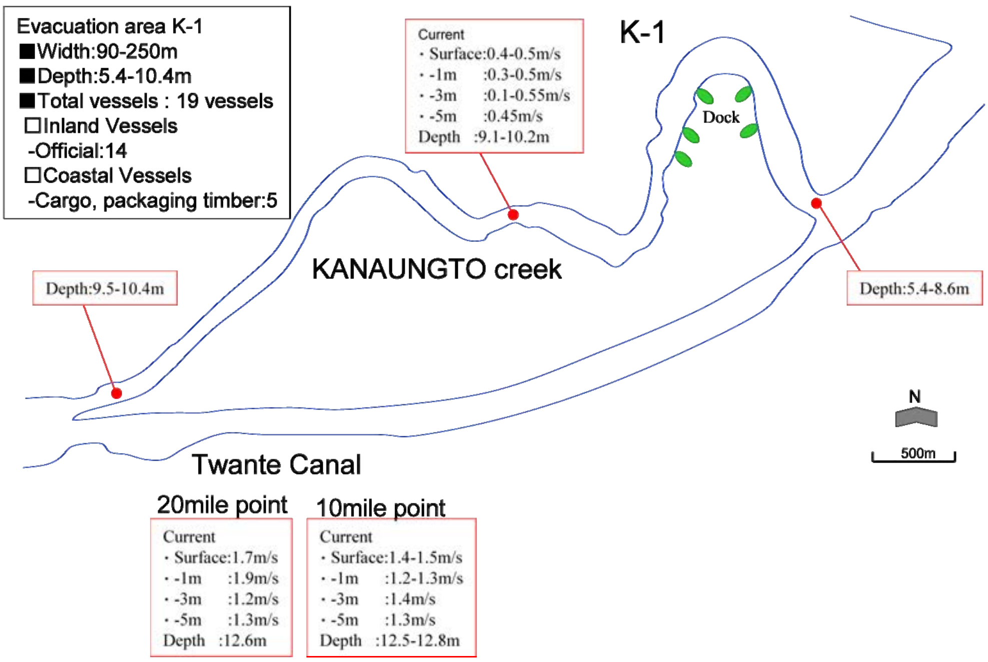
Background image: Satellite image of Landsat-8

Source: JICA Project Team

Figure 11.6.5 Evacuation Anchorage in Twante Canal and Kanaungto Creek

(a) Evacuation Anchorage of K-1

- K-1 is the evacuation anchorage for private ships.
- There are some docks for repairing ships. It is possible to evacuate into the docks.
- The creek is about 100 m in width, and 5 m in depth.
- The whole length of the evacuation anchorage is about 6.5 km, so there is enough space to evacuate 19 ships.
- The speed of current at the K-1 area, from the water surface to a depth of 5 m, is about 0.5 m/s. The speed of current at the K-1 area is 1 m/s lower than that of Twante Canal.



Source: JICA Project Team

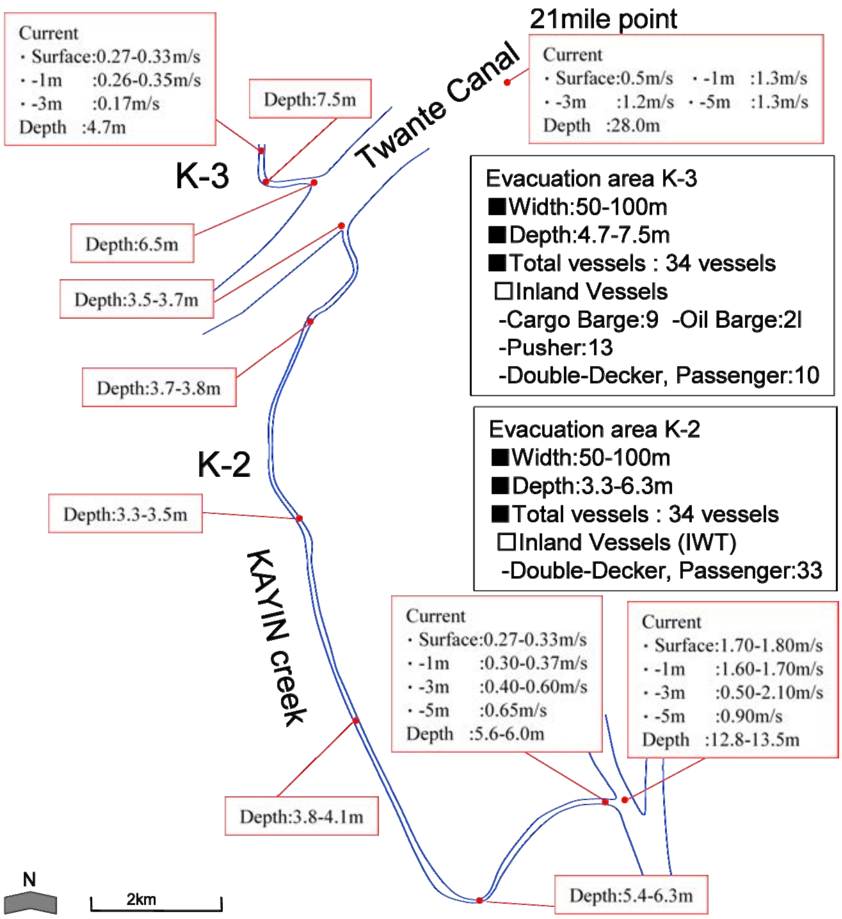
Figure 11.6.6 Field Survey Results in Twante Canal and Kanaungto Creek (K-1)

(b) Evacuation Anchorage of K-2

- K-2 is the evacuation anchorage for IWT ships.
- The creek is a little narrower at 50 m in width, and more than 3 m in depth.
- The whole length of the K-2 area is about 14.7 km, so there is enough space to evacuate 34 ships.
- The speed of current at the K-2 area is about 0.65 m/s. The speed of current at the K-2 area is about 1 m/s lower than that of Twante Canal.
- The creek mouth is narrow. However, the double-decker of IWT is able to pass through the creek. The mouth of the creek is not wide, but there is no problem for the double-decker of IWT to go through the creek.

(c) Evacuation Anchorage of K-3

- Large-scale ships that are not able to enter the K-2 area should be moored at Twante Canal.
- The creek is a little narrower at 50 m in width, and more than 4 m in depth.
- The speed of current at the K-3 area is about 0.35 m/s, which is about 1 m/s lower than that of Twante Canal.
- The water depth at the K-3 area becomes low in the dry season. Because there is a shallow place near the mouth of the creek, it is necessary to be careful when entering the creek. There are some shallow areas near the mouth of the creek, especially in the dry season, so it is necessary for ships to be careful when entering the creek.



