CHAPTER 3

FACILITY REQUIREMENTS AND MASTER PLAN

TABLE OF CONTENTS

Chapter 3 Facility Requirements and Master Plan

3.1. Design Year

For the purpose of this detailed design study, the new Bohol Airport construction is assumed to be implemented into two Phases.

The design year for Phase 1 development is maintained as previously envisaged (i.e. 2020). For this case the Phase 1 facilities could mainly meet the initial requirements for domestic A320 flight operations, but possibly can accommodate international flights from the neighboring countries such as China, Korea and Taiwan during the domestic off-peak hours (e.g. nighttime).

The airport facilities are expected to be expanded by 2025 to 2030 (called as "Phase 2"), so that the airport can accommodate simultaneously domestic and international flight operations by larger-sized aircraft throughout the day.

The Phase 1 development is hereinafter called the "Project".

3.2. Air Traffic Demand Forecast

3.2.1. Annual Passenger Traffic Demand

Annual passenger traffic demand in comparison with those forecasted in the previous studies is shown in Table 3.2-1.

Table 3.2-1 Annual Passenger Traffic Forecast (in comparison with previous studies)

CY	2000 FS				2006 JICA	2007 FS			2011 JICA Study			
	Filipino Tourist	Foreign Tourist	Filipino Resident	Total	Total	Filipino	Foreig-ner	Total	Case	Domestic	Inter-national	Total
	Actual Record											
2001	39,268	-	-	39,268								
	Forecast					Actual Record						
2006	96,000	64,000	57,000	217,000		240,176	-	240,176				
						Froecast						
						403,000		413,400		Actual Record		
2010	198,000	111,000	84,000	393,000	245,392	437,000	10,400	447,400		572,476	-	572,476
						525,000		535,400		Froecast		
						519,000		534,000	Low	898,000	2,000	900,000
2015	318,000	178,000	128,000	624,000	353,698	656,000	15,000	671,000	Midium	1,037,000	3,000	1,040,000
						992,000		1,007,000	High	1,185,000	3,000	1,188,000
						627,000		658,200	Low	1,125,000	6,000	1,131,000
2020	514,000	288,000	189,000	991,000	494,712	938,000	31,200	969,200	Midium	1,393,000	43,000	1,436,000
						1,561,000		1,592,200	High	1,615,000	50,000	1,665,000
						716,000		793,400	Low	1,295,000	50,000	1,345,000
2025	827,000	463,000	271,000	1,561,000	679,707	1,262,000	77,400	1,339,400	Midium	1,566,000	136,000	1,702,000
						2,019,000		2,096,400	High	1,908,000	169,000	2,077,000
	n/a				n/a	782,000		963,400	Low	1,343,000	137,000	1,480,000
2030						1,590,000	181,400	1,771,400	Midium	1,773,000	185,000	1,958,000
						2,333,000		2,514,400	High	2,231,000	274,000	2,505,000
						828,000		1,209,400	Low	1,414,000	164,000	1,578,000
2035						1,882,000	381,400	2,263,400	Midium	1,937,000	268,000	2,205,000
						2,479,000		2,860,400	High	2,590,000	362,000	2,952,000
						n/a			Low	1,469,000	189,000	1,658,000
2040									Midium	2,117,000	324,000	2,441,000
									High	2,960,000	459,000	3,419,000
									Low	1,508,000	209,000	1,717,000
2045									Midium	2,285,000	380,000	2,665,000
									High	3,342,000	563,000	3,905,000

Source: JICA Study Team

3.2.2. Peak-Hour Air Passengers Demand

Peak-day and peak-hour passenger traffic demands are forecasted as shown in Table 3.2-2

Table 3.2-2 Peak Hour Air Traffic Demand at New Bohol Airport (Medium Case)

				CY	2015		2020		2025		2030		2035		2040		2045	
Domestic Traffic																		
Peak-days of the year					320	days	320	days	320	days	320	days	320	days	320	days	320	days
2-way Annual Passengers						1,037,000		1,393,000		1,566,000		1,773,000		1,937,000		2,117,000		2,285,000
2-way Peek-day Passengers					(1/320)	3,241	(1/320)	4,353	(1/320)	4,894	(1/320)	5,541	(1/320)	6,053	(1/320)	6,616	(1/320)	7,141
1-way Peek-day Passengers						1,620		2,177		2,447		2,770		3,027		3,308		3,570
1-way Peak-day Traffic	aircract	Seat	L/F	Pax	flights	passenger	flights	passenger	flights	passenger	flights	passenger	flights	passenger	flights	passenger	flights	passenger
	DH3	50	70%	35	4.00	140	4.00	140	4.00	140	4.00	140	4.00	140	4.00	140	4.00	140
	A320	160	70%	112	13.22	1,480	16.00	1,792	16.00	1,792	16.00	1,792	16.00	1,792	16.00	1,792	16.00	1,792
	B767	260	70%	182														
	A330	300	70%	210			1.16	245	2.45	515	3.99	838	5.21	1,095	6.55	1,376	7.80	1,638
	subtotal				17.22	1,620	21.16	2,177	22.45	2,447	23.99	2,770	25.21	3,027	26.55	3,308	27.80	3,570
2-way Annual Traffic	aircract	Seat	L/F	Pax	flights	passenger	flights	passenger	flights	passenger	flights	passenger	flights	passenger	flights	passenger	flights	passenger
	DH3	50	70%	35	2,560	89,600	2,560	89,600	2,560	89,600	2,560	89,600	2,560	89,600	2,560	89,600	2,560	89,600
	A320	160	70%	112	8,459	947,400	10,240	1,146,880	10,240	1,146,880	10,240	1,146,880	10,240	1,146,880	10,240	1,146,880	10,240	1,146,880
	B767	260	70%	182														
	A330	300	70%	210			745	156,520	1,569	329,520	2,555	536,520	3,336	700,520	4,193	880,520	4,993	1,048,520
	subtotal				11,019	1,037,000	13,545	1,393,000	14,369	1,566,000	15,355	1,773,000	16,136	1,937,000	16,993	2,117,000	17,793	2,285,000
PHF	1.51/ (2-way peak-day movements) + 0.115				15.9%		15.1%		14.9%		14.6%		14.5%		14.3%		14.2%	
1-way Peak-hour Traffic	aircract	Seat	L/F	Pax	flights	passenger	flights	passenger	flights	passenger	flights	passenger	flights	passenger	flights	passenger	flights	passenger
	DH3	50	80%	40	0.64	25	0.60	24	0.59	24	0.59	23	0.58	23	0.57	23	0.57	23
	A320	160	80%	128	2.10	269	2.41	309	2.38	304	2.34	300	2.32	297	2.29	294	2.27	291
	B767	260	80%	208														
	A330	300	80%	240			0.18	42	0.36	87	0.58	140	0.76	181	0.94	226	1.11	266
	subtotal				2.73	294	3.19	375	3.34	416	3.51	464	3.65	501	3.81	542	3.95	580
International Traffic																		
Peak-days of the year					7	days	80	days	158	days	191	days	207	days	218	days	228	days
2-way Annual Passengers						3,000		43,000		136,000		185,000		268,000		324,000		380,000
2-way Peek-day Passengers						416		539		861		970		1,297		1,483		1,665
1-way Peek-day Passengers						208		270		431		485		649		742		833
1-way Peak-day Traffic		Seat	L/F	Pax	flights	passenger	flights	passenger	flights	passenger	flights	passenger	flights	passenger	flights	passenger	flights	passenger
	A320	160	65%	104			0.59	62	2.14	223	2.66	277	3.53	367	3.72	387	3.85	400
	B767 charter	260	80%	208	1.00	208	1.00	208	1.00	208	1.00	208	1.00	208	1.00	208	1.00	208
	A330	300	65%	195									0.38	74	0.75	147	1.15	225
	subtotal				1.00	208	1.59	270	3.14	431	3.66	485	4.91	649	5.47	742	6.00	833
2-way Annual Traffic		Seat	L/F	Pax	flights	passenger	flights	passenger	flights	passenger	flights	passenger	flights	passenger	flights	passenger	flights	passenger
	A320	160	65%	104			330	34,320	1,196	124,384	1,608	167,232	2,226	231,504	2,480	257,920	2,650	275,600
	B767charter	260	80%	208	16	3,328	40	8,320	58	12,064	84	17,472	104	21,632	126	26,208	148	30,784
	A330	300	65%	195									76	14,820	208	40,560	380	74,100
	subtotal				16	3,328	370	42,640	1,254	136,448	1,692	184,704	2,406	267,956	2,814	324,688	3,178	380,484
PHF	according to Simulated International Flight Schedule				one(1) A320		one(1) A320		one(1) A320		one(1) A320		one(1) A330		one(1) A330		one(1) A330	
1-way Peak-hour Traffic		Seat	L/F	Pax	flights	passenger	flights	passenger	flights	passenger	flights	passenger	flights	passenger	flights	passenger	flights	passenger
	A320	160	80%	128	1.00	128	1.00	128	1.00	128	1.00	128						
	B767charter	260	80%	208														
	A330	300	80%	240									1.00	240	1.00	240	1.00	240
	subtotal				1.00	128	1.00	128	1.00	128	1.00	128	1.00	240	1.00	240	1.00	240
Cargo Traffic																		
Peak-day Volumes (MT)						25.7		33.5		37.3		41.9		45.5		49.4		53.1

Source: JICA Study Team

3.2.3. Fleet Plan of Major Domestic Airlines in the Philippines

Short-term fleet plans of the four (4) major domestic airlines are summarized in Table 3.2-3.

Table 3.2-3 Short-term Fleet Plan of major domestic Airlines in the Philippines

Aircraft		Philippine Airlines (PAL)		Air Philippines		Cebu Pacific Air		Zest Airways	
type	seats	in 2011	in 2015	in 2011	in 2015	in 2011	in 2015	in 2011	in 2015
B747	400	5	0						
B777	370	2	15						
A340	264	4	0						
A330	302	8	8						
A320	150-180	13	27	6	23	15	27	5	9
A319	140-156	4	4			14	14	1	1
ATR72	72					8	8		
MA60	56							3	5
DH3	56			3	3				
DH4	76			5	5				
Total		36	54	14	31	37	49	9	15
Remarks		Plan to later replace the A330 and A340 with B787 or A350 Hub at Manila		Sister company of Philippine Airlines Hub at Manila		Expects delivery of thirty (30) A321 from 2017 to 2021 Hub at Manila, Cebu and Clark		Formerly named as Asian Spirit Hub at Kalibo and Clark	

Source: JICA Study Team

Philippine Airlines (PAL), the legacy national flag carrier, plans to increase from now up to 2015 the number of A320's from 13 to 27 and that of B777's from 2 to 15. PAL also plans to phase out the B747's and A340's and replace them with A330's to B787's or A350's.

Air Philippines, a LCC established in 1996 by PAL as its sister company, plans to increase from now up to 2015 the number of A320's from 6 to 23, and maintain the current 3 DH3's and 5 DH 4's (of Bombardier).

Cebu Pacific Air, a LCC established in 1996, plans to increase from now up to 2015 the number of A320's from 15 to 27, and lately announced to introduce thirty (30) A321's progressively from 2017 to 2021. Cebu Pacific Air now operates frequent regional international flights to Japan, South Korea, China, Hong Kong, Taiwan, Singapore, Thailand, Malaysia and Brunei. In 2010 Cebu Pacific Air carried the most numbers of passengers (international and domestic total) in the Philippines.

Zest Airways plans to increase the number of A320's from 5 to 9 and that of MA60's (of Xian) from 3 to 5. It has its hub at Kalibo Airport, and started regional international flights to South Korea and China from Kalibo Airport since 2009. In 2010 Zest Airways carried the most numbers of international passengers to and from Kalibo.

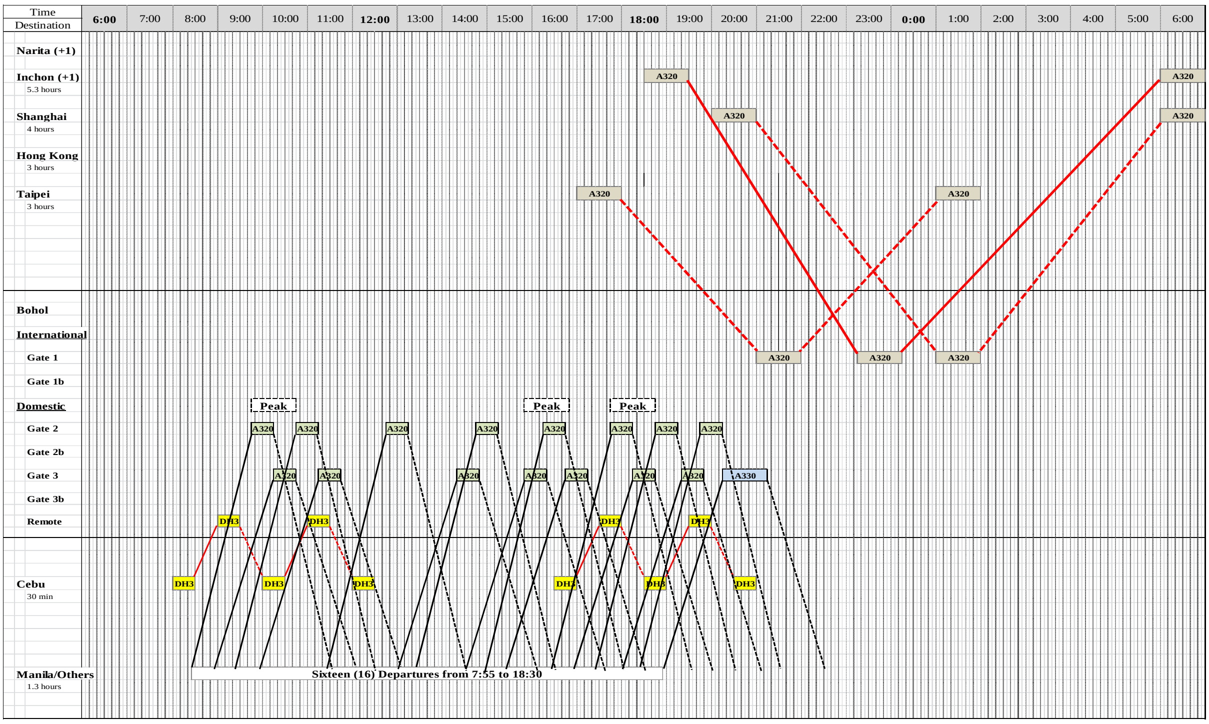
3.2.4. Development Feature determined by DOTC

Since the major four domestic airlines intend to double the number of small jets (e.g. A320 and A321), but not to increase their wide-bodied aircrafts, excepted of PAL who plans to introduce another 13 B777s presumably for long-haul international destinations, the new Bohol Airport is expected to mainly serve to small jet aircraft. Under these circumstances, DOTC decided that the Phase 1 PTB should be of a single-story building, which still can accommodate infrequent international flight during off-peak hours of domestic operations, without passenger boarding bridges and be sized only to cope with required numbers of domestic peak-hour passenger, to save initial investment.

3.2.5. Simulated Flight Schedule

Based on the current domestic flight pattern where round-trip fuel is loaded at Manila (i.e. no refueling service is made at Bohol), domestic turnaround time is assumed to be maintained at 30 minutes for A320 and 1 hour for A330:

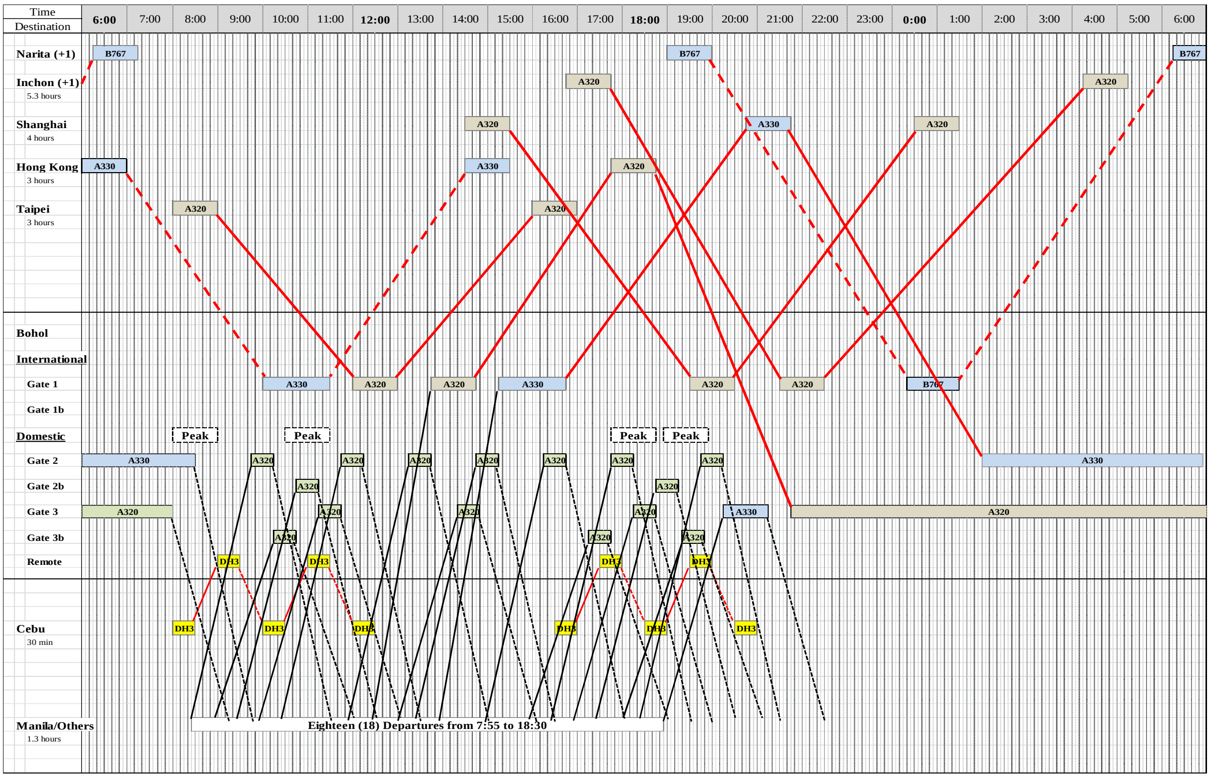
Assuming jet fuel depot is necessarily provided by a private company (e.g. Petron, Shell, Caltex or PAL) at the airport or Tagbilaran port, international operations for the year 2020, prior to start international flight operations, is assumed to be made during night times only. This is also because the Phase 1 PTB does not have dedicated floor space for international operations. Regional international flights are assumed to gradually start from 2020 onward, in order of the highest numbers of foreign visitors, i.e. for China, Taiwan, Korea, and Japan. Flight schedule forecasted for every 5 years (in medium case) are simulated hereunder



Source: JICA Study Team

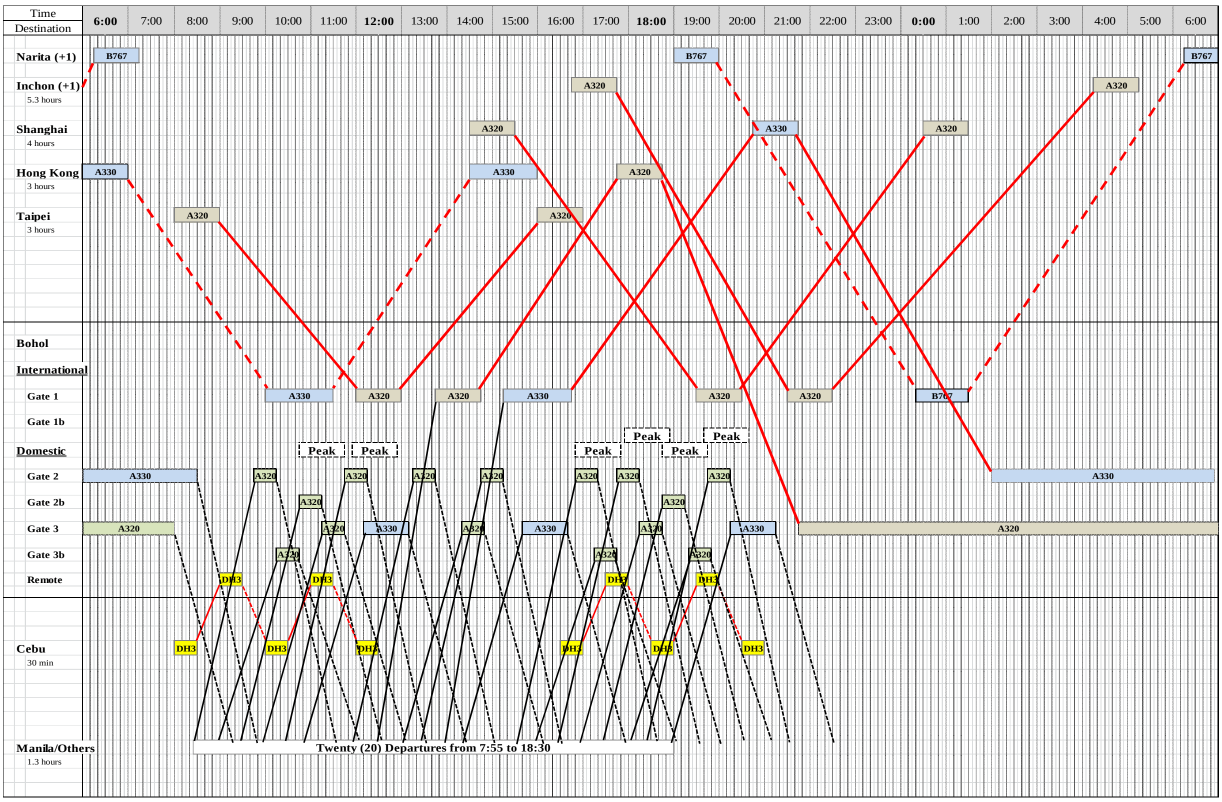
Figure 3.2-1 Simulated Flight Schedule at New Bohol Airport [Medium Case] (2020)

As simulated in Figures 3.2-2 through 5, international operations for the year 2025 onward are assumed to be scheduled through the day and night because the PTB is expected to be expanded to have dedicated floor space for not more than one (1) international flight operations at the same time frame.



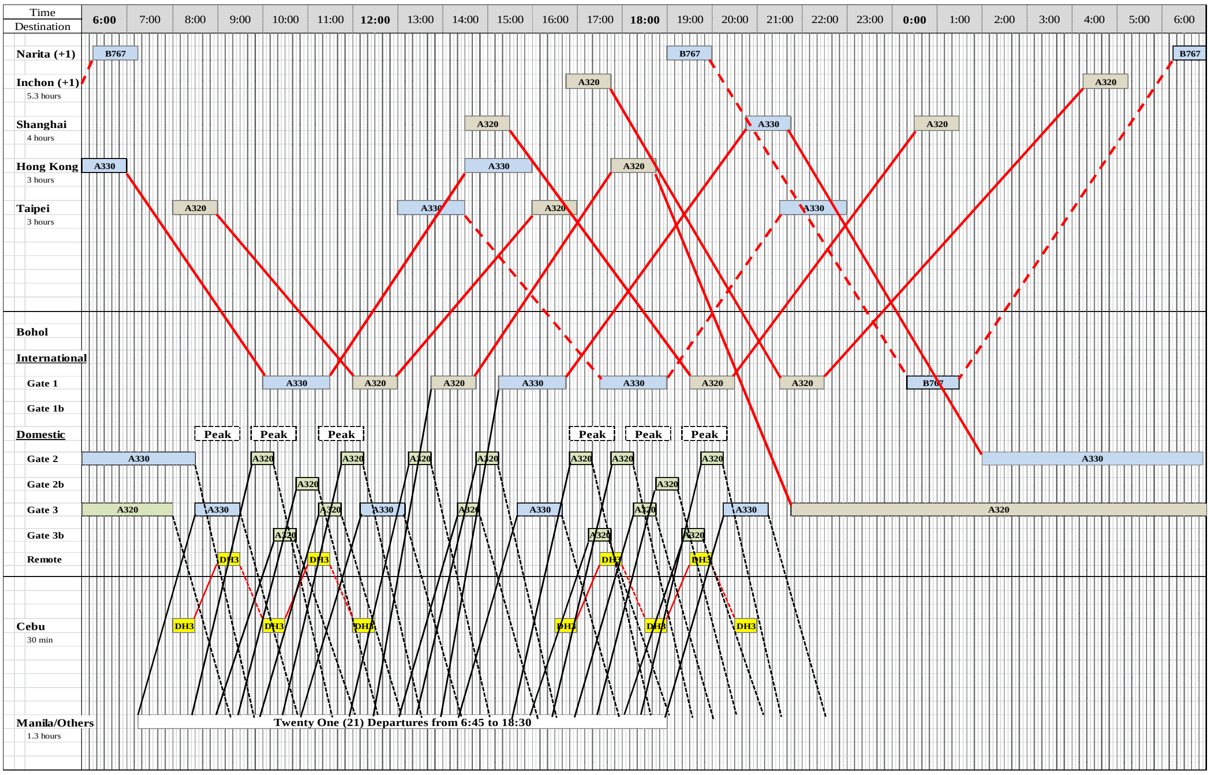
Source: JICA Study Team

Figure 3.2-2 Simulated Flight Schedule at New Bohol Airport [Medium Case] (2025)



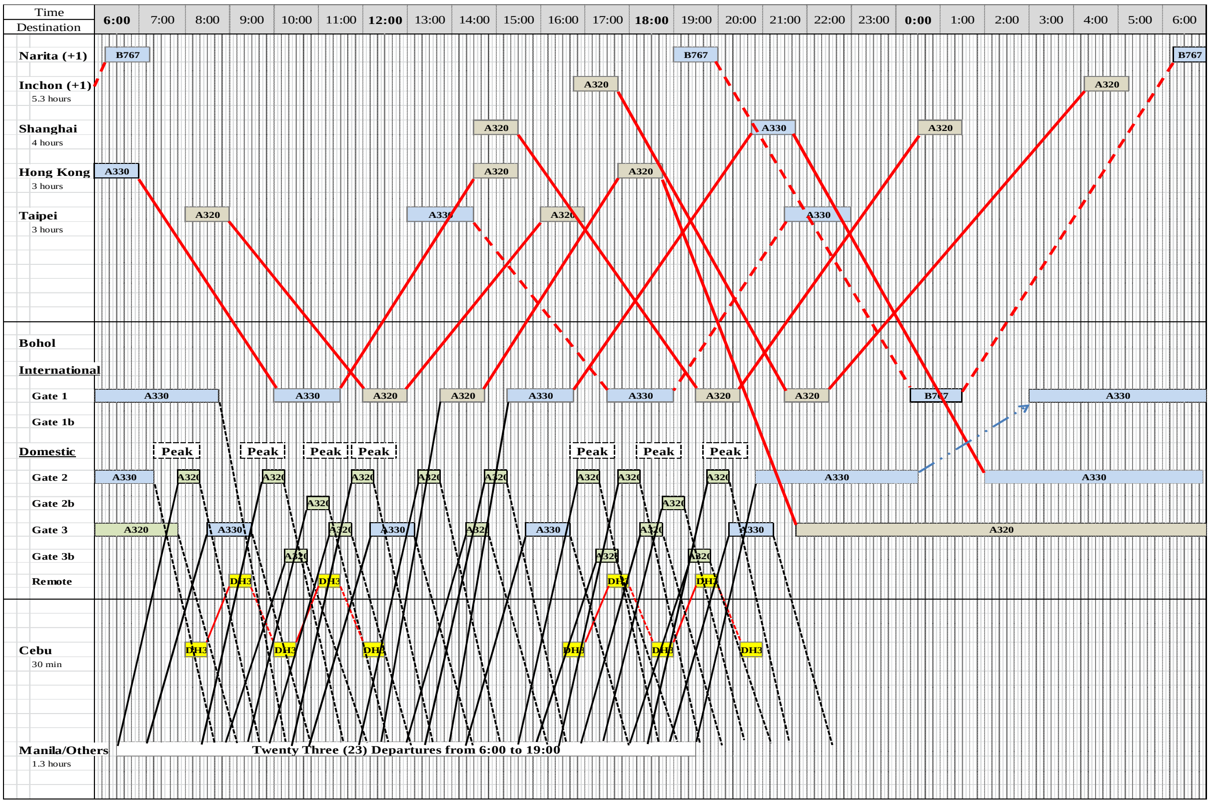
Source: JICA Study Team

Figure 3.2-3 Simulated Flight Schedule at New Bohol Airport [Medium Case] (2030)



Source: JICA Study Team

Figure 3.2-4 Simulated Flight Schedule at New Bohol Airport [Medium Case] (2035)



Source: JICA Study Team

Figure 3.2-5 Simulated Flight Schedule at New Bohol Airport [Medium Case] (2040)

3.3. Runway Length

3.3.1. Design Aircraft

The design aircraft is normally defined as an aircraft either with:

(i) the maximum seating capacity;

(ii) the maximum dimension of fuselage (wing span and length); and

(iii) the longest runway length required.

The current generation of aircraft with large fuselage however does not necessarily require a longer runway length, owing to its improved body structure and engine performance. Hence, the design aircraft is examined among probable future aircraft mix according to its manufacturer's specifications.

In relation to a probable future aircraft mix for the operations at the new Bohol Airport, the following should be noted:

a) At the existing Tagbilaran Airport, the types of aircraft being used by the 4 major airlines are A319 and A320, which are categorized as small jet (SJ; seating capacity varies from 140 to 180), the majority of which are of the latest models.

b) B747 of PAL is mainly used for international routes and some used for domestic routes (e.g. for Davao and Cebu). PAL, however, plans to phase out B747's by 2015, as is the trend worldwide due to its high fuel consumption, thus this aircraft type is eliminated from the fleet planning for the new Bohol Airport.

c) B777 or A340 of PAL are exclusively used for long-range international routes, thus are not considered as a predominantly-used aircraft at the new Bohol Airport.

d) A330 is long used by PAL with a good performance (low fuel consumption and requiring a shorter runway length). PAL intends to replace their A330 by A350, B787 or B777. Dimensions, weights and required runway lengths of those aircraft of this new generation are similar to A330, therefore A330 is assumed as the predominantly-used aircraft. However, the fuselage length of B777-300 (73.86 m) is considered as a critical dimension that is applied in the setting-up of building lines (to secure separation distance from taxiways required in the foreseeable future).

e) Since LCC's normally operate a single type of aircraft for their reason of easy maintenance with common spare parts availability, the A320 is assumed to be predominantly utilized in the Philippines. Cebu Pacific intends to add in their medium-term plan the A321 which is the advanced model and has the most critical dimension among A320's family. Thus, the dimension of the A321-200 (7 m longer and 1 m wider than the A320) is considered as the critical-sized SJ in the conceptual design of aircraft parking apron.

f) B737-800 (or -900) is a new Boeing version of SJ, equivalent to the Airbus 320 series, is gaining worldwide popularity for the use for regional international flights. This type of aircraft is now being operated by many foreign airlines in neighboring countries thus is considered to be occasionally operated at the new Bohol Airport.

g) B767's (MJ; 260 seats) are predominantly used for regional flight services by major foreign airlines in neighboring countries, thus is considered to be occasionally operated at the new Bohol Airport, but on a chartered base.

3.3.2. Runway Length Requirement

Meanwhile, the required runway length is studied for each type of the above named aircraft, in consideration of the following assumption:

a) Distance from Bohol to Manila is 620 km, and that to Seoul, Tokyo or Beijing is almost the same, e.g. approximately 3,100 km, as shown in the Figure 3.3-1. For the computation of the takeoff runway required, the critical distance is thus assumed to be 3,100 km.

Source: JICA Study Team

Figure 3.3-1 Distance to Regional Cities from Bohol

b) Reference temperature (average in the hottest month) at the new Bohol Airport is assumed to be the same as at Tagbilaran Airport, which is 34° C.

c) When taking off on a day of bad weather, a tropical depression of up to 980 hPa is considered to be safe, which is equivalent to the airport elevation of 1,000 feet (above mean sea level).

Following the above consideration, the runway length required for the above named aircraft, and design aircraft is selected among those tabulated in Table 3.3-1.

Table 3.3-1 Required Runway Length by ICAO Category of Aircraft

No	Description		Size	SJ			MJ	LJ			
			ICAO code	code C			code D	code E			
			Aircraft Type	A320	B737	A321	B767	A330	B777		B787
				-200	-800	-200	-300	-300	-200	-300	-8
1	Turbo Engine			CFM56		CFM56	CF6	CF6	GE	GE	GE
	Wing Span		m	34.10	35.79	35.48	47.57	60.30	60.93	60.93	60.12
	Fuselarge Length		m	37.57	38.02	44.50	54.94	63.69	63.73	73.86	56.72
2	Seating Capacity		1 class	180	184	220	290	335	418	500	375
			2 classes	150	160	185	261	303	375	451	286
			3 classes	-	-		-	253	305	368	224
3	Max Takeoff Weight		lb	166,449	174,200	191,802	350,000	467,380	535,000	632,500	502,500
			kg	75,500	79,016	87,000	158,758	212,000	242,630	286,900	227,930
4	Max Landing Weight		lb	142,198	146,301	166,449	300,000	390,218	445,000	524,000	380,000
			kg	64,500	66,361	75,500	136,078	177,000	201,800	237,680	172,365
5	Max Zero Fuel Weight		lb	133,380	138,300	157,630	278,000	368,172	420,000	495,000	355,000
			kg	60,500	62,732	71,500	126,099	167,000	190,470	224,530	161,025
6	Operating Empty Weight		lb	90,927	91,300	103,300	189,750	264,182	299,550	353,800	N/A
			kg	41,244	41,413	46,856	86,069	119,831	135,850	160,530	N/A
7	Max Structural Payload		lb	42,452	47,000	54,331	88,250	103,990	120,450	141,200	N/A
			kg	19,256	21,319	24,644	40,230	47,169	54,620	64,000	N/A
8	Fuel	Maximum Usable (0.785 kg/l)	litter	23,667	26,022	23,700	63,216	97,530	117,300	169,210	126,903
			lb	40,959	46,063	41,015	119,890	168,788	207,700	299,490	224,638
			kg	18,579	20,894	18,604	50,753	76,561	94,240	135,880	101,894
9		consumption per km	litter/km	3.10	3.39	4.80	7.01	6.62	7.92	7.78	N/A
			lb/km	5.36	5.86	8.31	12.13	11.46	13.71	13.47	N/A
			kg/km	2.43	2.66	3.77	5.50	5.20	6.22	6.11	N/A
10		consumption for TAG-MNL flight (620km)	litter	1,919	2,101	2,978	4,344	4,107	4,913	4,826	N/A
			lb	3,321	3,636	5,153	7,518	7,108	8,502	8,352	N/A
			kg	1,507	1,649	2,337	3,410	3,224	3,856	3,788	N/A
11		consumption for TAG-NRT flight (3,100 km)	litter	9,596	10,504	14,888	21,720	20,535	24,563	24,129	N/A
			lb	16,607	18,179	25,765	37,589	35,539	42,510	41,758	N/A
			kg	7,533	8,246	11,687	17,050	16,120	19,282	18,941	N/A
12		for Takeoff, Diversion, Holding	litter	750	750	750	3,200	3,700	3,700	3,700	N/A
			lb	1,298	1,298	1,298	5,538	6,403	6,403	6,403	N/A
			kg	589	589	589	2,512	2,905	2,905	2,905	N/A
13		total for TAG-NRT flight (3,100 km)	litter	10,346	11,254	15,638	24,920	24,235	28,263	27,829	N/A
			lb	17,905	19,477	27,063	43,127	41,942	48,913	48,161	N/A
			kg	8,122	8,835	12,276	19,562	19,025	22,187	21,846	N/A
14	Takeoff Weight for TAG-NRT flight (3,100 km)		lb	151,285	157,778	184,694	321,568	410,114	468,827	543,165	N/A
			kg	68,622	71,567	83,776	145,861	186,025	212,657	246,376	N/A
15	Takeoff Runway Length Required for TAG-NRT (3,100 km)	Elevation at sea level; or 1013 hPa	15°C	1,524	1,859	1,829	1,905	1,798	1,707	2,316	N/A
			30 °C	1,646	1,920	1,920	2,012	1,875	1,813	2,423	N/A
			34 °C	1,679	1,936	1,944	2,041	1,896	1,841	2,452	N/A
16		Elevation at 1000 feet; or 980 hPa	15°C	1,585	1,920	1,951	1,981	1,860	1,767	2,438	N/A
			30 °C	1,707	2,027	2,042	2,073	1,951	1,859	2,560	N/A
			34 °C	1,740	2,056	2,066	2,098	1,975	1,884	2,593	N/A
17	Landing Runway Length										
		at sea level	1013hPa	1,463	2,042	1,661	1,737	1,737	1,768	2,134	N/A
		at 1000 feet	980hPa	1,508	2,072	1,707	1,798	1,768	1,829	2,180	N/A

Source: JICA Study Team

The table shows that, in case of the critical conditions (i.e. temperature of 34 °C with a tropical depression of 980 hPa) the critical aircraft requiring the longest runway length is the B777-300.

At any rate, the eventual runway length required for the new Bohol Airport is 2,500 m as was envisaged in the previous study (2007 FS).

In view of the above notes, a comparison of design aircraft in each category of ICAO code is shown in Table 3.3-2.

Table 3.3-2 Comparison of Design Aircraft

Size	Condition	SJ			MJ	LJ	
ICAO code		C			D	E	
Aircraft		A320-200	B737-800	A321-200	B767-300	A330-300	B777-300
Airline		PAL/Cebu	JAL	Cebu	Asiana/JAL	PAL	PAL
Wing Span		34.10	35.79	35.48	47.57	60.30	60.93
Length		37.57	38.02	44.50	54.94	63.69	73.86
Normal Seats		160	185	200	260	300	
Maximum Payload		19 ton	21 ton	25 ton	40 ton	47 ton	64 ton
Takeoff Weight	to Narita	69 ton	72 ton	84 ton	146 ton	186 ton	246 ton
	Maximum	76 ton	79 ton	87 ton	159 ton	212 ton	287 ton
Usage		scheduled	future	future	charter	scheduled	future
Runway Length (34 C)	to Narita	1680 m	1940 m	1950 m	2050 m	1900 m	2460 m
	with tropical depression	1750 m	2060 m	2070 m	2100 m	1980 m	2600 m
Critical or Not		not critical, but most frequent	critical for takeoff runway	longest in Code C	critical for takeoff runway	Critical size, and frequent	longest in Code E
For Design		○			○	◎	

Source: JICA Study Team

It should be considered that possibly the B747-400 (wing span of 64.92 m, and length of 70.67 m) shall occasionally be used, although it is in the process of retiring.

Therefore, the following dimensions are considered for the purpose of the airfield design:

a) Critical Wingspan of Design Aircraft: 65 m (for B747-400 as maximum size of Code E);

b) Critical Length of Design Aircraft: 74 m (for B777-300 as maximum size of Code E);

c) Runway Length: eventually 2,500-m.

However, the runway length for Phase 1 development is planned to be 2,000 m, on the assumption that initially the airport would accommodate mainly domestic flight operations, and possibly accommodate international flights during off-peak hours operated only by domestic carriers (e.g. A321 of Cebu Pacific or A330 of PAL at maximum).

3.4. Utilities

3.4.1. Water Supply System

Domestic water users have been categorized into passengers, well-wishers, employees and restaurants. Table 3.4-1 shows the water demand computations for airport as of the year 2020.

Water demand variations during the year and during the day were also analyzed. The maximum day demand occurs during the airport's busy days. Records from the existing Tagbilaran Airport show 280 busy days in a year. A factor of [320/280] is then applied to derive the maximum day demand.

The peak hour demand happens during the time of day that the airport is busiest. This is commonly the case when several flights arrive and depart from the airport at the same time. A factor of 2.5 is applied to obtain the Peak-hour water demand.

Table 3.4-1 Water Demand Projection for 2020

Category	Assumptions and Computation	Unit Consumption		Water Demand (m^3/d)
Passengers	Average daily passengers = 1,436,000/320 =4,488 person	20	L/day. person	90
Well-wishers	As per 1 passenger=3 well- wishers; (=3x4,488=13,464 person/day; assumed 30% to use water; =13,464x30% =4,039 person)	20	L/day. person	81
Employees	Traffic unit x 0.6 x 67% for average day =(annual passengers/1,000+annual cargo/100) x 0.6 x 67% =620 person	100	L/day. person	62
Restaurants	Floor area= 840m2; seating area 60% of floor area; 1 m^2/seat; meal turnover 5 times /day; 840 x 60% x 1 x 5 =2,520 meals/day	40	L/day. meal	100
Total Domestic Consumption [A]	Sum of the above [A] (m^3/d)			333
Cooling System [B]	Make-up water rate = 0.00			0
Average Day Demand [C]	[C]=[A]+[B]=333+0			333
Maximum Day Demand [D]	Busy days = 280 days/year; [D]=[A] x (320/280) + [B]			383
Peak Hour Demand [E]	Peak hour factor = 2.5 [E]=([A] x 2.5 +[B])/24hr =(333 x 2.5 + 0)/24			35 m^3/hr.

Note) Year 2020 Forecast: Annual Number of Passengers=1,436,000
Annual Cargo=10,728 tons, Peak Days of Year=320 days

Source: JICA Study Team

The maximum daily demand (i.e. 383 m^3) for 2020 is assumed to increase, in proportion to the number of daily passengers, to be 522 m^3 against the daily passengers for 2030 (1,958,000/320 = 6,119), and 651 m^3 against daily passengers for 2040 (2,441,000/320 = 7,628)

3.4.2. Power Supply System

The area of the proposed new Bohol Airport is under the franchise of BOHECO-1, where electricity would be supplied via a planned 10MVA substation to be built along the Panglao Central Road. BOHECO-1 proposal for the 13.2 kV overhead lines will include supply and installation up to the receiving points of the project. Initial coordination with BOHECO-1 official concluded that the cost of the overhead facilities from the source going to the site shall be shouldered by the Project.

At present, there are three (3) overhead lines that crisscross the island municipalities of Dauis and Panglao which serve the whole of the island. The three (3) lines get power from the 10MVA DAMPAS substation in Tagbilaran City, around 6 km northeast of Dauis.

The source of power is from NAPOCOR's interconnection from geo-thermal power plant in Leyte. The total load capacity for the whole airport, including road lighting for the access road, is assumed to be approximately 1,600 kVA based on the provisional estimate of individual electricity requirement.

3.4.3. Sewage Treatment System

The sewage treatment system to be constructed within the airport boundary is designed to treat and dispose the sewage generated from domestic and commercial activities within acceptable environmental standards. The sewage treatment system will provide not only adequate sanitary conditions for the users and occupants of the airport but also prevent water pollution in the surrounding environs.

The sewage treatment system is planned to follow the phasing of the airport development plan wherein the first phase of staged construction is planned for the target year of 2020. The succeeding sub-sections presents the basic fundamentals considered in establishing the design criteria and facility requirements.

Sewage flow demand is generally estimated by applying a return factor (the ratio of discharged sewage against consumed water). In this basic design, it is assumed that design sewage volume demand is equal to the distributed water quantity. Considering the water demand estimates for domestic and commercial activities as presented in the previous sections of this report, the design sewage flow (Table 3.4-2) is assumed to be a return factor of 100%.

Table 3.4-2 Projected Design Sewage Flow

Sewage Flow	Value
Daily Average Flow	333 m^3/day
Daily Maximum Flow	383 m^3/day ~ 0.27 m^3/min
Hourly Average Flow / Peak Flow	35 m^3/hour ~ 0.58 m^3/min

Source: JICA Study Team

The maximum daily flow (i.e. 383 m^3 in 2020) is assumed to increase, in line with the increase in maximum daily water demand, to be 522 m^3 in 2030, and 651 m^3 in 2040.

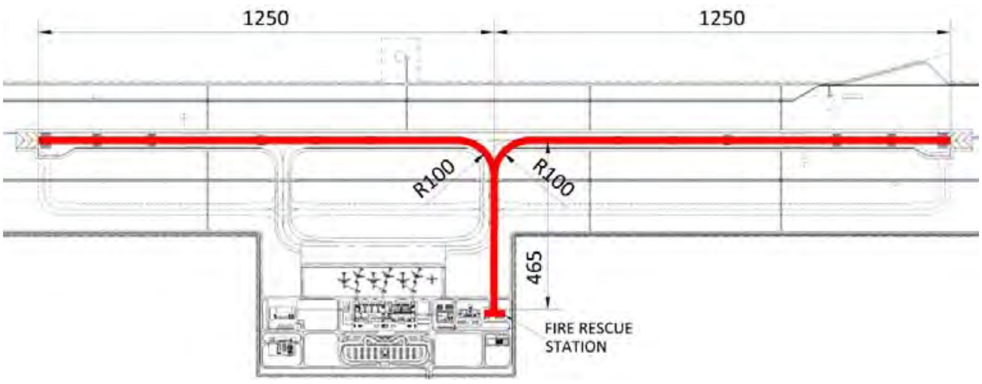
3.5. Rescue and Fire Station

In ICAO Annex 14 (Chapter 9.2), the rescue and fire-fighting facility to be provided at an airport is categorized into Categories 1 to 9 based on the maximum aircraft size and traffic operation at the new Bohol Airport.

Maximum aircraft size for Phase 1 development is assumed to be A320 family, thus the Phase 1 fire services is Category 6, which requires a minimum of two (2) fire-fighting vehicles, having a total water tank capacity of 7,900 liters with a foam solution discharge rate of 4,000 liters/minutes. Meanwhile, at the existing Tagbilaran Airport there are three (3) small fire-fighting vehicles with a total water tank capacity of 8,000 liters, which are still in working conditions, hence those vehicles are planned by DOTC to be utilized for initial years of operations upon completion of the new Bohol Airport. However, as air traffic increases such wide-bodied aircraft like A330 or B777 is soon or later expected to be mobilized at the new airport. The Category for such wide-bodied is Category 9, which requires a minimum of three (3) fire fighting vehicles, having a total water tank capacity of 24,300 liters with a foam solution discharge rate of 9,000 liters/minutes. The new rescue and fire station is planned to house three (3) vehicles of such future required water tank capacity of 10,000 litters, because difference in the body length between such existing one (7 m) and future-required vehicles (11 m) is not a critical element for the building structure.

To ensure sufficient space for future expansion of passenger and cargo terminals, to reduce cost and increase the efficiency of the airport as a whole, it is proposed that certain facilities with common or shared features shall be housed in one structure. As such it is proposed that the fire station and maintenance building shall be within one structural shell. The airport maintenance facility will serve as a garage for various types of airport equipment, and maintenance thereof can be shared with the fire fighting vehicles.

The location of the fire station was proposed to be right in the middle of both runway ends (of the eventual length of 2,500 m), and its distance to the runway end is 1,715 m in perpendicular, or 1,672 m along the curve as shown in Figure 3.5-1.



Source: JICA Study Team

Figure 3.5-1 Location of Fire station; and Distance to Runway ends

Computation of the response time is made through Table 3.5-1, showing that the response time of 2.08 minutes with a maximum speed of 90 km/h type and 2.55 minutes with a speed of 80 km/h can meet ICAO requirements of maximum 3 minutes.

Table 3.5-1 Response Time of Fire Fighting Vehicles

	A. High-speed Fire Fighting Vehicle (6,000L water capacity)			B. Normal Fire Fighting Vehicle (10,000L water capacity)		
a Maximum Speed		**90 km/h**			**80 km/h**	
b Acceleration length & time		length	time		length	time
	0 - 90 km/h	461 m	29 sec	0 - 80 km/h	527 m	37 sec
	0 - 70 km/h	120 m	15 sec	0 - 70 km/h	400 m	25 sec
	0 - 50 km/h	76 m	11 sec	0 - 50 km/h	115 m	15 sec
	50 - 90 km/h	385 m	18 sec	50 - 80 km/h	412 m	22 sec
c Deceleration length & time						
	90 - 50 km/h	52 m	3.5 sec	80 - 50 km/h	48 m	3.5 sec
	70 - 50 km/h	20 m	1.5 sec			
	50 - 0 km/h	17 m	2.5 sec	50 - 0 km/h	19 m	3 sec
	90 - 0 km/h	68 m	4.5 sec	80 - 0 km/h	63 m	4.5 sec
d Curving speeed	50 km/h	R = 100 m		50 km/h	R = 100 m	
	90 km/h	R = 300 m		90 km/h	R = 300 m	

e Distance to runway end

Fire station to start of curve	365m	Straight
to end of Curve	157 m	Curve (R=100 m)
to Runway end	1,150 m	Straight
Total distance from Fire Station	1,672 m	

A High-speed Fire Fighting Vehicle (Maximum Speed: 90 km/h)

Portion to run	Fire Station	Straight			Curve (R=100)	Straight			at Site	Response Time	
		through Road 13			to Runway	through Runway to end				(sec)	(min)
Length (m)	from fire call to start vehicle	365			157	1,150			to start dischrge foam at 50% rate of ICAO		
Speed (km/h)		0-70	70	70-50	50	50-90	90	90-0			
---in (m/sec)		varies	19.44	varies	13.89	varies	25.00	varies			
distance (m)		120	225	20	157	385	697	68			
Time (sec)	30.00	15.00	11.57	1.50	11.30	18.00	27.88	4.50	5.00	124.76	2.08

B Fire Fighting Vehicle (Maximum Speed: 80 km/h)

Portion to run	Fire Station	Straight			Curve (R=100)	Straight			at Site	Response Time	
		through Road 13			to Runway	through Runway to end				(sec)	(min)
Length (m)	from fire call to start vehicle	365			157	1,150			to start dischrge foam at 50% rate of ICAO		
Speed (km/h)		0-50	50	50	50	50-80	80	80-0			
---in (m/sec)		varies	13.89	13.89	13.89	varies	22.22	varies			
distance (m)		115	135	115	157	412	675	63			
Time (sec)	30.00	37.00	9.72	8.28	11.30	22.00	30.38	4.50		153.18	2.55

Source: JICA Study Team

If further a high-speed rapid intervention vehicle (RIV) is introduced, the response time can be minimized to be less than 2 minutes, which is the latest recommendation of ICAO.

3.6. Summary of Airport Facility Requirements

Through review of the facility requirements in the JICA Preparatory Survey, the airport facility requirements of the new airport for 2020, 2030 and 2040 are summarized in Table 3.6-1.

Table 3.6-1 Facility Requirements for New Bohol Airport

Item		at Present	Future Requirements		
		in 2010	2020	2030	2040
1	Annual Passengers (2-way)	572,476	1,436,000	1,958,000	2,441,000
	- Domestic	572,476	1,393,000	1,773,000	2,117,000
	- International	-	43,000	185,000	324,000
2	Annual Cargo (tons)	4,791	10,812	13,274	15,968
3.	Annual Air traffic Movements (2-way)	4,664	13,915	17,047	19,807
	- Domestic	4,664	13,545	15,355	16,993
	- International	-	370	1,692	2,814
4	Peak-day Passengers (2-way)	1,790	4,892	6,511	8,099
	- Domestic	1,790	4,353	5,541	6,616
	- International	-	539	970	1,483
5	Peak-Hour Passengers (1-way)				
	- Domestic (PH factor)	250	375 (15.1 %)	464 (14.6 %)	542 (14.3 %)
	- International (PH aircraft)	-	128 (A320)	208 (B767)	240 (A330)
6	Peak-Hour Passengers (2-way)				
	- Domestic	385	577	714	834
	- International	-	197	320	369
7	Peak-Hour Aircraft (1-way)				
	- Domestic	3	3.19	3.51	3.81
	- International	-	1	1	1
8	Design Aircraft	A320	A320	A321/B767/A330	
9	Longest Destination	Manila	Inchon/ Beijing/ Narita		
10	Aerodrome Reference Code	3C	4C	4E	
11	Fire Fighting Category	Cat 6	Cat 6	Cat 9	
12	Operational Category	VFR	Precision CAT 1: 24 hours		
13	Runway Length (m)	1,779 m	2,000 m	2,500 m	
	- Width (m)	30 m	45 m	45 m	
14	Runway Strip Length (m)	1,800 m	2,120 m	2,620 m	
	- Width (m)	100 m	300 m	300 m	
15	Taxiway	2 stub	2 stub		parallel
16	Apron Spot	Total	6 Self-maneuver	6 Nose-in Push-out	6 Nose-in Push-out
	- Domestic		4 A321	4 A321	4 A321
	- International		1 A321	1 B777	1 B777
	- Emergency		1 A321	1 B777	1 B777
17	Passenger Terminal Building				
	Floor Area for Domestic = (6) x 15 m²		8,600	10,700	12,500
	Floor Area for International = (6) x 25 m²			8,000	9,200
	Total Floor Area (m²)	850	8,600	18,700	21,700
	Dom Check-in Counter = (5) x 2/60 x 1.1	8	14	17	20
	Int'l Check-in Counter = (5) x 2/60 x 1.1	-	Common (5)	8	9
	Int'l Passport Control = (5) x 1/60 x 1.1	-	3	4	4
18	Water Demand (m³ /day)	-	383	522	651
19	Electricity (KVA for contract)	-	1600	3,000	

Source: JICA Study Team

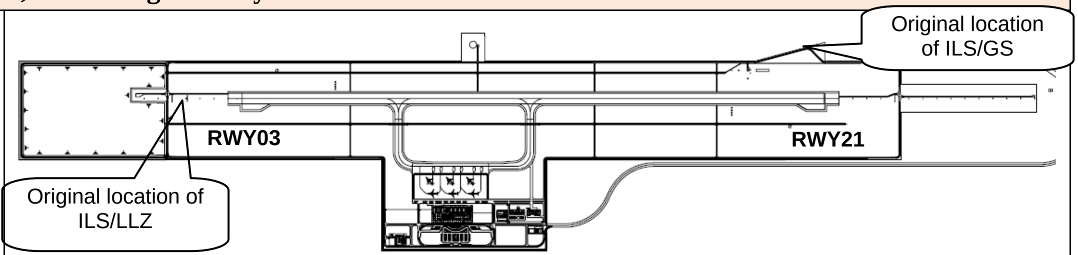
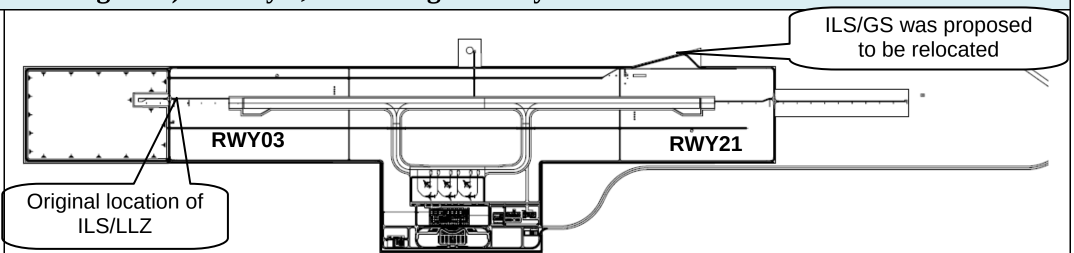
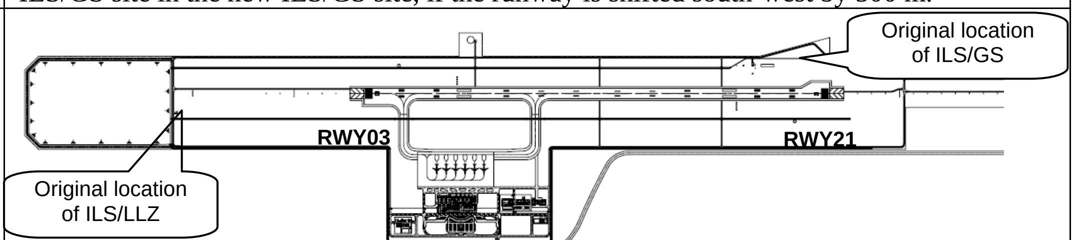
3.7. Review of Airport Layout Plan

3.7.1. Review of Runway Location for Phase-1 Development

Eventual runway length was determined at 2,500 m in 2009 design. Through the course of the JICA Preparatory Survey, DOTC decided that, for the purpose of reducing initial investment, the runway would be initially developed to be 2,000 m in length, with the north-east 20-ha area of airport property being undeveloped (i.e. 500- m long and 400-m wide). This required the ILS/Glide Slope (GS) antenna be shifted south-west by 500 m; which is herein called as Option 1. However, the additional topographic survey lately conducted has revealed that there is a church exists in the area for the ILS/GS if it is shifted.

Location of the Phase 1 runway has been reviewed to see if the RWY 21 shifted back in the original position (herein called as Option 2) is feasible or not. Those optional layout plans are tabulated below in Table 3.7-1.

Table 3.7-1 Alternative Locations of Phase-1 Runway

Description	Airport Layout Plan
Final Phase: 2,500-m long Runway	
Originally planned in 2009. Land acquisition being processed.	 The land for ILS/GS at the original location has been acquired.
Phase 1: (Cost Saving Plan) initially 2,000-m long Runway	
Option 1 Property minimized for JICA appraisal	 Additional topographic survey revealed that there is a church relocated from the original ILS/GS site in the new ILS/GS site, if the runway is shifted south-west by 500 m.
Option 2 to move Runway North-east by 500 m	 Location of the RWY21 threshold is back in the original location. The relocated church is not necessarily resettled.

Source: JICA Study Team

The above two (2) options for the location of 2,000-m long runway for Phase 1 are studied in conjunction with future convenience with cost implications for necessary relocation of the two ILS antennae (i.e. LLZ and GS), Approach Lighting Systems (PALS and SALS) and PAPI, corresponding to 500 m runway extension, as shown in Table 3.7-2.

Table 3.7-2 Alternative Study on Location of Phase-1 Runway

Description		**Option 1: Cost Saving for JICA appraisal**	**Option 2: To move North-east by 500 m**
ILS; when runway is extended	LLZ	Location maintained Services maintained	Location maintained Out of Services
	GS	To be relocated to north-east by 500 m Out of services during extension	Location maintained Services maintained
ALS; when runway is extended	PALS	To be relocated to north-east by 500 m Out of services during extension	Location maintained Services maintained
	SALS	Location maintained Services maintained	To be relocated south-west by 500 m Out of Services
Convenience in predominant operations (for RWY03)	Takeoff	Longer distance to RWY03 end with heavy takeoff weight	Shortest distance to RWY 03 end with heavy takeoff weight
	Landing	Shorter distance to apron with relatively lighter landing weight	Longer distance to apron with relatively lighter landing weight
Additional Cost for Phase 1	Option 1 requires acquisition / resettlement of a Church	Relocation of Church (15,000 sqm)	Earthwork: 113 mil
		Land Acquisition of.: 1 mil	Fence: 5 mil
		Demolition/ resettlement: 3 mil	Drainage: 17 mil
			Topsoil & grass: 13 mil
			maintenance Road: 10 mil
		Subtotal: 4 mil	**Subtotal: 158 mil**
Additional Cost for future 500-m Runway extension	Option 2 only requires relocation of SALS/ PAPI within property	Earthwork: 113 mil	
		Reconstruction of Fence: 10 mil	
		Drainage: 17 mil	
		Topsoil & grass: 13 mil	
		Reconstruction of Road: 10 mil	
		relocation of Glide Slope: 20 mil	
		relocation of PALS/ PAPI: 20 mil	relocation of SALS/ PAPI: 10 mil
		Runway Subgrade/ Sub-base course for 500m extension: 34 mil	
		Runway upper-base/ surface course for 500-m extension: 98 mil	
		Subtotal: 335 mil	**Subtotal: 142 mil**
Evaluation			Adopted by DOTC, since the Church is not necessarily resettled, and future runway extension is easy in the Phase-1airport property without relocation of ILS antennae

Source: JICA Study Team

The Table explained that the option 2 has been adopted by DOTC, since the church is not necessarily to be relocated again, and future runway extension is easy within the airport property without relocation of the both ILS antennae (i.e. Localizer and Glide Slope).

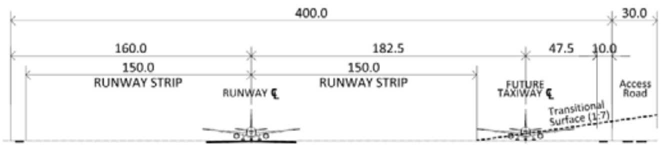
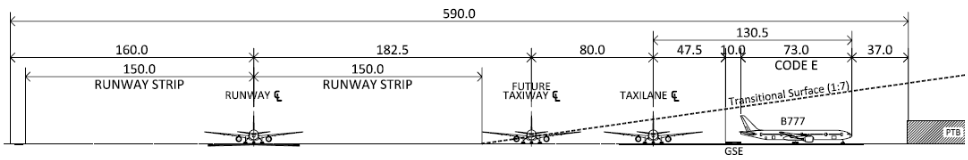
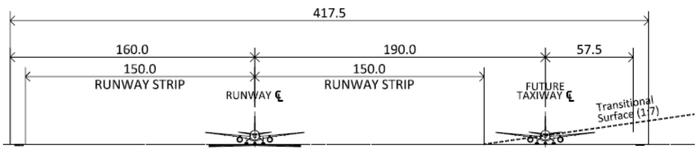
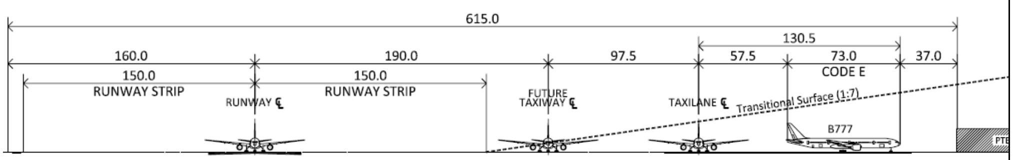
3.7.2. Review of Airfield Separation Distances

In the previous feasibility studies (made in 2000 and 2007), the airfield separation was planned to meet the requirements of Code E aircraft (e.g. for A330-300, B747-400, B777-300).

In the 2009 design, with the desire of the then client, Manila International Airport Authority, the separation between the runway and future parallel taxiway has been reset to safeguard the provision of a future parallel taxiway for Code F aircraft (i.e. A380).

Airfield separation distances for the respective ICAO codes E and F are shown in Table 3.7-3.

Table 3.7-3 Review of Airfield Separation Distances

ICAO Code	
2000/ 2007 FS Code E to meet A330-300 B747-400 B777-300 (wing span: up to 65 m)	Airfield  Terminal Area 
2009 Design Code F to meet A380 (wing span: up to 80 m)	Airfield  Terminal Area 

Source: JICA Study Team

The required width of airfield should be 400 m for Code E, and 417.5 m for Code F.

After 2000 and 2007 FS, land acquisition for the 400 m wide airfield was processed by the PGB. In addition, a 30 m wide land acquisition adjacent to the airfield was also intended to be made for the alignment of access road which was then planned to be connected from the central highway.

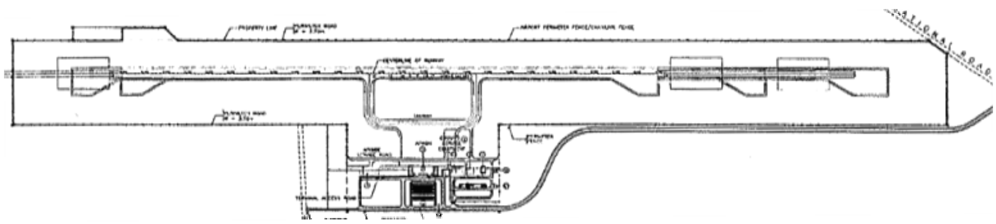
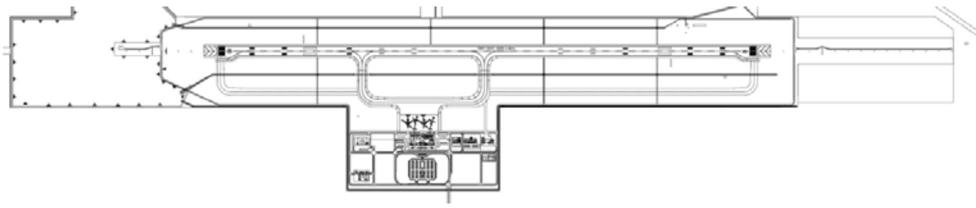
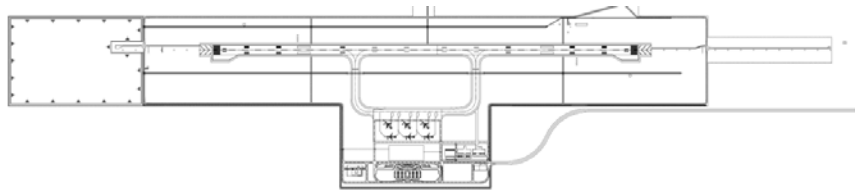
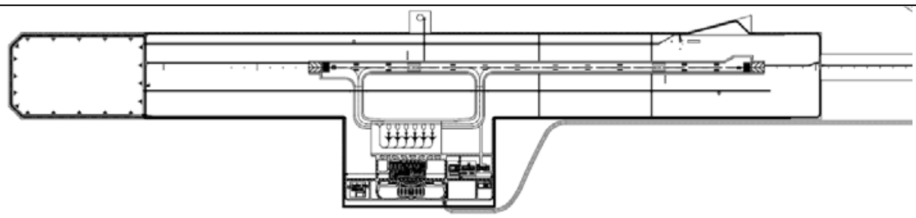
The 2009 design proposed the 417.5 m wide airfield for the provision of future parallel taxiway of Code F aircraft, alignment of access road was differently considered to be connected from the south circumferential road, instead of central highway. The total width now mostly completed for the land acquisition is at least 423 m, according to the PGB, which was therefore considered sufficient to cover the requirement.

Through the course of JICA Preparatory Study in 2012, the alignment of access road was proposed back to the area adjacent to the 417.5-m wide airfield and to connect from the central highway. Therefore, there is a need to newly acquire additional land (of some 20 m wide x 2 km long) for the access road if the airfield separation distance for Code F is pursued. To initiate such additional land acquisition now is not only difficult but also long time consuming. To negotiate with the lot owner to maintain the same land price (i.e. Php 60/ m^2) is extremely difficult.

It was finally decided by DOTC that future parallel taxiway would be made with the airfield separation for Code E, since there is very little possibility for this particular airport to accommodate such world largest aircraft as A380 for the foreseeable future.

Chronologically summary in the planned location of access road is shown in Table 3.7-4.

Table3.7-4 Chronological Summary in the planned Location of Access Road

	Interrelation between Airport and Access Road
2000/2007 FS Runway is extended progressively to 3300 m eventualy	 Airfield width was 400 m based on Code E. 30-m wide access road was planned adjacently.
2009 Design Runway is 2500 m	 Airfield width was 417.5 m based on Code F. Access road was planned to be perpendicular from South circumferential road.
July 2012 Preparatory Survey Runway is 2,000 m for Phase 1	 Airfield width was maintained at417.5 m. Access road was planned to be laid adjacently.
April 2013 Basic Design Runway is 2,000 m for Phase 1	 Airfield width was back to 400 m. 30-m wide access road was back in original position.

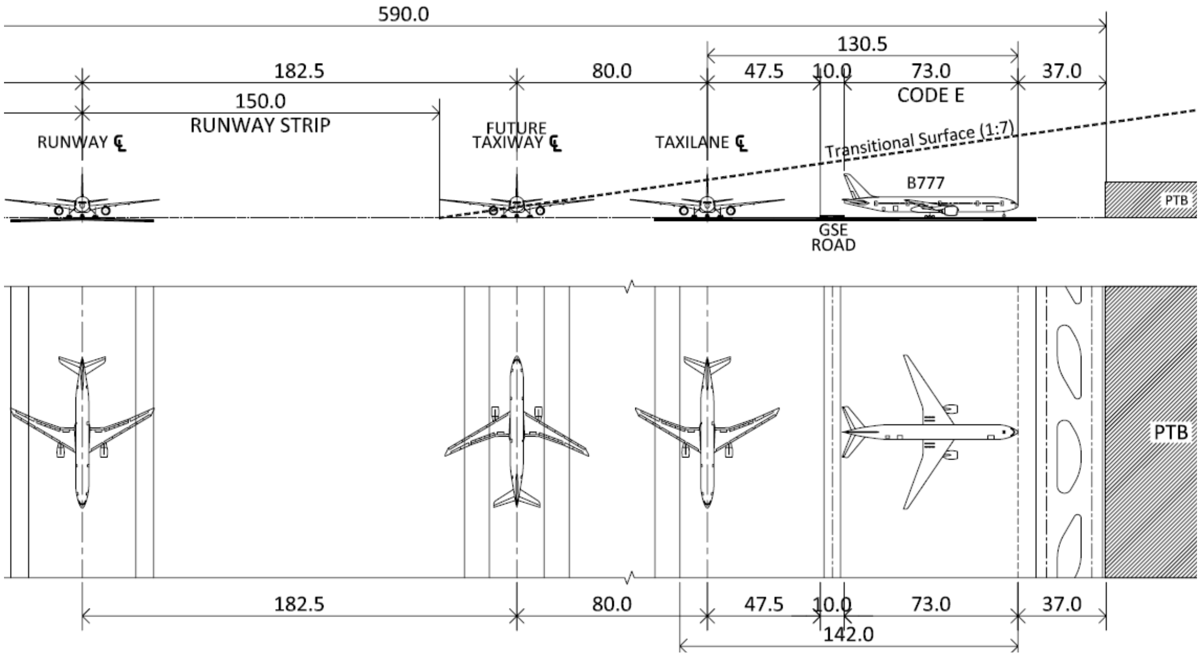
Source: JICA Study Team

3.7.3. Aircraft Parking Configuration

Unlike the Phase 1 PTB which could be commonly utilized for domestic and international, it is desired to provide a separate apron space for international flight because international flight occupies more time than domestic (e.g. for refueling), and smuggling might happen if international and domestic flights are mixed on the open apron. Therefore, required number of aircraft parking stands is 4 for domestic, 1 for international and 1 for emergency, or 6 in total.

It was decided by DOTC that the Phase 1 PTB to be of a single-story without passenger boarding bridges (PBBs), and to accommodate only small jet (i.e. Code C; A320 or A321), however the PTB should be so designed that it can accommodate wide-bodied aircraft (i.e. Code E; A330-300 or B777-300) and PBBs can be easily installed in near future so as to attain necessary security measures and barrier-free conditions when international operations are made.

The location of building lines are necessarily set-back not to jeopardize transitional surface (1/7 slope) when wide-bodied aircraft (the longest fuselage of Code E aircraft is B777-300 of 73-m long) parking on the apron.



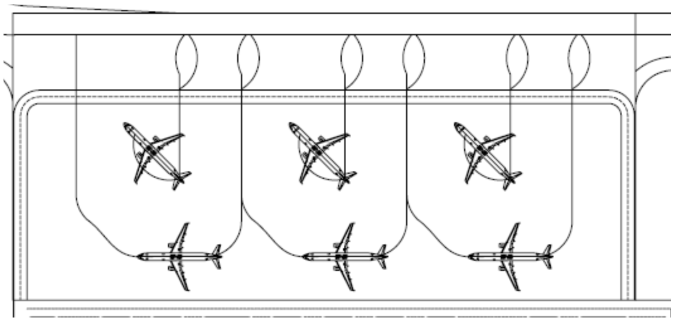
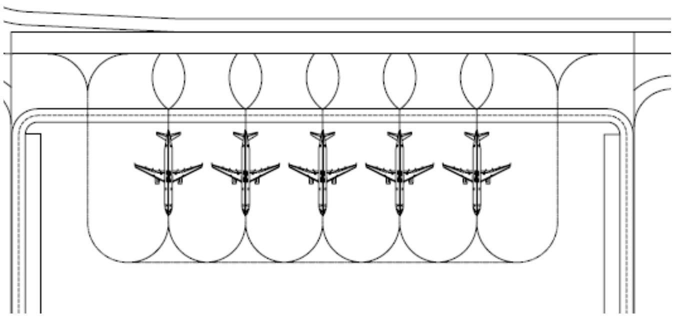
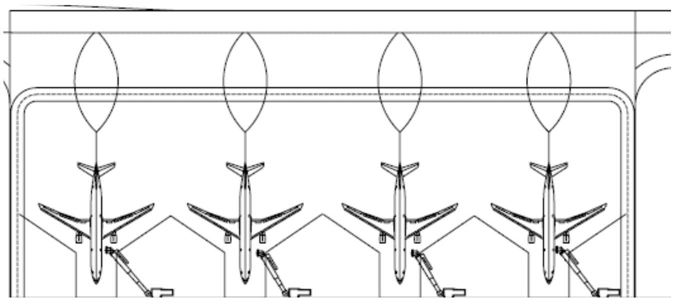
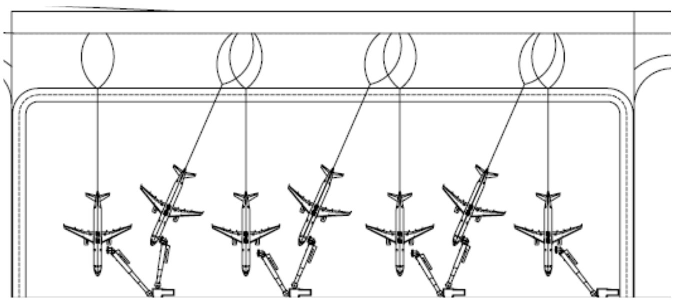
Source: JICA Study Team

Figure 3.7-1 Separation of Apron and Buildings from Code E Runway

For Phase 1 with a single-story PTB, aircraft operations are assumed to be made mainly by small-jet which normally prefer self-maneuvering parking configuration without being pushed back for their reason of fastest turn-around time. Meanwhile, for Phase 2 (after vertical expansion), PBBs are assumed to be installed, where nose-in/ push-out parking pattern is normally required.

Table 3.7-5 illustrate typical parking patterns of different size of aircraft for the respective Phases.

Table 3.7-5 Typical Aircraft Parking Patterns

Description		Apron Parking Patterns
Phase 1 **Without PBBs**	**Pattern 1** **Self-maneuvering at parallel or angled position** **6 A321**	
	Pattern 2 **Self-maneuvering at perpendicular position** **6 A321**	
Phase 2 **With 4 PBBs**	**Pattern 1** **Nose-in/ Push-out at perpendicular position** **4 A330 (or B777)**	
	Pattern 2 **Nose-in/ Push-out at perpendicular or angled position** **7 A321**	

Source: JICA Study Team

For Phase 1, small jet aircraft is assumed to park at self-maneuvering positions, where passengers are desired to be protected then transported by rump-buses. However, many low-cost terminals in the world allow passengers to embark/disembark the aircraft using the both front and rear doors and walk on the apron, for the sake of minimum turn-around time and competitive airfare of the airlines. In the event, manners of the passengers to walk on the apron are properly regulated to prevent interfering with the movements of ground service equipment and aircraft blast wind.

In Pattern 1, aircraft self-maneuvering is made 360º directions with its blast wind blowing around at the time of both arriving and departing operations, where route and timing for the passengers to walk are largely limited. Meanwhile, in the Pattern 2 the self-maneuvering directions of all aircraft are constant and such restriction to passengers are limited only at the time of departing operations. When aircraft movement increases and wide-bodied aircraft is mobilized soon or later, aircraft parking position for the Pattern 2 is easily reset forward and push-back operations by towing tractor can be commenced. For those reasons, Pattern 2 is adopted for Phase 1 for the purpose of this detailed design study.

At any rate, dimension of the apron area proposed for JICA appraisal can accommodate all the above- mentioned apron parking patterns.

3.7.4. Layout Plan of Terminal Facilities

With regard to the terminal facilities, the following facilities need to be provided and are shown in Figure 3.7-2.

a) Passenger terminal building

b) Cargo terminal building (in the future)

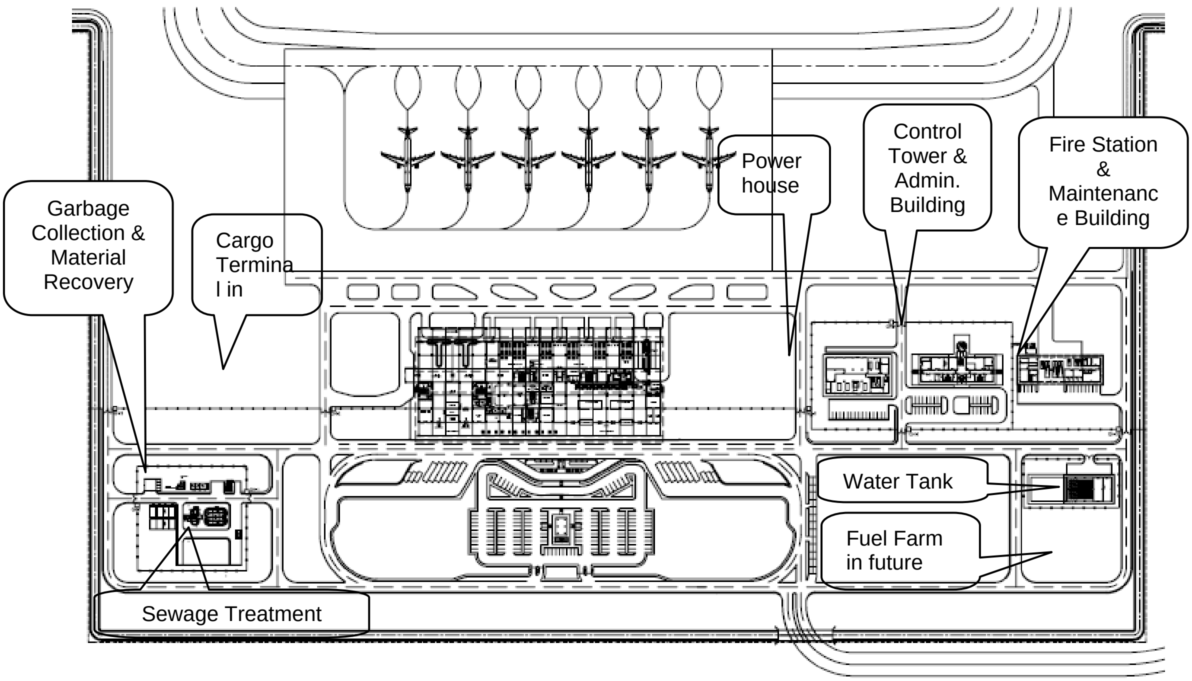
c) Control tower, ATC operation and administration building

d) Fire station and airport maintenance building

e) Power house

f) Water tank and pump house

g) Roads and car park



Source: JICA Study Team

Figure 3.7-2 Terminal Area Site Plan

The terminal area layout plan has been made in consideration of the following requirements:

All buildings have been sited so that their functional relationships are enhanced and to obtain the most cost effective development to result in an optimum airport operation. All land side facilities with exception of public related facilities are fenced off from the public and access is controlled by means of manned guardhouses.

As stated in the above para 3.5, location of rescue and fire station is firstly selected at exactly in the middle of the eventual 2,500-m long runway, so as to comply with the “Maximum 2-minutes Response Time” recommended in the latest ICAO Annex 14.

Axis of the Passenger Terminal Building (PTB) is selected to be in the middle of the terminal area. Control tower, ATC operation and administration building, fire station and airport maintenance building, power house are proposed to be located in the northern area of the terminal.

Public landside facilities such as drivers lounge, toilets and tollbooths form part of the land side car park facilities. Other land side facilities are related to the passenger terminal such as a large open-air departure and arrival public concourses for meters and greeters to cater for the Filipino custom of sending off and welcoming passengers-relatives. These concourses connected to the passenger terminal curb side are shaded by a large canopy structures complemented by public toilets, concessions and green areas to provide a comfortable waiting area.

The cargo terminal and sewage waste facilities are located on the southern section of the landside development allowing sufficient areas for future expansion for the passenger terminal building and its related facilities such as tourist buses and taxi loading and unloading stations and car park, including expansion of the cargo terminal.

3.7.5. Road and Car Park

Traffic flow direction will be counter-clockwise to enable right side unloading and loading at the terminal curb. The road system serving the other landside facilities will be a two-lane, two-way road network considering the lighter traffic volume that is expected.

In frontage of the passenger terminal building one lane is utilized for loading and unloading of passengers, a second lane will be used for maneuvering vehicles, a third lane is for other passenger-related traffic, such as bypass or thoroughfare to the car parking, whilst a fourth lane is to be utilized by staff vehicles and vehicular traffic to the cargo terminal.

Apart from passenger vehicles and taxis, ample space reservation is made for jeepney and tourist bus parking.

Car access to airside is provided with various security check points, so that full security at each cross point from landside to airside is controlled by a manned guardhouse.

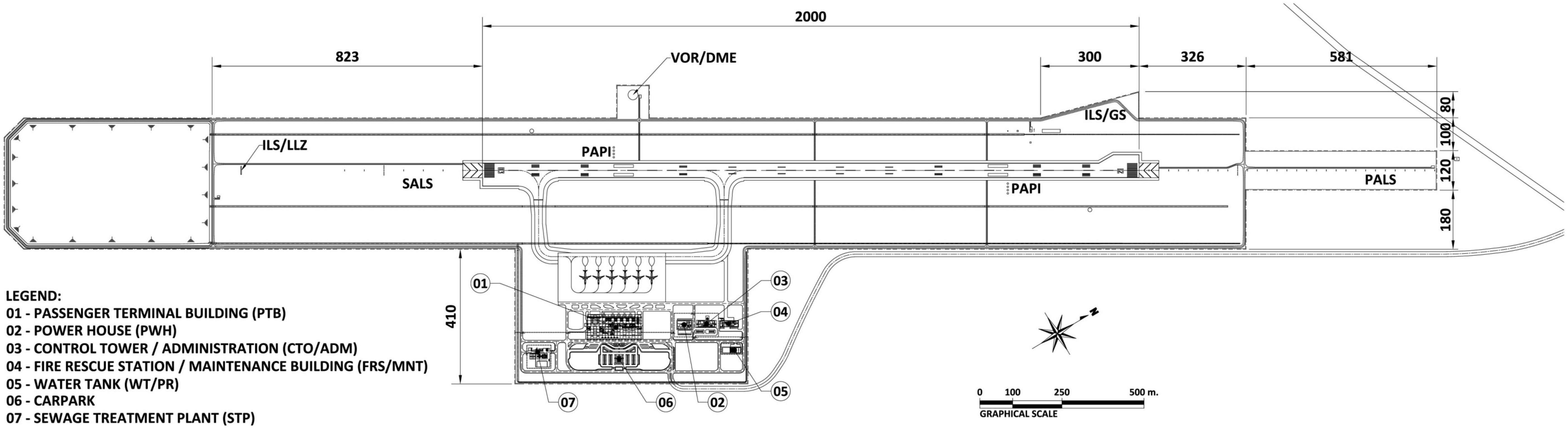
There are two airside access roads on either side of the passenger terminal building, two airside roads at either end to the south and the north of the landside terminal area.

Two more airside access roads are provided, one through the cargo terminal complex and another one through the Control Tower, ATC Operation/Administration Building (CTO) and Power House (PWH) complex.

3.7.6. Phase-1 Airport Layout Plan

Proposed Airport Layout Plans for Phase 1 and Phase 2 are shown in Figure 3.7-3.

Phase 1: 2,000-m Runway



Phase 2: 2,500-m Runway

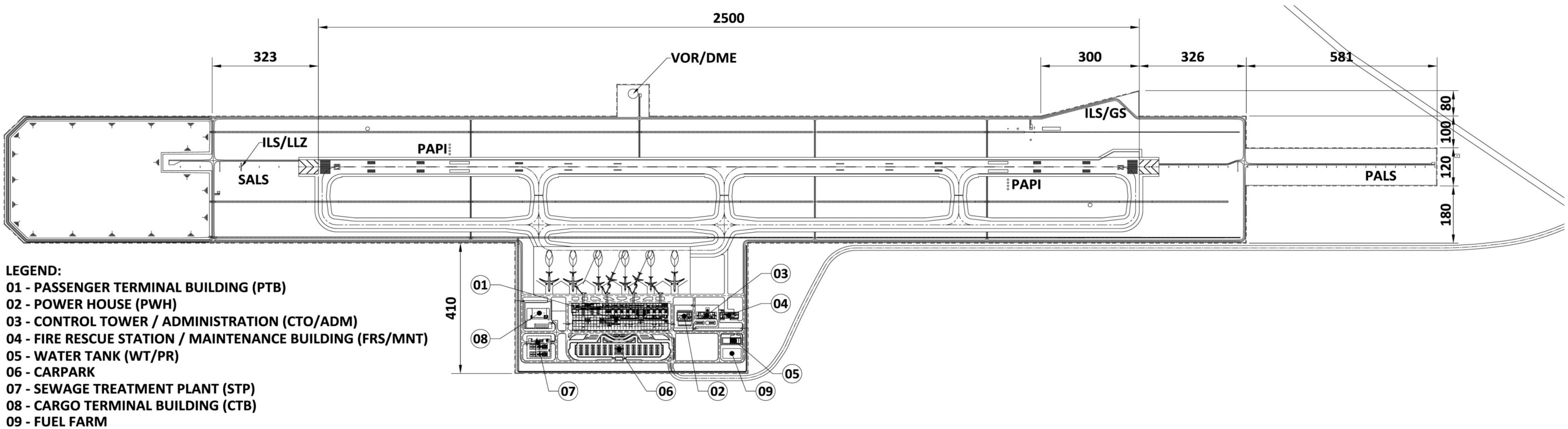


Figure 3.7-3 Proposed Airport Layout Plan

CHAPTER 4

DESIGN OF CIVIL WORKS

TABLE OF CONTENTS

Chapter 4 Design of Civil Works

4.1. Geometric Design of Airside Infrastructure

The runway has been defined to be 2,000 m in length for Phase 1 development and assumed to be extended to 2,500 m for Phase 2 when required due to increase in international traffic demand.

The terminal facilities are defined to locate at the south-eastern side of the runway.

Roads and car park are planned to accommodate anticipated traffic with a flow direction of generally counter-clockwise to enable right side unloading and loading at the terminal curb. The road system serving the other offices will be two-lane, two-way road network considering lighter traffic volume that can be expected.

4.1.1. Design Aircraft

Design aircraft in each category of ICAO code has been defined in earlier Chapter 3 as shown below.

Table 4.1-1 Design Aircraft in each category of ICAO code

Size	Condition	SJ			MJ	LJ	
ICAO code		C			D	E	
Aircraft		A320-200	B737-800	A321-200	B767-300	A330-300	B777-300
Airline		PAL/Cebu	JAL	Cebu	Asiana/JAL	PAL	PAL
Wing Span		34.10	35.79	35.48	47.57	60.30	60.93
Length		37.57	38.02	44.50	54.94	63.69	73.86
Takeoff Weight	to Inchon	69 ton	72 ton	84 ton	146 ton	186 ton	246 ton
	Maximum	76 ton	79 ton	87 ton	159 ton	212 ton	287 ton
Usage		scheduled	future	future	charter	scheduled	future
Runway Length (34 C)	to Narita	1680 m	1940 m	1950 m	2050 m	1900 m	2460 m
	with tropical depression	1750 m	2060 m	2070 m	2100 m	1980 m	2600 m
Critical or Not		not critical, but most frequent	critical for takeoff runway	longest in Code C	critical for takeoff runway	Critical size, and frequent	longest in Code E
Normal Seat		160	185	200	260	300	
For Design		○			○	◎	

Source: JICA Study Team

Initially the runway at the new Bohol Airport is considered to mainly accommodate domestic or regional international flight of code-C aircraft (e.g. A320, B737 or A321). However, as number of passenger increases the runway should soon or later accommodate wide-bodied aircraft (i.e. A330 of PAL) with more passengers onboard since NAIA's runway cannot accommodate further increase in domestic aircraft movements.

Therefore, for the purpose of the airfield design for new Bohol Airport, code-E aircraft (e.g. A330-300 or B777-300) are selected as design critical aircraft.

4.1.2. Runway

1) Aerodrome Reference Code

In accordance with ICAO Annex 14 (abstracted in Table 4.1-2 below), the 2,500-m long runway is defined as ICAO Code Number 4, and the wingspan of design aircraft of less than 65 m is defined as ICAO Code Letter E, thus the corresponding runway width shall be 45 m.

Table 4.1-2 ICAO Annex 14 (Aerodrome Reference Code and Width of Runway)

Code element 1		Code element 2		
Code number (1)	Aeroplane reference field length (2)	Code letter (3)	Wingspan (4)	Outer main gear wheel span[a] (5)
1	Less than 800 m	A	Up to but not including 15 m	Up to but not including 4.5 m
2	800 m up to but not including 1 200 m	B	15 m up to but not including 24 m	4.5 m up to but not including 6 m
3	1 200 m up to but not including 1 800 m	C	24 m up to but not including 36 m	6 m up to but not including 9 m
4	1 800 m and over	D	36 m up to but not including 52 m	9 m up to but not including 14 m
		E	52 m up to but not including 65 m	9 m up to but not including 14 m
		F	65 m up to but not including 80 m	14 m up to but not including 16 m

a. Distance between the outside edges of the main gear wheels.

Width of Runway

Code number	Code letter A	B	C	D	E	F
1[a]	18 m	18 m	23 m	–	–	–
2[a]	23 m	23 m	30 m	–	–	–
3	30 m	30 m	30 m	45 m	–	–
4	–	–	45 m	45 m	45 m	60 m

Source: ICAO Annex 14

2) Runway Strip

In accordance with ICAO Annex 14, the runway strip for a precision approach runway should extend laterally to a distance of at least 150 m to both sides of runway centerline, and longitudinally for a distance of 60 m before the threshold and beyond the end of the runway.

3) Runway End Safety Area

In accordance with the recommendation of ICAO Annex 14 (Table 4.1-3 below), the runway-end safety area is extended to a distance of at least 240 m from the end of the runway strip where the runway code number is 4, as shown in Figure 4.1-1.

Table 4.1-3 ICAO Annex 14 (Runway End Safety Area)

Dimensions of runway end safety areas

3.5.2 A runway end safety area shall extend from the end of a runway strip to a distance of at least 90 m.

3.5.3 **Recommendation.—** *A runway end safety area should, as far as practicable, extend from the end of a runway strip to a distance of at least:*

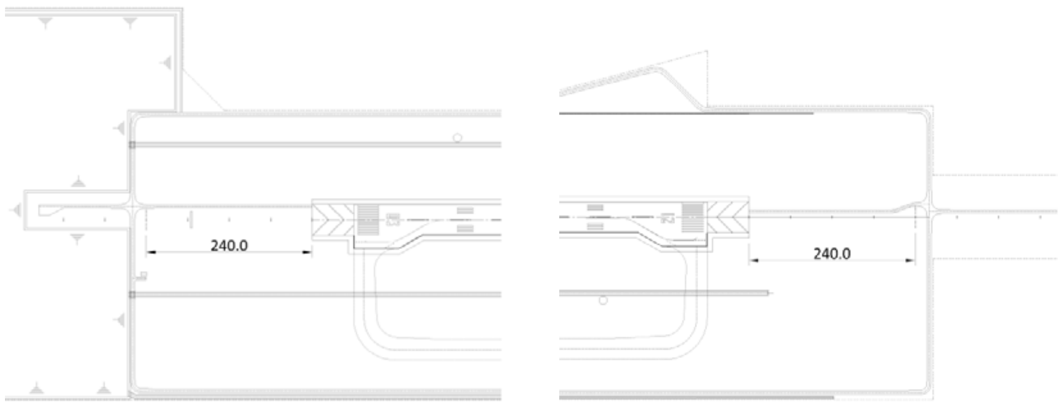
— *240 m where the code number is 3 or 4; and*

— *120 m where the code number is 1 or 2.*

3.5.4 The width of a runway end safety area shall be at least twice that of the associated runway.

3.5.5 **Recommendation.—** *The width of a runway end safety area should, wherever practicable, be equal to that of the graded portion of the associated runway strip.*

Source: ICAO Annex 14

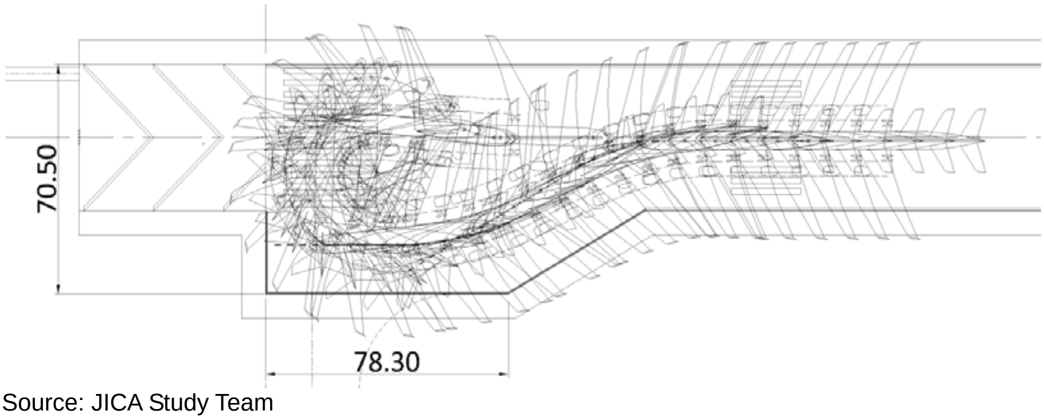


Source: JICA Study Team

Figure 4.1-1 Runway End Safety Area (240 m from the end of runway strip)

4) Runway Turn Pad

Since a parallel taxiway is not necessarily provided in the first phase, a turning pad shall be provided on both ends of the runway for the aircraft's U-turn. In simulating the manoeuvring of 180-degree by the design aircraft (i.e.A300-300), the width and length of the turning pad is set as shown in Figure 4.1-2.



Source: JICA Study Team

Figure 4.1-2 Width and Length of Turning Pad for A300-300

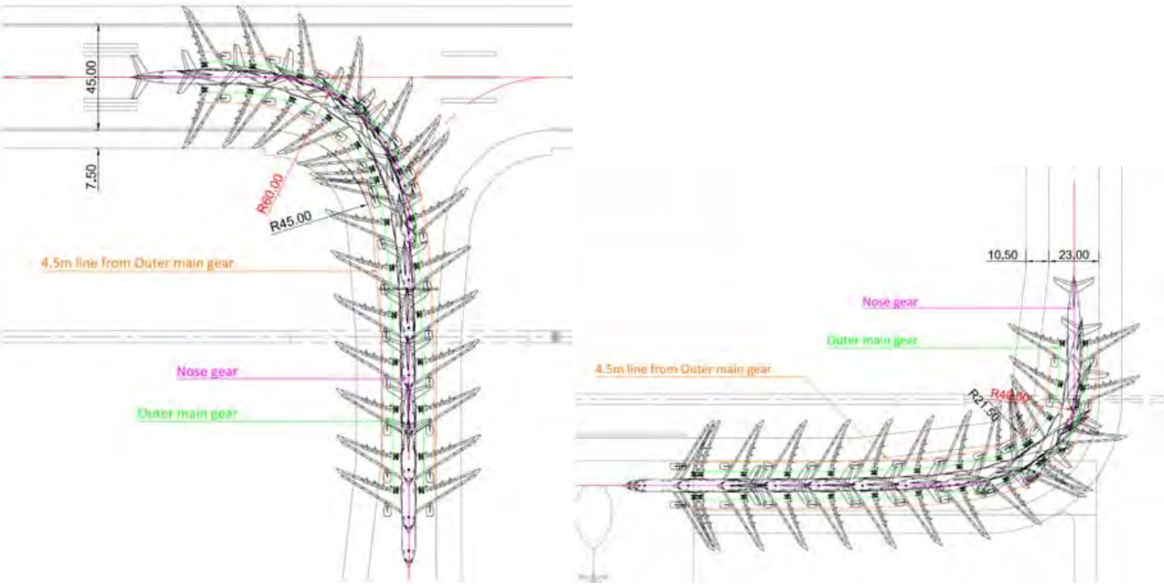
The above turning pad is not wide enough for the most critical aircraft in the code-E classification, i.e. B777-300 having a triple-tandem main-gear configuration with a longer wheel-base. If and when such critical aircraft is introduced and by the time a parallel taxiway has not been provided yet, the runway turning pad will have to be expanded.

4.1.3. Taxiways

(1) Width of Taxiway

Width of taxiway where the runway code is 4E should be 23 m in accordance with ICAO Annex 14.

The stub taxiways are perpendicular to the runway. So as to attain smooth manoeuvring out from the runway by the critical design aircraft (A330-300), the trace of A330-300 and required pavement fillet along the centerline turning radius of 60 m is studied as shown in Figure 4.1-3.



Source: JICA Study Team

Figure 4.1-3 Proposed Taxiway Width with required Fillet for A330-300

It should be noted the most critical aircraft in the code-E classification is the B777-300 having a triple-tandem main-gear configuration with longer wheel-base. If and when such critical aircraft is introduced, the pavement fillet will have to be expanded.

(2) Width of Taxiway Shoulder

In accordance with the recommendations of ICAO Annex 14, the taxiway and shoulder should cover a total width of 44 m where the runway code letter is 4E. Consequently, the required width of the taxiway shoulder shall be 10.5 m (i.e. 10.5 m + 23 m + 10.5 m = 44 m).