Source: JICA Project Team

Figure 11.6.7 Field Survey Results in Twante Canal and Kanaungto Creek (K-2 and K-3)

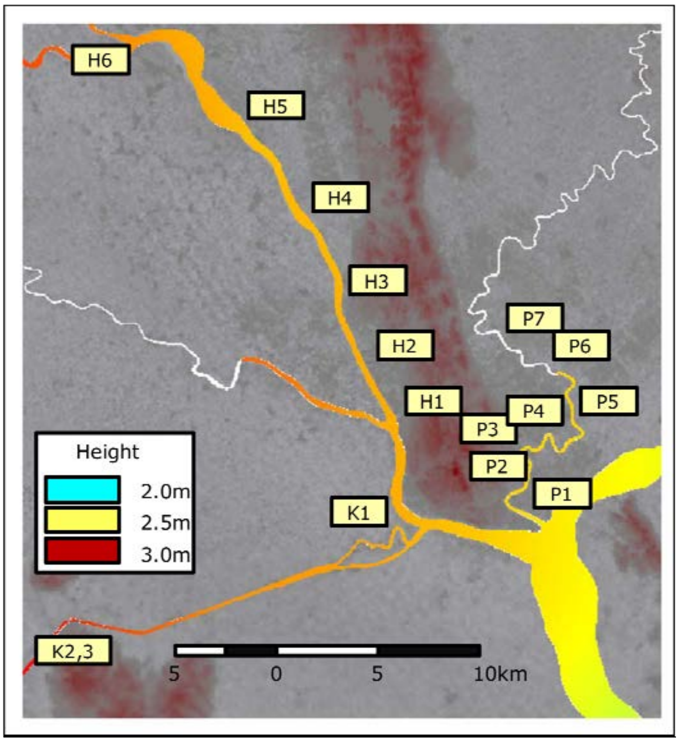
(3) Evaluation of Safety Level

1) Characteristics of Storm Surge around Yangon Port

The evaluation of safety level for ships has been carried out by using the results of the storm surge simulation. The characteristics of the storm surge deviation and the velocity in the evacuation anchorage are as follows:

(a) Storm Surge Deviation

Figure 11.6.8 shows the distribution of storm surge deviation, which is the result of storm surge simulation of Cyclone Nargis. It can be seen that storm surge deviation is higher at the west side of the evacuation anchorage than the east area. The east area, "P" and "K", are relatively stable during a cyclone.

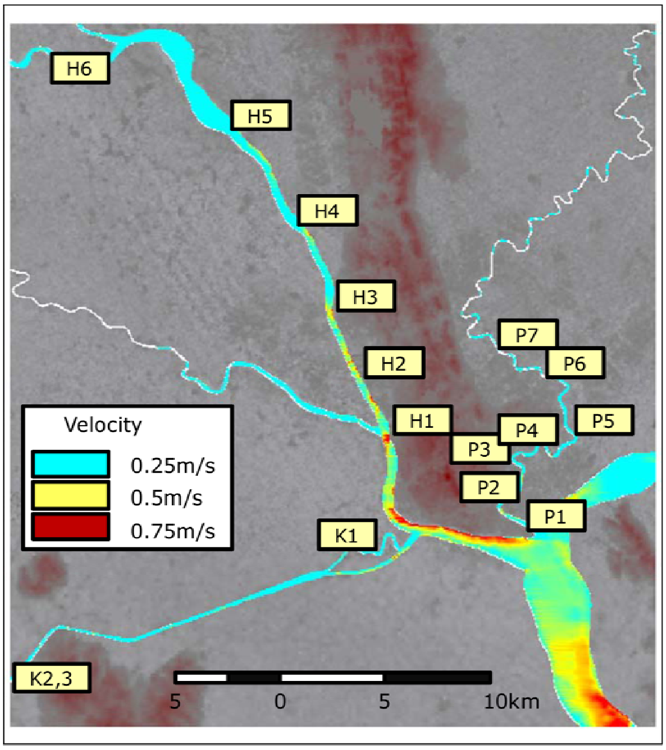


Source: JICA Project Team

Figure 11.6.8 Distribution of Storm Surge Deviation

(b) Flow Velocity

Figure 11.6.9 shows the flow velocity of storm surge deviation, which is the result of the storm surge simulation of Cyclone Nargis. It can be seen that flow velocity is high just around the Yangon Port area. On the other hand, flow velocity is relatively low in the "K" and "P" areas.



Source: JICA Project Team

Figure 11.6.9 Distribution of Storm Surge Velocity

2) Definition of Safety Level

In order to evaluate the level of safety for evacuation anchorage, the safety level has been defined and classified into several levels. The definition and classification are as follows:

(a) Definition of Safety Level against Storm Surge

The safety level is defined to evaluate safe evacuation of ships. The definition of safety level is for reference in planning for ship evacuation.

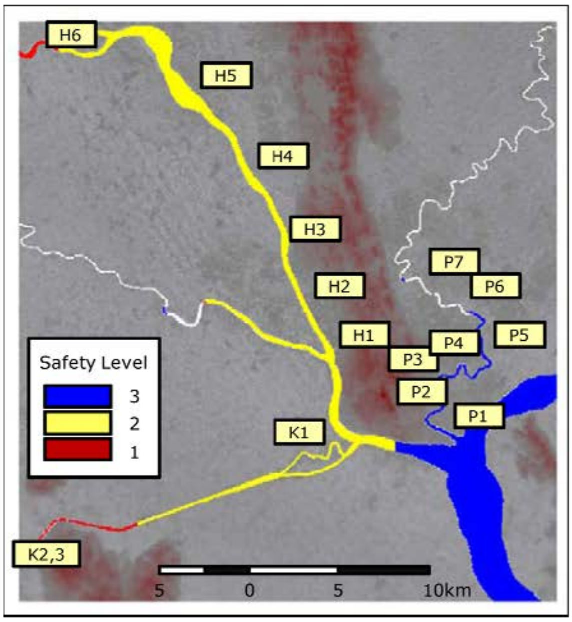
(b) Classification of Safety Level

The classification of safety level has been defined as follows:

- Safety level of storm surge deviation and velocity are defined using the simulation results.
- Safety level of storm surge deviation and velocity are classified into three levels.
- Comprehensive safety level is evaluated by using safety level by storm surge deviation and velocity.
- Comprehensive safety level is classified into five levels.

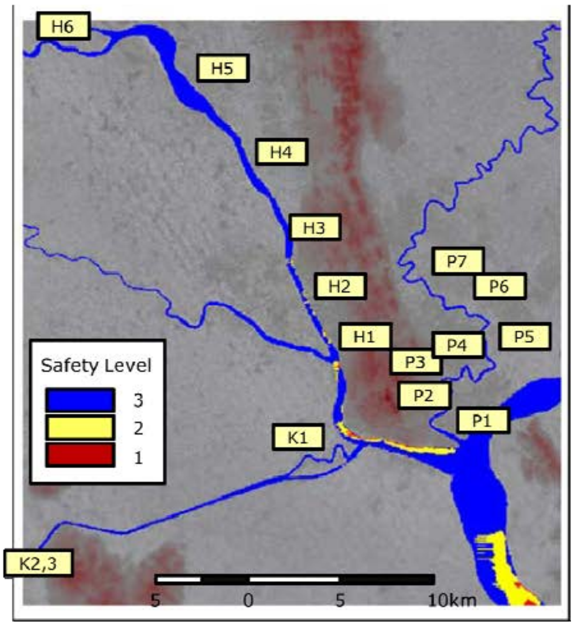
3) Distribution of Safety Level

Figure 11.6.10 shows the distribution of safety level against storm surge deviation. It can be seen that the K2, K3, and H6 areas are of high safety level. On the other hand, the safety level in the Pazundaung Creek area, "P", is lower than the other areas. Figure 11.6.11 shows the distribution of safety level against storm surge velocity. It can be seen that the K2, K3, and H6 areas are of lower safety level than the other areas. H2 and H3 are also of lower safety level than other "H" areas. On the other hand, the "P" and "K" areas are of high safety level as compared with other areas.