(3) Separation between Airfield (Runway, Taxiways and Apron)

Airfield separations are determined basically to follow the minimum separation distances recommended by ICAO Annex 14, as shown in Table 4.1-4.

Table 4.1-4 ICAO Annex 14 (Taxiway Minimum Separation Distances)

Code letter	Distance between taxiway centre line and runway centre line (metres) – Instrument runways Code number 1	2	3	3	Non-instrument runways Code number 1	2	3	4	Taxiway centre line to taxiway centre line (metres)	Taxiway, other than aircraft stand taxilane, centre line to object (metres)	Aircraft stand taxilane centre line to object (metres)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
A	82.5	82.5	–	–	37.5	47.5	–	–	23.75	16.25	12
B	87	87	–	–	42	52	–	–	33.5	21.5	16.5
C	–	–	168	–	–	–	93	–	44	26	24.5
D	–	–	176	176	–	–	101	101	66.5	40.5	36
E	–	–	–	182.5	–	–	–	107.5	80	47.5	42.5
F	–	–	–	190	–	–	–	115	97.5	57.5	50.5

Note 1.— The separation distances shown in columns (2) to (9) represent ordinary combinations of runways and taxiways. The basis for development of these distances is given in the Aerodrome Design Manual *(Doc 9157), Part 2.*

Note 2.— The distances in columns (2) to (9) do not guarantee sufficient clearance behind a holding aeroplane to permit the passing of another aeroplane on a parallel taxiway. See the Aerodrome Design Manual *(Doc 9157), Part 2.*

Source: ICAO Annex 14

Through the courses of previous feasibility studies (i.e. in 2000 and 2007) airfield separation distances of Code E was adopted. The 2009 design conducted under the initiative of Manila International Authority (NAIA), proposed to introduce the Code F for those separation distances, because generally airport would last its aircraft operations over half a century, the airfield and buildings, once constructed, cannot move in the future if the airport receives unforeseeable traffic demand in 30 to 40 years.

However, introduction of such world-largest aircraft (i.e. A380) to this particular remote-island airport is considered to be seldom, or no case if more than two A380s simultaneously passing each other in the same airfield. Together with another difficulty in the land acquisition for the adjacent access road, it was decided by DOTC that airfield separation distances between runway and taxiways of Code E are to be adopted for the purpose of detailed design.

ICAO notes that the distance between aircraft stand taxi-lane and object (42.5 m for Code E) may need to be increased if jet exhaust velocities cause hazardous conditions for ground service; therefore a distance of 47.5 m is used.

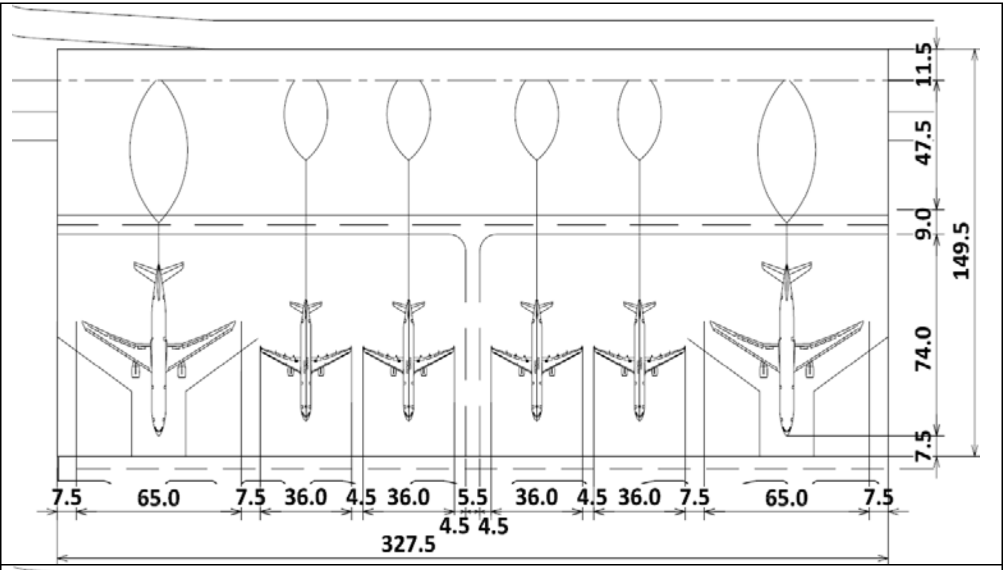
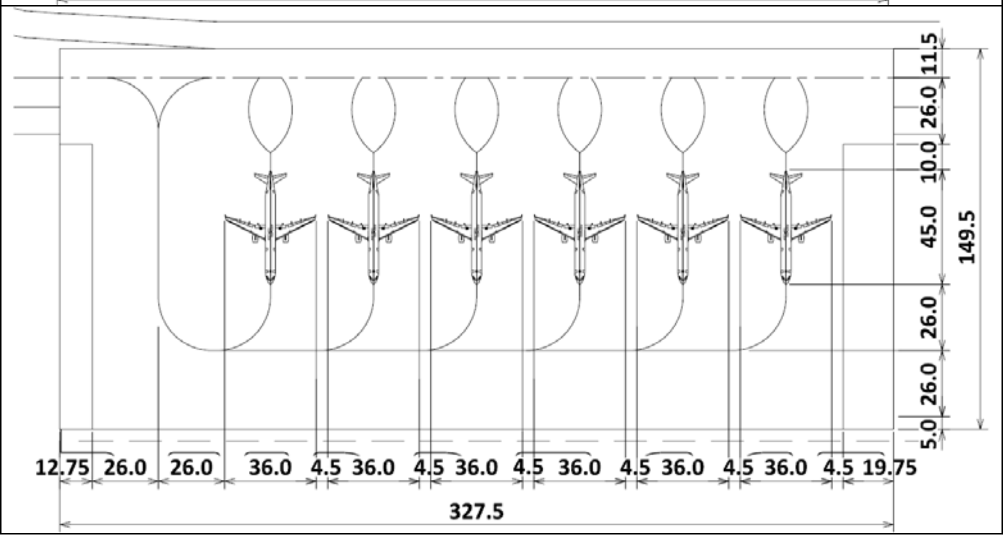
4.1.4. Apron

Required number of aircraft stands for 2020 is six (6) small jets, i.e. 4 for domestic, 1 for international and 1 for emergency, as shown in Table 3.6-1. However, the apron should have adequate depth to accommodate Code E aircraft in future.

Table 4.1-5 illustrates the proposed dimension of the apron in which Code E aircraft (e.g. B777) can be accommodated with a push-back assistance by towing tractor.

In the event, the size of emergency spot should be for Code E as well. The same dimension of the apron can accommodate self-manoeuvring operations of six (6) small jets (e.g. A321) in Phase 1.

Table 4.1-5 Dimension of Apron

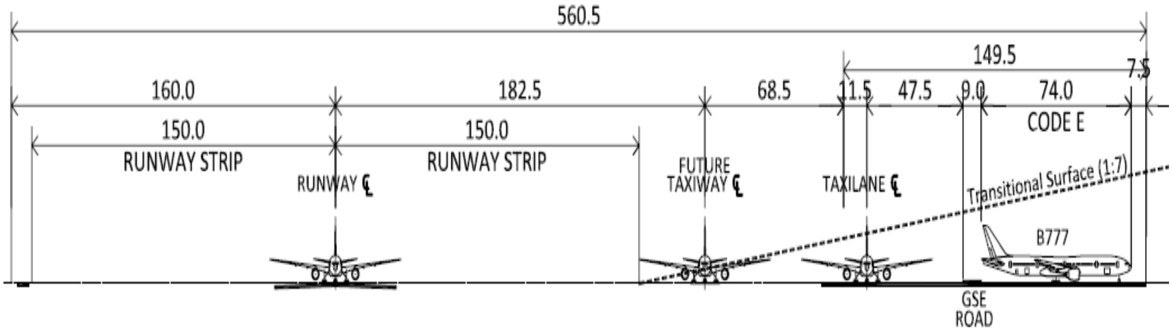
<u>Basic Dimension</u> Code E (wide-bodied) Nose-in and push-back Dom.: 4 A321 Int'l: 1 B777 Emergency: 1 B777 Total 6	
Phase 1 Code C (small jet) Self-maneuvering Dom: 4 A321 Int'l: 1 A321 Emergency: 1 A321 Total 6	

Source: JICA Study Team

GSE manoeuvring area (push-back operations of 50-ton towing tractor) in front of aircraft nose is planned to be a 7.5 m deep concrete pavement with the same thickness of the adjacent apron pavement, so that possible joint cracking when the thickness and joint patterns are different each other is prevented.

Hence, proposed dimension of the apron is 327.5 m in width and 149.5 m in depth including the GSE manoeuvring area.

In view of the above, separation distances between runway, taxiways and objects are set as shown in Figure 4.1-4.



Source: JICA Study Team

Figure 4.1-4 Separation between Runway and Taxiways

4.2. Longitudinal and Transversal Profile Design

4.2.1. Existing Terrain

The site of the proposed airport is generally flat with a moderate slope in the general direction of north to south varying only within a few meters based on previous topographic survey conducted for the project site.

The existing topography is shown in Figure 4.2-1.

4.2.2. Runway Profile

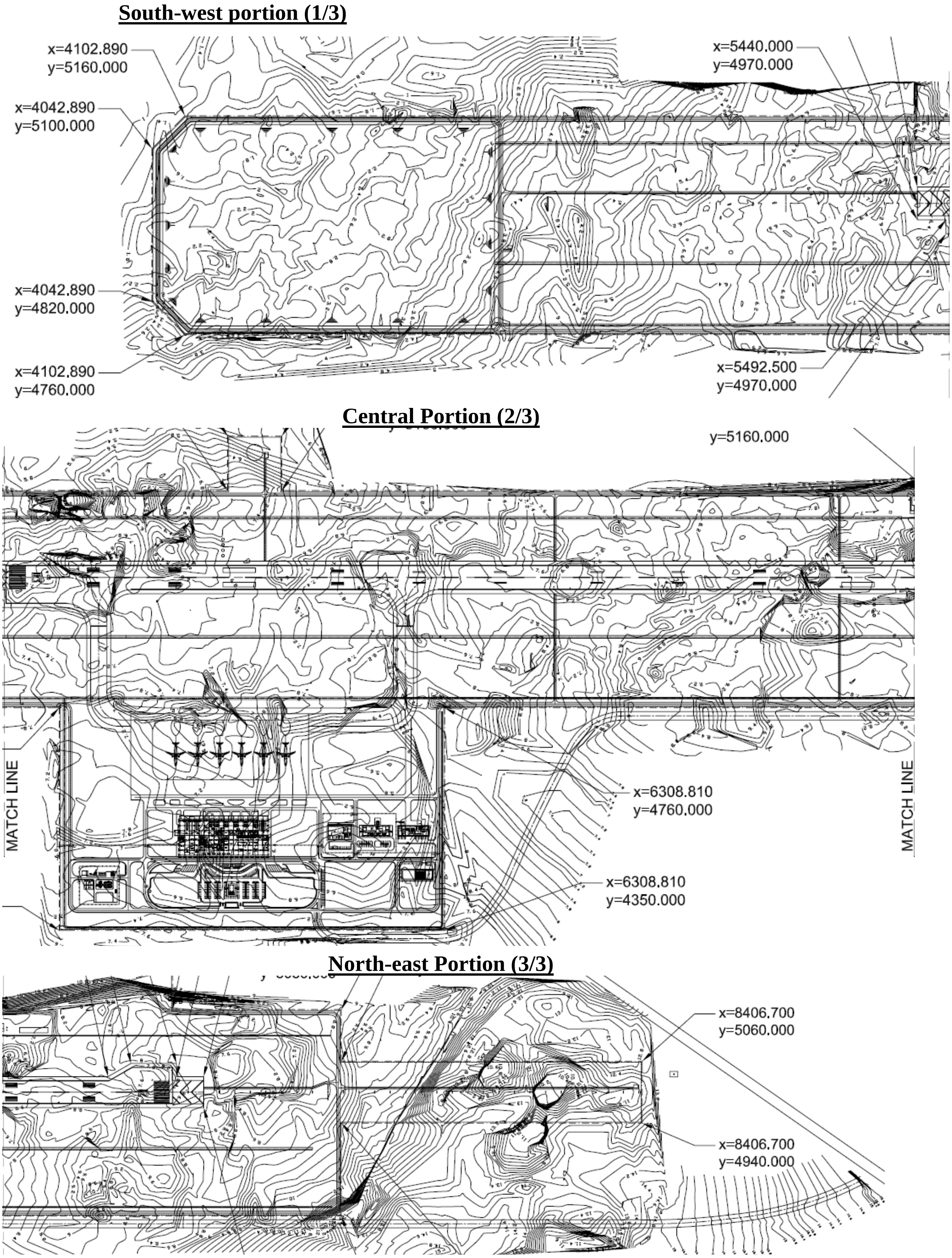
The runway centerline profile has been planned to generally follow the original ground slope to avoid excessive embankment of the original ground. The initial 2,000 m runway is planned to have a downward constant slope of 0.10% from north-east to south-west. Future 500 m extension is planned to have a constant downward slope of 0.15% toward soaking yard. The elevation of the runway centreline is generally set in average at one (1) meter above the original ground so that effective drainage of storm drain from runway area is properly attained.

The runway profile is shown in Figures 4.2-2 (1) to (4).

4.2.3. Transversal Slope and Grading

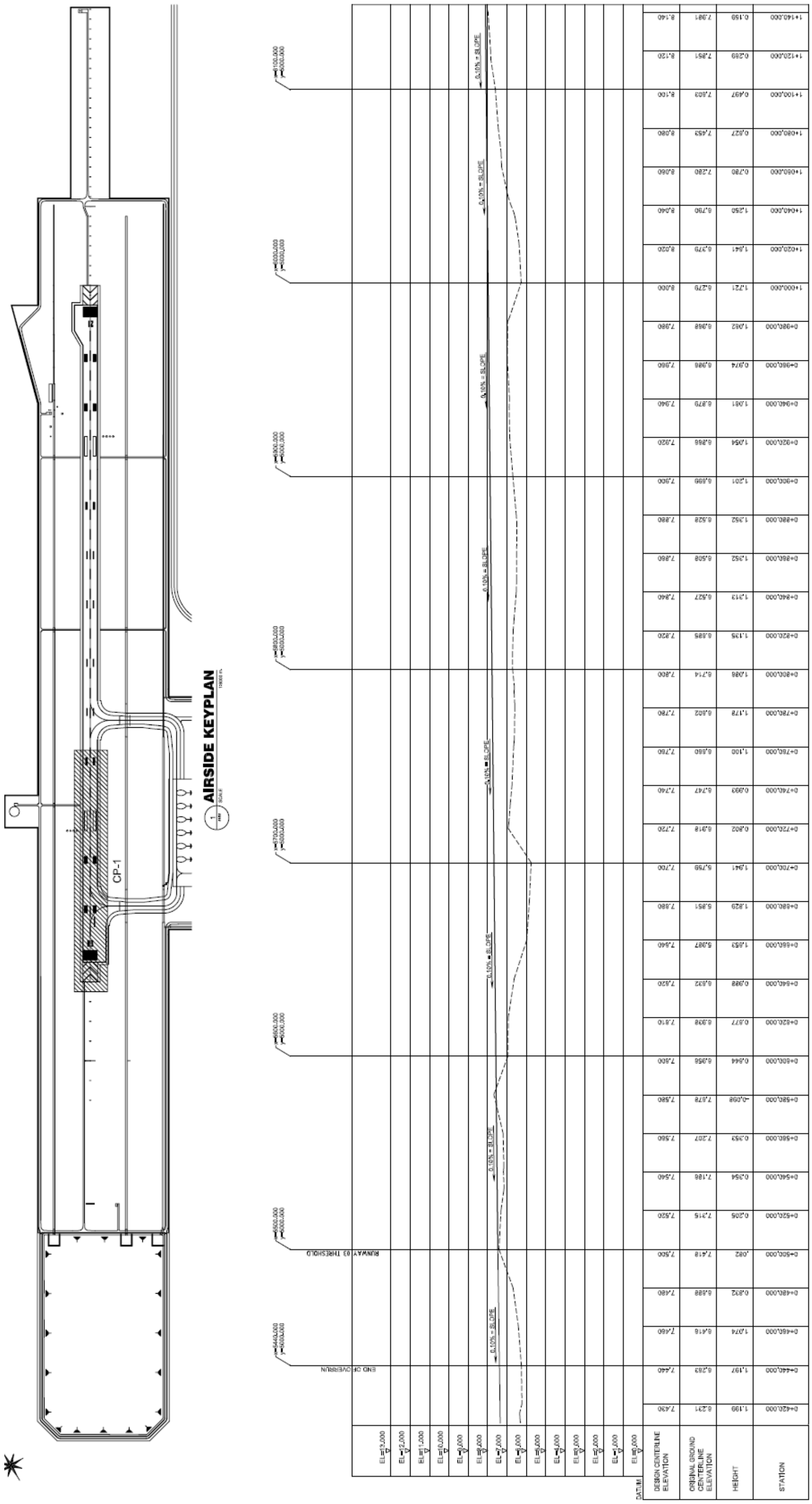
The 45 m wide runway pavement has a crown along the centreline and has a cross-fall of 1.3%. A 7.5 m wide paved shoulder will be provided on both sides having a slope of 2%. After the runway shoulders, 1.5 to 2% downward slope towards the proposed storm drain canal was adopted. The stub taxiway will have a certain downward slope to connect to the apron. The apron has a 0.50% crossfall and at the parking stand area sloped away from the building.

The typical airside section is shown in Figure 4.2-3 (1) to (8), and airside grading plan is shown in Figure 4.2-4 (1) to (4).



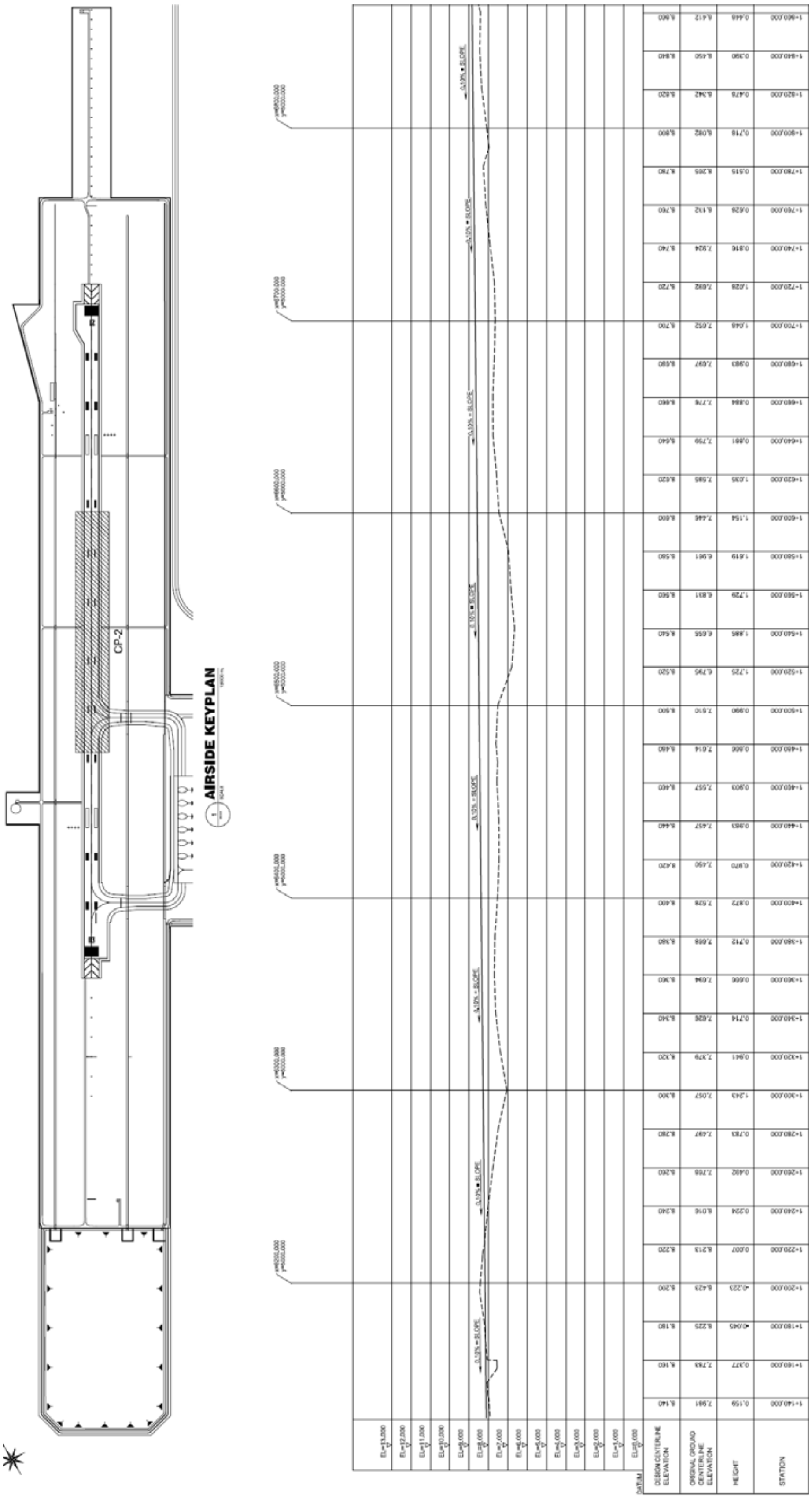
Source: JICA Study Team

Figure 4.2-1 Existing Topography



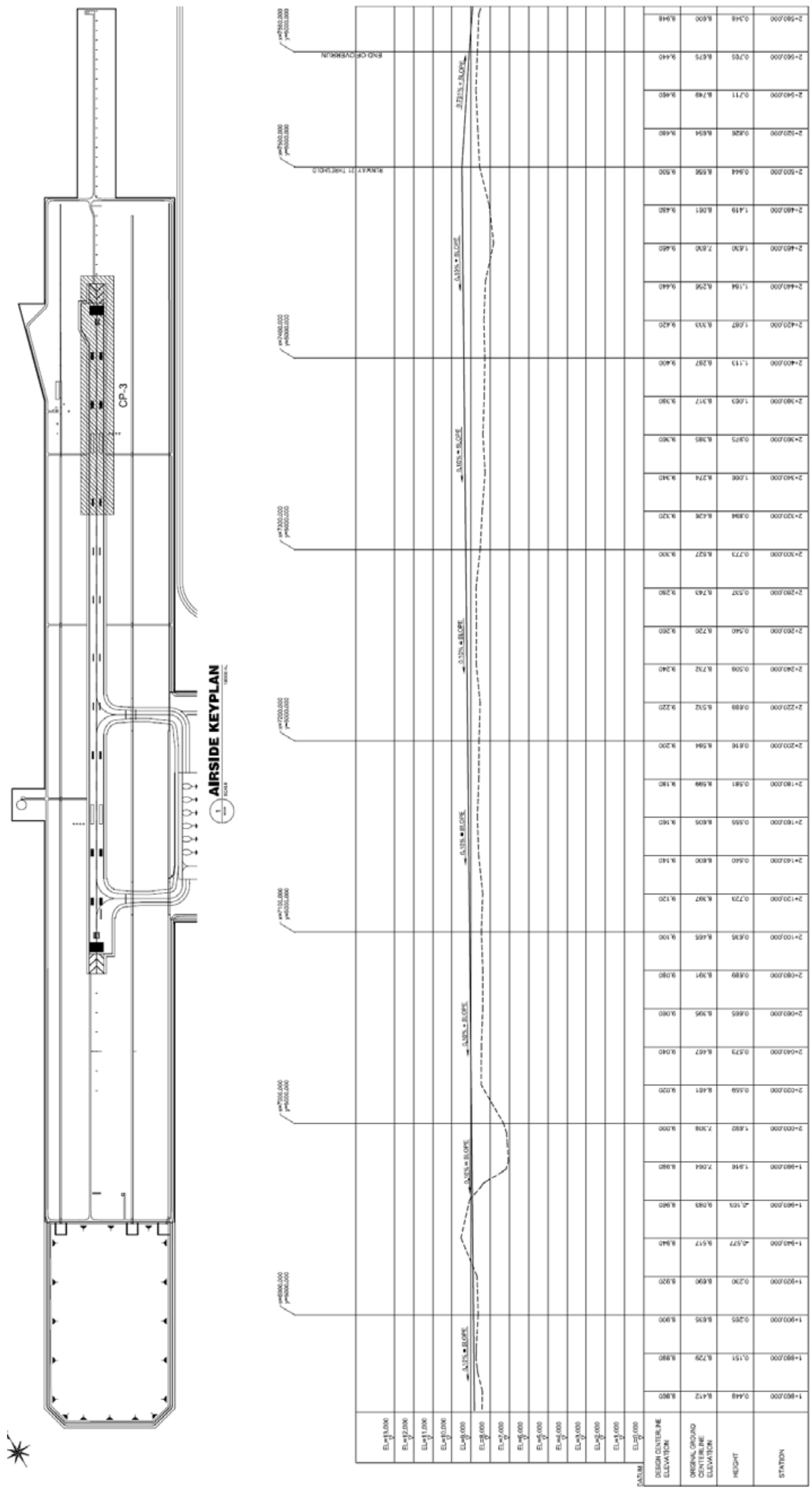
Source: JICA Study Team

Figure 4.2-2 (1) Runway Profile (Sta. 440 ~ 1,140 m)



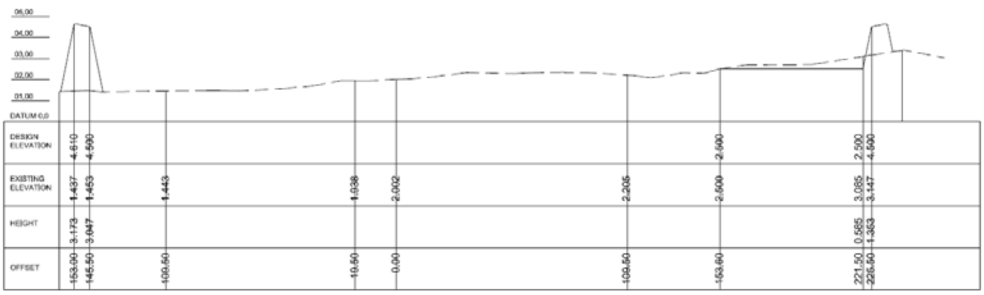
Source: JICA Study Team

Figure 4.2-2 (2) Runway Profile (Sta. 1,140 m ~ 1,860 m)



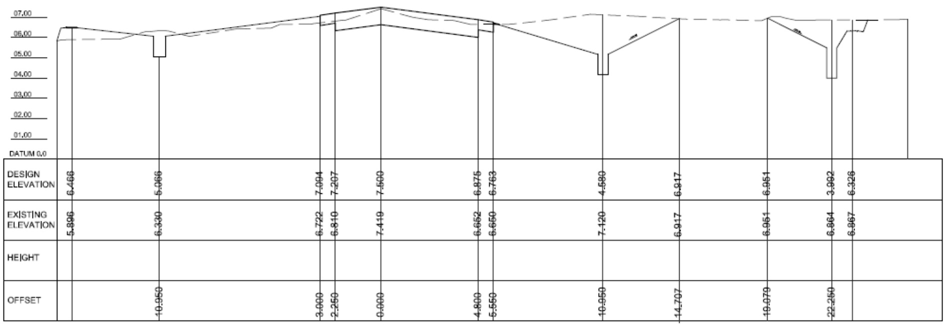
Source: JICA Study Team

Figure 4.2-2 (3) Runway Profile (Sta. 1,860 m ~ 2,560 m)



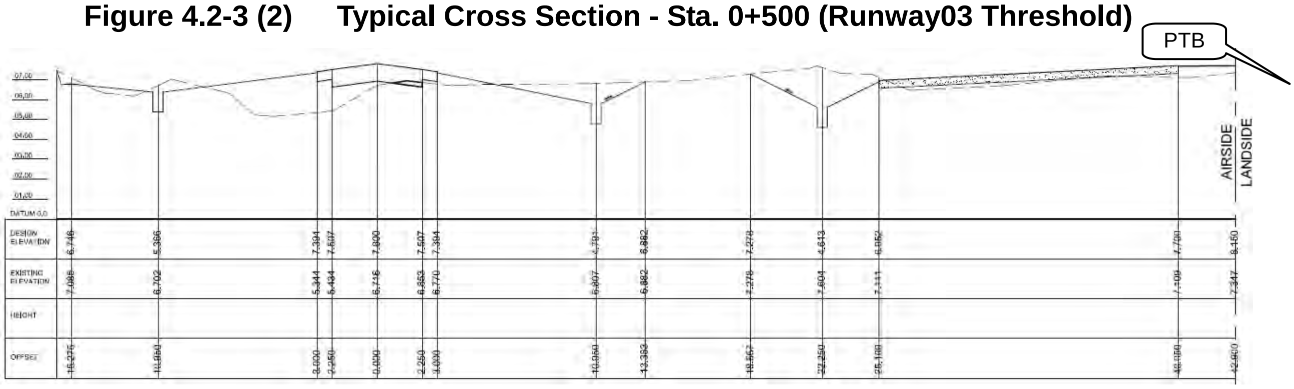
Source: JICA Study Team

Figure 4.2-3 (1) Typical Cross Section - Sta. 0-900 (Soaking Yard)



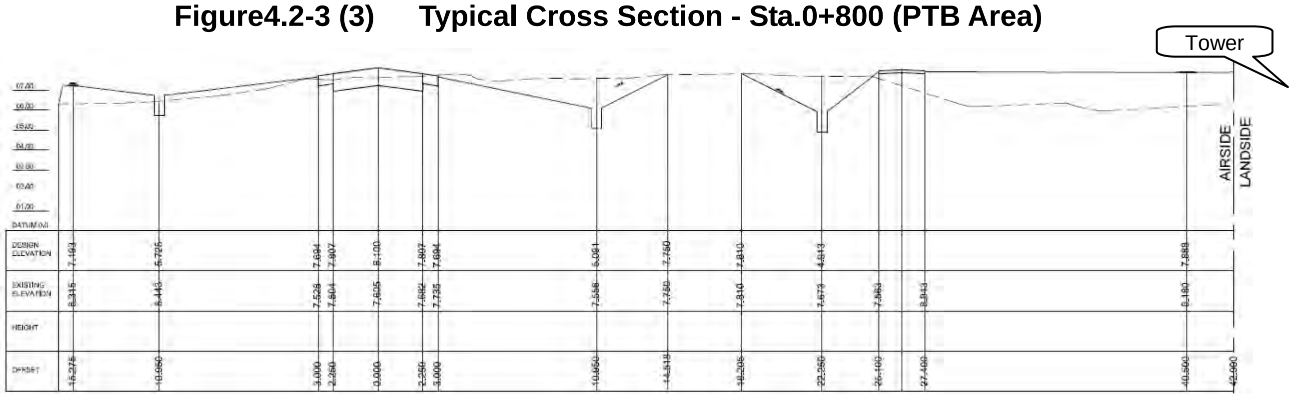
Source: JICA Study Team

Figure 4.2-3 (2) Typical Cross Section - Sta. 0+500 (Runway03 Threshold)



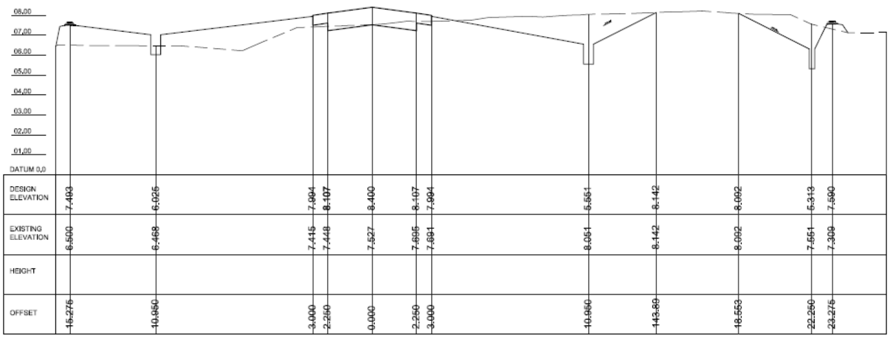
Source: JICA Study Team

Figure4.2-3 (3) Typical Cross Section - Sta.0+800 (PTB Area)



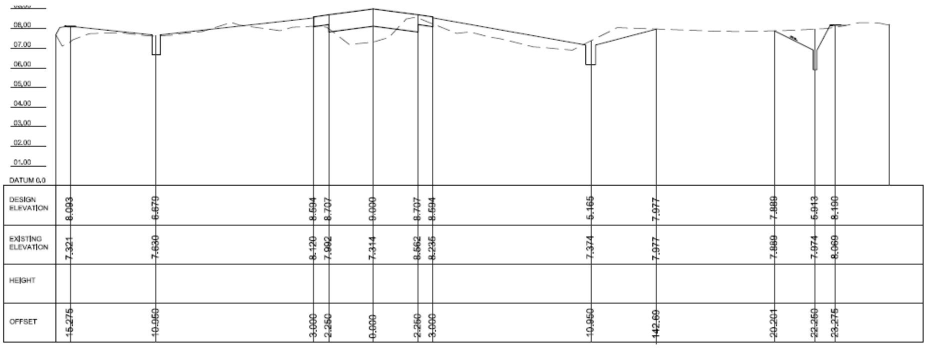
Source: JICA Study Team

Figure 4.2-3 (4) Typical Cross Section - Sta.1+100 (Area in front of Tower)



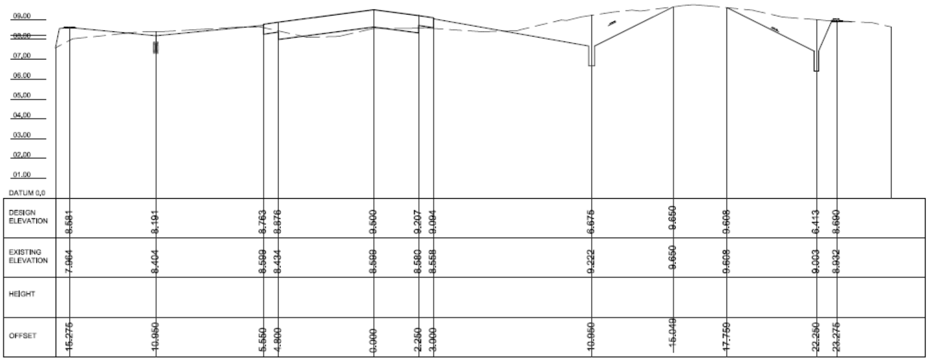
Source: JICA Study Team

Figure 4.2-3 (5) Typical Cross Section - Sta.1+400 (around middle of Runway)



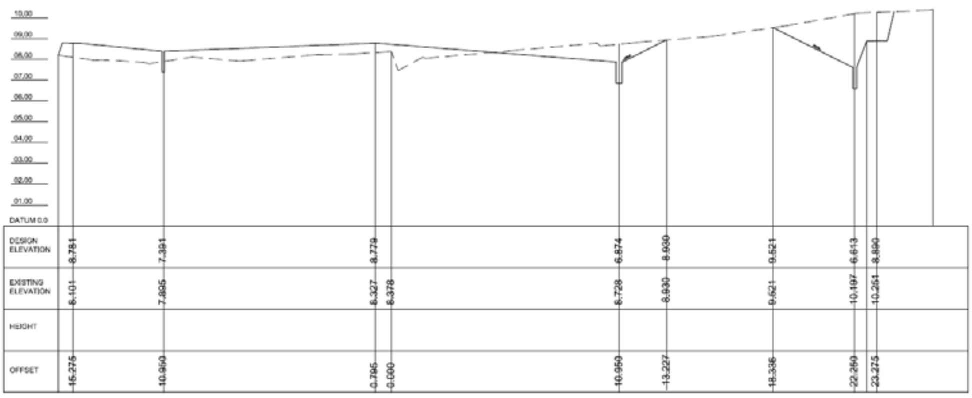
Source: JICA Study Team

Figure 4.2-3 (6) Typical Cross Section - Sta.2+000 (Touchdown Area for Runway 22)



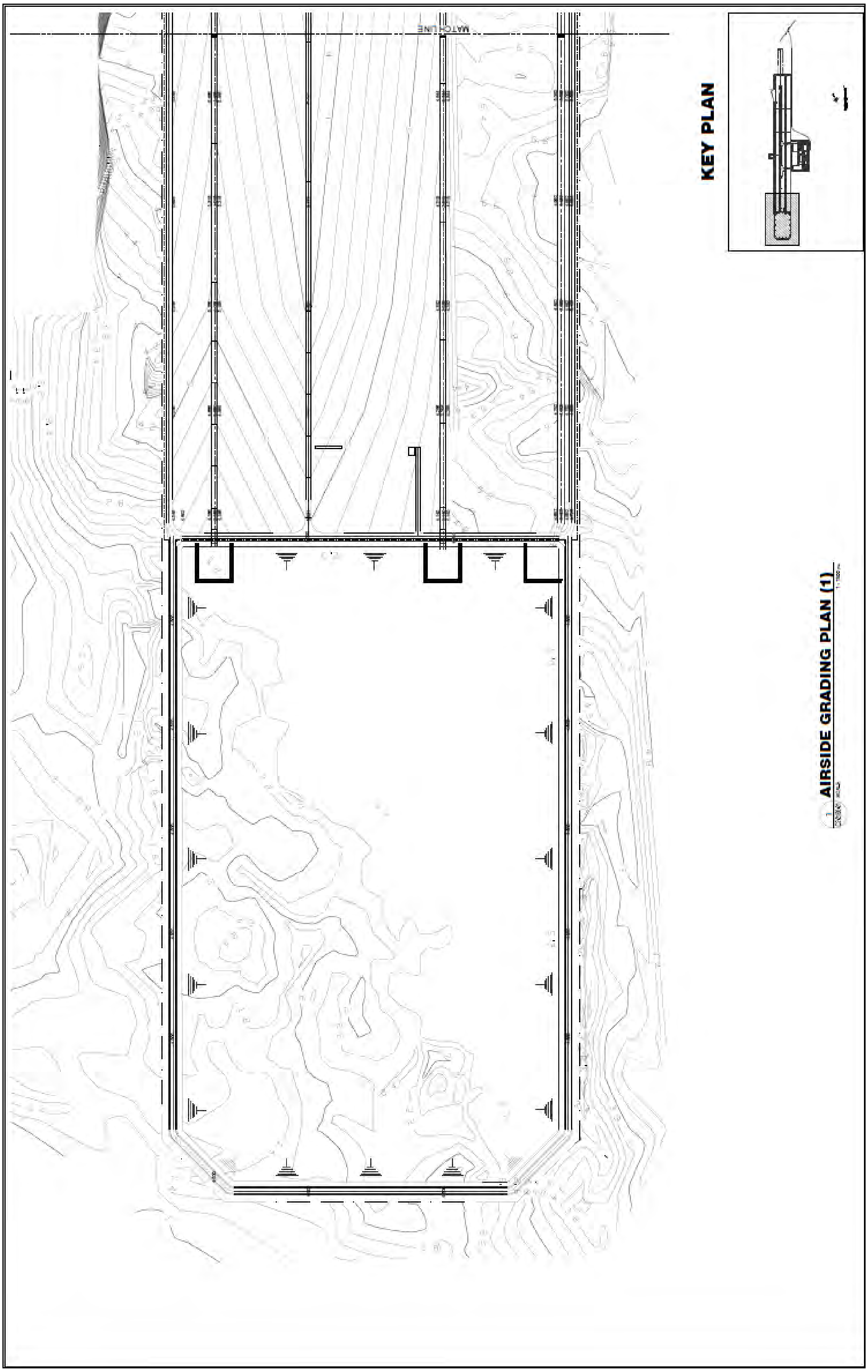
Source: JICA Study Team

Figure 4.2-3 (7) Typical Cross Section - Sta.2+500 (Runway22 Threshold)



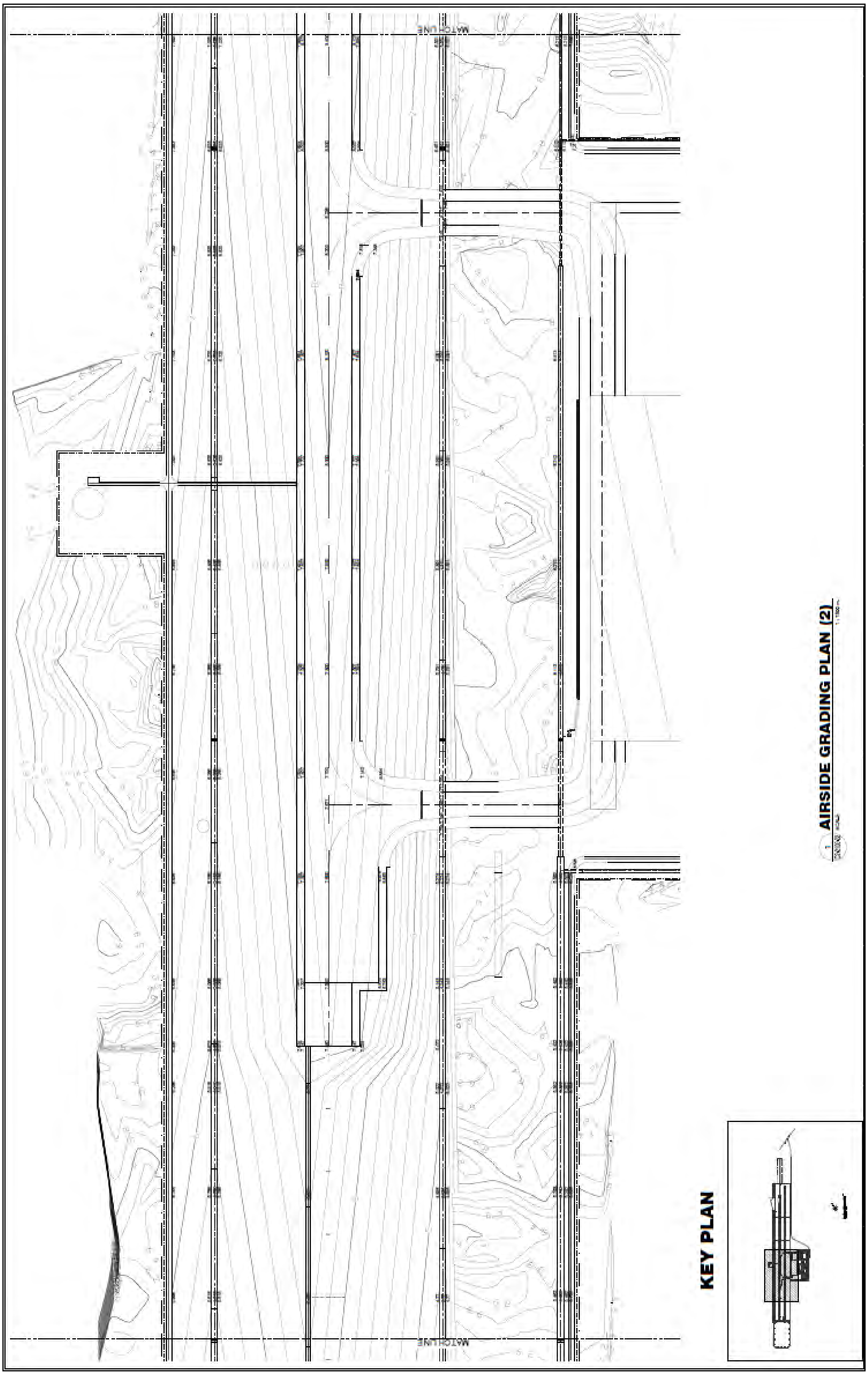
Source: JICA Study Team

Figure 4.2-3 (8) Typical Cross Section - Sta.2+700 (Approach Lighting)



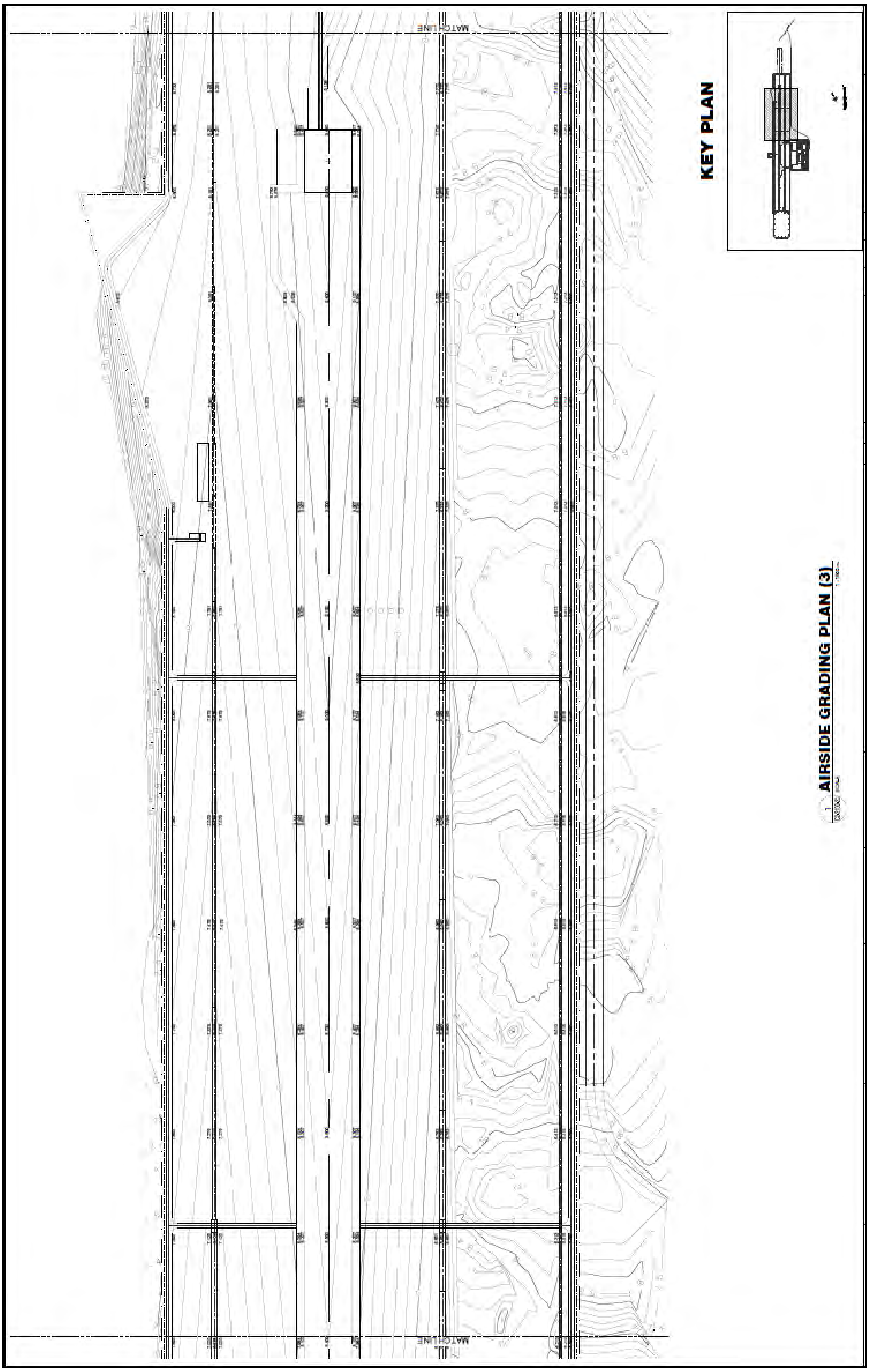
Source: JICA Study Team

Figure 4.2-4 (1) Airside Grading Plan – South-west end (1st quarter)



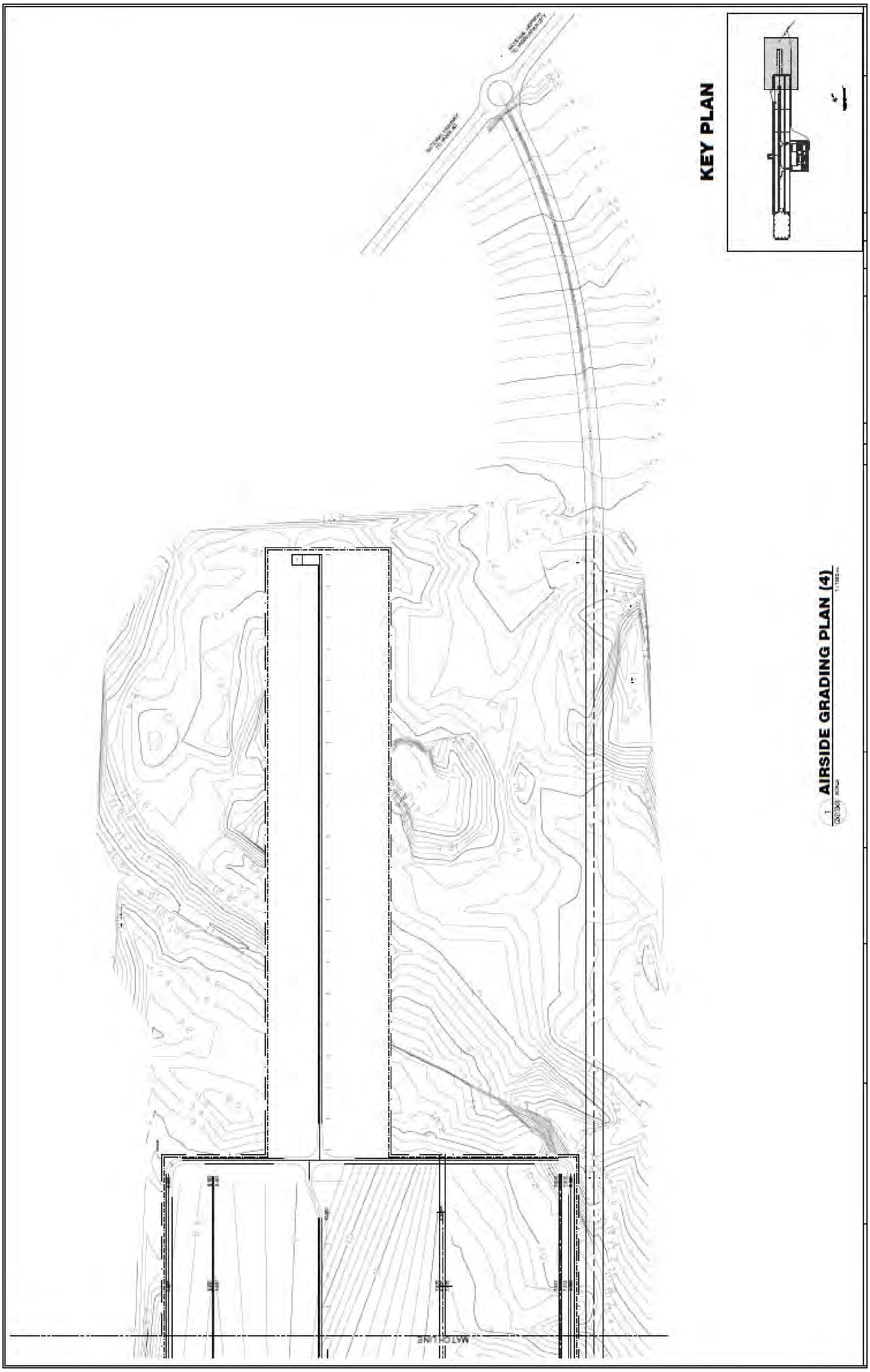
Source: JICA Study Team

Figure 4.2-4 (2) Airside Grading Plan – South-west (2nd quarter)



Source: JICA Study Team

Figure 4.2-4 (3) Airside Grading Plan – North-east 3rd quarter



Source: JICA Study Team

Figure 4.2-4 (4) Airside Grading Plan – North-east end (4th quarter)

4.3. Pavement Works

4.3.1. General

There are two (2) classes of pavements adopted to suit for airport and road pavements. This is primarily due to the substantial difference in the weight of the superimposed loads that the two classes will have for consideration in the design.