Source: JICA Project Team

Figure 11.6.10 Distribution of Safety Level against Storm Surge Deviation



Source: JICA Project Team

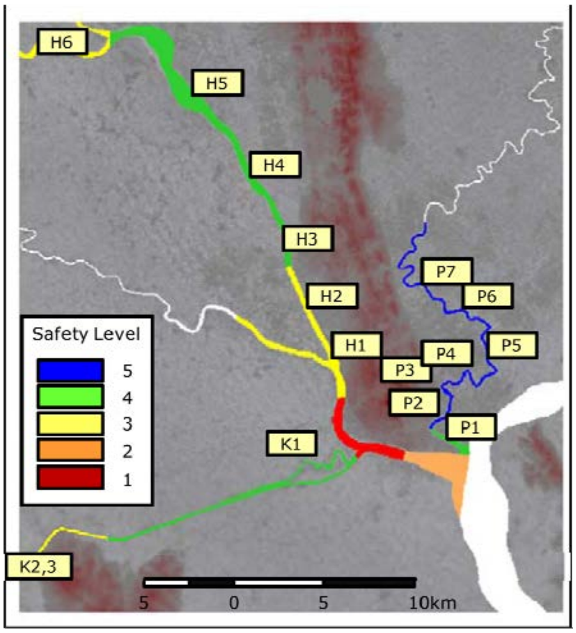
Figure 11.6.11 Distribution of Safety Level against Storm Surge Velocity

4) Comprehensive Safety Level

Figure 11.6.12 shows the comprehensive safety levels for ships. It shows several features.

- Safety level in Yangon Port (west) is the lowest. It is necessary to evacuate to another area.
- Safety levels of H1 and H2 are low because of velocity.
- Safety levels of K2, K3, and H6 are low because of storm surge.

- Safety level of the Pazundaung Creek area ("P") is higher than other areas.



Source: JICA Project Team

Figure 11.6.12 Distribution of Distribution of Comprehensive Safety Level

Table 11.6.1 Safety Levels for Ships

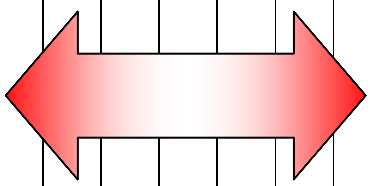
Area	Number of Vessels	Safety Level		
		Height	Velocity	Total
H1	50	2	2	3
H2	30	2	2	3
H3	30	2	3	4
H4	65	2	3	4
H5	70	2	3	4
H6	77	1	3	3
K1	20	2	3	4
K2	33	1	3	3
K3	34	1	3	3
P1	17	3	3	4
P2	42	3	3	5
P3	60	3	3	5
P4	20	3	3	5
P5	30	3	3	5
P6	30	3	3	5
P7	30	3	3	5
Yangon South		2	1	2
Yangon East		1	1	1

Source: JICA Project Team

(4) Evaluation of Ship Importance

1) Weighting of the Ship Importance

Paired comparison questionnaire survey was done to MPA and IWT regarding three types of ships. The weight of ship type was set by using the questionnaire survey results. The questionnaire is shown in Figure 11.6.13. The results of the paired comparison questionnaire are shown in Table 11.6.2. The assessment weight was set using geometrical average method. The results are shown in Figure 11.6.14. As a result, it can be seen that passenger cargo is of most important.



	Left is important								Right is important	
Passenger Cargo	9	7	5	3	1	3	5	7	9	Cargo
Passenger Cargo	9	7	5	3	1	3	5	7	9	Work ship
Cargo	9	7	5	3	1	3	5	7	9	Work ship

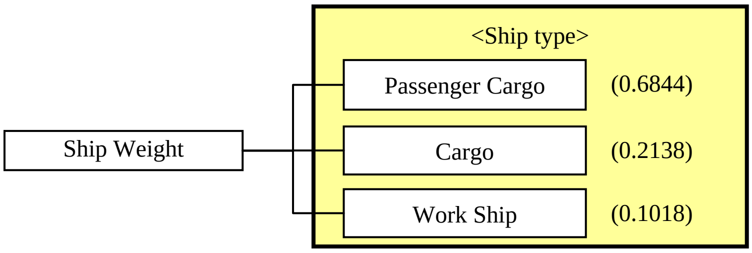
Source: JICA Project Team

Figure 11.6.13 Typical Method (AHP) by Weighted Value for Ship Damage

Table 11.6.2 Results of the Paired Comparison Questionnaire

			Answer						
			A	B	C	D	E	F	G
Ship Type	Passenger Cargo	Passenger Cargo	1	1	1	1	1	1	1
	Passenger Cargo	Cargo	3	5	9	7	9	7	1/7
	Passenger Cargo	Work Ship	3	7	7	7	7	7	5
	Cargo	Passenger Cargo	1/3	1/5	1/9	1/7	1/9	1/7	7
	Cargo	Cargo	1	1	1	1	1	1	1
	Cargo	Work Ship	1	5	5	5	5	5	1/7
	Work Ship	Passenger Cargo	1/3	1/7	1/7	1/7	1/7	1/7	1/5
	Work Ship	Cargo	1	1/5	1/5	1/5	1/5	1/5	7
	Work Ship	Work Ship	1	1	1	1	1	1	1

Source: JICA Project Team



Source: JICA Project Team

Figure 11.6.14 Weight of Assessment Items

2) Safety Evaluation of Evacuation Anchorage

The results of safety evaluation of evacuation anchorage are shown in Table 11.6.3. Importance level is indicated to evaluate the importance of evacuation anchorage for ship. The score of each evacuation anchorage was made considering the number of ship time weight of the ship type, and accumulated for all ship types.

A higher score means a more important evacuation anchorage. More than ten points is Level 3, more than five points is Level 2, and less than five points is Level 1.

All “P” evacuation anchorages are of less importance, except for P3, which is important, while “H” is of medium importance, and “K” is from Levels 1 to 3.