Of these two classes, two types are possible, being a rigid or a flexible type structure. Portland Cement Concrete Pavement (PCCP) is used for the rigid pavement where the load is mainly static, while the asphalt concrete surface course is used for the flexible type where smoothness is primarily of importance for fast running aircraft or vehicles.

4.3.2. Aircraft Movement Area

(1) General Approach

Airport pavements follow the design guidelines in accordance with the FAA Advisory Circular No. 150/5320-6E ("AIRPORT PAVEMENT DESIGN AND EVALUATION"). The type of pavement has been categorized according to its use and consideration of its ease in maintenance at optimum cost, in choosing the specific type of pavement. Generally, a flexible pavement design has been adopted while rigid pavement has been designed for the apron where a static load resistant surface is required.

The pavement structure shall be computed taking into consideration the following:

- Expected Volume of Traffic (annual departures with annual growth).
- Design Aircraft.
- Sub grade CBR and K value.

(2) Annual Traffic

Annual aircraft movements for international and domestic operations for the design years are given in Chapter 3 (Table 3.3-2), from which annual departures for the design aircraft are computed as shown in Table 4.3-1.

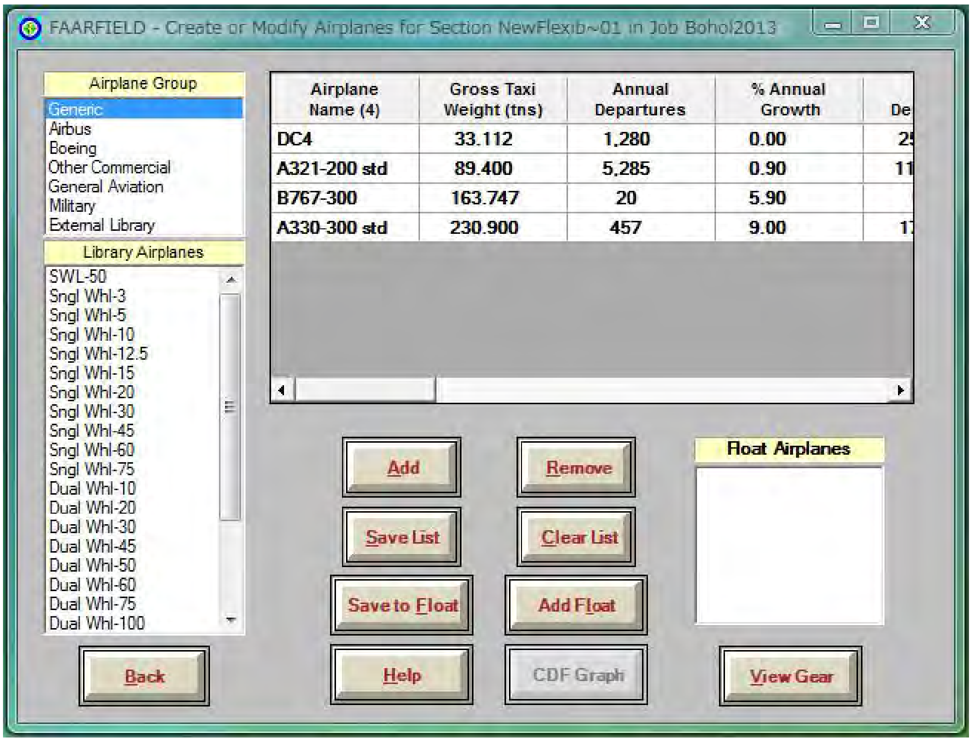
Table 4.3-1 Annual Departures of Design Aircraft

Aircraft	Year	2020		2040		Annual Growth
	Operations	2-way	1-way	2-way	1-way	
DH3	Domestic	2,560	1,280	2,560	1,280	0 %
A321-200	Domestic	10,240		10,240		
	International	330		2,480		
	Total	10,570	5,285	12,720	6,360	0.9 %
	International	40		126		
	Total	40	20	126	63	5.9 %
A330-300	Domestic	745		4,193		
	International			208		
	Total	745	457	4,401	2,552	9.0 %

Source: JICA Study Team

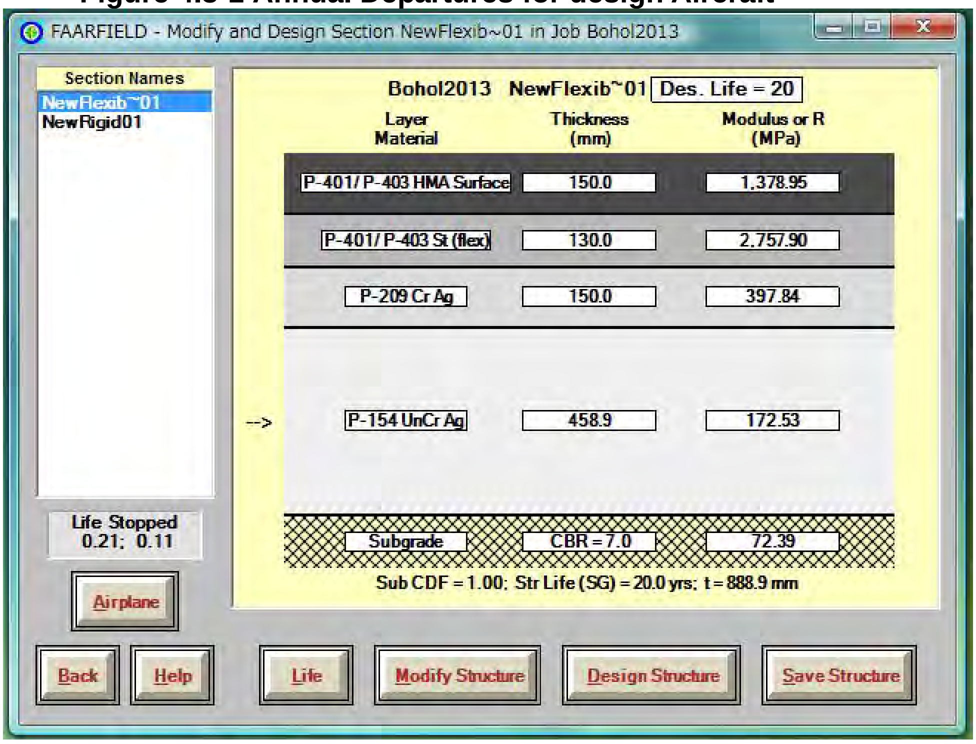
(3) Pavement Thickness Calculation

The values of the above criteria have been entered into the FAARFIELD Pavement Design Program. Preliminary pavement design is shown in Figure 4.3-1 to Figure 4.3-4.



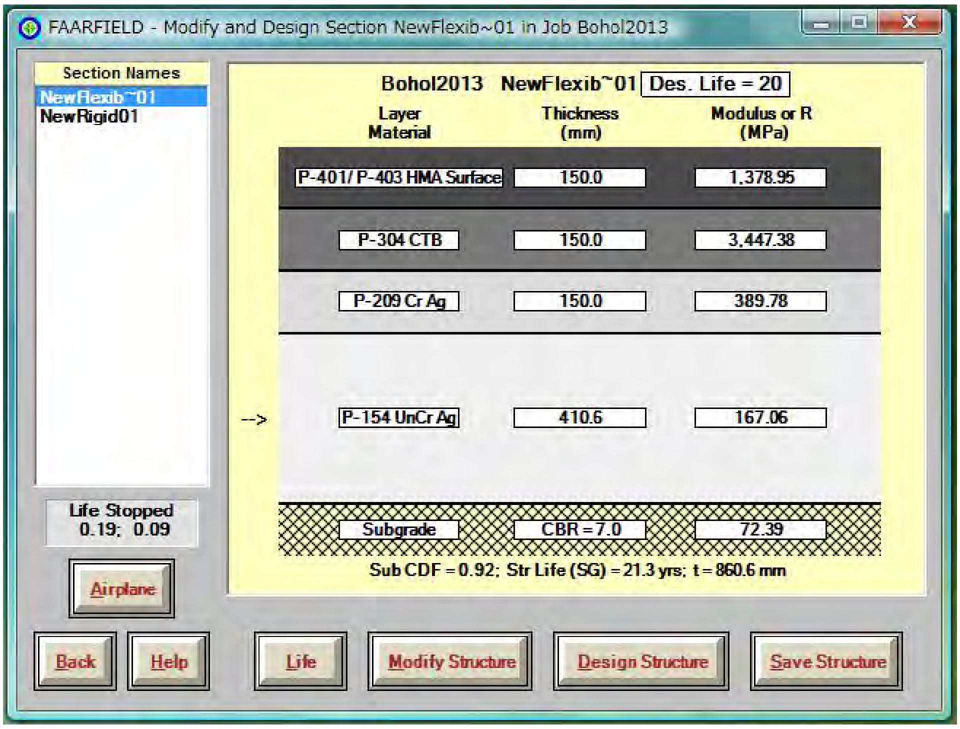
Source: Based on FAARFIELD Pavement Design Program

Figure 4.3-1 Annual Departures for design Aircraft



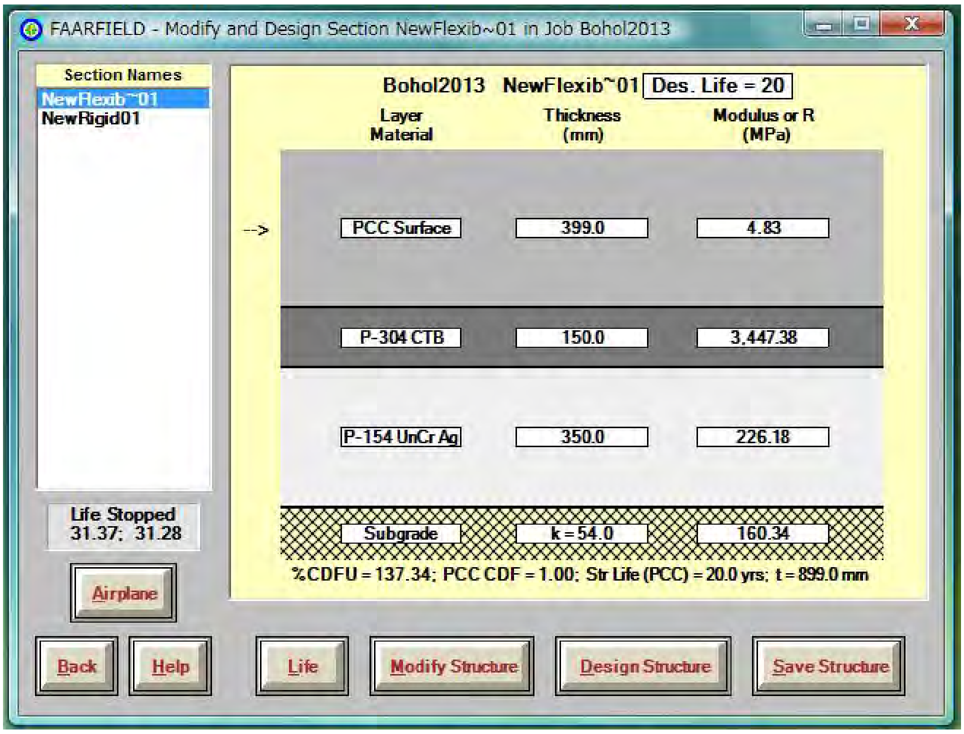
Source: Based on FAARFIELD Pavement Design Program

Figure 4.3-2 Thickness of Flexible Pavement - Runway



Source: Based on FAARFIELD Pavement Design Program

Figure 4.3-3 Thickness of Flexible Pavement - Taxiway



Source: Based on FAARFIELD Pavement Design Program

Figure 4.3-4 Thickness of Rigid Pavement – Apron

(4) Subgrade Thickness

FAA recommends that subgrade should be compacted as shown in Table 4.3-2.

Table 4.3-2 FAA's Subgrade Compaction Requirements for Flexible Pavement

GEAR TYPE	GROSS WEIGHT Lb.	NON-COHESIVE SOILS Depth of Compaction, inch				COHESIVE SOILS Depth of Compaction, inch			
		100%	95%	90%	85%	95%	90%	85%	80%
S	30,000	8	8-18	18-32	32-44	6	6-9	9-12	12-17
	50,000	10	10-24	24-36	36-48	6	6-9	9-16	16-20
	75,000	12	12-30	30-40	40-52	6	6-12	12-19	19-25
D (incls. 2S)	50,000	12	12-28	28-38	38-50	6	6-10	10-17	17-22
	100,000	17	17-30	30-42	42-55	6	6-12	12-19	19-25
	150,000	19	19-32	32-46	46-60	7	7-14	14-21	21-28
	200,000	21	21-37	37-53	53-69	9	9-16	16-24	24-32
2D (incls. B757, B767, A-300,DC-10-10, L1011)	100,000	14	14-26	26-38	38-49	5	6-10	10-17	17-22
	200,000	17	17-30	30-43	43-56	5	6-12	12-18	18-26
	300,000	20	20-34	34-48	48-63	7	7-14	14-22	22-29
	400,000 – 600,000	23	23-41	41-59	59-76	9	9-18	18-27	27-36
2D/D1, 2D/2D1 (incls. MD11,A340, C10-30/40)	500,000 – 800,000	23	23-41	41-59	59-76	9	9-18	18-27	27-36
2D/2D2 (incls. B747 series)	800,000	23	23-41	41-59	59-76	9	9-18	18-27	27-36
	975,000	24	24-44	44-62	62-78	10	10-20	20-28	28-37
3D (incls. B777 series)	550,000	20	20-36	36-52	52-67	6	6-14	14-21	21-29
	650,000	22	22-39	39-56	56-70	7	7-16	16-22	22-30
	750,000	24	24-42	42-57	57-71	8	8-17	17-23	23-30
2D/3D2 (incls. A380 series)	1,250,000	24	24-42	42-61	61-78	9	9-18	18-27	27-36
	1,350,000	25	25-44	44-64	64-81	10	10-20	20-29	29-38

Notes:

1. Non-cohesive soils, for the purpose of determining compaction control, are those with a plasticity index of less than 3.
2. Tabulated values denote depths below the finished subgrade above which densities should equal or exceed the indicated percentage of the maximum dry density as specified in Item P-152.
3. The subgrade in cut areas should have natural densities shown or should (a) be compacted from the surface to achieve the required densities, (b) be removed and replaced at the densities shown, or (c) when economics and grades permit, be covered with sufficient select or subbase material so that the uncompacted subgrade is at a depth where the in-place densities are satisfactory.

(Source: FAA)

The above notes that 1) soils with plasticity index (PI) of less than 3 should be non-cohesive. Meanwhile the PI measured at natural ground is 6 to 10 according to the Geological Survey Report (refer to Chapter 2.1.3), therefore natural ground at the new airport site is considered to be generally composed of cohesive soils.

The Table recommends subgrade of the cohesive soil to sustain B777 (gross weight of 543 lb) should be compacted to 95 % of maximum dry density (MDD) to the depth of 6 inches (15 cm), 90 % of MDD to the depth of 14 inches (35 cm), and at 85 % of MDD to the depth of 21 inches (53 cm).

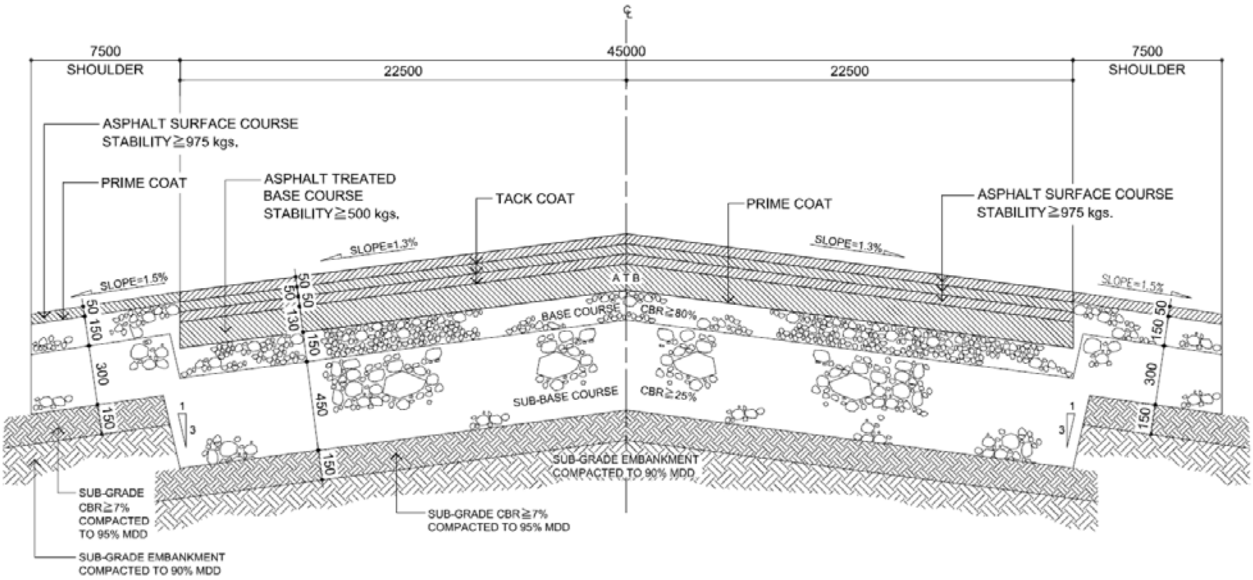
Reference is made to the boring data (Pages 2-39 to 107 of this report). N-values of natural ground at subgrade level are measured at 35 to 100, which are considered dense to very dense and equivalent to the compaction degree of at least 85 %. On the other hand, the compaction degree of structural embankment normally required in the Specifications for Civil Works is more than 90% which falls in the above requirement for subgrade below 6 to 14 inches (15 to 35 cm).

Hence, it could be so designed that the depth of top 15 cm subgrade beneath the pavement structure should be compacted to more than 95 % of MDD as subgrade surface, and subsequent 20 cm thickness should be compacted to more than 90 % of

MDD as a part of structural embankment, depending upon actual field density tests to be conducted from time to time during construction.

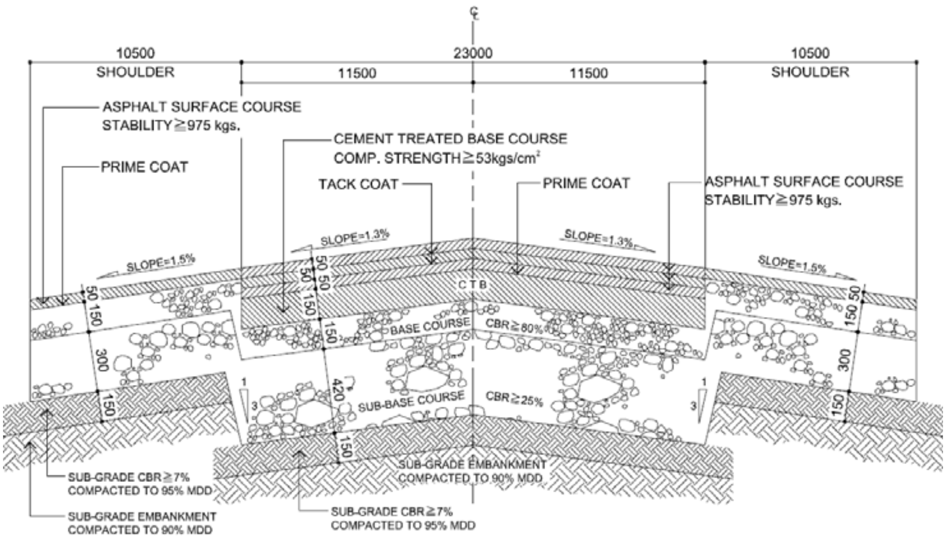
(5) Proposed Pavement Structure

Based on the pavement thickness given from the FAARFIELD Pavement Design Program, pavement structures for runway, taxiways and apron are shown in Figure 4.3-5, Figure 4.3-6 and Figure 4.3-7.



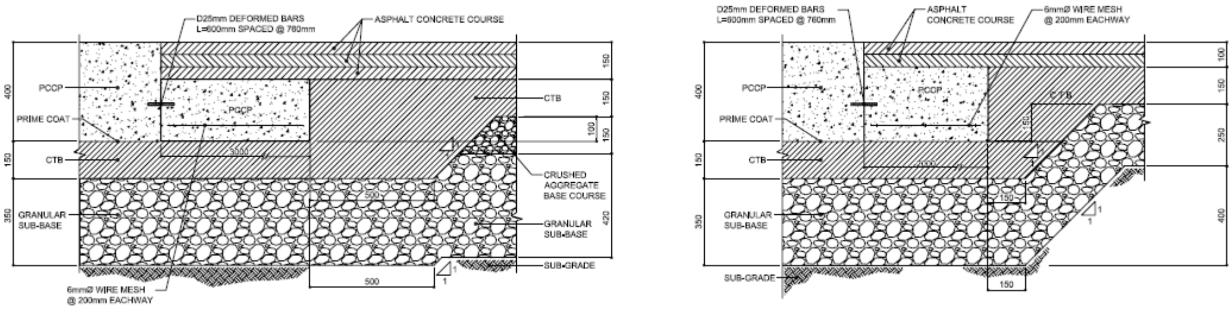
Source: JICA Study Team

Figure 4.3-5 Runway Pavement Structure



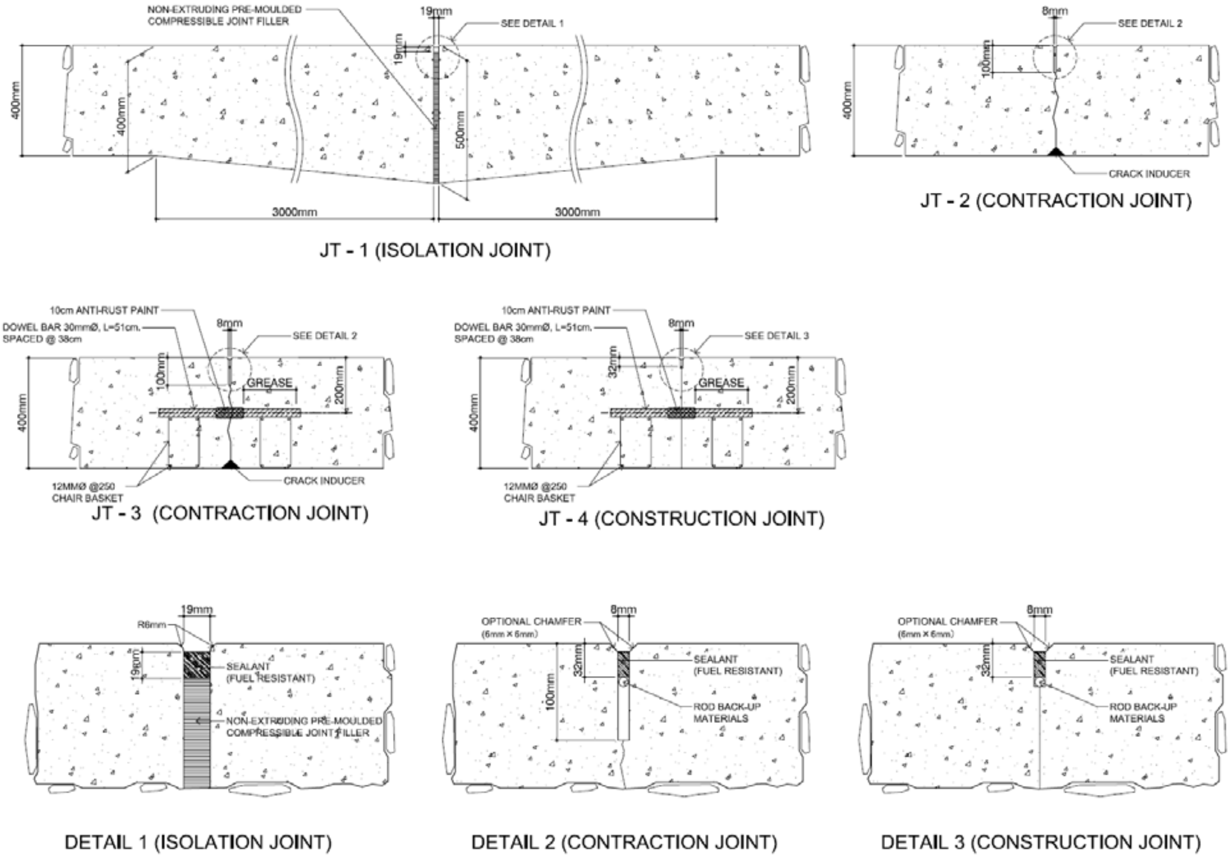
Source: JICA Study Team

Figure 4.3-6 Taxiway Pavement Structure



Source: JICA Study Team

Figure 4.3-7 Pavement Structure at Apron and GSE Road



Source: JICA Study Team

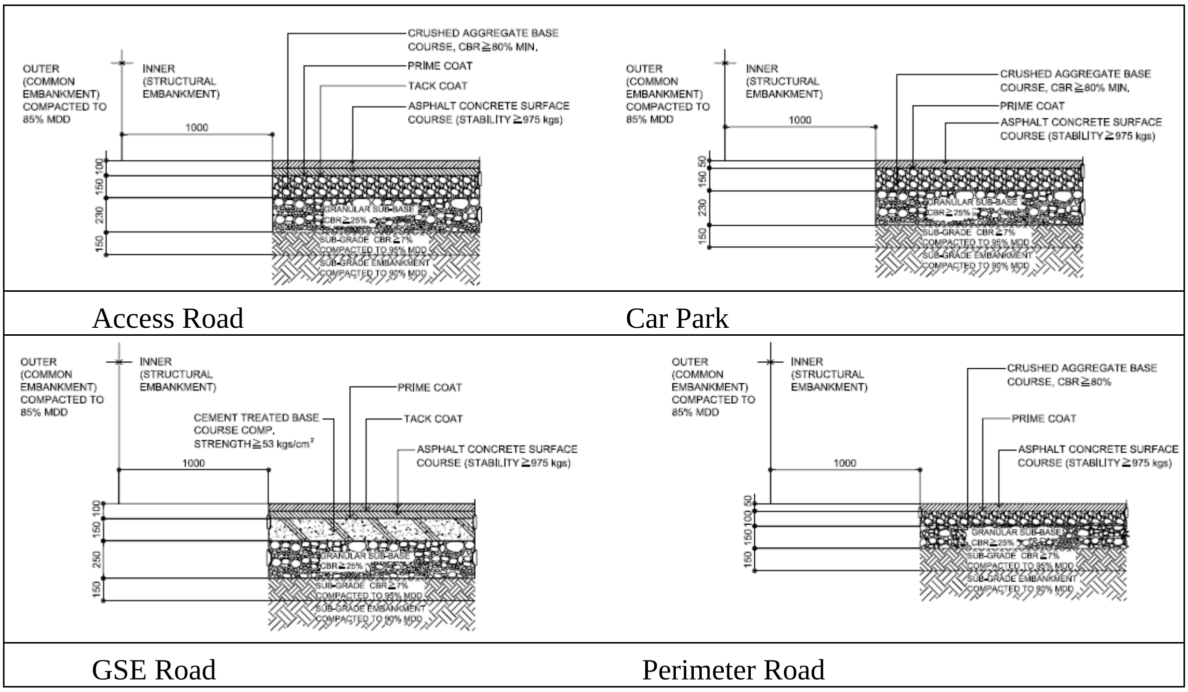
Figure 4.3-8 Apron Pavement Structure

4.3.3. Road Pavements

Road pavements follow the design guidelines of Department of Public Works and Highways (DPWH) and American Association of State Highway and Transportation Officials (AASHTO) criteria and standards.

Design speed for the access road is 60 kph while 30 kph or slower, around the terminal areas or the general circulation roads.

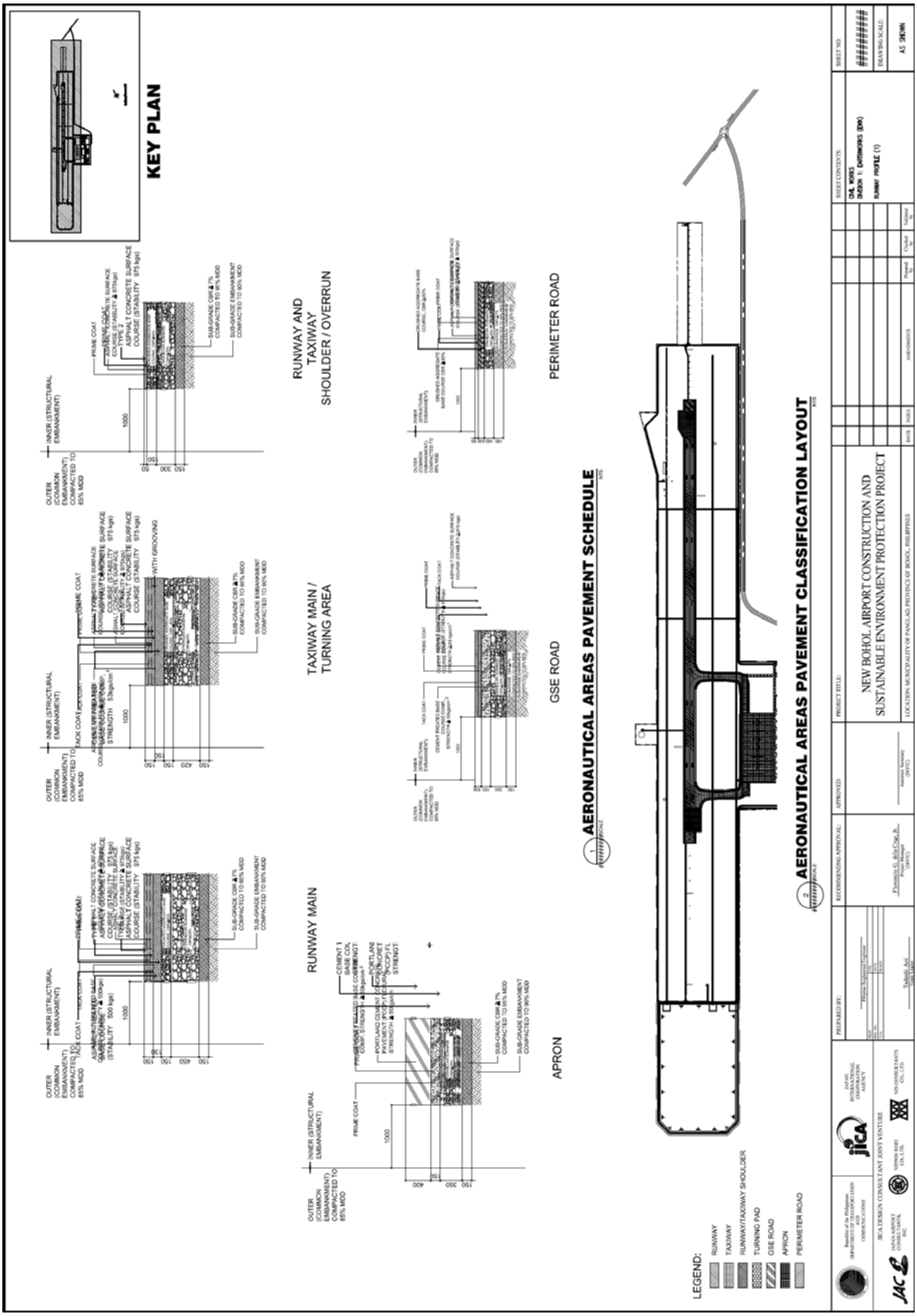
The typical sections of the road pavement are shown in Fig. 4.3-9.



Source: JICA Study Team

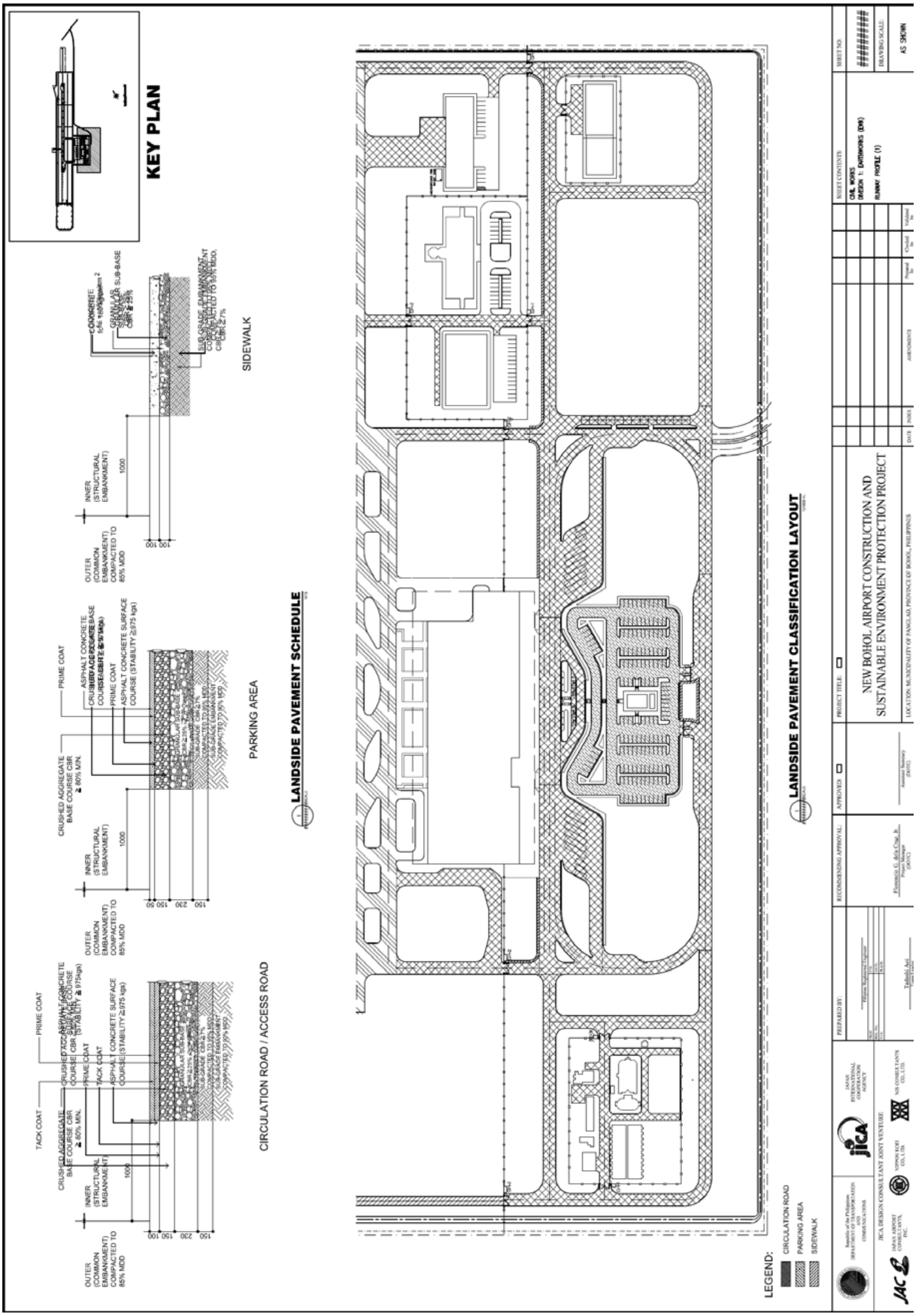
Figure 4.3-9 Road and Car Park Pavement Structure

Based on the foregoing discussion, each type of airport pavement structures are laid out as shown in Figures 4.3-10 and 11.



Source: JICA Study Team

Figure 4.3-10 Aeronautical Areas Pavement Layout Plan



Source: JICA Study Team

Figure 4.3-11 Terminal Areas Pavement Layout Plan

4.4. Drainage

4.4.1. Design Conditions and Formula

(1) Return Period

The flood return period used in the design is 10 years.

Table 4.4-1 Rainfall Intensity-Duration-Frequency Data for Tagbilaran City

Probability	Minutes											Hours			
years	5	10	15	20	30	45	60	80	100	120	150	3	6	12	24
Computed Extreme Value of Precipitation, mm															
2	8.2	12.5	16.2	19.3	23.6	27.9	30.5	34.2	37.7	40.5	44.2	47.4	60.0	71.6	81.7
5	13.6	20.9	28.6	34.5	41.4	47.5	54.0	58.1	60.8	63.5	67.7	75.9	95.5	107.2	118.6
10	17.1	26.5	36.8	44.6	52.6	60.4	69.6	73.8	76.0	78.7	83.3	94.7	119.1	130.7	143.0
15	19.1	29.6	41.5	50.4	59.2	67.7	78.4	82.7	84.6	87.3	92.0	105.4	132.3	143.9	156.7
20	20.6	31.8	44.7	54.3	63.8	72.8	84.6	89.0	90.7	93.3	98.2	112.8	141.6	153.2	166.4
25	21.6	33.5	47.2	57.4	67.3	76.8	89.3	93.8	95.3	97.9	102.9	118.6	148.8	160.4	173.8
50	25.0	38.7	54.9	66.9	78.1	88.9	103.9	108.6	109.6	112.2	117.5	136.2	170.8	182.4	196.7
100	28.3	43.9	62.6	76.3	88.9	101.0	118.4	123.2	123.8	126.3	131.9	153.8	192.7	204.3	219.4
Equivalent Average Intensity, mm/hr															
2	98.4	75.0	64.8	57.9	47.2	37.2	30.5	25.7	22.6	20.3	17.7	15.8	10.0	6.0	3.4
5	163.2	125.4	114.4	103.5	82.8	63.3	54.0	43.6	36.5	31.8	27.1	25.3	15.9	8.9	4.9
10	205.2	159.0	147.2	133.8	105.2	80.5	69.6	55.4	45.6	39.4	33.3	31.6	19.9	10.9	6.0
15	229.2	177.6	166.0	151.2	118.4	90.3	78.4	62.0	50.8	43.7	36.8	35.1	22.1	12.0	6.5
20	247.2	190.8	178.8	162.9	127.6	97.1	84.6	66.8	54.4	46.7	39.3	37.6	23.6	12.8	6.9
25	259.2	201.0	188.8	172.2	134.6	102.4	89.3	70.4	57.2	49.0	41.2	39.5	24.8	13.4	7.2
50	300.0	232.2	219.6	200.7	156.2	118.5	103.9	81.5	65.8	56.1	47.0	45.4	28.5	15.2	8.2
100	339.6	263.4	250.4	228.9	177.8	134.7	118.4	92.4	74.3	63.2	52.8	51.3	32.1	17.0	9.1

Source: Philippine Atmospheric Geophysical and Astronomical Services Administration

(2) Rainfall Characteristics

A 29-year record of the rainfall intensity-duration-frequency data for Tagbilaran City is shown in Table 4.4-1. The source of information is the Hydrometeorological Data Applications Section of PAGASA. Using the 10 year flood return period, the resulting equation using curve-fitting exercises is:

$$I = \frac{400}{t^{0.4}}$$

Where:

I = rainfall intensity (mm/hr)

t = rainfall duration (minutes)

(3) Time of Concentration

There are several formulas for estimating the time of concentration. For overland flow, the reliable approach is based on JCAB formula, the equation of which is as follows:

$$t = \frac{3.261\,(1.1 - C)\,\sqrt{D}}{\sqrt[3]{S}}$$

Where:

t = time of concentration (minutes)

C = runoff coefficient

D = overland flow length (m)

S = average slope of overland flow area (m/m)

(4) Peak Flows

The Rational Formula presented below was used to determine the peak discharges.

$$Q = \frac{CIA}{360}$$

Where:

Q = discharge (m^3/s)

C = runoff coefficient

= 0.30 for well-drained sand and gravel; high permeability

= 0.90 for concrete or building area

= 0.95 for asphalt paved areas

I = rainfall intensity (mm/hr)

A = catchment area (ha)

(5) Channel Capacities

The basic discharge equation for open canals, box culverts and pipes is:

$$Q = VA$$

Where:

Q = discharge (m^3/s)

V = mean velocity of flow (m/s)

A = cross sectional area of flow (m^2)

The velocity is computed using Manning's Formula:

$$V = \frac{R^{2/3}S^{1/2}}{n}$$

Where:

R = hydraulic radius = area/wetted perimeter (m)

S = slope of the hydraulic grade line

n = Manning's roughness coefficient

= 0.030 for CHB-walled bare ground open ditch

= 0.015 for concrete box culvert

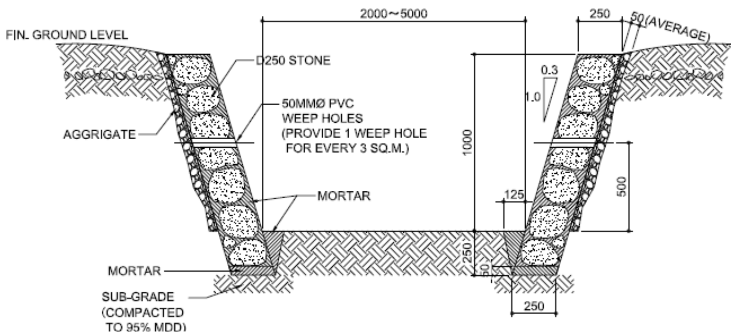
= 0.013 for concrete pipe culvert

= 0.010 for PVC pipe

4.4.2. Drainage for Airside

One of the prerequisite conditions for environmental protection is that any dirty water should not overflow from the new airport to the ocean. Towards this objective, storm water along airfield is planned to be collected through open ditch, bottom of which is not concreted, so that storm water is locally detained and soaked into the ground as much as possible, then only a minimal volume of storm water would flow into the soaking yard.

For the airfield, a riprapped open ditch with bare ground that runs parallel on both sides of the runway and perimeter (as shown in Fig4.4-1) will drain the airfield drainage.



Source: JICA Study Team

Figure 4.4-1 Riprap Open Canal for Aeronautical Area

As stated above in 4.3.1, runway longitudinal slope will be, following the existing terrain, a moderate down slope from north-east to south-east, longitudinal slope of which varies from 0.05% to 0.15%. The same moderate slope will be utilized for the airfield drainage. The height of the riprap open canal will be 1,000 mm in constant, and 1,500 mm for the place with big level difference in part of perimeter road.

Width of this riprapped open ditch will start from 2.0 m for upper stream, and gradually spread to 5 m for downstream. When crossing the taxiway strip, the 5 m wide open ditch will be connected to the Reinforced Concrete Pipe (RCP) of 750mm in diameter (as shown in Figure 4.4-2). The RCP which is directly under the taxiway pavement is covered with the concrete.

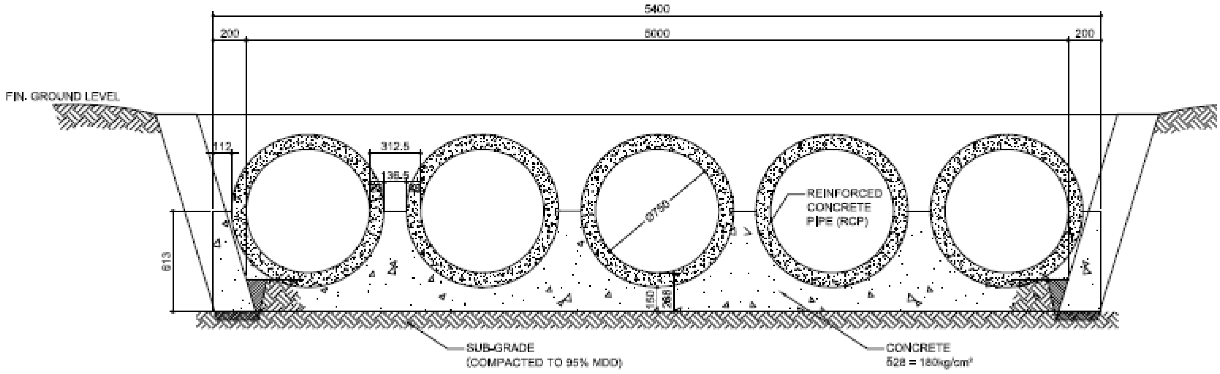
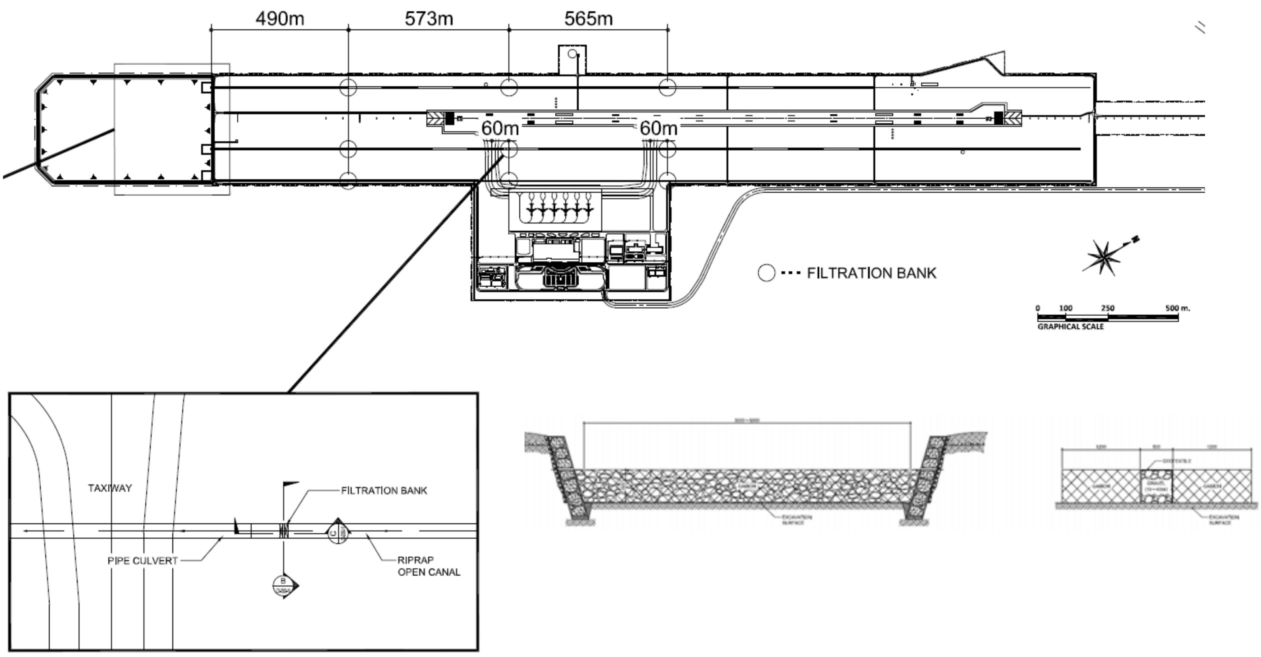


Figure 4.4-2 Reinforced Concrete Pipe

Just before the RCP crossing, a filtration bank will be constructed so that fine silt can be filtrated at this bank as shown in Figure 4.4-3.



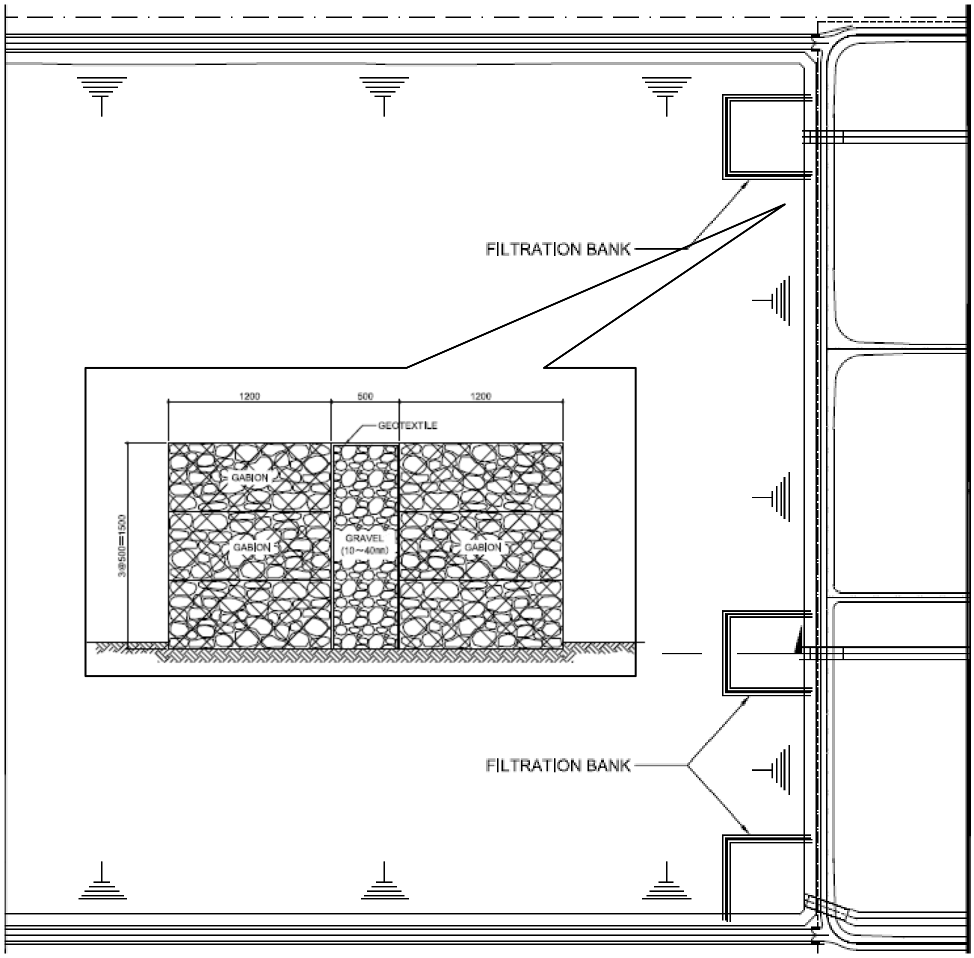
Source: JICA Study Team

Figure 4.4-3 Filtration Bank for Aeronautical Area

4.4.3. Soaking Yard

Normally, airport storm drainage system is designed based on the rainfall intensity of its return period of 5 years (by FAA) or 10 years (by JCAB). However, as JICA's Advisory Committee of Environmental and Social Considerations advised that the area of soaking yard should cope with extraordinary weather condition recently encountered worldwide, the capacity of the soaking yard is so designed that any storm water would not overflow from the airport property for long future.

Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA) analyzed based on their 29-year record, that daily maximum rainfall could be 143 mm for the return period 10 year, 197 mm for that of 50 years, and 219 mm for that of 100 years. Assuming 50 % of the rainfall is naturally absorbed into the ground of approximately 200 ha, reservoir capacity of detention pond (soaking yard) for the return period of 100 years should not be less than 220,000 tons of water (i.e. 50% x 0.219 m x 2,000,000 m^2). In addition, maximum 420 tons in total of water used for the building complex will be discharged via sewage treatment plant to the same soaking yard, which culminate a total of 220,420 ton of water. Meanwhile, dimension of the soaking yard is planned to be 20 ha in area and 2.5 m in depth, where 500,000 tons of reservoir capacity is available.



Source: JICA Study Team

Figure 4.4-4 Filtration Bank on Soaking Yard

To preserve the soaking function in the open ditch, a filtration bank covered with geo-textile and gabion should be designed and strategically located.

Further it was studied to cover the bottom of the soaking yard with geo-textile materials to prevent the fine sand from stucking into the natural underground-watercourse.

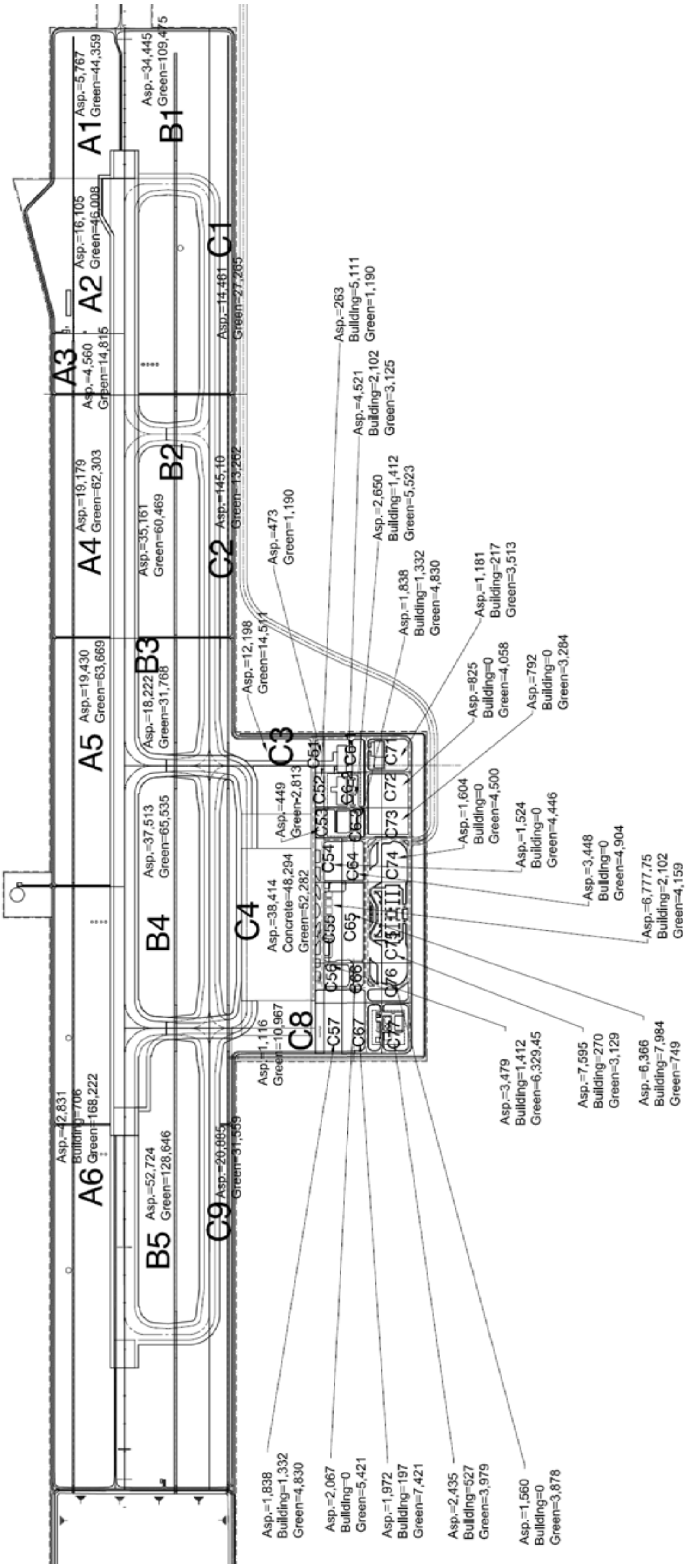
4.4.4. Drainage for Terminal Area

The terminal area will include aircraft parking apron, passenger terminal building, control tower, ATC operation and administration building, fire station and airport maintenance building, power house, water tank and pump house, main car park area, other car park areas, future expansion areas, and sewage treatment plant. The proposed storm drainage system will mainly consist of drainage manholes, road inlet catch basins and pipe culverts. The drainage system will convey the run-off on the terminal area through the perimeter channel to soaking yard.

4.4.5. Airport Drainage Plan

Following item will be shown after the following pages.

a)	Drainage District:	Figure 4.4-5
b)	Computation of Run Off:	Table4.4-2 (1)～(5)
c)	Drainage Layout Plan for Aeronautical Areas:	Figure 4.4-6 (1)～(3)
d)	Drainage Layout Plan for Terminal Areas:	Figure 4.4-7 (1)～(2)
e)	Drainage Facility Detail for Terminal Areas:	Figure 4.4-8 (1)～(3)
f)	Oil Separator for Terminal Area:	Figure 4.4-9



Source: JICA Study Team

Figure 4.4-5 Drainage Catchment Areas

Table 4.4-2(1) Airport Drainage Computation – Catchment Areas a and b

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)					(21)	(22)	(23)
	Surface Runoff												Tributary Area "A" and Coefficient							Designed Drain							
Description	Length of Surface Flow	Slope of Surface Flow	Type	Runoff Coefficient	t_1=3.261(1.1−C)√D/ ∛S	Inlet Time	Inlet	Line Segment	Length of Segment	Flow Time t_2 = L /60 V	Time of Concentration t = Σ t_1 + t_2	Rain fall intensity return period of 10-year i = 400/ (t^0.4)	Tributary Area "A"	Type	Area	Coefficient	Area x Coefficient	Cummulative CA	Runoff "Q" Q_1 = I x Σ CA / 3,600,000	Height open ditch	Width of open ditch	Number of Pipes	Size of Pipe	n	Slope of Pipe	Velocity of Drain	Capacity of Pipe Q_2 = 3.14*D²/4 * V
Catchment Area	D	S		C	t_1	Σ t_1	I No.	L No.	L	t_2	t	i	No.		A	C	CA	Σ CA	Q_1	H	B		dia.			V	Q_2
	m	%			min.	min.			m	min.	min.	mm/hr			m²		m²	m²	m³/sec				m		%/100	m/sec	m³/sec
entire "a"	107	1.0	green	0.30	26.99	26.99	Ia-1	La-1					a1	asphalt	5,767	0.95	5,479	5,479									
									245.0	3.89	30.88	101.44		green	44,359	0.30	13,308	18,786	0.529	1.0	2.00			0.03	0.0010	1.05	2.100
								A2-1	50.0	1.21	32.09	99.89							0.521			2	0.600	0.013	0.0010	0.69	0.380
								A2-2	50.0	1.21	33.30											2	0.600	0.013	0.0010	0.69	0.380
								A2-3	50.0	1.21	34.51											3	0.600	0.013	0.0010	0.69	0.570
								A2-4	50.0	1.21	35.72											3	0.600	0.013	0.0010	0.69	0.570
								A2-5	50.0	1.21	36.93											3	0.600	0.013	0.0010	0.69	0.570
								A2-6	50.0	1.21	38.14			asphalt	16,105	0.95	15,300	34,086				4	0.600	0.013	0.0010	0.69	0.760
								A2-7	50.0	1.21	33.30	98.42	a2	green	46,008	0.30	13,802	47,889	1.309			4	0.600	0.013	0.0010	0.69	0.760
								A2-8	50.0	1.21	34.51	97.02							1.291			4	0.600	0.013	0.0010	0.69	0.760
								A3-1	118.0	1.87	36.38	95.00	a3	asphalt	4,560	0.95	4,332	52,221		1.0	3.00			0.03	0.0010	1.05	3.150
								A3-2	12.0	0.18	36.56	94.81		green	14,815	0.30	4,445	56,665	1.492			3	0.750	0.013	0.0020	1.13	1.500
								A4-1	512.0	8.13	42.64	89.15	a4	asphalt	19,179	0.95	18,220	74,885		1.0	4.00			0.03	0.0010	1.05	4.200
								A4-2	12.0	0.14	42.78	89.04		green	62,303	0.30	18,691	93,576	2.314			4	0.750	0.013	0.0030	1.38	2.440
								A5-1	522.4	8.29	51.07	82.95	a5	asphalt	19,430	0.95	18,459	112,034		1.0	5.00			0.03	0.0010	1.05	5.250
								A5-2	12.0	0.14	51.21	82.85		green	63,669	0.30	19,101	131,135	3.018			5	0.750	0.013	0.0030	1.38	3.050
								A6-1	1,284.6	16.6	67.81	74.05	a6	asphalt	42,831	0.95	40,689	171,825		1.0	5.00			0.03	0.0015	1.29	6.450
								A6-2	14.0	0.09	67.90	74.01		green	168,928	0.30	50,678	222,503	4.574			5	0.750	0.013	0.0100	2.52	5.550
entire "b"	107	1.0	green	0.30	26.99	26.99							b1	asphalt	34,445	0.95	32,723	32,723									
							Ia-1	B1-1	728.0	11.56	38.55	92.82		green	109,475	0.30	32,843	65,565	1.690	1.0	3.00			0.03	0.0010	1.05	3.150
								B1-2	12.0	0.18	38.73	92.65							1.687			3	0.750	0.013	0.0020	1.13	1.500
													b2	asphalt	35,161	0.95	33,403	98,968									
								B2-1	512.0	8.13	46.86	85.85		green	60,469	0.30	18,141	117,109	2.793	1.0	5.00			0.03	0.0010	1.05	5.250
								B2-2	12.0	0.18	47.04	85.72							2.788			5	0.750	0.013	0.0020	1.13	2.500
													b3	asphalt	18,222	0.95	17,311	134,420									
								B3-1	219.9	3.49	50.53	83.30		green	31,768	0.30	9,530	143,950	3.331	1.0	5.00			0.03	0.0010	1.05	5.250
								B3-2	100.0	1.21	51.74	82.51							3.299			5	0.750	0.013	0.0030	1.38	3.050
													b4	asphalt	37,513	0.95	35,637	179,588									
								B4-1	465.0	7.38	59.12	78.23		green	65,535	0.30	19,661	199,248	4.330	1.0	5.00			0.03	0.0010	1.05	5.250
								B4-2	100.0	0.85	59.97	77.78							4.305			5	0.750	0.013	0.0060	1.95	4.300
													b5	asphalt	52,724	0.95	50,088	249,336									
								B5-1	934.1	12.07	72.04	72.28		green	128,646	0.30	38,594	287,930	5.781	1.0	5.00			0.03	0.0015	1.29	6.450
								B5-2	14.0	0.09	72.13	72.25							5.779			5	0.750	0.013	0.0100	2.52	5.550

assuming aqueduct

Source: JICA Study Team

Table 4.4-2(2) Airport Drainage Computation – Catchment Area c

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)					(21)	(22)	(23)
	Surface Runoff												Tributary Area "A" and Coefficient							Designed Drain							
Description	Length of Surface Flow	Slope of Surface Flow	Type	Runoff Coefficient	$t_1=3.261(1.1-C)\sqrt{D}/\sqrt[3]{S}$	Inlet Time	Inlet	Line Segment	Length of Segment	Flow Time $t_2 = L/60V$	Time of Concentration $t = \Sigma t_1 + t_2$	Rain fall intensity return period of 10-year $i = 400/(t^{0.4})$	Tributary Area "A"	Type	Area	Coefficient	Area x Coefficient	Cummulative CA	Runoff "Q" $Q_1 = I \times \Sigma CA / 3{,}600{,}000$	Height open ditch	Width of open ditch	Number of Pipes	Size of Pipe	n	Slope of Pipe	Velocity of Drain	Capacity of Pipe $Q_2 = 3.14*D^2/4 * V$
Catchment Area	D	S		C	t_1	Σt_1	I No.	L No.	L	t_2	t	i	No.		A	C	CA	Σ CA	Q_1	H	B		dia.			V	Q_2
	m	%			min.	min.			m	min.	min.	mm/hr			m²		m²	m²	m³/sec				m		%/100	m/sec	m³/sec
entire "c"	40	1.0	green	0.30	16.50	16.5							c1	asphalt	14,461	0.95	13,738	13,738									
								C1-1	765	12.14	28.64	104.54		green	27,265	0.30	8,180	21,917	0.636	1.0	2.00			0.03	0.0010	1.05	2.100
								C1-2	12	0.18	28.82	104.28							0.635			2	0.75	0.013	0.0020	1.13	1.000
													c2	asphalt	14,510	0.95	13,785	35,702									
								C2-1	512	8.13	36.95	94.41		green	13,262	0.30	3,979	39,681	1.041	1.0	2.00			0.03	0.0010	1.05	2.100
								C2-2	12	0.18	37.13	94.23							1.039			2	0.75	0.013	0.0020	1.13	1.000
													c3	asphalt	12,198	0.95	11,588	51,269									
								C3-1	220	3.49	40.62	90.90		green	14,511	0.30	4,353	55,622	1.404	1.0	3.00			0.03	0.0010	1.05	3.150
								C3-2	100	1.47	42.09	89.62							1.385			3	0.75	0.013	0.0020	1.13	1.500
														concrete	48,294	0.90	43,465	99,087									
													c4	asphalt	38,414	0.95	36,493	135,580									
								C4-1	465	5.62	47.71	85.23		green	52,282	0.30	15,685	151,264	3.581	1.5	5.00			0.03	0.0010	1.38	10.350
								C4-2	100	1.05	48.76	84.50							3.551			5	0.75	0.013	0.0040	1.59	3.500
													c5	asphalt	19,915	0.90	17,924	169,188									
														building	4,846	0.85	4,119	173,307									
														green	24,975	0.30	7,493	180,800									
													c6	asphalt	22,862	0.90	20,576	201,375									
														building	13,027	0.85	11,073	212,448									
														green	26,552	0.30	7,966	220,414									
													c7	asphalt	15,992	0.90	14,393	234,807									
														building	1,014	0.85	862	235,669									
														green	26,341	0.30	7,902	243,571									
													c8	asphalt	1,116	0.90	1,004	244,575									
														green	10,967	0.30	3,290	247,865									
													c9	asphalt	20,885	0.95	19,841	264,416									
								C9-1	932	9.19	57.95	78.86		green	31,559	0.30	9,468	273,884	6.000	1.5	5.00			0.03	0.0015	1.69	12.680
								C9-2	16	0.11	58.06	78.80							5.995			5	0.75	0.013	0.0100	2.52	5.550

Source: JICA Study Team

Table 4.4-2(3) Airport Drainage Computation – Catchment Area subdivision c5

Catchment Area	(1) Length of Surface Flow D (m)	(2) Slope of Surface Flow S (%)	(3) Type	(4) Runoff Coefficient C	(5) $t_1=3.261(1.1-C)\sqrt{D}/\sqrt[3]{S}$ t_1 (min.)	(6) Inlet Time Σt_1 (min.)	(7) Inlet I No.	(8) Line Segment L No.	(9) Length of Segment L (m)	(10) Flow Time $t_2 = L/60V$ t_2 (min.)	(11) Time of Concentration $t = \Sigma t_1 + t_2$ t (min.)	(12) Rain fall intensity return period of 10-year i = 400/(t^0.4) i (mm/hr)	(13) Tributary Area "A" No.	(14) Surface	(15) Area A (m²)	(16) Coefficient C	(17) Area x Coefficient CA (m²)	(18) Cummulative CA ΣCA (m²)	(19) Runoff "Q" $Q_1 = I \times \Sigma CA / 3{,}600{,}000$ Q_1 (m³/sec)	(20) Height open ditch H	(20) Width of open ditch B	(20) Number of Pipes	(20) Size of Pipe dia. (m)	n	(21) Slope of Pipe (%/100)	(22) Velocity of Drain V (m/sec)	(23) Capacity of Pipe $Q_2 = 3.14 \cdot D^2/4 \cdot V$ Q_2 (m³/sec)
"c51–c57"	20	1.0	green	0.30	11.67	11.67		C51-1	28.5	0.78	12.45	145.88	c51	asphalt	473	0.9	426	426	0.032			1	0.300	0.013	0.0020	0.61	0.040
								C51-2	26.0	0.71	13.16	142.68		green	1,190	0.3	357	783	0.031			1	0.300	0.013	0.0020	0.61	0.040
								C52-1	33.3	0.69	13.85	139.79	c52	asphalt	5,374	0.9	4,837	5,619	0.232			1	0.450	0.013	0.0020	0.80	0.130
								C52-2	31.3	0.65	14.50	137.25		green	1,190	0.3	357	5,976	0.228			1	0.450	0.013	0.0020	0.80	0.130
								C52-3	34.2	0.59	15.09	135.08							0.224			1	0.600	0.013	0.0020	0.97	0.270
								C53-1	40.3	0.69	15.78	132.68	c53	asphalt	449	0.9	404	6,380	0.266			1	0.600	0.013	0.0020	0.97	0.270
														green	2,831	0.3	849	7,230									
								C54-1	48.2	0.83	16.61	129.99	c54	asphalt	1,524	0.90	1,372	8,601	0.359			1	0.600	0.013	0.0020	0.97	0.270
								C54-2	35.6	0.61	17.22	128.13		building		0.85	0	8,601	0.354			1	0.600	0.013	0.0020	0.97	0.270
								C54-3	40.4	0.6	17.82	126.39		green	4,446	0.30	1,334	9,935	0.349			1	0.750	0.013	0.0020	1.13	0.500
															5,970												
													c55	asphalt	6,778	0.95	6,439	16,374									
								C55-1	41.1	0.61	18.43	124.70		building	2,102	0.85	1,787	18,161	0.672			1	0.750	0.013	0.0020	1.13	0.500
								C55-2	40.2	0.59	19.02	123.13		green	4,159	0.30	1,248	19,409	0.664			1	0.750	0.013	0.0020	1.13	0.500
								C55-3	43.1	0.57	19.59	121.69			*13,039*				0.656			1	0.900	0.013	0.0020	1.27	0.810
								C55-4	29.8	0.39	19.98	120.73							0.651			1	0.900	0.013	0.0020	1.27	0.810
													c56	asphalt	3,479	0.90	3,131	22,540									
														building	1,412	0.85	1,200	23,740									
								C56-1	28.4	0.37	20.35	119.85		green	6,329	0.30	1,899	25,639	0.854			1	0.900	0.013	0.0020	1.27	0.810
								C56-2	40.5	0.53	20.88	118.62			*11,220*				0.845			1	0.900	0.013	0.0020	1.27	0.810
								C57-1	35.6	0.47	21.35	117.57	c57	asphalt	1,838	0.95	1,746	27,385	0.979			1	0.900	0.013	0.0020	1.27	0.810
								C57-2	34.8	0.46	21.81	116.57		building	1,332	0.85	1,132	28,517	0.970			1	0.900	0.013	0.0020	1.27	0.810
								C57-3	42.1	0.5	22.31	115.52		green	4,830	0.30	1,449	29,966	0.962			1	1.050	0.013	0.0020	1.41	1.220
								C57-4	22.0	0.26	22.57	114.99			*8,000*				0.957			1	1.050	0.013	0.0020	1.41	1.220
													Total	asphalt	*19,915*												
														building	*4,846*												
														green	*24,975*												

Source: JICA Study Team

Table 4.4-2(4) Airport Drainage Computation – Catchment Area c6

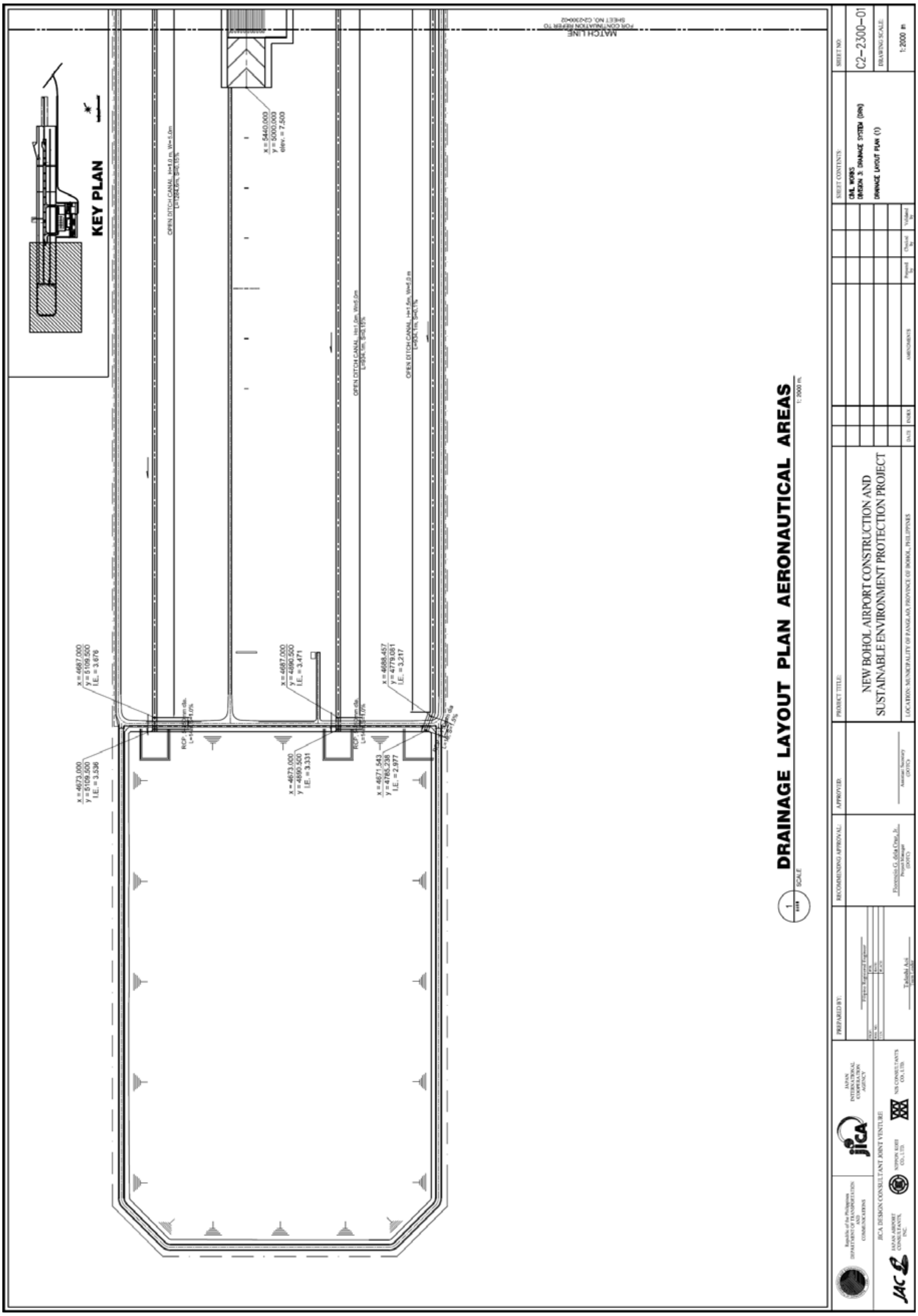
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)					(21)	(22)	(23)
	Surface Runoff												Tributary Area "A" and Coefficient							Designed Drain							
Description	Length of Surface Flow	Slope of Surface Flow	Type	Runoff Coefficient	$t_1=3.261(1.1-C)\sqrt{D}/\sqrt[3]{S}$	Inlet Time	Inlet	Line Segment	Length of Segment	Flow Time $t_2 = L/60V$	Time of Concentration $t = \Sigma t_1 + t_2$	Rain fall intensity return period of 10-year $i = 400/(t^{0.4})$	Tributary Area "A"	Surface	Area	Coefficient	Area x Coefficient	Cummulative CA	Runoff "Q" $Q_1 = I \times \Sigma CA / 3{,}600{,}000$	Height open ditch	Width of open ditch	Number of Pipes	Size of Pipe	n	Slope of Pipe	Velocity of Drain	Capacity of Pipe $Q_2 = 3.14 * D^2/4 * V$
Catchment Area	D	S		C	t_1	Σt_1	I No.	L No.	L	t_2	t	i	No.		A	C	CA	Σ CA	Q_1	H	B		dia.			V	Q_2
	m	%			min.	min.			m	min.	min.	mm/hr			m^2		m^2	m^2	m^3/sec				m		%/100	m/sec	m^3/sec
"c61~c67"	30	1.0	green	0.30	14.29	14.29	branch	C61-1	31.2	0.85	15.14	134.90	c61	asphalt	4,521	0.90	4,069	4,069				1	0.300	0.013	0.0020	0.61	0.040
							branch	C61-2	12.9	0.35	15.49	133.67		building	2,102	0.85	1,787	5,856				1	0.300	0.013	0.0020	0.61	0.040
							branch	C61-3	22.8	0.54	16.03	131.85		green	3,125	0.30	938	6,793				1	0.375	0.013	0.0020	0.71	0.080
							branch	C61-4	16.9	0.35	16.38	130.72			*9,748*							1	0.450	0.013	0.0020	0.80	0.130
								C61-6	37.1	0.77	17.15	128.34										1	0.450	0.013	0.0020	0.80	0.130
							main	C62-1	63.8	1.1	18.25	125.19							0.236			1	0.600	0.013	0.0020	0.97	0.270
							branch	C62-2					c62	asphalt	2,650	0.95	2,518	9,311				1	0.300	0.013	0.0020	0.61	0.040
							branch	C62-3						building	1,412	0.85	1,200	10,511				1	0.300	0.013	0.0020	0.61	0.040
							branch	C62-4						green	5,523	0.30	1,657	12,168				1	0.375	0.013	0.0020	0.71	0.080
							branch	C62-5							*9,585*				0.000			1	0.450	0.013	0.0020	0.80	0.130
								C62-6														1	0.450	0.013	0.0020	0.80	0.130
							main	C63-1	59.8	0.88	19.13	122.85							0.415			1	0.750	0.013	0.0020	1.13	0.500
							branch						c63	asphalt	1,838	0.90	1,654	13,822									
							branch							building	1,332	0.85	1,132	14,954									
							branch							green	4,830	0.30	1,449	16,403				1	0.750	0.013	0.0020	1.13	0.500
							main	C64-1	39.7	0.52	19.65	121.54			*8,000*				0.554			1	0.900	0.013	0.0020	1.27	0.810
							branch						c64	asphalt	3,448	0.95	3,276	19,679									
							branch							building		0.85	0	19,679									
							branch							green	4,904	0.30	1,471	21,150									
							main	C64-3	39.9	0.52	20.17	120.28			*8,352*				0.707			1	0.900	0.013	0.0020	1.27	0.810
							main	C64-5	40.9	0.54	20.71	119.01							0.699			1	0.900	0.013	0.0020	1.27	0.810
													c65	asphalt	6,366	0.90	5,729	26,879									
							main	C65-1	33.0	0.39	21.10	118.13		building	7,984	0.85	6,786	33,666	0.882			1	1.050	0.013	0.0020	1.41	1.220
							main	C65-2	39.9	0.47	21.57	117.09		green	749	0.30	225	33,890	1.095			1	1.050	0.013	0.0020	1.41	1.220
							main	C65-3	33.4	0.39	21.96	116.25			*15,099*				1.094			1	1.050	0.013	0.0020	1.41	1.220
							main	C65-4	40.7	0.48	22.44	115.25							1.085			1	1.050	0.013	0.0020	1.41	1.220
													c66	asphalt	2,067	0.95	1,964	35,854									
														building		0.85	0	35,854									
														green	5,421	0.30	1,626	37,480									
							main	C65-5	38.7	0.46	22.90	114.32			*7,488*				1.190			1	1.050	0.013	0.0020	1.41	1.220
							main	C66-2	45.3	0.54	23.44	113.26							1.179			1	1.050	0.013	0.0020	1.41	1.220
													c67	asphalt	1,972	0.90	1,775	39,255									
														building	197	0.85	167	39,423									
							main	C67-2	55.3	0.65	24.09	112.03		green	7,421	0.30	2,226	41,649	1.227			1	1.050	0.013	0.0020	1.41	1.220
							main	C67-4	52.9	0.63	24.72	110.88			*9,590*				1.283			1	1.050	0.013	0.0020	1.41	1.220
							main	C67-6	22.0	0.26	24.98	110.41							1.277			1	1.050	0.013	0.0020	1.41	1.220
													Total	asphalt	*22,862*												
														building	*13,027*												
														green	*26,552*												

Source: JICA Study Team

Table 4.4-2(5) Airport Drainage Computation – Catchment Area c7

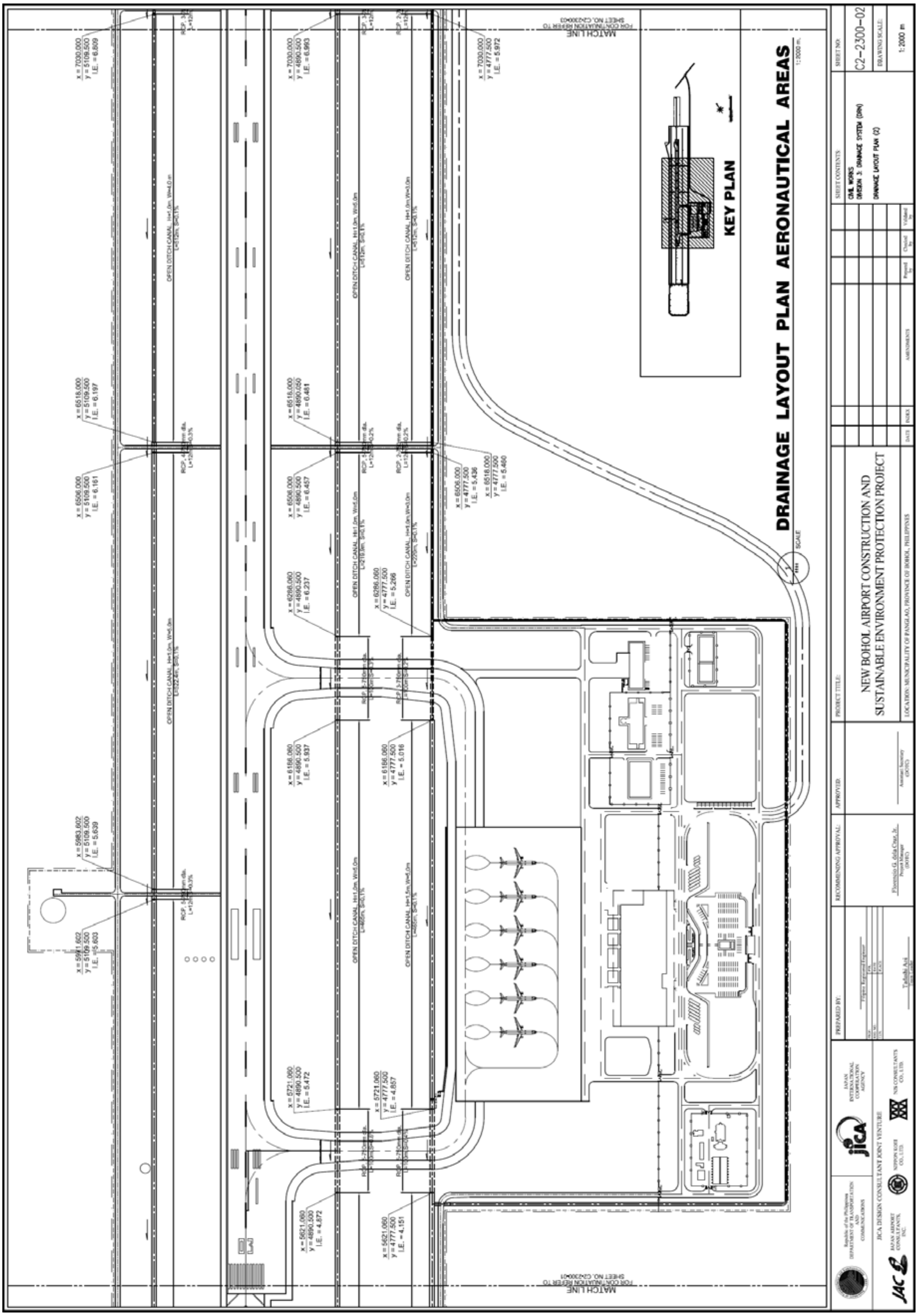
Description	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)					(21)	(22)	(23)
	Surface Runoff												Tributary Area "A" and Coefficient							Designed Drain							
	Length of Surface Flow	Slope of Surface Flow	Type	Runoff Coefficient	$t_1 = 3.261(1.1-C)\sqrt{D} / \sqrt[3]{S}$	Inlet Time	Inlet	Line Segment	Length of Segment	Flow Time $t_2 = L / 60 V$	Time of Concentration $t = \Sigma t_1 + t_2$	Rain fall intensity return period of 10-year i = 400/ (t^0.4)	Tributary Area "A"	Surface	Area	Coefficient	Area x Coefficient	Cummulative CA	Runoff "Q" $Q_1 = I \times \Sigma CA / 3{,}600{,}000$	Height open ditch	Width of open ditch	Number of Pipes	Size of Pipe	n	Slope of Pipe	Velocity of Drain	Capacity of Pipe $Q_2 = 3.14 * D^2 / 4 * V$
Catchment	D	S		C	t_1	Σt_1	I No.	L No.	L	t_2	t	i	No.		A	C	CA	Σ CA	Q_1	H	B		dia.			V	Q_2
Area	m	%			min.	min.			m	min.	min.	mm/hr			m^2		m^2	m^2	m^3/sec				m		%/100	m/sec	m^3/sec
	30	1.0	green	0.30	14.29	14.29							c71	asphalt	1,181	0.95	1,122	1,122									
														building	217	0.85	184	1,306									
														green	3,513	0.30	1,054	2,360									
															4,911												
								C71-1	49.3	1.16	15.45	133.81							0.088			1	0.375	0.013	0.0020	0.71	0.080
													c72	asphalt	825	0.90	743	3,103									
								C72-1	59.5	1.24	16.69	129.74		building		0.85	0	3,103				1	0.450	0.013	0.0020	0.80	0.130
														green	4,058	0.30	1,217	4,320									
															4,883												
								C73-1	54.3	0.93	17.62	126.96							0.152			1	0.600	0.013	0.0020	0.97	0.270
													c73	asphalt	792	0.95	752	5,073									
														building		0.85	0	5,073									
														green	3,284	0.30	985	6,058									
															4,076												
								C73-2	45.7	0.79	18.41	124.75							0.210			1	0.600	0.013	0.0020	0.97	0.270
													c74	asphalt	1,604	0.90	1,444	7,501									
														building		0.85	0	7,501									
														green	4,500	0.30	1,350	8,851									
"c71-c77"								C74-1	39.9	0.59	19.00	123.19			*6,104*				0.303			1	0.750	0.013	0.0020	1.13	0.500
								C74-2	44.1	0.65	19.65	121.54							0.299			1	0.750	0.013	0.0020	1.13	0.500
													c75	asphalt	7,595	0.95	7,215	16,067									
								C75-1	50.0	0.74	20.39	119.75		building	270	0.85	230	16,296				1	0.750	0.013	0.0020	1.13	0.500
								C75-2	50.0	0.74	21.13	118.06		green	3,129	0.30	939	17,235				1	0.750	0.013	0.0020	1.13	0.500
								C75-3	43.7	0.64	21.77	116.66			*10,994*							1	0.750	0.013	0.0020	1.13	0.500
								C75-4	38.7	0.51	22.28	115.58							0.553			1	0.900	0.013	0.0020	1.27	0.810
													c76	asphalt	1,560	0.90	1,404	18,639									
								C76-1	45.3	0.59	22.87	114.38		building		0.85	0	18,639				1	0.900	0.013	0.0020	1.27	0.810
														green	3,878	0.30	1,163	19,802									
															5,438												
								C76-2	55.3	0.73	23.60	112.95							0.621			1	0.900	0.013	0.0020	1.27	0.810
													c77	asphalt	2,435	0.95	2,313	22,116									
														building	527	0.85	448	22,563									
														green	3,979	0.30	1,194	23,757									
								C77-1	52.9	0.69	24.29	111.66			*6,941*				0.737			1	0.900	0.013	0.0020	1.27	0.810
								C77-2	22.0	0.29	24.58	111.13							0.7334			1	0.900	0.013	0.0020	1.27	0.810
													Total	asphalt	15,992												
														building	1,014												
														green	*26,341*												