Table 11.6.3 Result of Safety Evaluation of Evacuation Anchorage

Evacuation Area	Number of Ships			Gathering Important Ships Index ∑ (Weight × Ship)	Important Level**
	Passenger (0.6844)*	Cargo (0.2138) *	Work Ship (0.1018) *		
H1		23	27	7.67	2
H2		30		6.41	2
H3		30		6.41	2
H4	35	20	10	29.25	3
H5	15	27	28	18.89	3
H6		15	62	9.52	2
K1	5		14	4.85	1
K2	33			22.59	3
K3	10	2	22	9.51	2
P1			17	1.73	1
P2		19	18	5.89	2
P3	4	38	16	12.49	3
P4			20	2.04	1
P5			30	3.05	1
P6			30	3.05	1
P7			30	3.05	1

* ( ): Weight of ship type
* * Index 1.0-4.9 ⇒ Rank 1, Index 5.0-9.9 ⇒ Rank 2, Index 10.0- ⇒ Rank 3

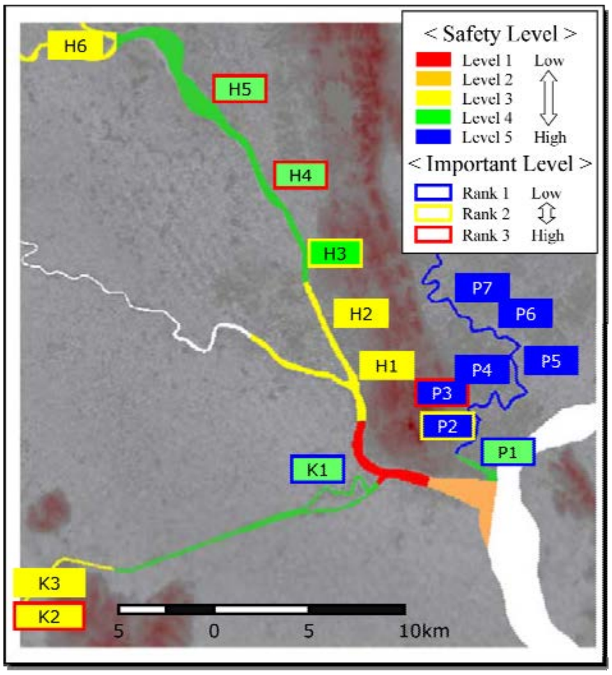
Source: JICA Project Team

(5) Safety and Importance Evaluation of Evacuation Anchorage

Both the safety level and importance level of evacuation anchorage are shown in Figure 11.6.15. Fill color of the text box indicates the safety level, and border color indicates the importance level.

The importance level at K2, H4, H5, and P3 are high, while the safety level at H1, H2, H6, K2, and K3 are at the middle.

K2 requires attention because the safety level thereat is middle but its importance level is high.



Source: JICA Project Team

Figure 11.6.15 Safety and Important Evaluation of Evacuation Anchorage

11.6.2 SHIP OPERATION FOR EVACUATION

(1) Background

Before Cyclone Nargis there was only a simple disaster prevention plan and no clear guidelines of evacuation anchorages in Myanmar. Therefore, damage was extensive due to late evacuation or inappropriate anchorages.

The Myanmar government established guidelines for evacuation alarm and anchorages, and it was informed to ships in parallel with the project. The JICA Project Team assessed the safety of the designated evacuation anchorages with simulations, as described in Section 11.6.1. In this section, evacuation alarm and ship operation during disasters are described.

(2) Results of Safety Assessment of Evacuation Anchorages

The safety level of evacuation anchorages were assessed based on the storm surge simulation. In the results, evacuation anchorages that were specified by the Myanmar government were safer than the unspecified area, which means specification by the Myanmar government was appropriate. However, safety levels were different among the evacuation anchorages, and each evacuation anchorage had limitation of ship size. Therefore, it is recommended to describe detailed information in the guidelines.

(3) Causes of Damage to Ships during Cyclone Nargis

When Cyclone Nargis came, large ships departed Yangon Port following MPA's instructions. Accidents such as collisions or stranding did not occur. However, the port was mired in confusion as ferries, small cargo ships, and barges were in collision, sinking, or stranding by the strong wind and storm surge. The following were the factors with respect to soft and hard measures:

1) Soft Measure Factors

There were no evacuation guidelines in case of a cyclone. Evacuation anchorages were not designated clearly. The contents of the evacuation alarm and its dissemination method and timing were not specified clearly.

2) Hard Measure Factors

In Yangon Port, there were many old ships with 50 years of age such as IWT ferries. In addition, the lack of hardware in the port was also a major problem. Such included pontoon jetties that are weak to gales and storm surges, lack of mooring buoys, and lack of supporting ships and communication facilities.

(4) Evacuation of Ships at the Time of Storm

Evacuation of ships in ports differ with respect to the ship's size and type, and the strength/weakness of berths against gales and storm tides. Generally, small ships with sizes less than 1,000 gross tons can evacuate to somewhere in the port less influenced by the wind. However, ships of over 1,000 gross tons should move away from the berth (pier, jetty, and anchorage) in order to avoid the effects of strong wind by the reasons listed below. Generally for major ports in the world, the evacuation of ships is recommended by the coast guard or the port authority (coast guard in case of Japan).

- Generally, the space of the port is narrow; thus there is no space for evacuation of ships.
- Dragging anchor of one ship damages many other ships due to the narrow space in the port.
- Effects from waves are small in the port; however, the wind effect is the same as outside the port. Container ships and car carrier ships are largely affected by the wind pressure, and cannot withstand the wind pressure at piers.
- It is recommended for large ships to move out of the port or out of the bay when an approaching typhoon is expected.

In some cases, the outside of the port is also congested with many evacuated ships from the port. Wave action outside of a breakwater is strong. It is necessary to be careful because accidents between ships can occur as caused by anchor dragging.

(5) Considerations at the Time of Evacuation

In case of mooring at a pier/jetty, the following should be considered:

- Location of berth is desirably at a pier blocking the wind.
- Shallow draft ships have a risk to be pushed up to the land by storm surge. Especially, Yangon Port needs attention.
- Deepening the draft of the ship by ballasting water.
- Checking the conditions of the pier/jetty fenders to avoid damage on the ship's hull.
- Confirming the strength of the shore bitts.
- Increasing the number of mooring ropes. A rope is taken in far and to be horizontal.
- Mooring ropes are to be adjusted to fit the height of tide.

- Standby main engine and ships pumps.

Evacuation anchorages outside the port:

- Generally, a ship's evacuation moving outside the port is initiated based on advisories from the coast guard or the port authority. Ships should move outside the port 10 to 15 hours before a cyclone strikes.
- When the direction of gale is announced by weather forecast, ships choose anchorages where the wind is blocked such as in shade of islands or lands. For preparation of a ship's movement, anchorages should be so chosen that the water depth (under keel clearance) is over 10 m. As a countermeasure against strong winds, the ship's draft is better to be kept as deep as possible incorporating trim by the head or even keel by ballasting.

(6) Evacuation of Ships in Japan

When a typhoon approaches, the evacuation of ships in main Japanese ports is generally implemented as follows:

1) Legal System in Japan

Ship evacuation during typhoons is defined in the "Act on Port Regulations" as follows:

Act on Port Regulations, Article 10, Order of Moving

"The Captain of the specially designated port has a power to order the ships berthing in his port to move out in the special situations, such as the case in which evacuation of ships is necessary due to an approaching typhoon."