Source: JICA Study Team



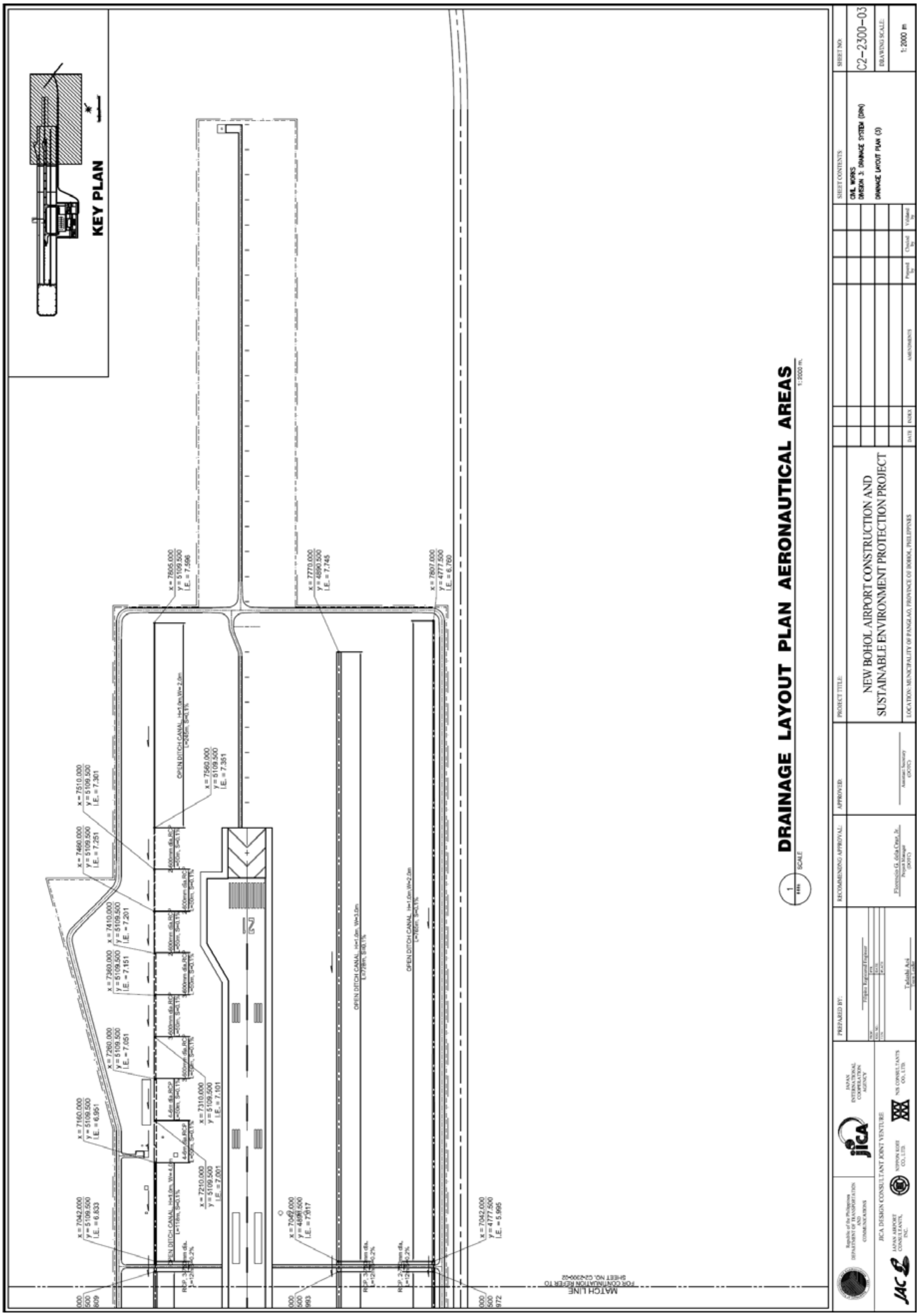
Source: JICA Study Team

Figure 4.4-6(1) Drainage Layout Plan for Aeronautical Areas



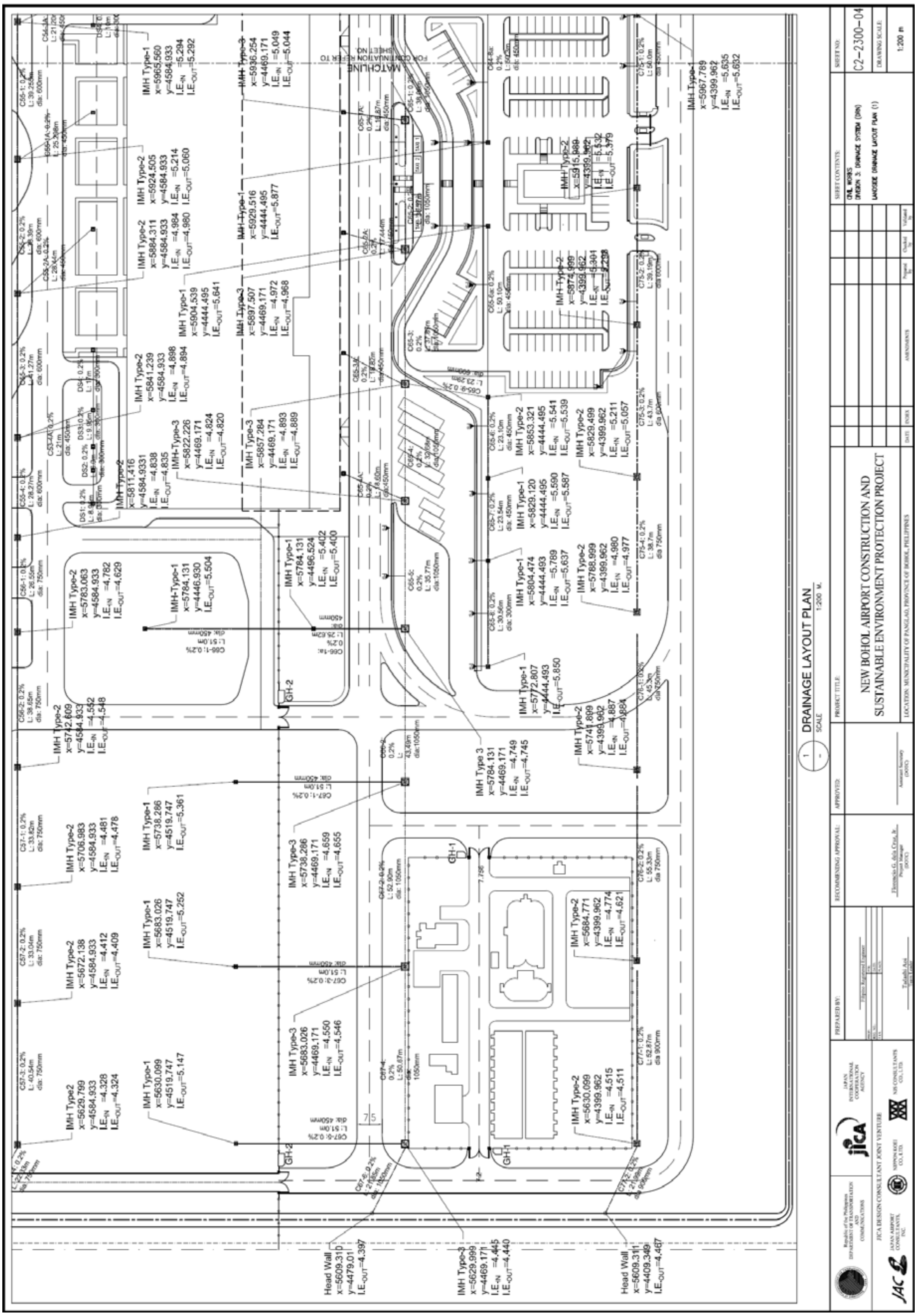
Source: JICA Study Team

Figure 4.4-6(2) Drainage Layout Plan for Aeronautical Areas



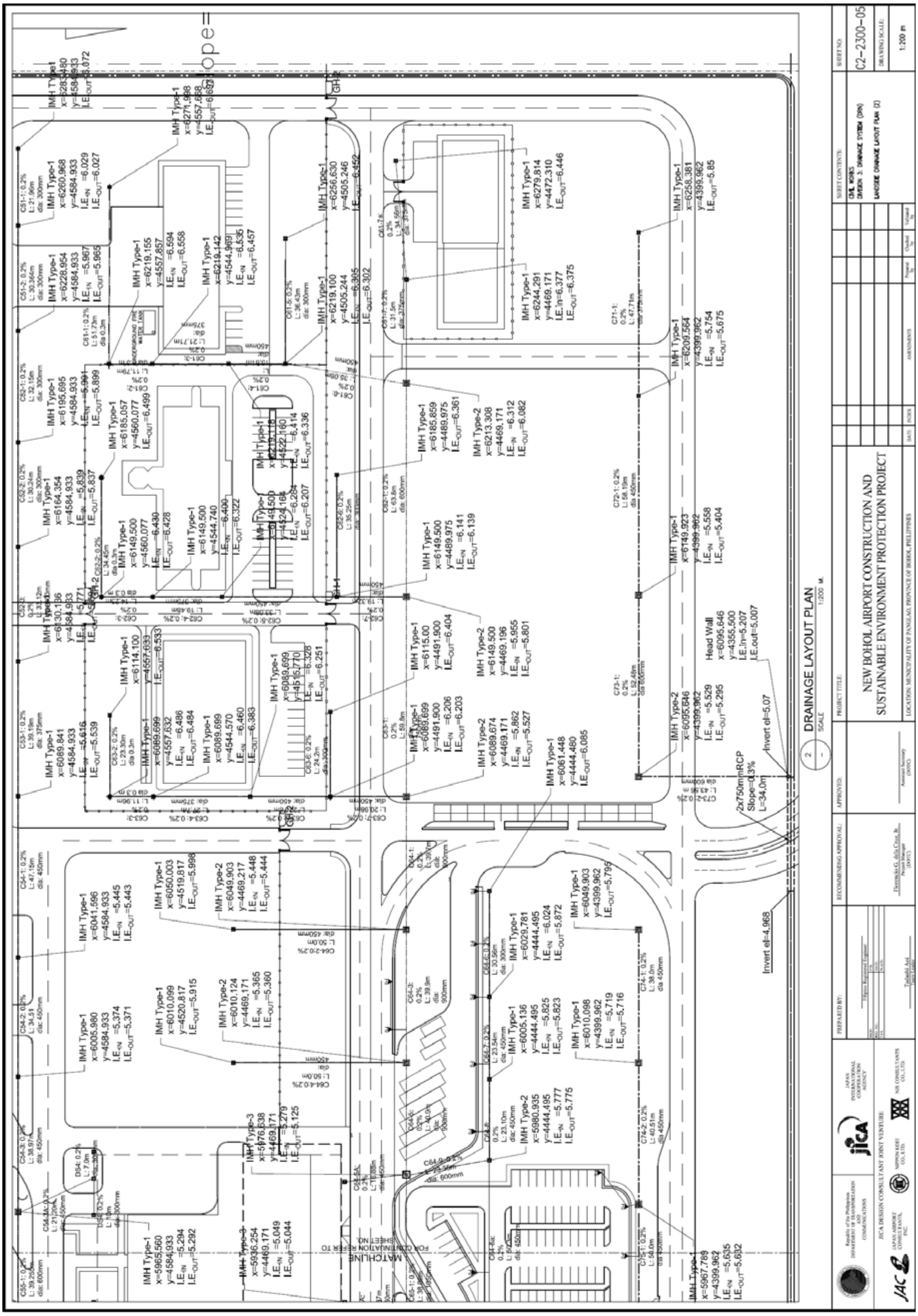
Source: JICA Study Team

Figure 4.4-6(3) Drainage Layout Plan for Aeronautical Areas



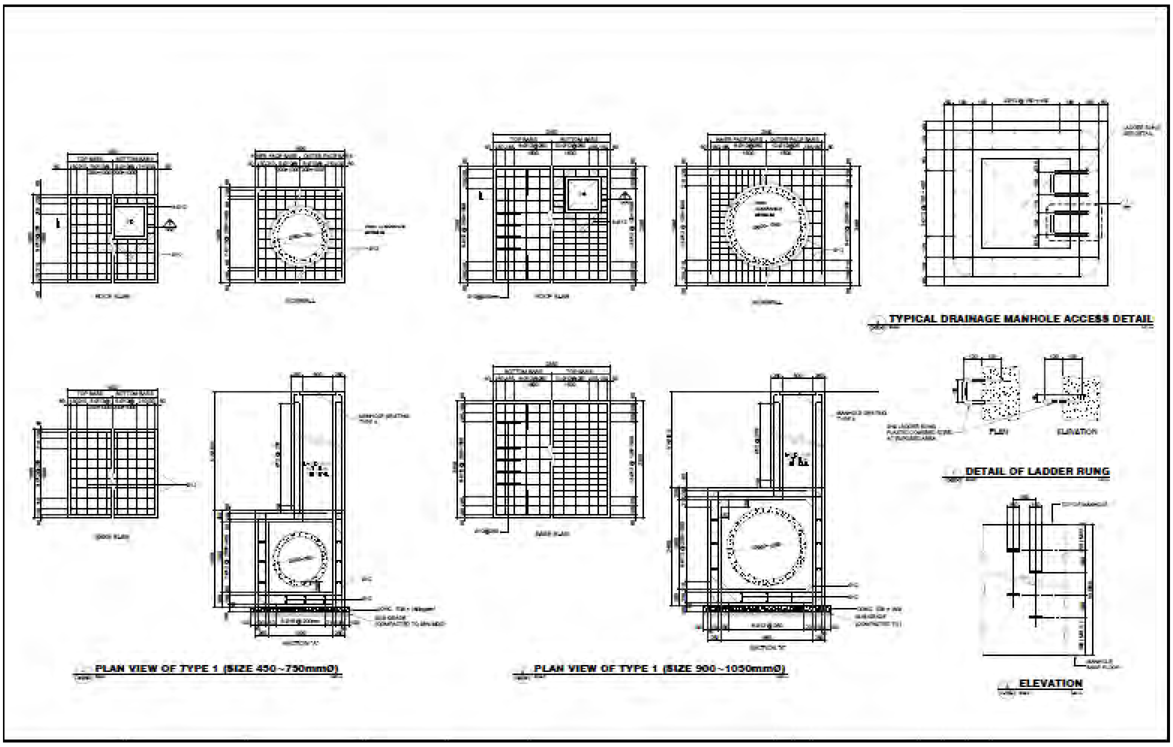
Source: JICA Study Team

Figure 4.4-7(1) Drainage Layout Plan for Terminal Areas



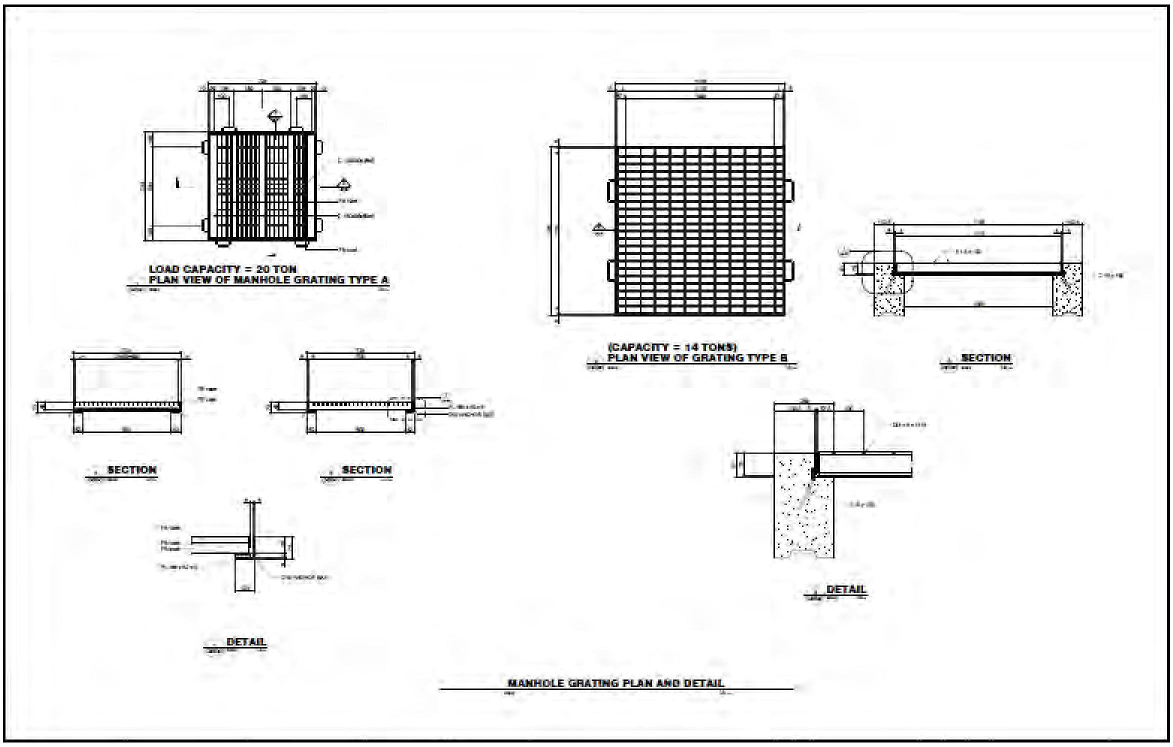
Source: JICA Study Team

Figure 4.4-7(2) Drainage Layout Plan for Terminal Areas



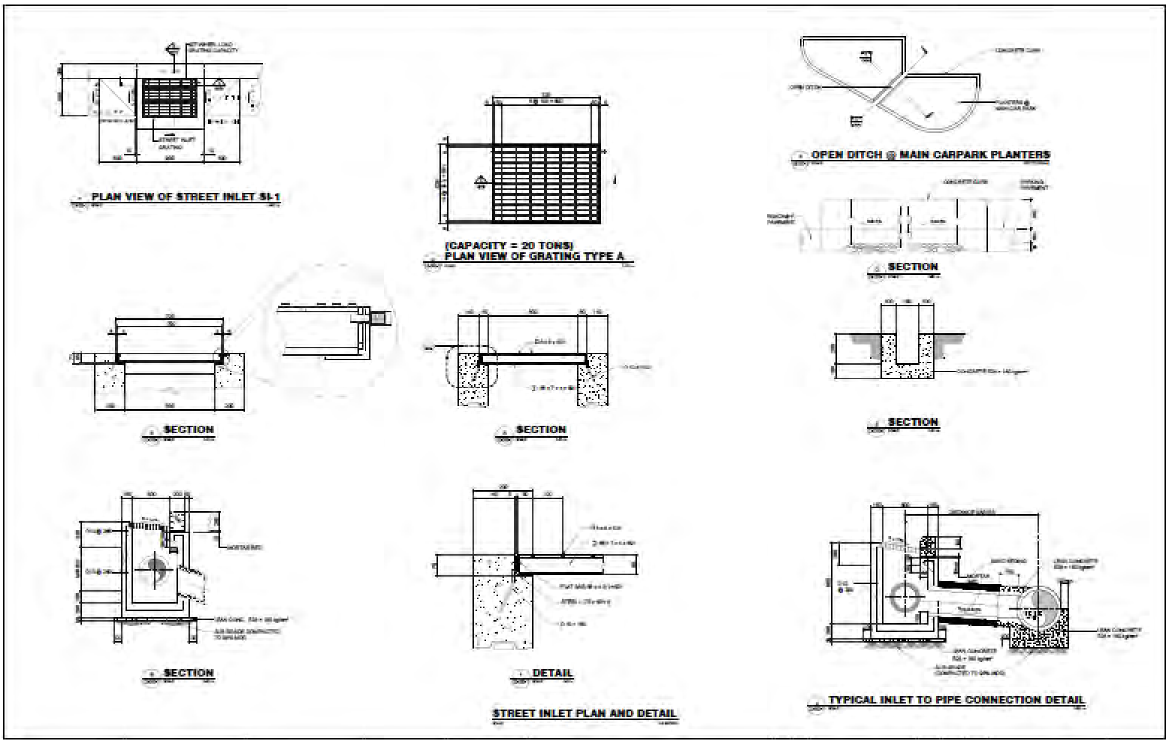
Source: JICA Study Team

Figure 4.4-8 (1) Drainage Facility Detail for Terminal Areas



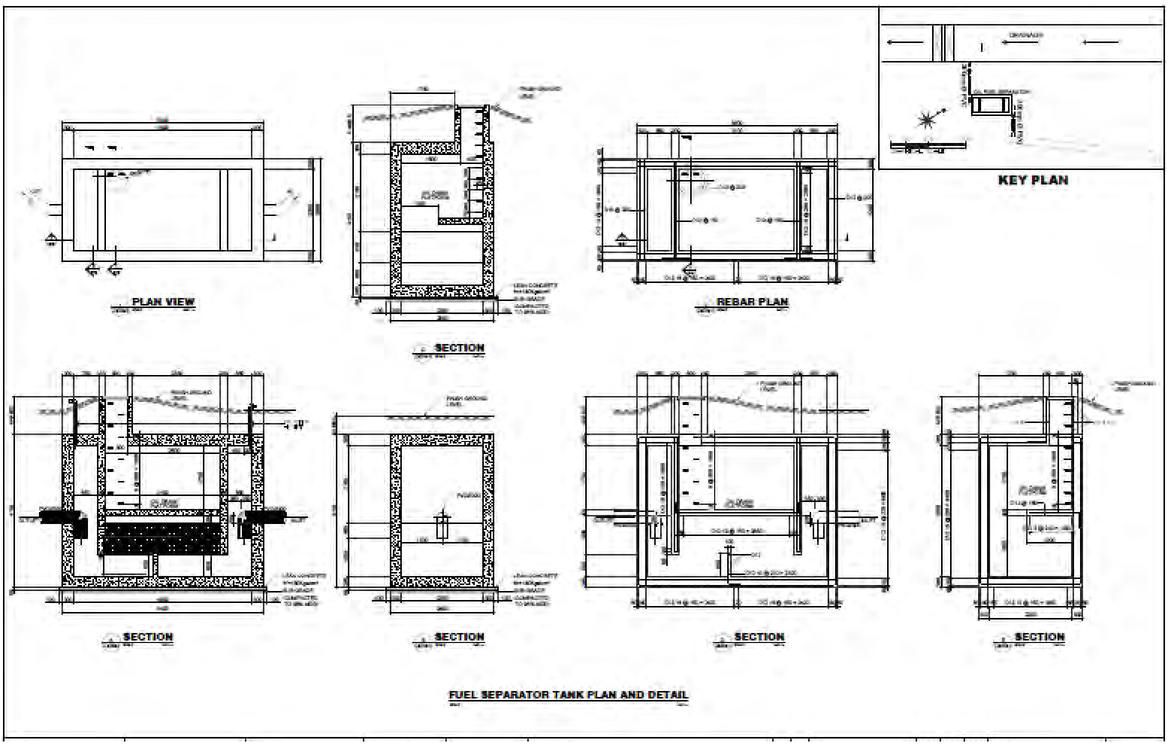
Source: JICA Study Team

Figure 4.4-8 (2) Drainage Facility Detail for Terminal Areas



Source: JICA Study Team

Figure 4.4-8 (3) Drainage Facility Detail for Terminal Areas



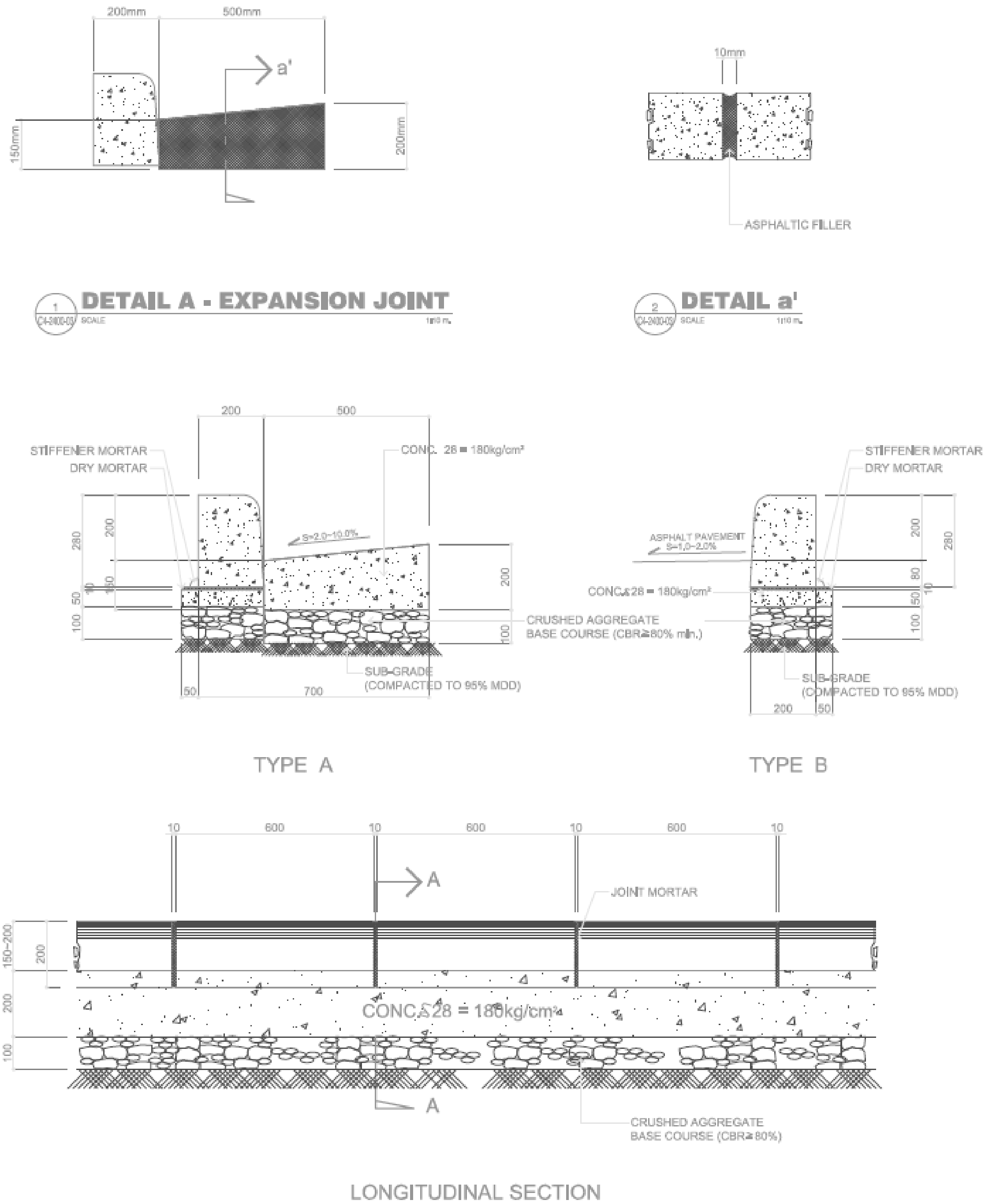
Source: JICA Study Team

Figure 4.4-9 Oil Separator for Terminal Area

4.5. Miscellaneous Facilities

4.5.1. Curbstone and Gutter

Typical plans and sections of curbstone and gutter are shown in Figures 4.5-1.

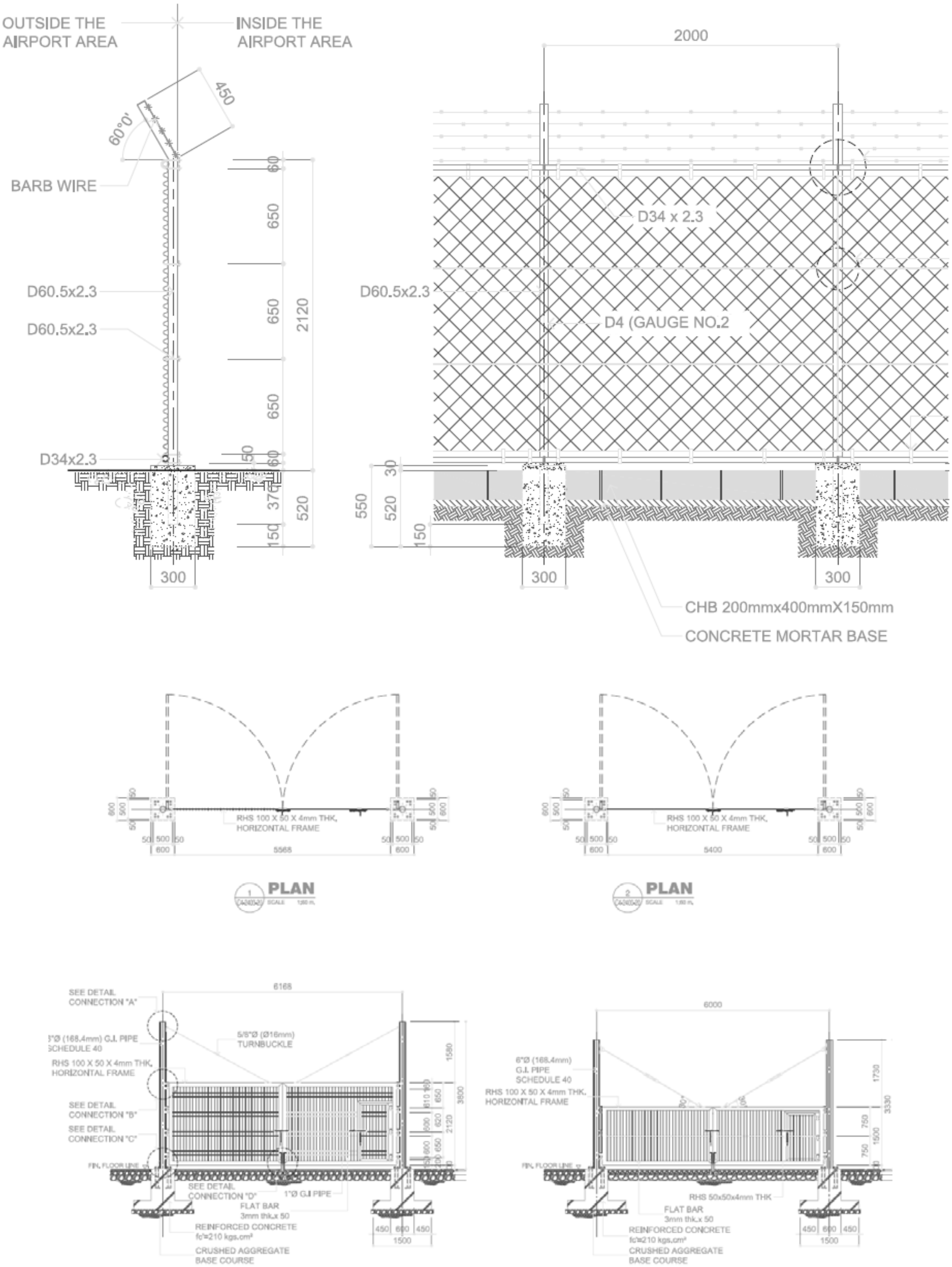


Source: JICA Study Team

Figure 4.5-1 Curbstone and Gutter

4.5.2. Fence and Gate

Typical plans and sections of perimeter fence and gate are shown in Figure 4.5-2.



Source: JICA Study Team

Figure 4.5-2 Typical Plan, Section and Elevation of Perimeter Fence and Gate

4.6. Landscaping

4.6.1. Basic Concept

Bohol Airport was designed to deserve eco-airport in such a tropical environment that harmonizes with the surrounding attractive sea, unique culture, historic places, and natural scene.

As a part of the airport design, the landscaping should have passengers who spend a certain period of time within a limited space of the airport premise, enjoy the image of such tropical island with ease of mind and relaxation at home through enjoying beautiful scene with trees and plants.

4.6.2. Landscape as the Tropical Island Airport

(1) Scene from Airside

The multi-curved roof concept of the PTB is inspired by the motifs of gentle sea wave and “Chocolate Hills” surrounding the island of Bohol. To match this concept, the landscaping has been so designed that passenger could feel relaxation from the moment he disembarked off the airplane. Tropical trees and plants beside arrival corridor are desired to immediately get rid of business or mannerism that passenger has in his ordinary life.

Ramp Bus Stop on Airside

Courtyard on Airside

(2) Scene from the Access to Front-Curb

The landscaping through access road to departure curb-front has been so designed that departing tourist approaching to the terminal could enjoy the combined-view of tropical trees and multi-curved roof of PTB under the blue sky. So the tourist will continue holding his wonderful experience in Bohol after his departure.

Road (Curb Side)

(3) Scene from Car Park

The landscaping at car park has been so designed that the waving shape of PTB reflecting behind the tropical trees can attract passenger who even stands on the hot asphalt concrete surface.

Planting on Car Parking

4.6.3. Growing Trees and Plants by Recycling Waste Water

The new airport will daily create 300 to 400 tons of effluent after flushing toilet, washing hand and plates, cleaning and cooking. To conserve the precious water, the vast volume of treated water is proposed to be recycled to daily irrigate the landscaping area.

4.6.4. Interphase with ECC

Landscape or surface vegetation is to store carbon and to absorb GHG (Green-house Gas) as well, therefore is considered to be one of the most effective measures for climate change mitigation.

Total quantities of landscaping are approximately 1.900 trees and 240 thousand pieces of shrub and ground cover.

It is normal practice that sodding onto the entire airfield is made in the airport, however, 10 m wide hydro-seeding is only planned to be made alongside the perimeter of runway and taxiway pavement for the reasons stated below.

Since the existing airport ground is generally made of coralline limestone with not much humus topsoil on the surface, the planned quantity of landscaping may suffice to compensate the loss of existing flora grown on site.

Past weather record showed that average annual rainfall is 1,578 mm (from 1998 to 2008) but is yearly very much fluctuated, varying from 2,400 mm (in 2010) to 790 mm only (in 1998).

For the purpose of supplementing such possible lack of rainfall, together with conservation of natural water, it is proposed that daily effluent of 300 to 400 tons should be recycled for irrigation of the limited landscaping area. As the length of access road is extended by 1.5 km from the original 2009 design, purchase of a water sprinkling truck is proposed be included in BOQ for General Requirements (as Maintenance equipment)..

In the original ECC (Environmental Compliance Certificate) issued by DENR in 2003, the Project had been tasked to plant 200 thousand seedling, which was revised to 500 thousand in the amended ECC in June 2013. Notwithstanding the interpretation of definition of “seedling”, increase in the quantity of landscaping from the above-mentioned 240 thousand to 500 thousand is difficult in consideration of the allocated budget and nature of the coralline limestone ground at the new Bohol Airport.

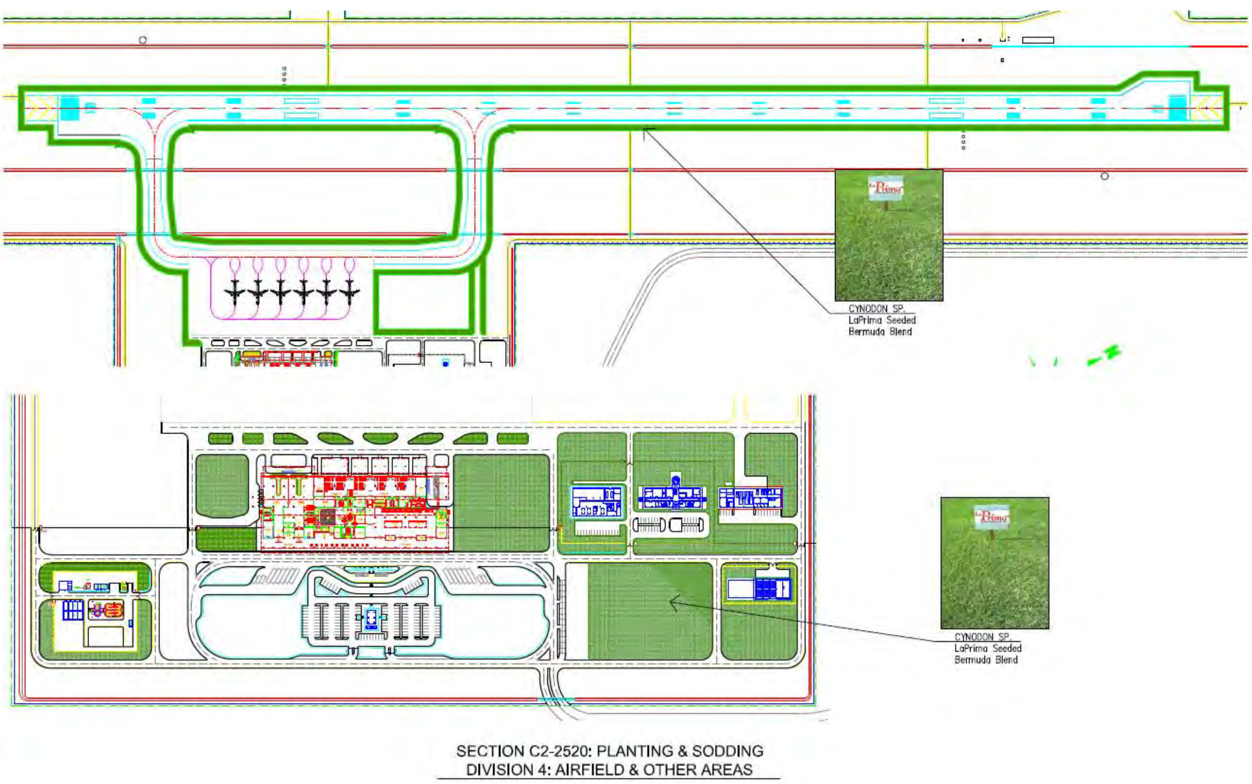
It is mentioned in the separate report of this JICA study, i.e. “Environmental and Socio Consideration Report” that the seedlings not affordable within the new airport premise would be proposed to be compensated in the mainland of Bohol or other island of Region VII.

Source: JICA Study Team

Figure 4.6-1 Planting Plan of Car Parking

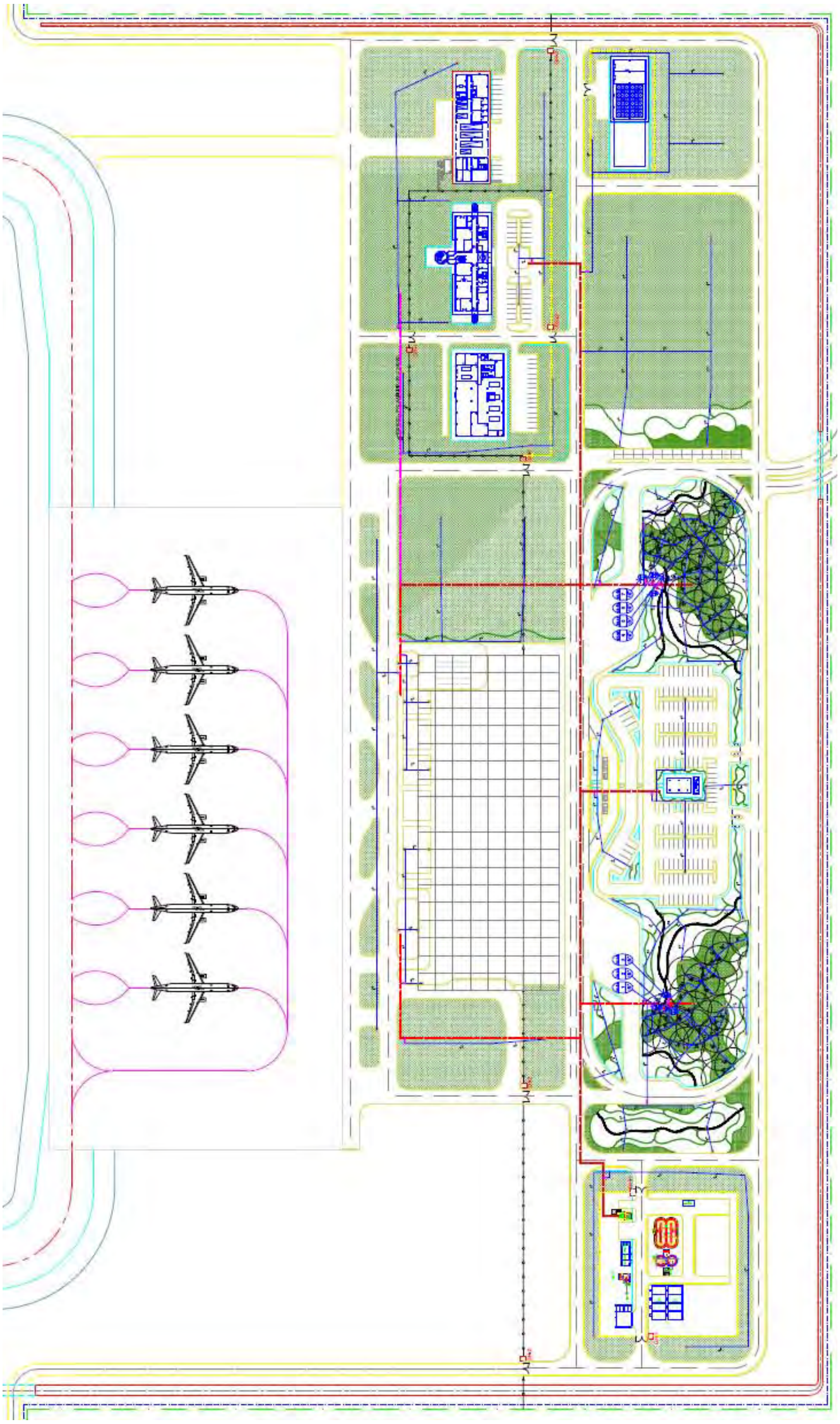
Source: JICA Study Team

Figure 4.6-2 Planting Plan of Courtyard (PTB Airside)



Source: JICA Study Team

Figure 4.6-3 Sodding Layout Plan



Source: JICA Study Team

Figure 4.6-4 Irrigation Plan of Landside

CHAPTER 5

DESIGN OF UTILITY WORKS

TABLE OF CONTENTS

Chapter 5 Design of Utility Works

5.1. Water Supply System

5.1.1. General

It was agreed during the course of meetings in March 2013 with DOTC and Bohol Government for basic design that tapping point between the main water pipe to be installed prior to the new airport construction under the responsibility of DOTC and Bohol Government and airport water supply system will be at the intersection of central spine road and the new airport access road.

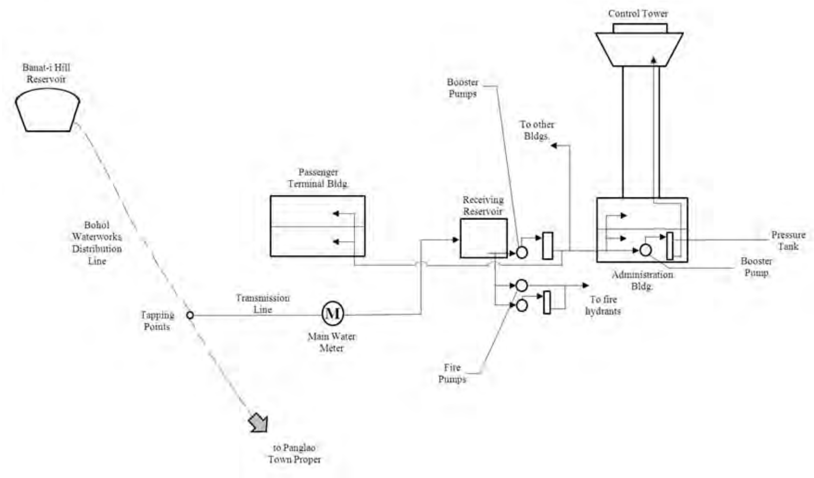
Potable water shall be conveyed through a transmission line along access road up to the airport's receiving reservoir. This reservoir is planned to be constructed at ground level within the pump house located at the northernmost part of the airport terminal premises.

Potable water to the buildings in the landside area shall be supplied from the receiving reservoir through booster pumps and a pressure tank to maintain the pressure. Additional booster pump and pressure tank system shall be installed for the water supply to VFR room on the control tower.

Exterior fire protection facilities shall also be installed around the buildings. Fire hydrants shall be strategically located to facilitate firefighting during the emergency case. Firefighting water will be also come from the receiving reservoir. A fire pump shall directly deliver to the fire hydrants the required flow and pressure during a fire.

Design of the water supply system shall be made in accordance with the National Plumbing Coder of the Philippines as well as Japanese Industrial Standards.

The overall flow diagram is shown in Figure 5.1-1.



Source: JICA Study Team

Figure 5.1-1 Flow Diagram of Water Supply System

5.1.2. Water Demand Projection

Domestic water users have been categorized into passengers, well-wishers, employees and restaurants. Table 5.1-1 shows the water demand computations for year 2020.

Water demand variations during the year and during the day were also analyzed. The maximum day demand occurs during the airport's busy days. Records from the existing Tagbilaran Airport show 280 busy days in a year. A factor of [320/280] is then applied to derive the maximum day demand.

The peak hour demand happens during the time of day that the airport is busiest. This is commonly the case when several flights arrive and depart from the airport at the same time. A factor of 2.5 is applied to obtain the peak hour demand.

Table 5.1-1 Water Demand Projection

Category	Assumptions and Computation	Unit Consumption		Water Demand (m^3/d)
Passengers	Average daily passengers = 1,436,000/320 =4,488 person	20	L/day. person	90
Well-wishers	As per 1 passenger=3 well- wishers; (=3x4,488=13,464 person/day; assumed 30% to use water; =13,464x30% =4,039 person)	20	L/day. person	81
Employees	Traffic unit x 0.6 x 67% for average day =(annual passengers/1,000+annual cargo/100) x 0.6 x 67% =620 person	100	L/day. person	62
Restaurants	Floor area= 840m2; seating area 60% of floor area; 1 m^2/seat; meal turnover 5 times /day; 840 x 60% x 1 x 5 =2,520 meals/day	40	L/day. meal	100
Total Domestic Consumption [A]	Sum of the above [A] (m^3/d)			333
Cooling System [B]	Make-up water rate = 0.00			0
Average Day Demand [C]	[C]=[A]+[B]=333+0			333
Maximum Day Demand [D]	Busy days = 280 days/year; [D]=[A] x (320/280) + [B]			383
Peak Hour Demand [E]	Peak hour factor = 2.5 [E]=([A] x 2.5 +[B])/24hr =(333 x 2.5 + 0)/24			35 m^3/hr.

Note) Year 2020 Forecast: Annual Number of Passengers=1,436,000

, Annual Cargo=10,728 tons, Peak Days of Year=320 days

Source: JICA Study Team

Maximum daily water demand is estimated at 383 m^3 for 2020, 522 m^3 for 2030, and 651 m^3 for 2040.

5.1.3. Water Source

Water shall come from one of water supply companies in Bohol. Exact location of the tapping point shall be finalized with DOTC during the course of the detailed design. It is also assumed that the quality of water meets the standard set by the PNSDW and that no further water treatment is needed. The proposed tapping point should be able to supply the maximum day demand of 383 m^3. Measuring meter shall be installed before the entrance to the airport premises.

5.1.4. Storage Facilities

The receiving reservoir should be able to contain the operational storage requirement as well as the fire reserve of the airport. The operational storage is normally computed to be 20-30% of the maximum day demand. The fire reserve is computed given the automatic fire sprinkler system requirement of 1,500 gpm running for one hour.

The year 2020 storage requirement is therefore:

Operational storage = 25% of MDD = 96 m^3,	say 100 m^3	
Fire storage = 1,500 gpm for 1 hour =	340 m^3	

Total storage	440 m^3,	say 450 m^3

The receiving reservoir shall be housed inside the pump house. For easy maintenance, the reservoir should have at least two compartments. Therefore, two (2) water tanks of 225 m^3 reservoir capacity are planned to be constructed for Phase 1, and area for additional water tanks of the same capacity is provided in the vicinity.

Water level controls must be placed corresponding to the operational water requirements of the airport. The lowest water level must be maintained having the fire reserve intact at all times. However, shuffling of operating compartments must be made in order to avoid deterioration of water quality.

5.1.5. Water Distribution System

The proposed layout is planned to be a looped system so that water supply can come from two directions. This will be advantageous during repair conditions. Gate valves have been laid out at appropriate locations to aid repair and maintenance work. Sizes of the proposed distribution pipelines are 50 mm to 150 mm diameter. The 150 mm line is planned from the outlet of the pump house to the nearest connecting point (e.g. control tower or fire and rescue station). The 100 mm line extends up to the end of the passenger terminal building where demand is highest. The rest of the looped system is 50 mm diameter. Smaller 32 mm diameter pipes are extended to the sewage treatment plant, future fuel farm and main parking concessions, if any. All sizes mentioned are internal diameters.

The length of water distribution pipes are approximately measured as follows:

150 mm diameter	387 m
100 mm diameter	408 m
50 mm diameter	925 m
40 mm diameter or below	333 m

Total length	2,053 m

There shall be two booster pumps on duty up to the design year. A third pump shall be on stand-by. They shall be sized equally at peak hour capacity. The size computations are as follows:

Booster Pump Nos. 1-3: Q = 7.08 lps; TDH = 30 m; Overall e = 60%

$$HP = \frac{Q \times TDH}{75e} = 5.19 \text{ hp, say 6 hp (3 units)}$$

All water supply pumps shall be directed to a 3 m^3 capacity pressure tank.

Another booster pump and pressure tank assembly shall be installed at the foot of the control tower. A small sized pump (say 1.1 kW) and pressure tank (80 liters) will be able to supply the requirements of the control tower as long as the TDH can reach up to 37 m considering the height of the tower and residual pressure at the topmost level.

To account for all the water usage, all service connections to the airport water distribution system are proposed to be metered. Losses can be easily computed by comparing the individual meter readings with that of the main water meter.

5.1.6. Exterior Fire Protection System

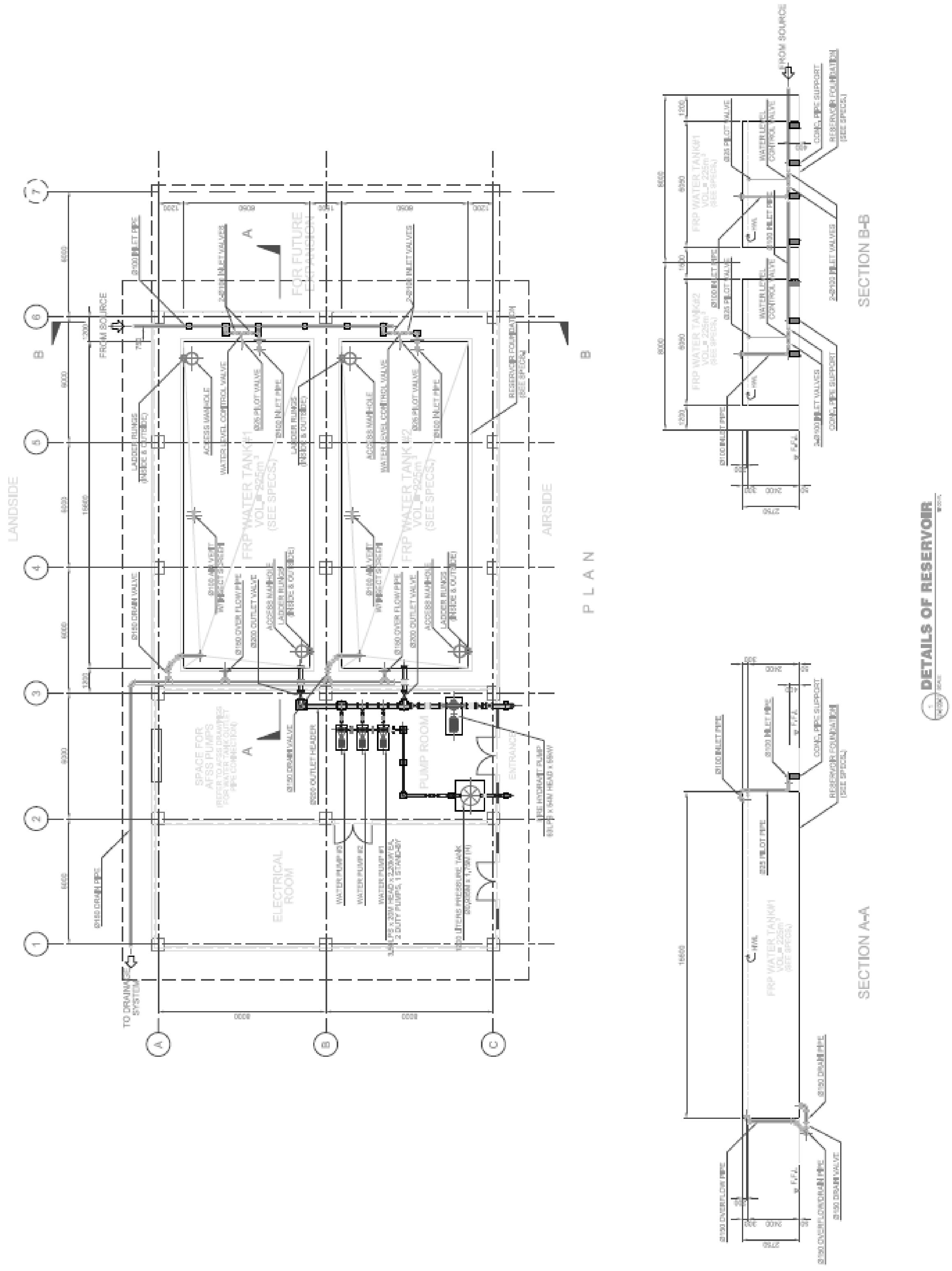
The proposed layout is also a looped system so that water supply can come from two directions. Fourteen (14) fire hydrants have been laid out at strategic locations around the buildings to be protected. Sizes of the proposed fire protection pipelines are 150 mm to 250 mm diameter. The 250 mm line is the discharge line of the pump and extends up to end of passenger terminal building including future expansion area. From there, a short 200 mm diameter pipe will be laid along the south side of the passenger terminal building. The rest of the looped system is 150 mm diameter to accommodate the size of the fire hydrants.

The length or pipes of the exterior fire protection system are approximately measured as follows:

250 mm diameter	634m
200 mm diameter	68 m

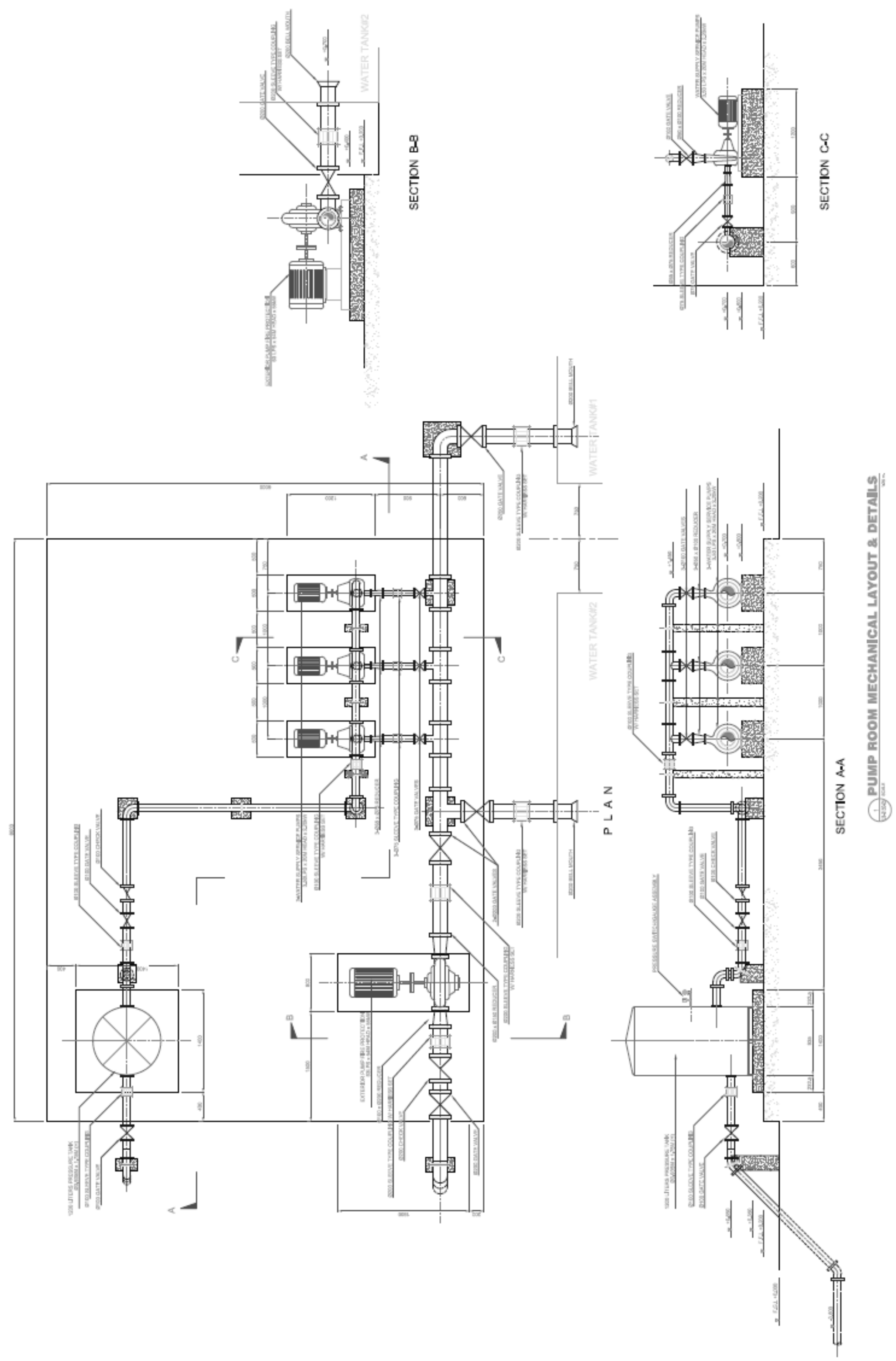
150 mm diameter	1,209 m

Total length	1,911 m



Source: JICA Study Team

Figure 5.1-2 Layout of Water Tank and Pump Facilities



Source: JICA Study Team

Figure 5.1-3 Layout and Section of Pump Room

5.1.7. Study on the possible conversion of Rainfall to Potable Water

(1) Collectible Water Volume and Possible Annual Saving

PTB roof (12,000 m^2) is only the area considered to collect certain amount of rainfall which is relatively clean thus can be purified for potable water.

As shown in Chapter 2 (Table 2.2-1), average annual rainfall recorded from 1998 to 2008 at Tagbilaran City was 1,577 mm.

As rainfall on the roof partly sticks to the surface and evaporates, or partly drains away due to the reasonable capacity of reservoir tank, it was assumed that maximum collectible annual volume of water is 80% of the annual total rainfall. Hence, average annual collectible rainfall is computed at 16,148 ton (i.e. 80 % x 1,577 mm x 12,800m^2), say, daily 44 tons (i.e. 16,148 ton/365 days).

Assuming the price of water is 35 Peso/ton, daily water of 44 tons out of the total demand (333 tons) are available for usage, 562,100 Peso could be annually saved from the assumed total expense for the water supply of Peso 4,254,075 as follows:

Table 5.1-2 Possible collectible rainfall and Cost Saving

	Total water demand	Collectible rainfall
Daily average supply (tons)	333 tons	44 tons
Daily price of water	11,655 Pesos	1,540 Pesos
Annual average supply (x 365)	121,545 tons	16,040 tons
Annual price of water	4,254,075 Pesos	562,100 Pesos

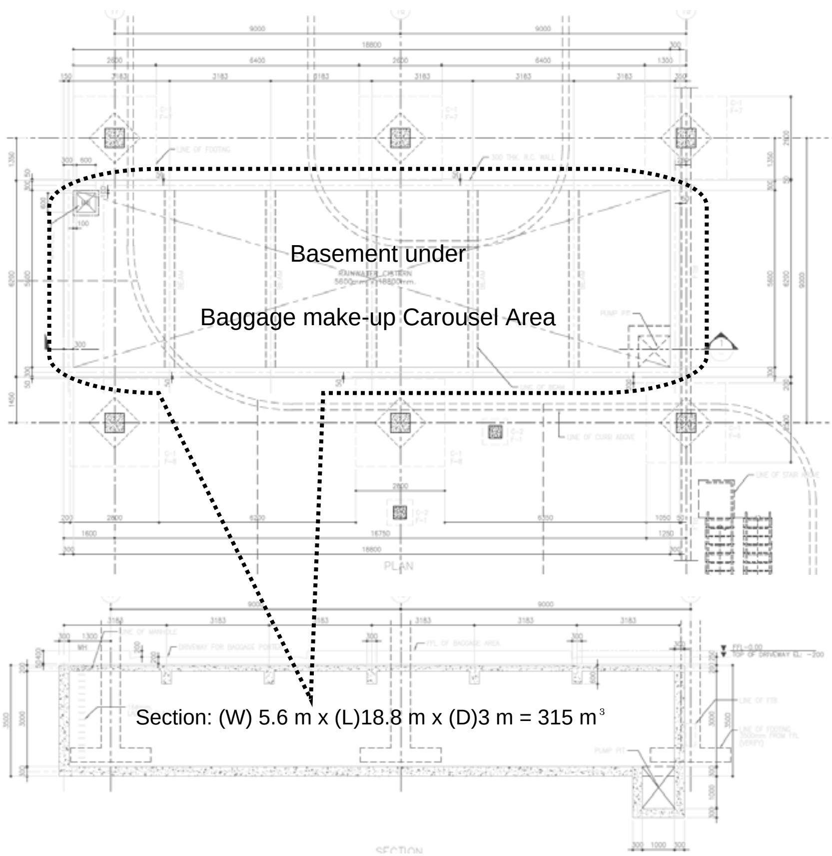
Source: JICA Study Team

(2) Required Facility Requirements for Rainfall Conversion

Daily 44 tons of water collected from PTB roof is equivalent to 4.3 mm rainfall (4.3 mm x 12,800 m^2 x 80% = 44 tons)

According to daily weather data from June 2010 to May 2011 (Table 2.2-3), no rainfall day was counted at 142 days through the year (in average 12 days a month). Days with less than 5 mm rainfall is 255. Meanwhile, the days with more than 5 mm rainfall is110, the days with more than 10 mm rainfall is 70, and days with 20 mm rainfall is only 36. A period in which no rain falls for the consecutive 5 to 8 days is counted at 5 or 6 times of the year.

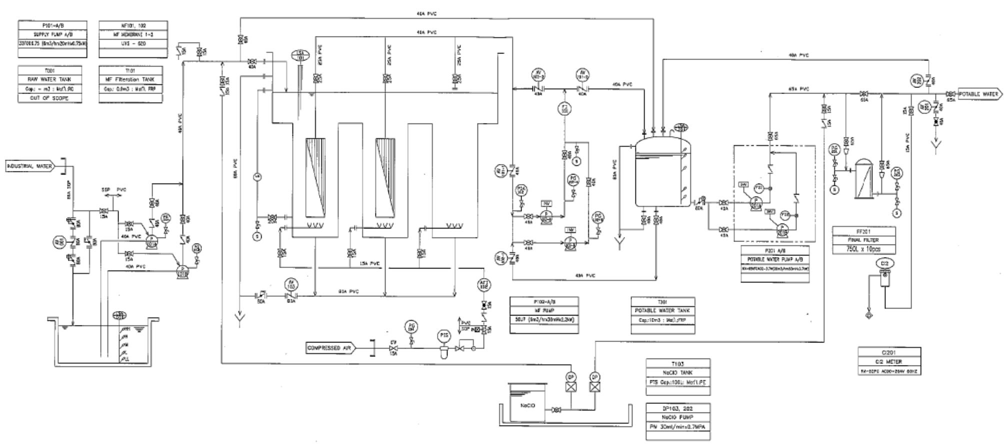
Therefore, certain volume of rainfall should be stored for the use of consecutive no-rainy days. It is considered that a reservoir tank with a week capacity, say 300 tons (i.e. 44 tons x 7 days) is at least necessary. It is assumed that a water reservoir tank is constructed underground of PTB (under baggage make-up carousel) as shown in Figure 5.1-4. The water should be sent via 300 m long transmission pipe to the permanent water tank (450 tons capacity) and accommodated to the system as a whole.



Source: JICA Study Team

Figure 5.1-4 Possible Rain fall Reservoir Tank under PTB (Baggage make-up area)

Water purifier should be installed either in the vicinity of the above reservoir tank or the permanent airport water tank. Available type and capacity of the purifier is to purify hourly 6 tons, or daily 100 tons of water which is equivalent to 100 mm rainfall on the PTB roof (i.e. 80% x 10mm x 12,800 m²= 100 tons). Electricity consumption of the machine is 10 kW/hour, which means the machine should daily operate 18 hours to produce 100 tons of potable water and requires 13.5 Pesos to create 1 tons of potable water (i.e. 180kW/100 ton x 7.5 Peso/kW).



Source: JICA Study Team

Figure 5.1-5 Possible Single Line Diagram for Water Purifier

(3) Probable Initial Investment Cost

Probable initial investment costs are estimated as follows:

a)	300-ton reservoir Tank under PTB basement	4,000,000 Peso
b)	Water Purifier	10,000,000 Peso
c)	Pump and Transmission Pipe:	1,500,000 Peso
d)	Electrical Equipment:	500,000 Peso
e)	Total:	16,000,000 Peso

(4) Evaluation

A mentioned above, the annual total volume of water 16,040 tons can be purified for the potable water, by which 562,100 Peso can be possibly saved as far as the payment to water company is concerned. However, electricity for the operation of purifier would annually cost 216,540 Peso (13.5 Peso x 16,040 tons). This means that actual annual 345,560 Peso (i.e. 562,100 -216,540) are only possible to be saved, which would pay back the above initial investment cost in over 46 years. In fact the life of water purifier is 10 to 15 years; the initial investment is most probably not recovered.

On the other hand, increase in electricity is against environmental consideration, therefore, rainwater.

5.2. Power Supply System

5.2.1. System Summary

The power house, located between the passenger terminal building and control tower, ATC operation and administration building will consist of the following facilities for the purpose of achieving good maintenance and serviceability to all mechanical and electrical system.

- Electric power substation
- Emergency generators
- Constant current regulator (CCR)
- Control room
- Applicable codes and standards for design works are as follows:
- JIS – Japanese Industrial Standard
- PEC – Philippine Electrical Code
- NEMA – National Electrical Manufacturing Association
- ANSI – American National Standards Institute
- ASTM – American Society for Testing and Materials
- NFPA – National Fire Protection Association
- UL – Underwriter Laboratories, Inc.
- Fire Code of the Philippines
- ICAO Annex 14 Aerodrome
- ICAO, Aerodrome Design Manual, Part 5 Electrical System

From the power house, a series of underground cable ducts will be installed to serve all the buildings and other electro-mechanical facilities inside the airport complex including the navigation aids facilities.

5.2.2. Power Distribution System

(1) Main System

The power receiving system including future demand with 2,000 kVA shall be prepared for entire airport facilities based on the calculation of the power consumption on the Table 5.2-1.

Power supply line of 13.2 kV will be distributed by underground lines from the last receiving poll of the electric service company to the power house.

Power circuit breakers, high voltage switchgears, distribution transformer, generators, and low voltage switchgear, power capacitors will be housed in the power house.

Usage of low voltage power supply is tentatively allocated as follows:

- 230V: All of Mechanical, Electrical & Special Equipment

Basic single line diagram for electric power distribution system is illustrated in Fig. 5.2-1.

Other equipment to be housed in the power house is the aeronautical ground lighting equipment, monitoring equipment and equipment for maintenance purposes.

(2) Passenger Terminal Building

Detailed design load is approximately 680 kVA at 230 V, 3 Phase. Most of the total design load of the passenger terminal building shall be covered by solar power energy (480 kVA) except in the case of cloudy sky and night time. Around 34.6% of the design load will be energized by a generator during power failure.

(3) Control Tower, ATC Operation & Administration Building and Fire Station, Maintenance Building

Detailed design is approximately 484 kVA at 230 V, 3 Phase. When excess of solar power energy is generated on photovoltaic panel at passenger terminal building, the power shall be directly distributed to ATC operation and administration building. Around 39.9% of the design load will be energized by a generator during power failure.

(4) Power House, Car Park and Road Lights Facilities

Detailed design load is approximately 99 kVA at 230 V, 3 Phase. Around 25% of the design load will be energized by a generator during power failure, except for road lighting.

(5) Fire Pump and Water Pump Facilities

Detailed design load is approximately 153 kVA at 230 V, 3 Phase. Around 85.7% of the design load will be energized by a generator during power failure.

(6) Sewage Treatment Plant

Detailed design load is approximately 56 kVA at 230 V, 3 Phase. Around 45% of the design load will be energized by a generator during power failure.

(7) Aeronautical Ground Light Facilities

Detailed design load is approximately 166 kVA at 230 V, 3Phase. 88% of the design load will be energized by the generator during power failure.

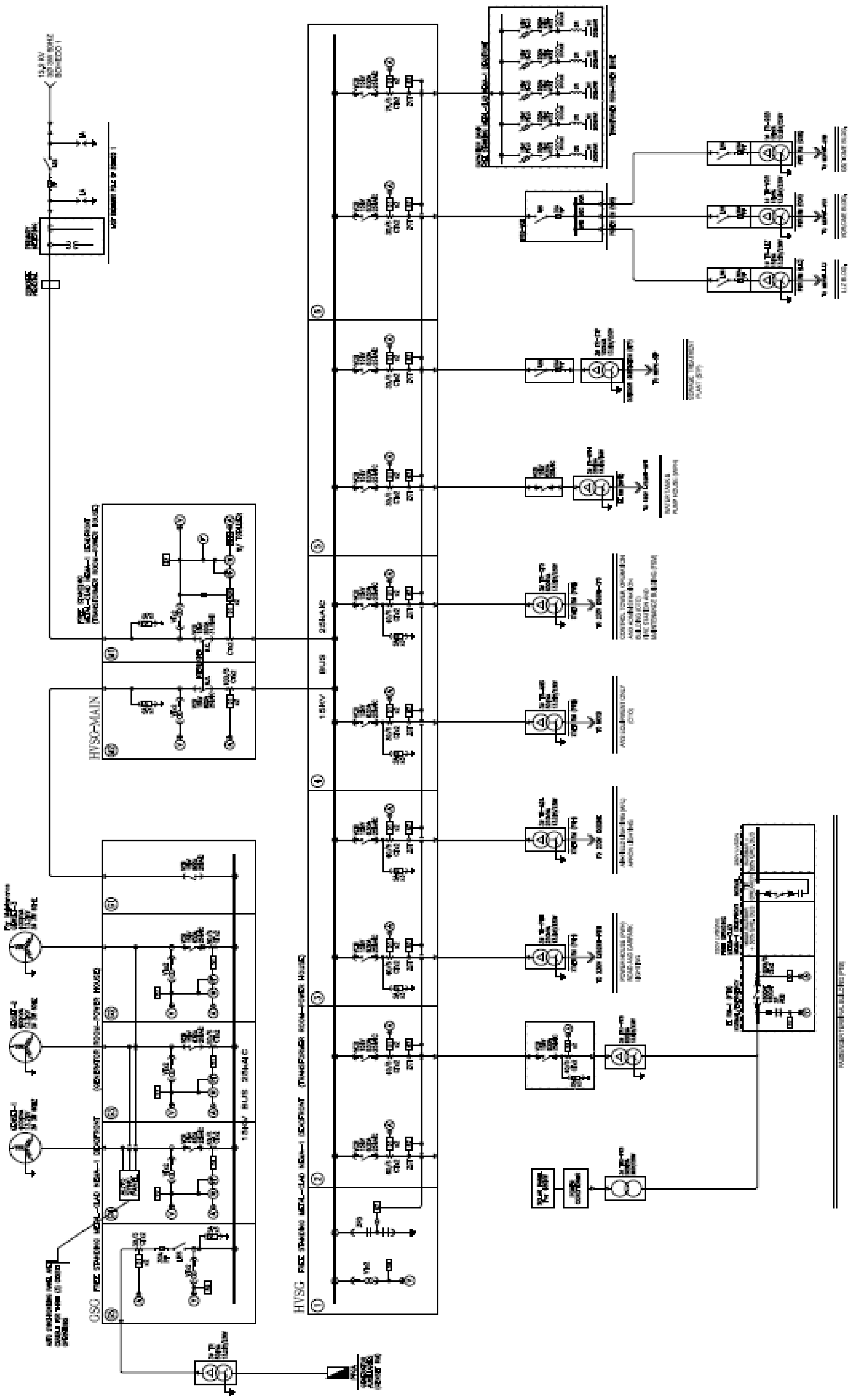
(8) ILS and VOR/DME Facilities

Basic design load is approximately 10 kVA at 230 V, 3 Phase. 100% of the design load will be back up by the generator during power failure.

Table 5.2-1 Total Load for the Airport

	TOTAL DESIGN LOAD ***(SUM OF TRANSFORMER RATING EXCLUDING ACCESS ROAD)***	=	**2000**	**kVA**
	SUMMARY OF NORMAL LOADS:			
	LOAD DESCRIPTION		**Load (kVA)**	
	Passenger Terminal Building	=	678.29	
	Power House	=	99.08	
	Aeronautical Ground Lights	=	165.75	
	Radio Navaids System	=	21.23	
	Control Tower, Opearation & Admi Building and Fire station	=	483.89	
	Water Pump House	=	152.60	
	Sewage Treatment Plant	=	55.95	
	LLZ Building	=	8.95	
	GS Building	=	10.44	
	VOR Building	=	13.97	
	TOTAL NORMAL CONNECTED LOAD	=	**1690.16**	**KVA**
	FUTURE LOADS (TDL - TNCL) = 2000 - 1664.72	=	**309.84**	**KVA**

Source: JICA Study Team



Source: JICA Study Team

Figure 5.2-1 Power Supply System Line Diagram

5.2.3. Emergency Generators

(1) Requirements

The tentative design load of the generator set is approximately 800 kVA at 13.2 kV, 3 Phase. The purpose of the generator is to provide power for the essential load of the airport during normal power failure.

In consideration of the quality of the normal power source and the needs to be prepared for periodical inspection and maintenance services of the generator, two (2) sets of generators and one (1) spare generator shall be provided with a rating of 320 kW (400 kVA) each.

(2) Fuel Tank

A fuel tank will be provided for five (5) full days operating capacity of the generator at the power house. This estimate is based on the minimum requirements of 72 hrs (3days) of engine generator operation under ICAO Aerodrome Design Manual, Part 5 Electrical System and an allowance of two (2) days based the cycle of ordering and delivery of fuel in Bohol Island.

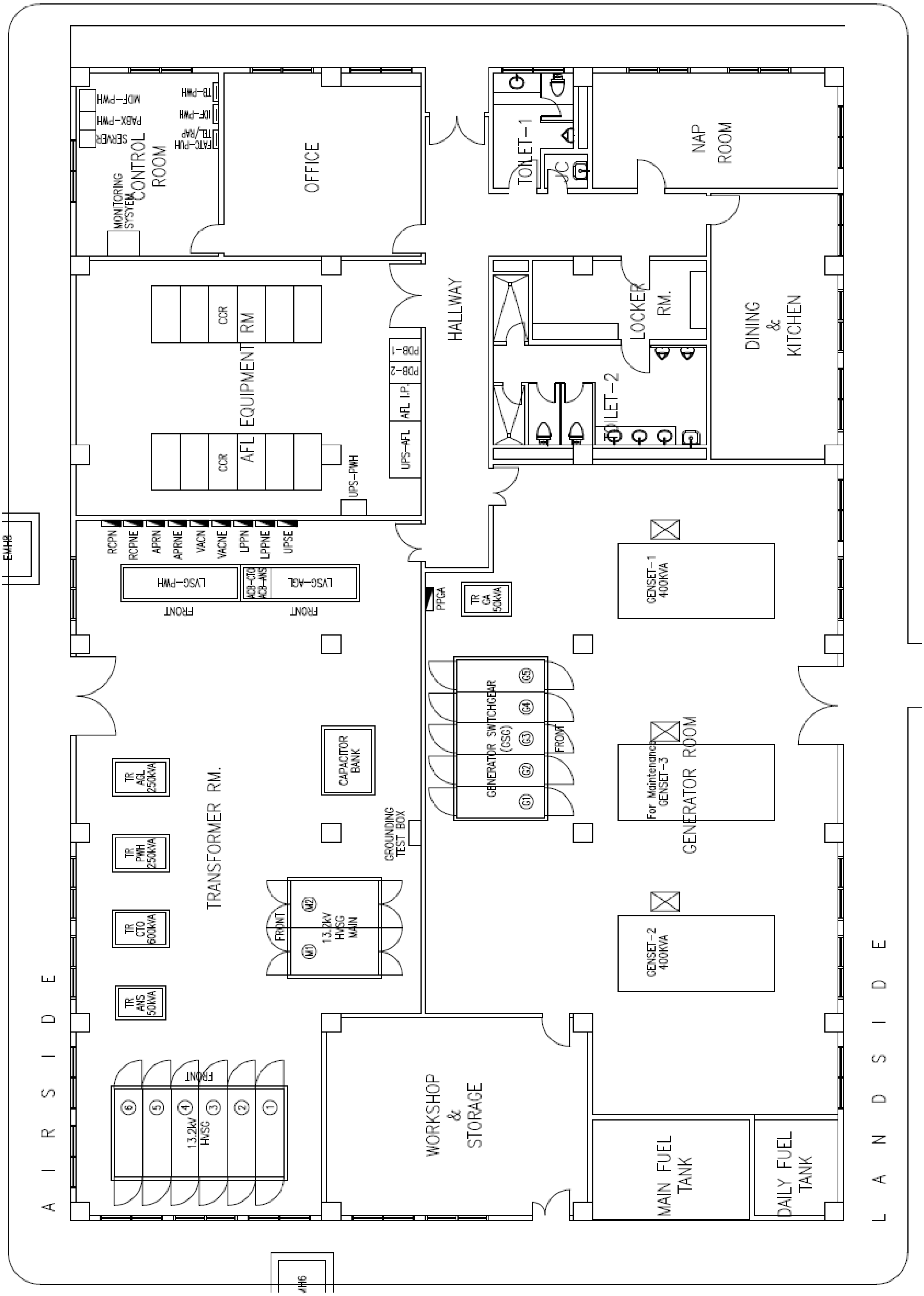
(3) Control and Rating

The diesel engine driven stand-by generating sets shall be controllable both manually and automatically.

(4) Rating and Characteristics

Rating and characteristics of each generating set will be as follows:

- Type : 3 Phase, 3 Wires
- Rated voltage : 4.16 kV AC
- Rated revolution : 1800rpm (60Hz)
- Power factor : Lag. 80%
- Rating : Continuous
- Max. Switch-over time : within 10 seconds (For Navaids)
- : within 40 seconds (Others)
- Cooling system : Radiator system



Source: JICA Study Team

Figure 5.2-2 Power House Layout Plan

5.2.4. Solar Power Generation System

(1) Climate Condition

a) Solar Insolation

The study team contacted Philippine Atmospheric, Geophysical and Astronomical. Services Administration (PAGASA) to obtain solar insolation data[1] at the project site; however no data was available because the observing station in Tagbilaran was closed and there is no solar insolation data of the observing station in Cebu, which is nearby the project site.

The solar insolation data published at the website of National Aeronautics and Space Administration in United States (NASA)2 is used for the design of solar power generation system and estimation of power generation.

Department of Energy (DOE) reported that yearly average horizontal solar insolation is 5.1 kWh m-2 day $^{-1}$ in the country[3]. A survey conducted by National Renewable Energy Laboratory in United States (NREL)[4] shows that yearly average horizontal solar insolation in Bohol Island and Panglao Island is 4.5 to 5.5 kWh m^{-2} day^{-1}. Considering these values, it is appropriate to use 4.85 kWh m^{-2} day^{-1} which is published by NASA as the yearly average horizontal solar insolation.

Table 5.2-2 Horizontal Solar Insolation Data by NASA

Unit: kWh・m^{-2}・day^{-1}

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
4.25	4.81	5.48	5.97	5.56	4.86	4.72	4.73	4.75	4.57	4.38	4.17	4.85

Source: Website of NASA (http://eosweb.larc.nasa.gov/sse/RETScreen/)

b) Temperature and Rainfall

According to the weather data from June 2010 to May 2011 of Tagbilaran observing station of PAGASA, the average of maximum temperature and minimum temperature are around 32 degree C and 24 degree respectively throughout the year. 30 degree C is assumed as the atmosphere temperature of the operation of the solar power generation system.

It is recorded that yearly rainfall is around 2,400 mm. The rainfall varies from month to month, however certain rainfalls are observed in each month. The rainfall can wash the surface of the photovoltaic module, however it is highly recommended to wash the surface to remove bird dropping and dust periodically.

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[1] http://kidlat.pagasa.dost.gov.ph/agssb/nrc.html
[2] http://eosweb.larc.nasa.gov/sse/RETScreen/
[3] http://www.doe.gov.ph/ER/BioOSW.htm
[4] Assessment of Solar Resources for the Philippines, Philippine Renewable Energy Project (2000)

Table 5.2-3 Temperature (Max. and Min.) and Rainfall

Unit: C^0 and mm

	2010							2011					Average
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	
Max. Temp.	36.5	35.2	35.0	35.0	34.5	34.0	34.4	33.5	33.2	33.2	34.0	34.3	34.4
Min. Temp.	23.0	23.5	23.3	21.2	23.2	23.3	22.5	21.4	21.5	22.5	22.6	21.5	22.5
Ave. Max. Temp.	34.0	33.2	32.8	33.2	32.9	32.4	32.6	30.1	31.1	31.4	32.5	32.3	32.4
Ave. Min. Temp.	24.9	24.8	24.5	23.9	24.9	24.2	24.0	23.4	23.4	23.7	23.7	24.6	24.2
Rainfall	148.8	164.3	137.8	206.5	305.1	140.6	282.6	363.9	140.6	289.5	50.3	165.8	199.7
Rainfall Days*1	13	13	16	12	17	16	15	21	11	22	9	15	15.0

*1: The number of days equal to or more than 1mm of rainfall

Source: Prepared by JICA Study Team based on the data from PASAGA

c) Wind Speed

Assumed maximum wind speed for the design is 200 km/hour which is mentioned in Chapter 7 and same as the design of the passenger terminal building (PTB).

(2) Grid Connection to Power System

a) Feed-in Tariff

In Philippines the tariff of feed-in tariff (FiT) was determined in July 2012; however no project for FiT has been approved as of the end of May 2013 although hundreds of projects have been applied for FiT. According to an article of a newspaper5, an official stated the first project with FiT scheme will be realized in 2014.

The system of FiT is mainly for power generation business, and a lot of permissions, approvals and costs are required to apply FiT[6]. In addition to this, it is assumed that the surplus power from solar power generation system will be very few or none. Therefore the application of FiT for the solar power generation system is not considered.

b) Conditions on Grid Connection to Power System

The solar power generation system will be indirectly connected to the power system of Bohol I Electric Cooperative, Inc. (BOHECO I) through the power system of the airport, and very little surplus electricity will be assumed since the most of electricity from the solar power generation system will be consumed based on the estimated energy demand of the airport.

Following opinions and comments for such solar power generation system are collected from DOE, Energy Regulatory Commission (ERC) and BOHECO I.

5 "Philippine clean energy tariffs to start next year – government" (Agence France-Presse), March 27, 2013 (http://business.inquirer.net/114493/philippine-clean-energy-tariffs-to-start-next-year-government)

6 According to "PV in the Philippines beginning to pay off" (PV Magazine), February 18, 2013 (http://www.pv-magazine.com/news/details/beitrag/pv-in-the-philippines-beginning-to-pay-off_100010251/), a lot of permissions, approvals and more than USD 300,000 are required.

- ERC has no objection as long as following the instruction and consultation from DOE, BOHECO I and Environmental Management Bureau (EMB) under Department of Environment and Natural Resources (DENR).
- BOHECO I has no objection to grid connection of the solar power generation system. BOHECO I can purchase the surplus electricity if the purchase rate is less than the rate for other power supplier e.g. power generation company since the solar power generation system exceeding 100 kW is outside the scope of “Rules Enabling the Net-metering Program for Renewable Energy”.
- DOE commented that it is on the decision of Department of Transportation and Communications. (DOTC) whether the system is registered as “Own Use System” or “RE Developer”, which can sell the surplus electricity to BOHECO I. It is easier to register as “Own Use System”. After the registration to DOE, the custom duty will be exempted when related equipments for the solar power generation system are imported from abroad.

Based on the opinions and comments above, the solar power generation system will be designed and registered as “Own Use System” without reverse power flow to the power system of BOHECO I. The study team arranged a draft of some of documents to be submitted to DOE for registration.

(3) Installation Places of Components of Solar Power Generation System

a) Components to be installed on the roof

(i) Photovoltaic Module (Solar Panel)

The modules will be installed on the wave-shaped curve roof (land side) of PTB. Other option of installation places are not considered because of following reasons.

- Ground mount: not enough available space
- On other building than PTB: costly because of several smaller buildings
- On the parking: extra cost for preventing thefts

No photovoltaic module will be installed on the wave-shaped curve roof (air side) on PTB because of limitation of whole project cost.

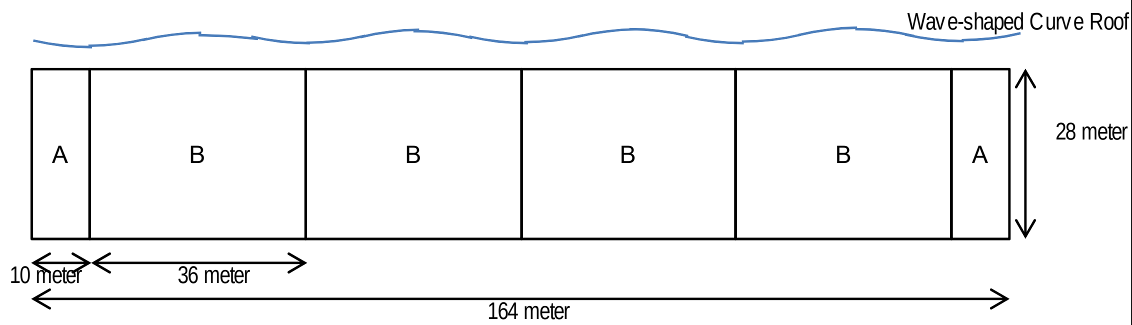
Total capacity of photovoltaic modules is 480 kW or more. The capacity of one module and the number of modules cannot be decided at the detail design stage since the contractor will decide them as their design work; however it is assumed that around 2,300 modules of 200 Watt module will be installed. The following table shows the capacity, dimension7 and possible number of photovoltaic module installed on the space in case of

[7] Each manufacturer produces products with several size/capacity. The study team chose one of products from each manufacturer’s line-up.

modules of Japanese major manufacturer.

Table 5.2-4 Possible Capacity and Size of Product of Japanese Manufacturer

Manufacturer	Capacity	Dimension (mm)		Arrangement			Possible Capacity		Cell Type
	(W)	W	H	Row	Col(A)	Col(B)	Pcs.	kW	
K	215	1,500	990	18	8	28	2,304	495.360	Polycrystalline
M	209	1,657	858	16	8	32	2,304	481.536	Monocrystalline
P	233	1,580	812	17	9	33	2,550	594.150	Hybrid (Monocrystalline)
S	240	1,652	994	16	8	28	2,048	491.520	Polycrystalline



(Conditions)
Available space is 28 * 164 meter.
1.8 meter of width is kept between each area (A or B).
Installation direction of module is horizontal.
10 mm is kept between modules.
Maintenance space is kept every 4 rows of module.

Source: JICA Study Team based on the Websites of Manufacturers

Photovoltaic array to be installed on the roof is one of symbol of the eco-airport (green airport) concept; however the array cannot be seen by the passengers. To appeal the existence of solar power generation system, the status of power generation and the image of the system will be displayed on the monitors to be installed at the lobbies of the PTB.

(ii) Connection Box and Junction Box

Photovoltaic modules will be connected in series and in parallel. In case of this system around 480 kW, around 16 to 18 modules are connected in one series and 130 series will be connected in parallel.

The connection point of the series is connection box and junction box. Usually one connection box can connect 5 or 6 circuits (series of modules); therefore 22 to 26 connection boxes are required. Same as connection box one junction box also can connect 5 or 6 circuits; therefore around 5 junction boxes are required. By using these boxes, the number of circuits is reduced into the number of input circuits of power conditioner (PV inverter).

The total number of boxes cannot be decided at the detail design stage since the contractor will decide them as their design work; however it is assumed that around 30 boxes will be installed.

The boxes will be installed near the array on the roof.

(iii) Metrological Monitoring System

To evaluate the status of power generation of the solar power generation system, it is essential to measure solar insolation and ambient temperature. It is possible to check whether there is any problem on the system or not by comparing theoretical amount of power generation and actual power generation.

One pyranometer to measure horizontal solar insolation[8] and one thermometer to measure ambient temperature near the photovoltaic array will be installed with the solar power generation system. Data will be transfer to data collecting system installed in CCO room via communication cable(s).

b) Components to be installed in the PTB

(i) Power Conditioner (PV Inverter)

Power conditioner is an equipment to be installed in the electrical room and it converts DC power from photovoltaic array to AC power and synchronizes frequency with connected grid.

The total capacity of power conditioner(s) is 480 kW or more. The capacity of one power conditioner and the number of power conditioners cannot be decided at the detail design stage since the contractor will decide them as their design work, however it is assumed that one 500 kW type power conditioner will be installed because of limitation of the space in the electrical room.

(ii) Electrical Board and Transformer

A transformer to convert voltage from output voltage of power conditioner to 230 V, and electrical board(s) to disconnect the system from the power system of the airport at necessary timing are installed in the electrical room.

(iii) Data Collecting System

The system is a set of computer, and will collect and store metrological data and operation data of power generation system (e.g. operation status of power conditioner), and generate and send data to the monitor to be installed at lobbies of PTB. The system is installed in CCO room.

[8] Generally not only horizontal insolation, but inclined insolation in same tilt angle as the photovoltaic module is installed, and theoretical amount of power generation is calculated based on the inclined insolation. In the solar power generation system tilt angle of photovoltaic module are not same because the modules are installed on the wave-shaped curve roof, and the tilt angles are relatively small (maximum around 15 degree only). Therefore no pyranometer to measure inclined insolation is installed.

c) Other Major Materials

(i) Mount on Metal Roof

Photovoltaic modules are rigidly fixed on the wave-shaped curve roof by the mounting parts. The mount shall be approved or certified by the manufacturer of the metal roof to install with the metal roof. The mount shall be installed on the roof metal sheet without making any hole on the metal roof.

The quantities, size, interval and any other detail of the parts cannot be decided at the detail design stage since the contractor will decide them as their design work.

(ii) Cables

Color and installation method of cables e.g. power cables and control cable used at outdoor shall not disturbed architectural design of the PTB. Installation method of cable will be considered not to be a route of rainwater flowing with the cables.

(iii) Display Monitor

The monitors display data sent from data collecting system in CCO room. Three monitors will be installed in PTB. Data will transfer from CCO room via communication cable.

(4) Consideration of Impact of Installation of Solar Power Generation System

a) Architectural Design

Photovoltaic modules and related equipments and materials installed on the wave-shaped curve roof shall not disturb the architectural design of the PTB.

Photovoltaic modules will be installed along with the tilt angle of the wave-shaped curve roof, and the impact will be minimized.

Following considerations will be done regarding the installation places of connection boxes and junction boxes, and cables especially thick power cable.

- Connection Box and Junction Box:
  These boxes will be installed a space between wave-shaped curve roofs of land side and air side. The location of these boxes will be considered not to make power cables long. The boxes shall be protected against direct sunlight if necessary.

- Power Cable from Junction Boxes to Power Conditioner (PV Inverter):
  The cables go down to the electrical room just above the room and minimize the impact against architectural design.

No additional lighting protection system for solar power generation system is installed. A lighting protection rod to cover the PTB will cover the solar power generation system.

The grounding wires will be routed in the PTB not to give negative impact to architectural design of the PTB. Individual wire will be given to each equipment since common grounding might not be permitted by the manufacturer of equipment.

b) Sunlight Reflection to Aircraft Operation and Control Tower

The PTB will be built in parallel with the runway and the surface of photovoltaic modules will installed in vertical direction of the PTB. Therefore the surface will faced to landing aircraft. It is necessary to consider the impact to the aircraft operation, as well as control service at the control tower.

Generally the impacts of reflection from photovoltaic modules are summarized shown in below[9].

- Reflection coefficient of photovoltaic module is lower than ordinary glass since special glass is utilized for photovoltaic module to catch energy of sunlight.
- However reflection coefficient is relatively higher if angle of incidence is larger.

In a report published by Federal Aviation Administration[10], United States (FAA), it is written “Project managers from six airports where solar has been operational for one to three years were asked about glare complaints. Air traffic controllers were contacted from three of those airports and asked to comment on the effect of glare on their daily operations. To date, there have been no serious complaints from pilots or air traffic controls due to glare impacts from existing airport solar PV installations” and “Any potential problems in this area have apparently been resolved prior to construction through one or a combination of the strategies described above11.”

As long as the result of assessing baseline reflectivity conditions, relatively strong reflected sunlight toward to landing aircraft and the control tower in limited season and timing as described later. Anti-glare type or equivalent type photovoltaic module is recommended for the project not to disturb operation of the aircraft and control service at the control tower, and it is recommended to evaluate the impact of reflection at the design and installation stage by the contractor.

The conclusion of analysis of estimated reflection is shown below. At first the relationship of azimuth angles of the sun and landing aircraft is summarized.

- The direction of the runway is 03/21 and photovoltaic modules are also facing the direction of 03 and 21. (Half of modules are facing the direction of 03 and

[9] Japan Photovoltaic Energy Association (JPEA)
[10] “Technical Guidance for Evaluating Selected Solar Technologies on Airports”, November 2010, FAA
[11] “1) Assessing Baseline Reflectivity Conditions”, “2) Tests in the Field” and “3) Geometric Analysis”

the other half is facing the direction of 21). It is necessary to evaluate the reflection of the sun when the sun is located in the direction of 30 degree east from the north and 30 degree west from the south.

- The site is located in the northern hemisphere, however in the south from the tropic of cancer. Therefore the sun goes to northern side in the summer afternoon. In this case the reflected sunlight by the photovoltaic module with small tilt angle goes to higher because the sun is also located in high altitude. No negative impact is assumed if the sun is located in the direction of 03.
- Therefore more consideration is needed if the sun is located in the direction of 21

Secondary the relationship of altitude of the sun and landing aircraft is summarized.

- The azimuth angle will be 210 degree (30 degree west from the south) afternoon of autumn, winter and spring.
- The reflected sunlight by the photovoltaic module with small tilt angle goes to higher because the sun is also located in high altitude in spring and autumn. (For example, the azimuth angle will be around 210 degree at 12:15 on the equinox days in spring and autumn, and the altitude of the sun is around 78 degree in the day.)
- Comparing to the spring and autumn, the altitude of sun is relatively low in the winter. The azimuth angle will be around 210 degree and the altitude of the sun is around 50 degree at 13:00 on the winter solstice. The reflected sunlight by the photovoltaic modules facing the direction of 21 (30 degree west from the south) goes to the high altitude (50 to 80 degree); however the reflected sunlight by the modules facing the direction of 03 (30 degree east from the north) goes to relatively low altitude (20 to 50 degree) and angle of incidence is relatively larger (40 degree to 55 degree) in this case.

As the conclusion, the relatively maximum impact of reflection is caused at the photovoltaic modules facing 30 degree east from the north in winter afternoon toward the aircraft landing to the runway 21. Same as the landing aircraft landing to the runway 21, the relatively maximum impact of reflection to the control tower also caused in the same timing since the control tower is located in the north-east side of the PTB.

c) Salt Damage

The PTB will be constructed around 1 km from the sea cost. No typical salt damage was observed near the places when the study team conducted a field survey in June 2013. No countermeasure against salt damage will be requested on the specification; however equipment/material not requiring additional painting for operational period of the solar power generation system will be utilized.

(5) Requirement of EIA

The responsible organization of Environmental Impact Assessment (EIA) is DENR-EMB. The office covering Bohol Province is EMB Region 7 in Cebu.

For the solar power generation project less than 5 MW, EIA is not required and obtaining Certificate of Non-Coverage (CNC) is required[12]. It takes 15 working days to obtain CNC after submission of application[13]. A request letter, application form (including the outline of the project) and Zoning Certificate which is available at municipality office are required to apply CNC.

The study team arranged a draft of the request letter and application form in the detail study period.

(6) Amount of Power Generation and Reduction of CO_2 Emission

a) Amount of Power Generation

The amount of power generation by 480 kW solar power generation system is shown in below. In this calculation, 4.85 kWh・m-2・day-1 , which is the value of horizontal solar insolation, is used as the inclined solar isolation value[14].

In accordance with JIS C 8907:2005 "Estimation method of generating electric energy by PV power system" with some different parameters[15] for more practical estimation, estimated amount of power generation is 559,962 kWh/year. It is equivalent to 3,284,238PHP/year in case of the calculation based on the current tariff of electricity sold by BOHECO I (5.8693 PHP/kWh). Addition to this, more electricity saving mainly for air conditioning is expected because of thermal barrier effect by the photovoltaic module installed on the roof.

b) Reduction of CO_2 Emission

The power system in Bohol and Panglao Islands is a part of Visayas power system, which is one of power system in Philippines. (Other two power systems are Luzon and Mindanao.) Visayas system was connected to Luzon system in 1996.

Energy mixes of Luzon and Visayas system are shown below. The pie chart shows the

[12] "Revised Procedural Manual for DAO 2003-30", EIAMD, EMD, DENR, August 2007

[13] "Project Groups, EIA Report Types, Decision Documents, Processing/Deciding Authorities and Process Duration" (http://www.emb.gov.ph/eia-adb/categories.html, as of May 3, 2013)

[14] Tilt angle of photovoltaic module is relatively small (around 15 degrees or less than 15 degrees only) and site is located in low latitude area. In such case, there is only a few percent difference of solar insolation value between horizontal and inclined solar insolation.

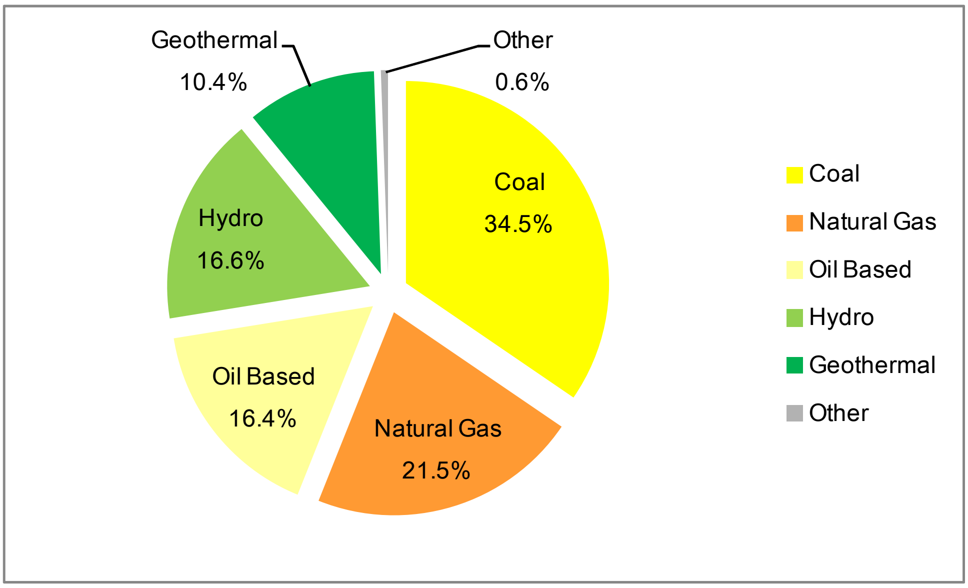
[15] 95%, not 90% in JIS, is used as efficiency of inverter, 60 degree C is used as cell temperature and -0.5%/degree C is used as temperature coefficient.

energy mix of whole of Luzon-Visayas system.

In Luzon-Visayas system, more than 70% of the energy mix depends on fossil fuels although 27% of the energy mix depends on renewable energies. The installation of the solar power generation system is expected to contribute the reduction of the consumption of fossil fuels and the emission of CO_2. 274.19 ton/year of CO_2 emission will be reduced in case combined margin value (0.49 ton-CO_2/KWh as of January 2013) in Philippines by Institute for Global Environmental Strategies, Japan (IGES) is applied for the estimation.

(Unit MW)

	Coal	Natural Gas	Oil Based	Hydro	Geothermal	Other	Total
Luzon	3,664	2,770	1,633	2,124	587	46	10,824
Visayas	777	0	476	13	745	26	2,037
Total	4,441	2,770	2,109	2,137	1,332	72	12,861
Total (%)	34.5%	21.5%	16.4%	16.6%	10.4%	0.6%	100.0%
	72.5%			27.0%			



Source: Prepared by JICA Study Team based on "Transmission Development Plan 2012", NCGP, November 2012

Figure 5.2-3 Energy Mix of Luzon-Visayas Power System (Capacity Basis)

(7) Maintenance and Management of Solar Power Generation System

Following maintenance and management is required for the solar power generation system, and it is recommended to arrange necessary organization/human resource arrangement and budget arrangement. A set of fuses and lumps for replacement is provided by the Contractor as a part of the contract.

- Regular check as electrical facility (e.g. once a month)
  Visual inspection and check-up of operational status etc. (in addition to this, it is recommended to inspect the surface of the photovoltaic module and remove bird drop and dust as needed.)
- Periodical check as electrical facility (e.g. once or twice a year)
  Visual inspection, check-up of screw/connector loose, and measurement of open circuit voltage of photovoltaic modules and insulation resistance etc.
- Future replacement of parts and equipment
  Power conditioner (PV inverter): expected life span is 10 years.
  Computer for data collecting system: expected life span is 5 or 10 years.
  Replacement of consumable parts (e.g. filter): as recommended by the manufacturer
  Fuse and lump: as needed

5.2.5. External Lighting System

(1) General

A complete external lighting system for the internal road of the airport, car park area and access road will be provided for proper illumination.

Lighting fixtures, ballast, lighting poles, concrete base, cable pipes and wiring shall be included.

(2) Lighting System

Internal road lighting shall be provided at approximately 45 m interval or more. Access road lighting shall be provided at approximately 50 m interval.

The illumination level for road lighting shall be at least as specified in Table 5.2-5 below, and the average horizontal illumination for car park lighting shall be 20 lux.

Table 5.2-5 Road Lighting – Required Average Horizontal Illuminance

Area	Average Illuminance (lux)
Access Road	15 lux
Internal Road (around car parking lot)	10.5 lux
Internal Road (other areas)	7.5 lux

Source: JICA Study Team

5.3. Sewage Treatment System

5.3.1. System Summary

Detail design study is prepared to provide a suitable sewerage system within the airport facility, designed to treat and dispose the sewage generated from domestic, commercial activities and airplane lavatory within acceptable environmental standards. The sewerage facility other than providing adequate sanitary conditions for the users and occupants of the airport would also prevent water pollution in the surrounding environs.

The planning, more specifically the criteria adopted, is in accordance with the development plan of the airport facilities established for the year 2020.

Design of the system is based on the Japanese Industry Standards and DENR (Department of Environmental and Natural Resources) Administrative Order (35 series of 1992).

5.3.2. Design for Sewage Treatment Plant (STP)

(1) Assumption of Sewage Flow

Sewage quantity is assumed to be equal to the distributed water quantity plus sewage from airplane. Airplane sewage quantity is calculated based on $0.4m^3$ from 1/3 of domestic airplane plus $1.2m^3$ from international airplane.