Article 10 can be applied to other ports than the specially-designated port, by provisions applied mutatis mutandis.

2) Typhoon Measures Council

When a typhoon approaches, the Typhoon Measures Council is held under the Act on Port Regulations in Japanese main ports. Members of the council consist of the Maritime Safety Agency and port representatives, as shown in Figure 11.6.16 below. The results of the conference are submitted as recommendations to the port captain.

Source: JICA Project Team

Figure 11.6.16 Typhoon Measures Council

Considerations regarding typhoon measures in the council are as follows:

- Forecast of path and impact of typhoon.
- Condition of ships in the port and work of dangerous cargo.
- Necessity of alert, time of issue and termination.
- Method of evacuation.
- Other necessary measures.

3) Contents of Evacuation Call

The state of alert and contents of an evacuation call, which are decided by the Typhoon Measures Council are summarized in Table 11.6.4.

Table 11.6.4 Summary of Measures on Typhoon

Classification	Items of Implementation
First Alert (Standby Alert)	1. Ships in the port should start preparation for stormy weather and shift outside the breakwaters. 2. Cargo work involving dangerous cargo, discharging of wood into the water, and raft ride should be cancelled. 3. Wood and equipment should be prevented from dropping into the water.
Second Alert (Evacuation Alert)	1. Ships should complete preparation for stormy weather and be put on a heightened alert. 2. Ships (which is defined in the following note) are strongly recommended to shift outside the breakwaters. (Unseaworthy vessels should take extra safety measures.) 3. Small ships should be evacuated to safer places, such as rivers and canals. 4. Prevention of dropping of wood and work equipment should be completed. Heightened alert should be observed.
Limitation of Entry into Port	All ships of 1,000 G/T and over should not enter the port. (This shall not apply for ships and ferries with boarding passengers)

Note: The following ships except unseaworthy vessels are strongly recommended to shift to outside of breakwaters.
1. Tankers (carrying dangerous goods) of 1,000 G/T and over.
2. High-freeboard-ships (i.e., car ferries, container ships, car carriers)
3. Other ships of 1,000 G/T and over mooring berths which are not considered to be well sheltered from the waves and winds.

Source: Port of Keihin, Japan

4) Standard Evacuation Recommendation in Tokyo Bay

The Typhoon Measures Council gets called and evacuation recommendation is issued in the following situations, as necessary:

1) A typhoon moves.
2) The typhoon reaches.
3) The typhoon is expected to strike.
4) The wind speed increases.

Evacuation should be finished under weather conditions in which embarking and disembarking of the pilot, work of tugboat, and unmooring work can be performed safely. Evacuation due to typhoon is finished by experience appropriately before the wind speed becomes more than 15 m/s. Therefore, an evacuation recommendation is issued by calculating the time that allows the evacuation to be completed before the wind speed becomes 15 m/s.

Table 11.6.5 Standard Evacuation Recommendations in Tokyo Bay

Typhoon with wind speed of 25 m/s or over on average.	
1.	Ships carrying dangerous goods (VLCC, LNG, LPG, etc.) and high-freeboard ships (PCC, car ferries, container ships) evacuate outside the port.
2.	Ships mentioned in no. 1 above moving toward Tokyo Bay postpone entering the port and evacuate to safer sea areas or ports temporarily.
3.	General cargo ships (more than 3,000 G/T) evacuate to the inside of Tokyo Bay.
Typhoon with wind speed of more than 20 m/s, and less than 25 m/s on average.	
1.	Ships carrying dangerous goods evacuate outside the port if necessary.
2.	High-freeboard ships evacuate to favorable anchorage. General cargo ships (except for good berths mooring ship) evacuate to inside the port.
3.	As a general rule, mooring ships (moderate draft, small are exposed to wind) at good berths (serenity degree is high in the expected typhoon) stay at the berths.
Typhoon with wind speed of less than 20 m/s.	
1.	Ships carrying dangerous goods, high-freeboard ships, ships with fore and aft mooring, mooring to buoy and mooring ships at low serenity of berth evacuate inside the port.
2.	General cargo ships weather out the typhoon by berthing.

Source: Port of Keihin, Japan

5) Report and Contact System

The captain of the port issues the recommendations to the members of the council with time to spare. Members transmit this warning to their ships (including fish boats, barges, and small ships) mooring at the pier, jetty or buoy in the port. Then each ship takes precautionary measures. Report and contact are implemented by telephone, FAX or email. The system is based on the “Contact system of the Typhoon and Tsunami Measures Council”. In case of emergency, members contact the ships by VHF, etc.

(7) Comments on the Evacuation of Ships in Myanmar

MPA has the authority on ship evacuation during disasters in Yangon Port. Ship evacuation of IWT is managed by IWT, which is the owner of ships.

As the situation during Cyclone Nargis was compared with the ship evacuation in Japan, studies on the following points are recommended:

- Improvement of rules and regulation on ship evacuation,
- Improvement of data collection and analysis methods for weather and sea conditions, and
- Implementation of regular public-private joint disaster drills based on the Maritime Disaster Prevention Programme.

11.7 TSUNAMI DAMAGE ESTIMATION IN YANGON PORT

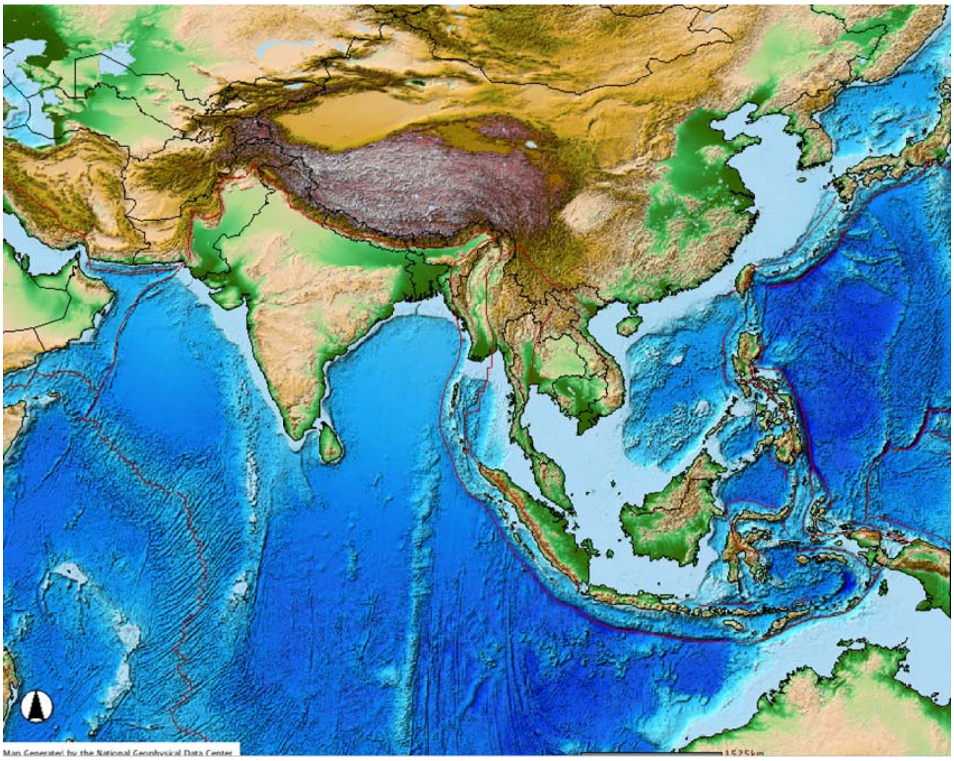
11.7.1 EARTHQUAKE IN MYANMAR

(1) Geological Structure

Myanmar is located at the boundary of the India-Australia Plate and the Eurasia Plate, as shown in Figure 11.7.1. The Sagaing Fault bisects the east and west parts of Myanmar, as shown in Figure 11.7.2. This active fault is strike-slip and the interval of fault activity is short.

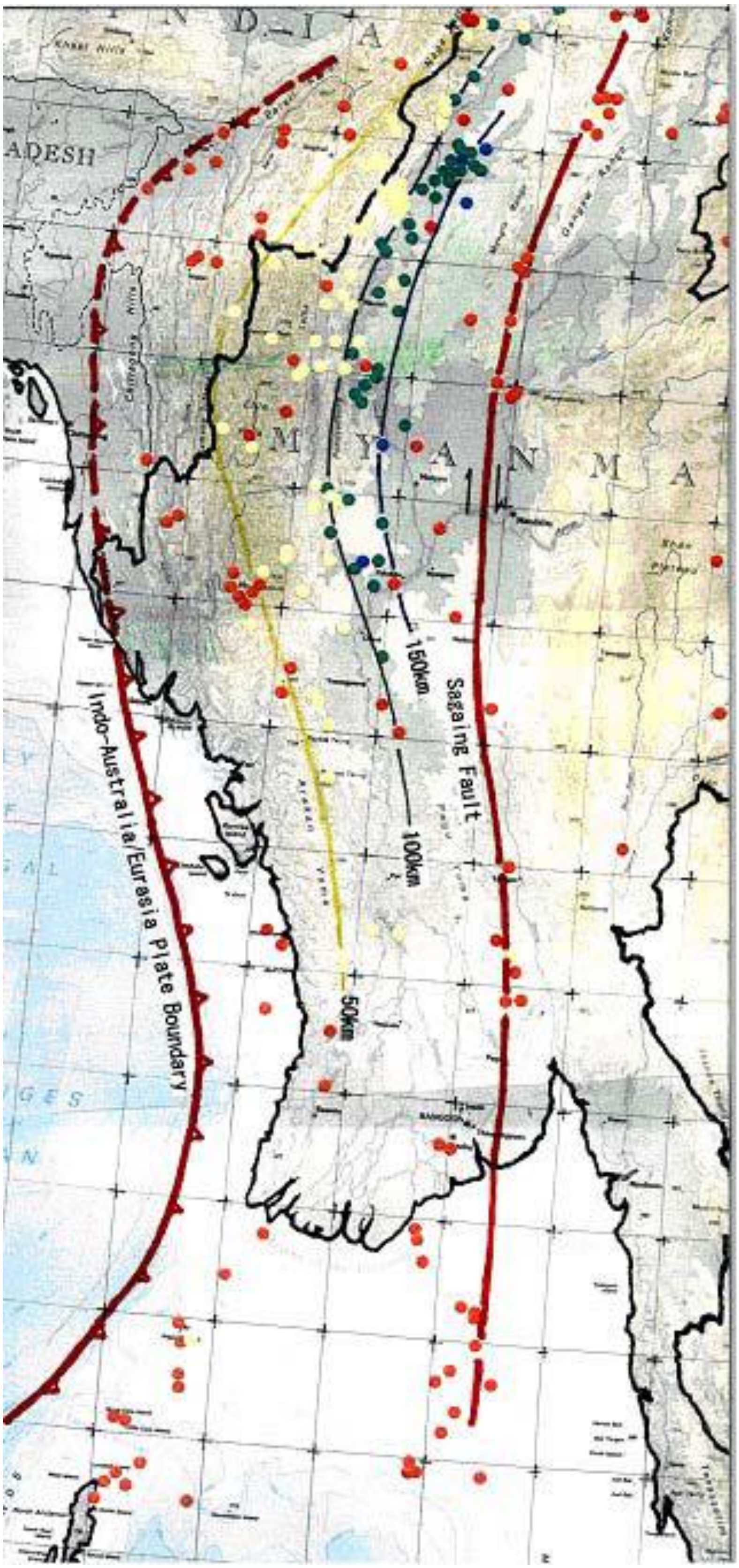
Geological characteristics of Myanmar is divided by the Sagaing Fault, namely, moderately hard granite/ dolomite in the east, and soft sandstone/limestone/conglomerate in the west. Furthermore, a large delta is formed by the Ayeyarwady River and the Sittang River.

Due to the existence of plate boundaries and long and active faults in Myanmar, this country is susceptible to earthquakes. It is to be noted that earthquakes with epicenters at the plate boundaries often causes tsunamis. Thus, disaster prevention against earthquakes and tsunamis is very important for safety and security in Myanmar.



Source: National Geophysical Data Center

Figure 11.7.1 Location of Tectonic Plate around Myanmar



Source: GUPI Newsletter No.12, 2005

Figure 11.7.2 Location of Sagaing Fault and Plate Boundary around Myanmar

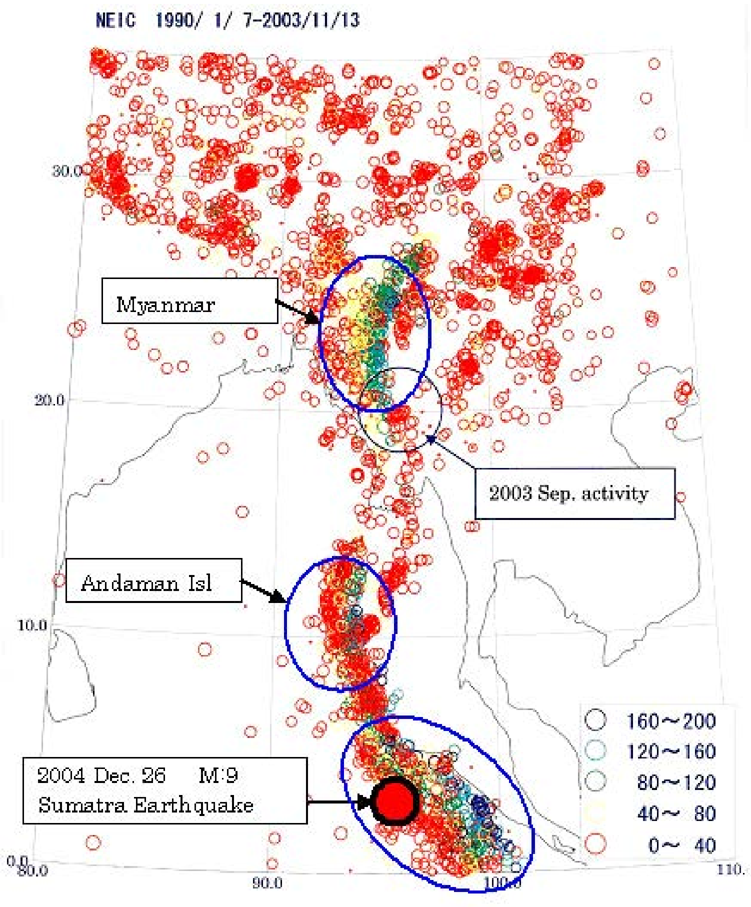
(2) Past Earthquakes in Myanmar and in Adjacent Countries

In accordance with the literatures shown in Table 11.7.1, a database of past earthquakes in Myanmar was made. The database records the earthquakes that occurred within a 1,000 km radius from Yangon City. An epicenter location map based on the combined earthquake data is shown in Figure 11.7.3. Since 1900, about 760 earthquakes of magnitude equal to or greater than 4.8 occurred (see Figure?11.7.4). Majority of earthquakes occurred in the north (Sagaing Division), but several earthquakes also occurred in the south (see Figure 11.7.3). Several epicenters were near Yangon, nevertheless most of the epicenters were located more than 400?km away from Yangon (see Figure 11.7.5). Especially, many facilities were damaged in Yangon by the 1970 Rangoon Earthquake (see Figure 11.7.6).

Table 11.7.1 Collected Earthquake Literature List

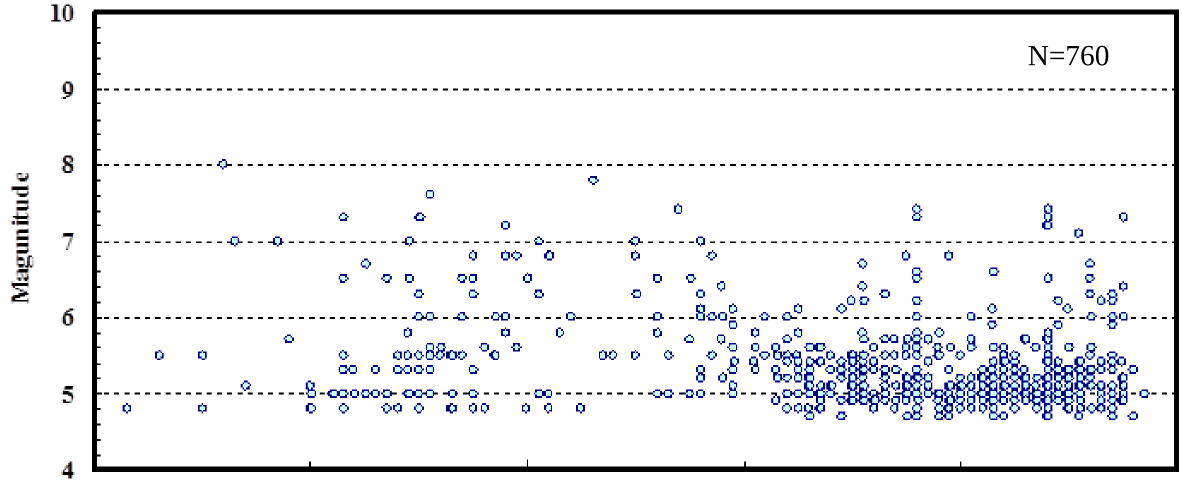
Name of Literature	Period of Earthquake Record	Number of Earthquakes	Notes
US Geography Survey	BC 7670 - 1997	14,299	
Utsui Catalog	1762 - 2008	29	Earthquakes in Myanmar only
Lin Catalog	1912 - 2003	15	ditto
Aung Cho, U Htu	1906 - 1991	25	ditto

Source: JICA Project Team



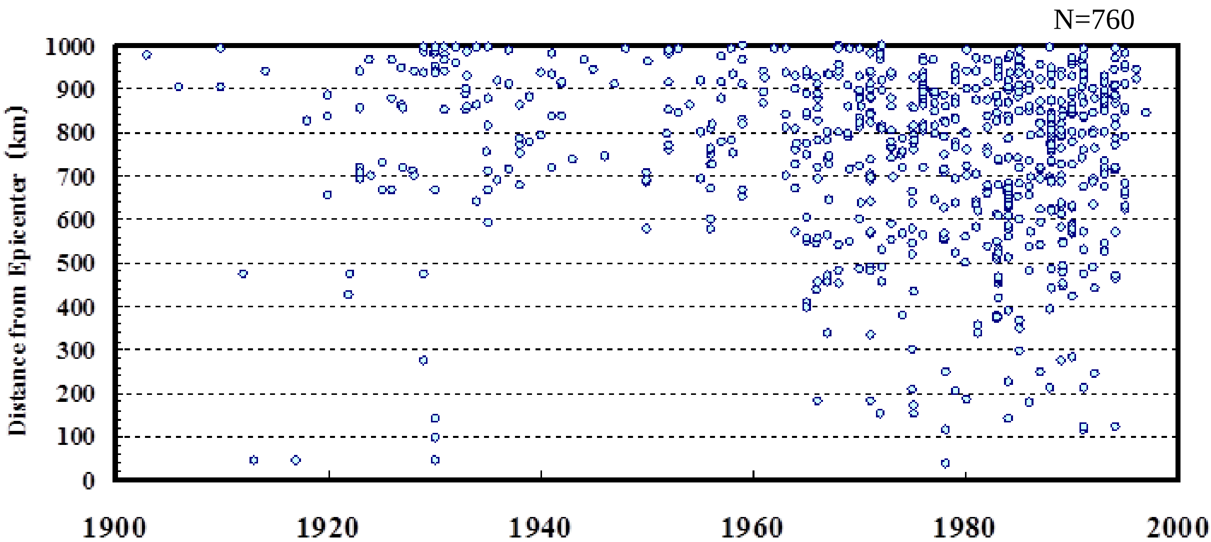
Source: GUPI Newsletter No.12, 2005

Figure 11.7.3 Epicenter Location Map Based on the Combined Earthquake Data



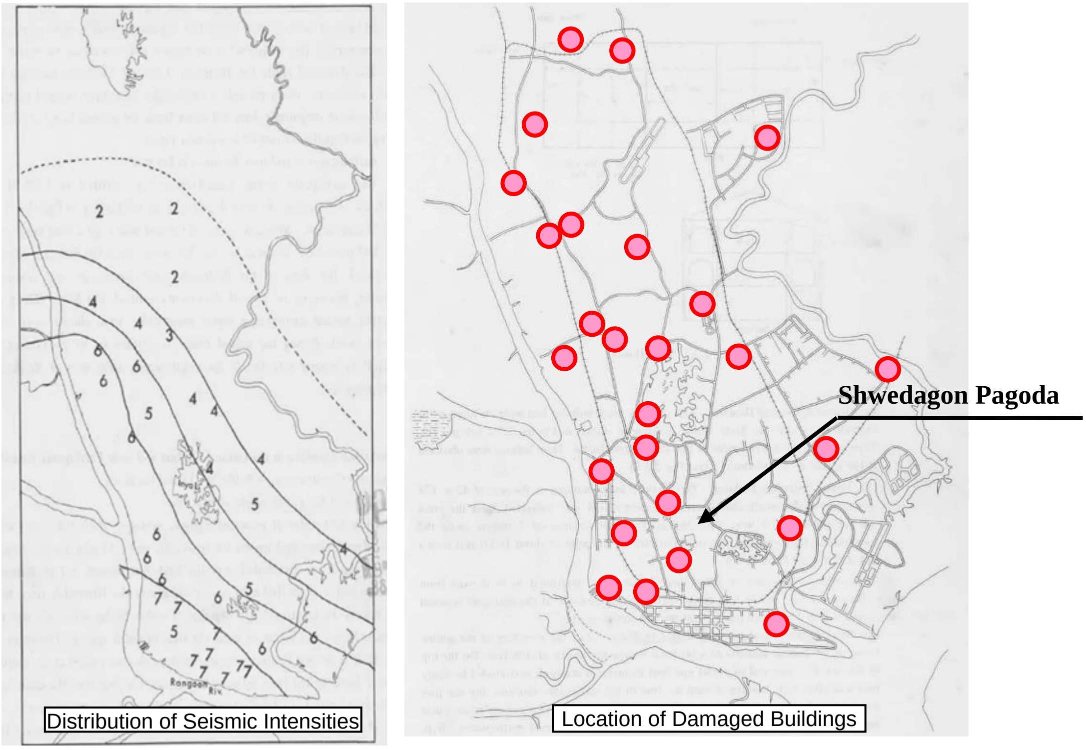
Source: JICA Project Team

Figure 11.7.4 Magnitude of Earthquakes Based on the Combined Earthquake Data



Source: JICA Project Team

Figure 11.7.5 Distance from Epicenter to Yangon Based on the Combined Earthquake Data



Source: Preliminary Survey on Present Status and Scope of Seismology and Earthquake Engineering in the Burma, edited by JICA Project Team

Figure 11.7.6 Distribution of Seismic Intensities and Location of Buildings Damaged by the 1970 Rangoon Earthquake

11.7.2 TSUNAMI CONDITIONS IN MYANMAR AND ADJACENT COUNTRIES

(1) Past Damage by Tsunami

There are not many records of tsunami damage in Myanmar due to the fact that (i) tsunamis do not become high due to topography (unlike ria shoreline), and (ii) populated cities are not located in coastal areas.

The 2004 Indian Ocean Tsunami caused tremendous damage in Indian Ocean countries including Myanmar. Table 11.7.2 summarizes the size of the tsunami. Table 11.7.3 summarizes the damage by the tsunami in each country. According to the announcement by the Myanmar government, the casualty toll (dead and injured) was about 100 (including about 60 deaths). The damage in Myanmar is relatively smaller than in other countries such as Indonesia, Thailand, and Sri Lanka, as shown in Table 11.7.3.

Table 11.7.2 Summary of the 2004 Indian Ocean Tsunami

Date	26 Dec. 2004 at 0:58:49 (UTC)
Size	Mw=9.0 (the 4th largest size on record)
Location	3.30 N, 95.78 E
Depth	10 km
Tsunami Height	Maximum height among affected countries：48.9 m (run-up height, in Indonesia) Myanmar：1 to 2 m (3 to 7 feet) (location unknown)

Source: JICA Project Team

Table 11.7.3 Damage by the 2004 Indian Ocean Tsunami by Country

Country	Casualty Toll (Dead and Missing)	Victim	Amount (USD)
India	16,389	647,599	1.5 billion
Indonesia	242,322		4.45 billion
Thailand	8,466	73,672	45.2 million
Malaysia	74	8,000	N.A.
Myanmar	62	3,600	*265 million*[1)]
Sri Lanka	36,593	408,407	1.0 billion
Maldives	102	12,000	410 million
Seychelles	3	125	30 million
Somalia	150	54,000	
Total	**304,161**	**1,207,403**	**7,795.2 million**

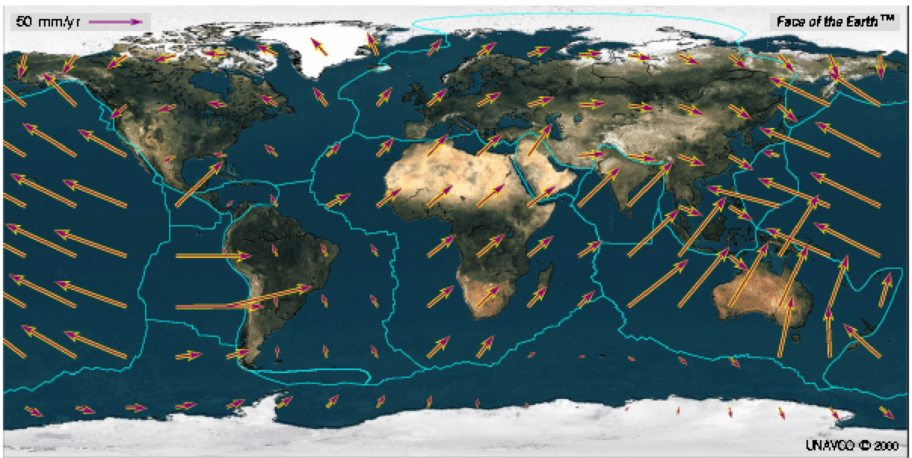
Source: 1):Announcement by the Myanmar Government. Others: Cabinet office in Japan as of 2005.3

(2) Activity of Tectonic Plates in Myanmar

Since Myanmar faces the Indian Ocean, where the Indian Plate lies, Myanmar is susceptible to tsunamis. Figure 11.7.7 shows the movements of tectonic plates on Earth. Plate subduction in the Indian Ocean occurs only at the boundary between the India-Australia Plate and Eurasia Plate around the Indian Ocean. Thus, the potential tsunami occurrence area is limited to this boundary, where the 2004 Indian Ocean Tsunami occurred.

If a tsunami arrives within 30 minutes after an earthquake occurrence, it is difficult to evacuate inhabitants and properties on the coastal area. It would result in huge damage. However, if a tsunami arrives after several hours' notice, the evacuation of inhabitants and properties would be possible. Recently, tsunami arrival forecasts in a short time after occurrence of earthquake have become possible, and subsequently the disaster prevention information system is being improved. It is to be noted that the most important factor in view of disaster prevention is the elapsed time between the occurrence of earthquake and the arrival of tsunami.

Considering the possibility of tsunami occurrence and the tsunami arrival time from the occurrence of earthquake, the target tsunami of this study has been determined as the tsunami caused by earthquakes originated from the boundary of the Indo-Australia Plate and Eurasia Plate.



Source: UNAVCO

Figure 11.7.7 Plate Movement