Table 5.3-1 Projected Design Sewage Flow

Particular	2020	2030	2040
Passenger	1,436,000	1,958,000	2,441,000
Daily Max. Sewage Flow (m^3/day)	400	540	680
Daily Ave. Sewage Flow (m^3/day)	350	470	590
Hourly Max. Sewage Flow (m^3/day) (Hourly: m^3/hr)	875 (36.5 m^3/hr)	1,175 (49.0 m^3/hr)	1,475 (61.5 m^3/hr)

Source: JICA Study Team

(2) Effluent Quality from STP

Although treated water will be discharged to soaking yard, the treated wastewater from the new Bohol Airport STP will be in conformance to Category II Protected Waters (Class SB) so that it will not contaminate the quality of underground water. The appropriate standards set in the DENR DAO 35 were adopted as the treatment objective criteria for the proposed STP. The specific water qualities are shown on Table 5.3-2 considering airplane sewage quality.

Table 5.3-2 Planed Influent Sewage Quality

	Item	Unit	2020	2030	2040
From Airport Facilities	BOD	mg/L	150	150	150
	COD_{Mn}	mg/L	80	80	80
	SS	mg/L	150	150	150
	T-N	mg/L	25	25	25
	T-P	mg/L	3	3	3
	Daily MAX	m^3/d	390	530	660
	Daily AVE	m^3/d	340	460	570
From Airplane	BOD	mg/L	11,000	11,000	11,000
	COD_{Mn}	mg/L	6,500	6,500	6,500
	SS	mg/L	14,000	14,000	14,000
	T-N	mg/L	4,200	4,200	4,200
	T-P	mg/L	480	480	480
	International	Airplane/d	3	9	10
	Domestic	Airplane/d	7	7	8
	Airplane Sewage	m^3/d	6.3	13.7	15.3
Total	BOD	mg/L	350	470	440
	COD_{Mn}	mg/L	200	270	250
	SS	mg/L	400	560	510
	T-N	mg/L	100	150	140
	T-P	mg/L	20	20	20
	Daily MAX	m^3/d	400	540	680
	Daily AVE	m^3/d	350	470	590

Source: JICA Study Team

Design quality is shown in Table 5.3-3 which is conformed to meet required DENR effluent standards. Inflow quality is adopted the quality in 2020, in case of increasing contamination which is assuming in Table 5.3-1 the expansion facility will treat such increasing. Nitrogen and phosphorous will not be treated. Following is shown as design quality.

Table 5.3-3 STP Design Quality

Item	Unit	Design Values		Standard Effluent Values*
		Influent	Effluent	
pH	-	6.0-8.0	6.5-9.0	6.5-9.0
COD_{Mn}	mg/l	200	60	60
Settleable Solids	ml/l	20	0.3	0.3
BOD	mg/l	350	20	30
TSS (SS)	mg/l	400	30	50
Oil and Grease	mg/l	20	5	5
Total Coliform	MPN/100 ml	5×10^7	3,000	3,000

* DENR Administrative Order 35 series of 1992 (Class SB Waters)

(3) Recommended Sewage Treatment Method

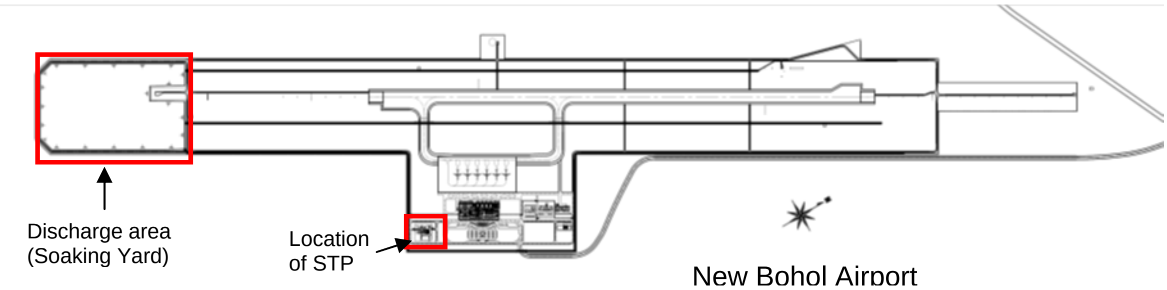
The most appropriate treatment systems must be able to produce an effluent that meets the required discharge standards shown in Table 5.3-3, and must be cost-efficient with minimal operational and maintenance requirements. In consideration of the aforementioned factors, Oxidation Ditch Process (OD) shall be chosen.

(4) Location of Sewage Treatment Plant

The STP's location was determined guided by the following conditions:

- ✓ Land availability for possible expansion of the plant.
- ✓ Most appropriate site where sewage can be collected by gravity flow as well as its proximity to discharge area (soaking yard) of the treated effluent.
- ✓ Minimum effect on the surrounding area in terms of odor nuisance
- ✓ Will not disrupt aircraft activities

According to above criteria the location will be recommended as shown in Fig 5.3-1. Considering future expansion of the STP required land area is about 5,500m^2.

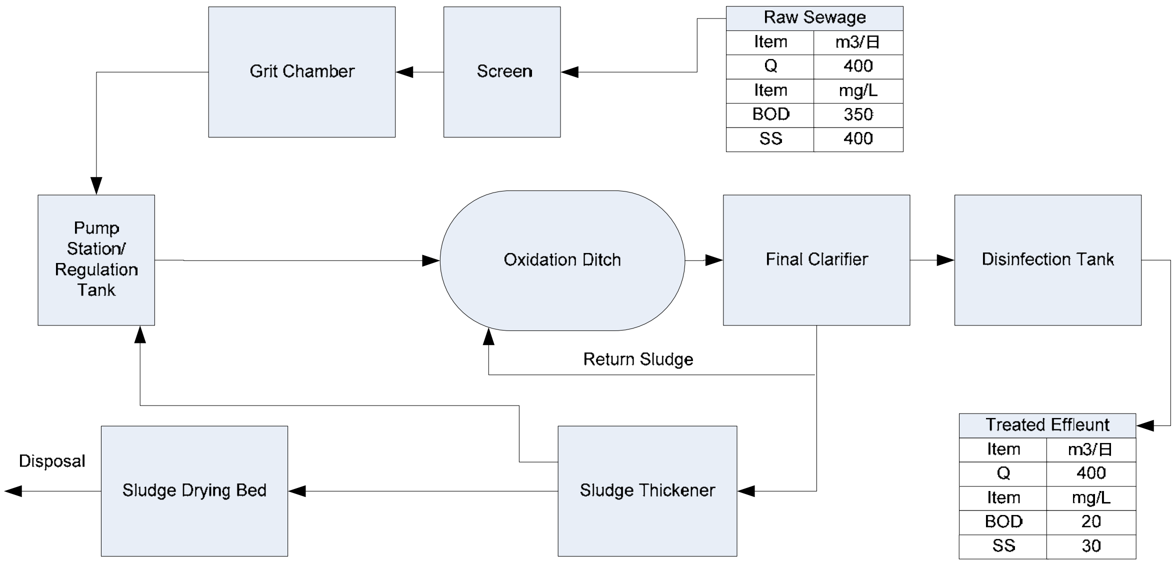


Source: JICA Study Team

Figure 5.3-1 Location of STP

(5) General Outline of STP

The treatment strategy is shown in Table 5.3-7 and treatment flow chart is shown in Fig 5.3-2.



Source: JICA Study Team

Figure 5.3-2 STP Process Flow Diagram

Followings are explanation for each facility shown in above process flow.

- **<u>Screen</u>**

To remove solid waste which cannot be lifted by pump, mechanical screen with 15 mm slit will be installed. Considering easy maintenance removed garbage fall dawn into cage automatically. Manual bar screen with 15 mm slit will be installed in future trench.

- **<u>Grit Chamber</u>**

Grit Chamber can remove comparatively heavy material such as sand. Such removed material will settle in the pit. Due to separate sewer system in the airport, such heavy material should be little quantity in the sewer system therefore the grit will be removed by vacuum car a few times a year.

Airplane sewage is collected by lavatory service car and put into the automatically drum screen located side by grit chamber, sewage after treated by screen get into grit chamber by gravity.

- **<u>Pump/Regulation Tank</u>**

Inflow fluctuation will be big due to crowded airplane's arrival and departure, the pump pit capacity should be more than 8 hours retention time to regulate inflow fluctuation. Sewage pump will be non-clogging type submergible pump.

- **<u>Oxidation Ditch</u>**

Retention time of oxidation ditch is 24 hours in order to handle shock load. Tank has 2.5 m water depth and slanting screw type aerator will be installed. Due to high concentration pollution of sewage return sludge ration is about 50% for usual operation.

- **<u>Final Clarifier</u>**

Final clarifier is circle shape type and centre driven sludge scraper will be installed. Scam floating in the final clarifier is collected by scam skimmer and transferred to the grit chamber by scam pump.

- **Disinfection Tank**

  Hypochlorite calcium solution will be dosed to disinfect the treated water. A treated water tank will be constructed at the end of disinfection tank to keep treated water for watering to the tree and grass in the airport.

- **Sludge Thickener**

  To get more concentration of SS, excess sludge will be sent to sludge thickener. The capacity of the tank for excess sludge generated in one day, thickened sludge is transferred to sludge drying bed once a day.

- **Sludge Drying Bed**

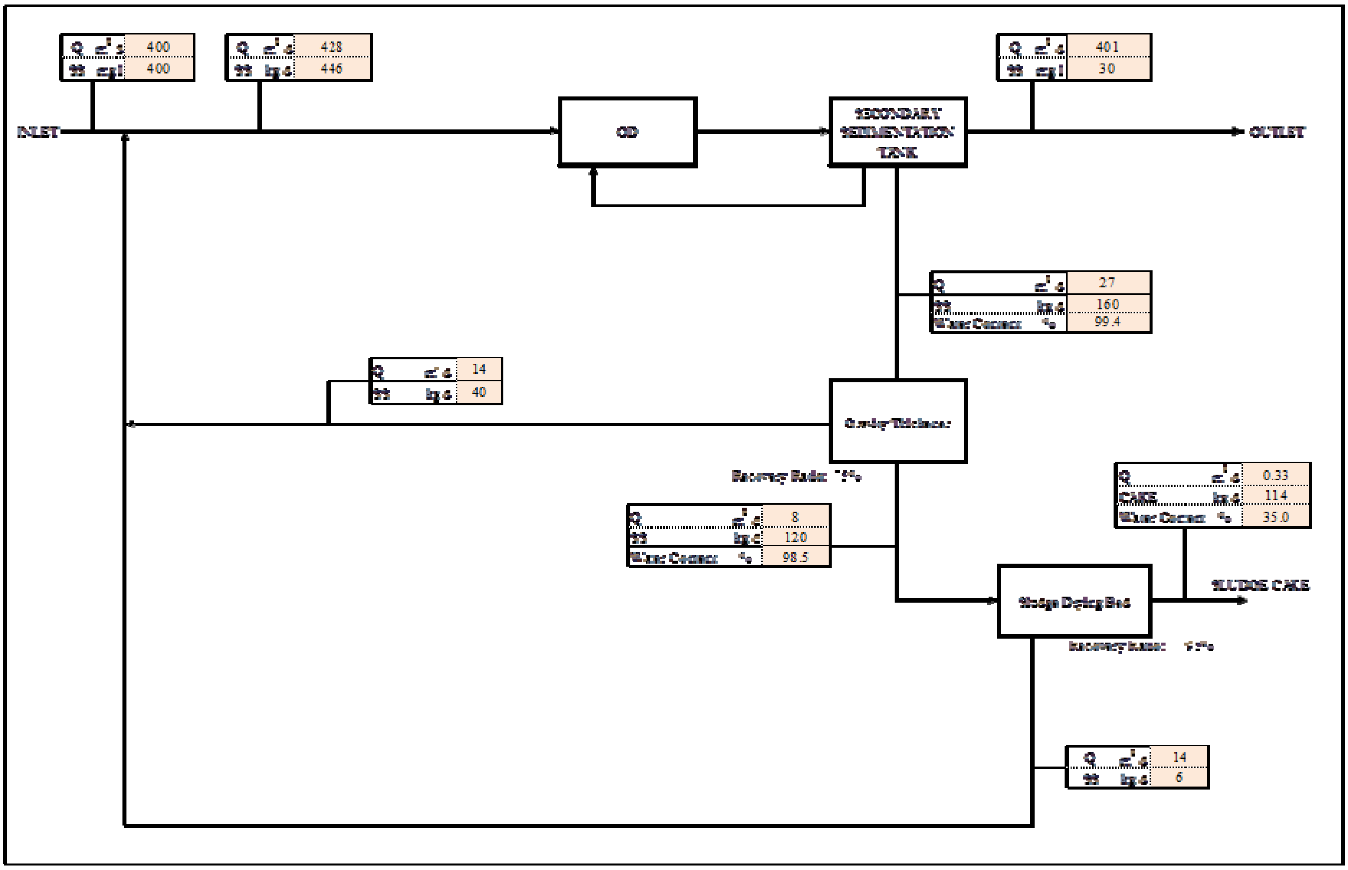
  Thickened sludge will be dried until about 65% water content in 20 days at the sludge drying bed. And one bed is for generated thickened sludge in one day. Dried sludge is utilized for planting tree in the airport.

(6) Mass-Balance Calculation

The following values were assumed in the mass-balance calculation:

SS Removal Gross Yield Coefficient:	0.75
Excess Sludge SS Concentration:	6,000 mg/l
Thickened Sludge Concentration:	15,000 mg/l
Dried Sludge Cake water contents:	35%

The following Mass-balance sheet shows mass-balance in the plant



Source: JICA Study Team

Figure 5.3-3 Mass-Balance Sheet

(7) Establishment of Tank Dimensions

Design guideline for sewage system in 2009 was used for the establishment of the volume of each facility. The adopted value and the corresponding required tank volumes are presented in Table 5.3-4.

Table 5.3-4 Design Value of Necessary Volume of Tanks

Facility		Unit	Guideline	Adopted
Grit Chamber	Surface load	m^3/m^2/day	1,800	1,800
	Settlement time	seconds	45	45
Pump well (Regulation tank)	Settlement time	minutes	-	480
OD	Retention time	Hours	24～36	24
Final Clarifier	Retention time	Hours	4	4
	Surface load	m^3/ m^2/day	8～12	8
	Weir load	m^3/ m/day	50	50
Disinfection tank	Contact time	minutes	15	15
Sludge thickener	Depth	m	3～4	3.5
	Sludge load	kg/ m^2/day	60	60
Sludge Drying Bed	Drying time	days	20～30	20

Source: JICA Study Team

The oxidation ditch and the final clarifiers which functions as a set are usually divided into several systems for operations and maintenance purposes as well as safety. The recommended tank dimensions and the operation room requirements are presented in Table 5.3-5.

Table 5.3-5 Recommended Tank Dimensions

No	Facility		Actual Capacity		Dimensions	Guideline
1	Grit Chamber		1,417	m^3/m^2/day	W0.7m×L1.5 m×H0.8m ×2 Chamber	<1,800 m^3/m^2/day
2	Pump Pit		126	m^3	W6m×L6 m×H3.5m	-
3	OD		408	m^3	Ellipse shape：W2.4m×L34 m×H2.5m×2tanks	HRT=24~36 hour
			24	hour		
4	Final Clarifier	Depth	3.5	m	Circle shape：Dia 6m Depth3.5m ×2Units	3～4m
		Surface Load	7	m^3/m^2/day		8～12 m^3/m^2/day
5	Disinfection Tank		30	min	W1.4m×L6 m×H2m	15min<
6	Sludge Thickener	Sludge Load	55	kg/m^2/day	Rectangular：W1.7m×L1.7m H3.5m×1Tank	<60 kg/m^2/day
7	Sludge Drying Bed		5	kg/m^2	W3m×L8m ×20Beds	<5kg/m^2

Source: JICA Study Team

(8) Main Mechanical Equipment List

Main mechanical equipment is shown in Table 5.3-6.

Table 5.3-6 Equipment Specifications

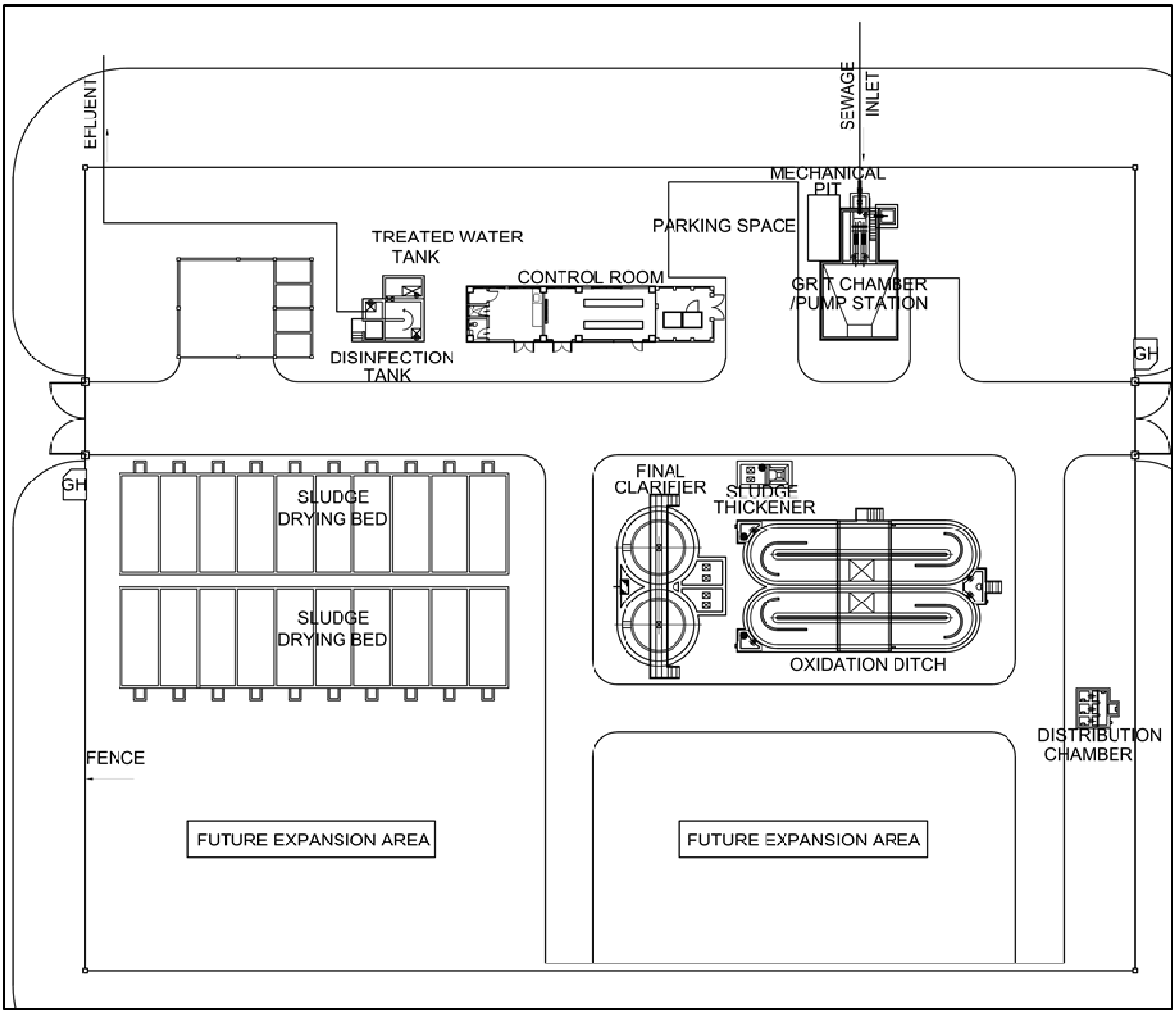
No.	1	2	3
Item	Inflow Valve	Mechanical Screen	Mechanical Screen for Plane
Type	Manual gate valve	Belt traveling automatic screen	Automatic Drum Screen
Specification	φ 200mm	width：380mm slit : 15mm 0.025kw	1.3m3/min×2.2kw slit : Corse70mm fine5mm
Number	1	1	2
No.	**4**	**5**	**6**
Item	Hoist Block for Screen	Main Pump	Hoist Block for Pump
Type	Manual chain block with geared trolley	Submergible sewage pump	Manual chain block with geared trolley
Specification	1t	φ65mm×0.27m^3/min×11m× 1.5kw	0.5t
Number	1	3 (1) (1*)	1
No.	**7**	**8**	**9**
Item	Agitator	Separation Gate at Pump Well	Distribution Weir
Type	Submergible mixer	Manual Gate	Manual adjustable weir
Specification	φ 300mm × 1.5kw	200mm × 200mm	W300mm×H300mm
Number	2	1	2
No.	**10**	**11**	**12**
Item	Inlet Distribution Weir	Aerator	Outlet Distribution Weir
Type	Manual adjustable weir	Mechanical screw type	Manual adjustable weir
Specification	W300mm×H300mm	3.7 kW x Air 183m3/hr x 61.5 kg-O2/day	W300mm×H300mm
Number	2	5(1*)	2
No.	**13**	**14**	**15**
Item	Hoist Block for Aerator	Sludge Scraper	Return Sludge Pump
Type	Manual chain block with geared trolley	Center driven clarifier	Submergible sludge pump
Specification	0.5t	φ 6m × H3.5m× 0.4kw	φ65mm×0.28m^3/min×6m× 1.5kw
Number	1	2	3 (1) (1*)
No.	**16**	**17**	**18**
Item	Excess Sludge Pump	Sludge Suction Valve	Treated water recycling
Type	Submergible sludge pump	Manual non-clogging valve	Water supply unit
Specification	φ65mm×0.17m^3/min×5m× 1.5kw	φ150mm	Submergible Pump 50mm 0.28m3/min×30m×3.7kw Pressure Tank
Number	3(1) (1*)	2	1
No.	**19**	**20**	**21**
Item	Inlet gate for Treated water tank	Sodium Hypochlorite Tank	Hypochlorite Dosing Pump
Type	Manual Gate	Polyethylene tank with dosing pump	Diaphragm Pump
Specification	500mm×500mm	0.5m3	12.5～50ml/min×0.2kw
Number	2	2(1)	2(1)
No.	**22**	**23**	**24**
Item	Sludge Suction Valve	Sludge Transfer Pump	Hoist Block for Cage of Scum
Type	Motorized non-clogging valve	Submergible sludge pump	Manual chain block with geared trolley
Specification	φ150mm× 0.4kw	φ65mm×0.17m^3/分×4m× 1.5kw	0.5t
Number	1	3(1) (1*)	1

( ): stand-by unit *: spare kept in the store room

Source: JICA Study Team

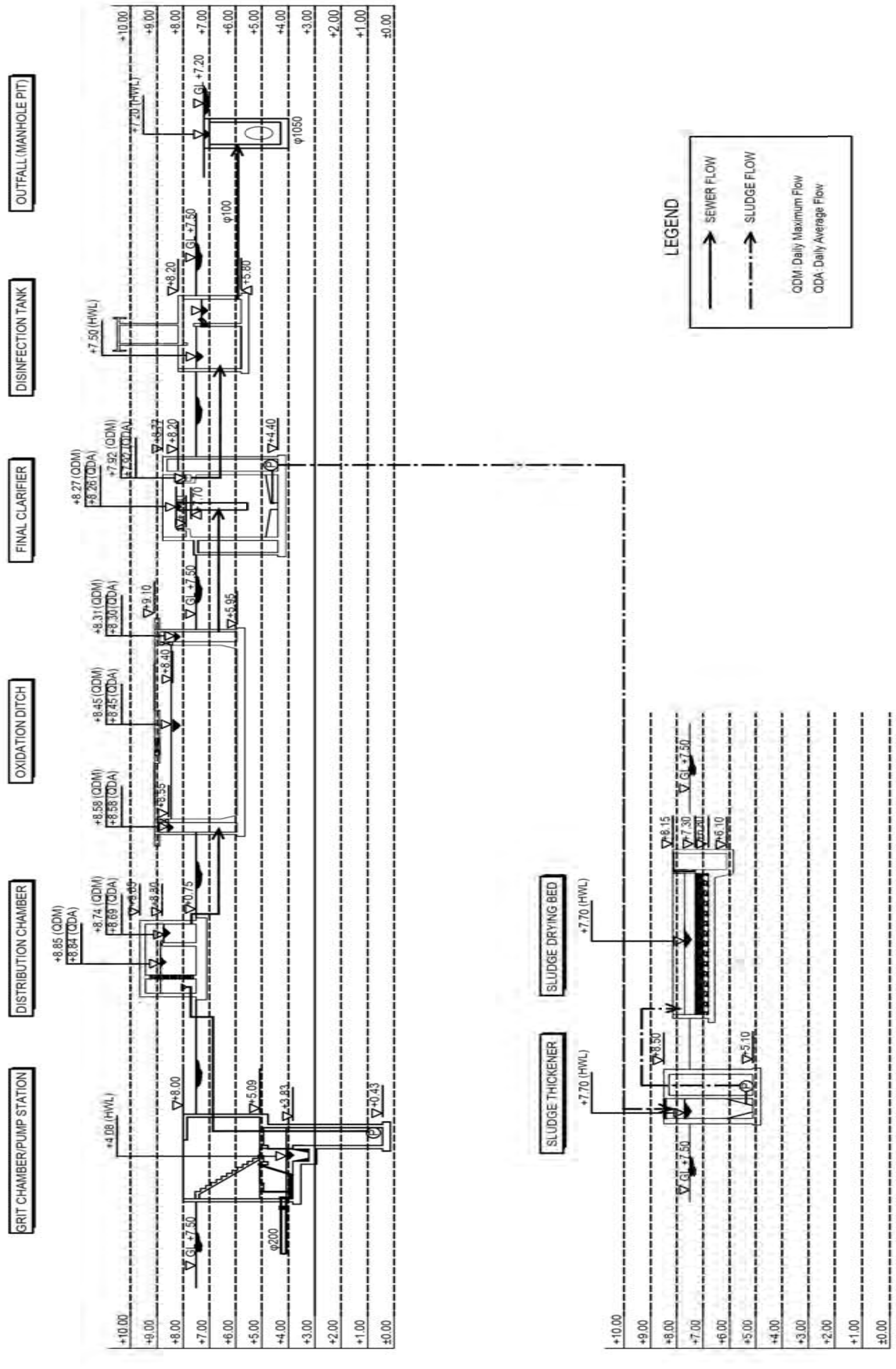
(9) Layout Plan and Hydraulic Profile

Layout plan is shown in Fig.5.3-4 and hydraulic profile is shown in Fig 5.3-5.



Source: JICA Study Team

Figure 5.3-4 STP Layout Plan



Source: JICA Study Team

Figure 5.3-5 STP Hydraulic Profile

(10) Structural Calculation

Structural calculation was carried out according to “National Structural Code of The Philippines (NSCP)”

Condition of structural calculation is as follows;

Concrete strength: 280 kgf/cm^2

Reinforcement Bar tensile strength: 276 MPa (Less than or equal16mm diameter)

414 MPa (More than 16mm diameter)

Soil bearing capacity: 25 t/m^2

Live load: Pump Floor Area 0.5 kN/m^2

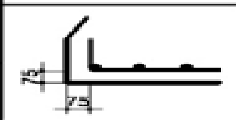
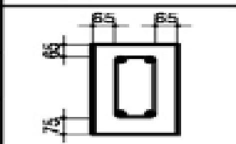
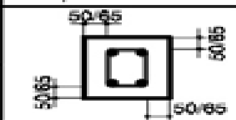
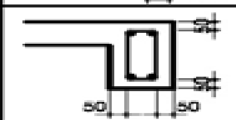
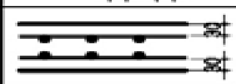
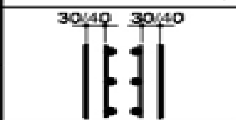
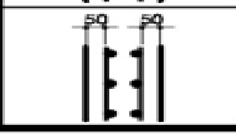
Storage Floor Area 1.0 kN/m^2

Platforms and Walkways 0.5 kN/m^2

Seismic load and wind load are considered according to NSCP standard.

Although the groundwater is not found during soil investigation, considering the case of rain water coming into an excavation area, uplift force was checked.

Concrete cover is as follow;

MEMBER	LOCATION OR CONDITION	MINIMUM CONCRETE COVER (mm)	FIGURE
FOOTING/ FOUNDATION SLAB	SIDE	75	
	BOTTOM	75	
FOOTING TIE BEAM	TOP	65	
	SIDE	65	
	BOTTOM	75	
COLUMN	ABOVE GROUND LEVEL	50	
	BELOW GROUND LEVEL	65	
BEAM		50	
SUSPENDED SLAB AND STAIR	TOP & BOTTOM	30*	
WALL	STRUCTURAL WALL (DRY CONDITION)	40	
	NON STRUCTURAL WALL (DRY CONDITION)	30	
	FORMED CONCRETE SURFACES EXPOSED TO EARTH, WATER, SEWAGE, WEATHER OR IN CONTACT WITH GROUND	50	

Source: JICA Study Team

5.3.3. Sewage Collection System Design

(1) Basic Consideration and Design Criteria

The following are the basic conditions for the planning of the sewer system:

- ✓ The gravity type sewer shall be employed in principle wherein the earth cover of the sewer line shall be a minimum of 1.0m.
- ✓ Pipe material shall be PVC to be placed on coarse sand bedding.
- ✓ The allowance of flow rate to determine the pipe diameter shall be 100% of hourly maximum design flow for the pipe.

Table 5.3-7 Hydraulic Calculations

Parameters	Formula/Value
Manning formula is used for sewer pipe sizing:	$v = (l/n)\ R^{2/3}\ I^{1/2}$ where, v: velocity of flow (m/s) n: roughness coefficient R: hydraulic radius (m) I: slope n: roughness coefficient for PVC/Plastic pipe = 0.010
Minimum velocity:	0.60 m/sec
Maximum velocity:	3.0 m/sec
Minimum pipe size:	200mm for sewer; 150mm for building service connection

Source: JICA Study Team

Table 5.3-8 Location, Minimum Size, and Maximum Spacing of Manhole

Parameters	Value
Location of Manhole	sewer interconnection, change in horizontal direction, major change in slope, change in pipe size, at horizontal interval
Minimum Size of Manhole	900mm
Manhole Maximum Spacing	50m

Source: JICA Study Team

Table 5.3-9 Minimum Depth of Cover and Alignment

Parameters	Value
Minimum Depth of Cover	Under the road: 1.0 m Under footway or green space 0.6m
Alignment	Laid with a straight alignment between manholes.

Source: JICA Study Team

(2) Determination of Main Sewer Route and Profile

- <u>Pipe Diameter and Gradient</u>

A 200 mm diameter PVC pipe is decided to be utilized. Minimum slope shall be 0.4%. The calculated sewer flow in 2020 and 2040 are shown in Table 5.3-10 and Table 5.3-11.

Table5.3-10 Flow Calculation（2020）

Start	End	Pipe Dia (mm)	Length (m)	Flow (m³/min)	Slope (m/m)	Velocity (m/s)	Capacity (m³/min)
MH-1	MH-2	200	45	0.195	0.00443	0.60	1.7025
MH-2	MH-3	200	45	0.195	0.00443	0.60	1.7025
MH-3	MH-4	200	45	0.195	0.00443	0.60	1.7025
MH-4	MH-5	200	45	0.195	0.00443	0.60	1.7025
MH-5	MH-6	200	45	0.195	0.00443	0.60	1.7025
MH-6	MH-7	200	45	0.195	0.00443	0.60	1.7025
MH-7	MH-8	200	45	0.487	0.004	0.75	1.618
MH-8	MH-9	200	27	0.487	0.004	0.75	1.618
MH-9	MH-10	200	29.4	0.5842	0.004	0.79	1.618
MH-10	MH-11	200	45	0.5842	0.004	0.79	1.618
MH-11	MH-12	200	45	0.5842	0.004	0.79	1.618
MH-12	MH-13	200	45	0.5842	0.004	0.79	1.618
MH-13	MH-14	200	45	0.5842	0.004	0.79	1.618
MH-14	STP	200	30	0.5842	0.004	0.79	1.618
MH-9b	MH-9a	200	38	0.0972	0.012	0.70	2.8025
MH-9a	MH-9	200	30	0.0972	0.012	0.70	2.8025

Source: JICA Study Team

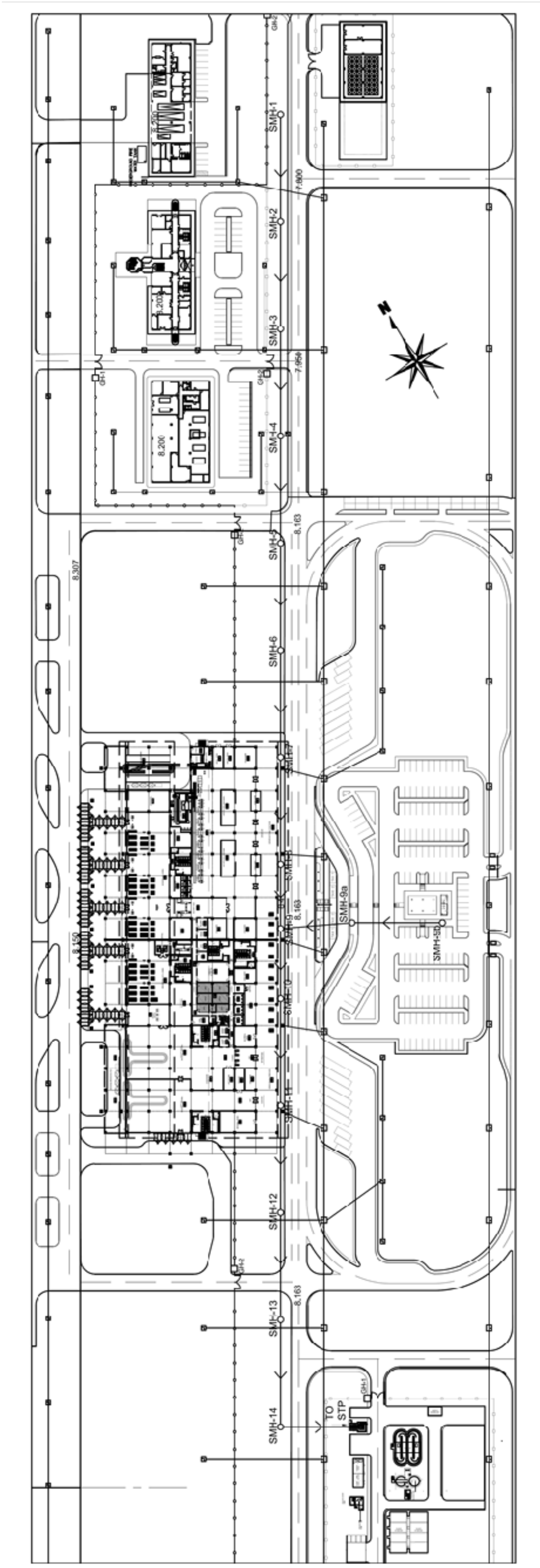
Table 5.3-11 Flow Calculation（2040）

Start	End	Pipe Dia (mm)	Length (m)	Flow (m³/min)	Slope (m/m)	Velocity (m/s)	Capacity (m³/min)
MH-1	MH-2	200	45	0.3282	0.00443	0.70	1.7025
MH-2	MH-3	200	45	0.3282	0.00443	0.70	1.7025
MH-3	MH-4	200	45	0.3282	0.00443	0.70	1.7025
MH-4	MH-5	200	45	0.3282	0.00443	0.70	1.7025
MH-5	MH-6	200	45	0.3282	0.00443	0.70	1.7025
MH-6	MH-7	200	45	0.3282	0.00443	0.70	1.7025
MH-7	MH-8	200	45	0.8197	0.004	0.86	1.618
MH-8	MH-9	200	27	0.8197	0.004	0.86	1.618
MH-9	MH-10	200	29.4	0.9833	0.004	0.90	1.618
MH-10	MH-11	200	45	0.9833	0.004	0.90	1.618
MH-11	MH-12	200	45	0.9833	0.004	0.9	1.618
MH-12	MH-13	200	45	0.9833	0.004	0.9	1.618
MH-13	MH-14	200	45	0.9833	0.004	0.9	1.618
MH-14	STP	200	30	0.9833	0.004	0.9	1.618
MH-9b	MH-9a	200	38	0.1636	0.012	0.81	2.8025
MH-9a	MH-9	200	30	0.1636	0.012	0.81	2.8025

Source: JICA Study Team

Results of the calculation shows the sewer flow velocity is more than 0.6 m/s in 2020 and capacity is enough in 2040 with 200 mm diameter PVC pipe. Therefore 200 mm PVC pipe shall be adopted.

Sewer pipe plan drawing is shown as below.



Source: JICA Study Team

Figure 5.3-6 Sewer Pipe Plan Drawing

CHAPTER 6

DESIGN OF BUILDING WORKS

TABLE OF CONTENTS

Chapter 6 Design of Building Works

For the purpose of ease of reference, the building works under the project are classified into the following 7 Subcomponents, some of which are further classified into sub-component (small buildings) as shown below:

Subcomponent B1:	Passenger Terminal Building (PTB)
Subcomponent B2:	(Not used)
Subcomponent B3:	Control Tower, ATC Operation and Administration Building (CTO)
Subcomponent B4:	Fire Station and Airport Maintenance Building (FSM)
Subcomponent B5:	Ancillary Buildings (ACB)
	B51: Drivers Lounge (DRL)
	B52: Car Parks Toilet (CPT)
	B53: Guard House (GDH)
	B54: Toll Booths (TLB)
Subcomponent B6:	Utility Buildings (ULB)
	B61: Water Tank & Pump Houses (WPH)
	B62: Power Houses (PWH)
	B63: STP Control Room (STP)
	B64: Material Recover Facility (MRF)
Subcomponent B7	Navaids Buildings (NAV)
	B71: LLZ Building (LLZ)
	B72: GS Building (GSB)
	B73: VOR Building (VOR)

6.1. Passenger Terminal Building (Subcomponent B1)

6.1.1. Architectural Works

(1) Design Targets and Facility Requirement

Facility requirements of PTB were calculated based on the estimated peak-hour passenger movements as well as IATA design standards in year 2020 (1st Phase). Detailed facility requirements of the passenger terminal building have been computed as shown in Table 6.1-1.

Table 6.1-1 Floor Area Summary of Passenger Terminal Building

Item	Floor Area (m^2)
Check-in Hall	1,593.88
Central Security Check	153.84
Staff Security Check	98.69
In-Line Security Check	158.68
Passport Control (Dep. for International PAX)	56.03
Domestic Gate Lounge	949.17
International Gate Lounge	420.67
Passport Control (Arr. for International PAX)	176.78
International Baggage Claim Area	596.31
Custom Control	238.02
Domestic Baggage Claim Area & Arrival Lobby	834.77
Office (incl. CIQ Office)	630.66
Concession (incl. Duty Free Shops & Service Counter)	981.90
Toilets	514.02
Technical Premises (incl. Ramp Accom. BHS In-line Screening, FOBS)	566.31
Circulation	192.80
Total Net Floor Area (m2)	**7,943.96**
Total Gross Floor Area (m2)	**8,281.26**
Covered Area (Arrival Public Concourse, Baggage Make-up/ Breakdown, Lobby, Int. Bus Arr. Canopy, Ext. Walkways) (m2)	**3,508.03**

The passenger terminal building concept also has taken into account the followings:

- Global standards to meet IATA, ICAO and airlines' requirements;
- Provision of simultaneous domestic and international operations;
- Highest security;
- Barrier free (Universal Design);
- Easy expansion in future;
- Environment friendly;
- Ease of maintenance; and
- Reasonable construction and low maintenance costs.

(2) Passenger Terminal Building Design Concept

Considering the design targets and facility requirements, the design of the passenger terminal building is based on a single level passenger processing concept. This single level structure allows for maximum smooth simultaneous domestic and international operations.

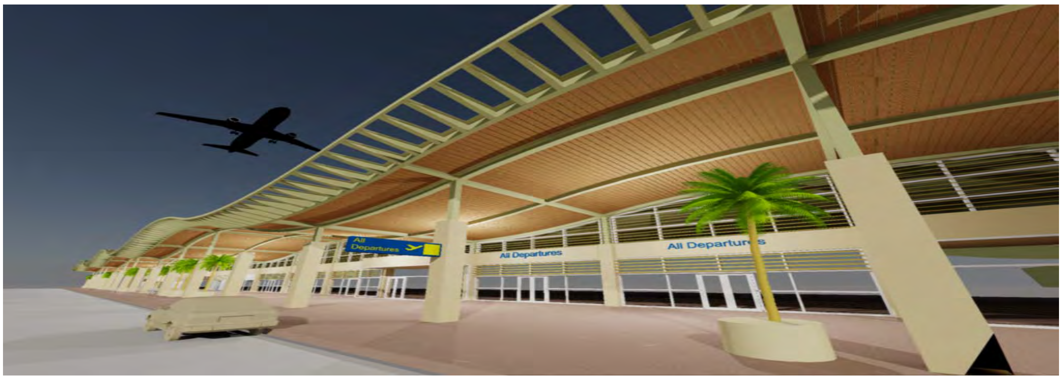
Curb in front Passenger Terminal Building

The single level (ground floor), with a total floor area of 8,281 m^2, houses the combined international and domestic check-in hall, domestic and international pre-departure lounges, offices for direct passenger related services and building management, international and domestic baggage claim areas, airline - and concession spaces including duty free shops for international departures and arrivals. The concessions spaces are a generic term for commercial rental areas which include a smokers lounge and possible CIP lounge, which locations shall be determined during the next study stage.

As the passenger terminal building is predominately handling domestic passengers the whole of the building can operate as a domestic terminal, but in off-peak domestic traffic hours a portion of the building can be dedicated for international passengers. Immigration counters are located in front of a segregated gate lounge and the baggage claim hall is divided into two sections, immigration and customs counters are located along the (international) passenger flow to allow for simultaneous operations.

Even though the baggage claim hall is divided into two separate areas, each for domestic operations and for international operations, at times of sole domestic or sole international operations, the two baggage claim halls can be combined to function as one, thus increasing the capacity of the domestic or international peak.

In front of the terminal building is the departure and arrival public concourse for meeters, greeters and well-wishers. An external shaded area of 1,958 m^2 is provided to cater for the Filipino custom of sending off and welcoming passenger-relatives. This area has access to public toilets and various concessions spaces, including a car rental, a bank, and an airline ticketing office and is directly connected to the passenger terminal curb side and car park area.



Landside Concourse

The passenger process of this single level passenger terminal building is simple and straightforward with minimum walking distance. The check-in hall is open to passengers and their well-wishers. This is a change from the common practice at airports in the Philippines and was newly introduced to the New Bohol Airport during a series of workshop meetings conducted with technical officers of DOTC during the course of March 2013. In the check-in hall the passengers will proceed to their respective check-in counter for handing over their check-in baggage and to obtain their boarding passes. The check-in area should be screened off from the common accessible check-in hall by low partitions, to allow access by passengers only, to avoid crowding in front of the check-in counters.

Check-In Lobby opened for well-wishers

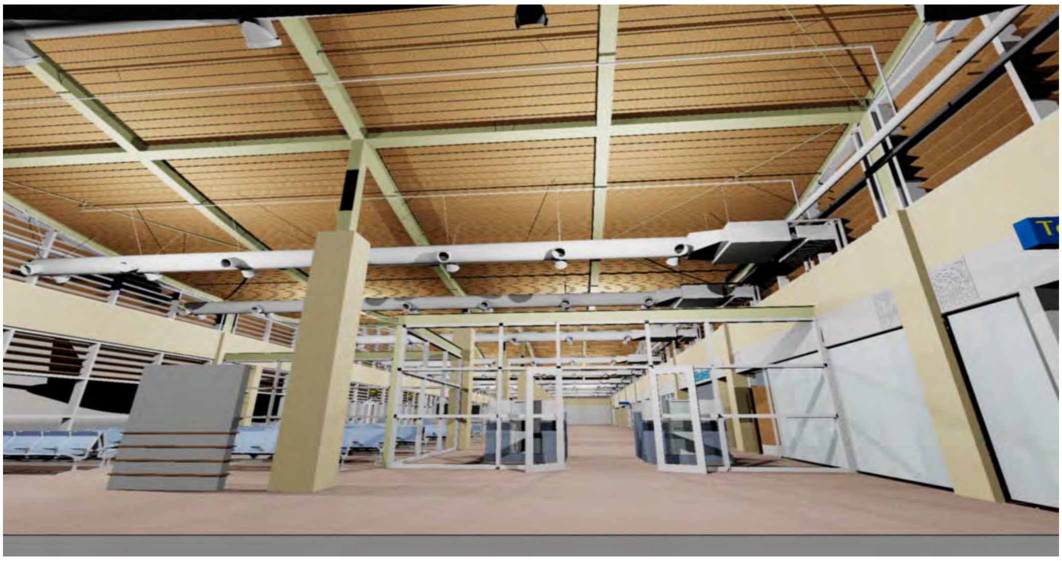
The checked-in baggage will be transported by belt conveyor to the baggage make-up carousel located behind check-in hall. Due to the removal of the initial security at the entrance of the check-in hall, an in-line security check system has become a necessity. An in-line screening facility has been provided behind the check-in counters. This facility is also facing the pre-departure lounge, thus easy access for passenger baggage reconciliation is provided. As well suspected bags can be quickly disposed off, as the in-line screening room provides direct access to the baggage make-up area, which is open to the elements.

The make-up carrousel has a total baggage collection length to accommodate two tugs with each three dollies. The baggage handling make up and breakdown areas are conform to the dimensional requirements as specified in the IATA design manual, for comfortable circulation of the tug and dollies. The baggage make-up area is supported by a changing room and a staff room.

After the passenger has completed his check-in procedure, he will proceed to the pre-departure area. Counters for payment of airport service tax have been omitted as the practice is expected to be obsolete by the time of operation of the new airport. This was also a decision by DOTC during said workshop meetings conduction during the course of March 2013. Prior to entering the pre-departure lounge the passenger will undergo a security check for his hand luggage and body scan. Two central security check points are provided to be shared among the domestic and international passengers. From the pre-departure lounge the waiting passengers will have access to concessions and toilet facilities.

For international flights the passengers are directed to the departure gate lounge on the far left side, prior to entering this area the passengers will submit to emigration counters. The international passengers have access to a large duty free concession and toilet facilities facing their gate lounge.

Domestic Departure Gate Lounge



International Departure Gate Lounge

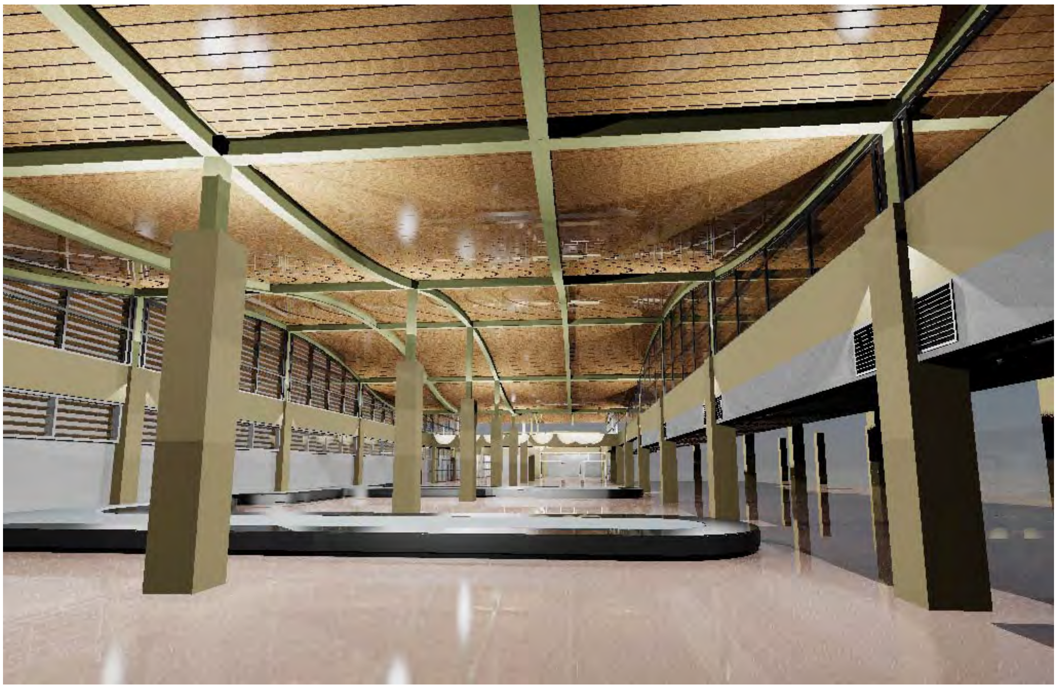
Both domestic passengers and international passengers are transported from their gate lounges to their respective aircraft by ramp bus, prior to exiting the terminal building the passenger will present their boarding pass and passport or identity card prior to boarding their bus.

Ramp Bus Stop

Both domestic and international arriving passengers are transported from their aircraft to their respective baggage claim hall by ramp bus, two separate entrances into the passenger terminal building have been provided. One of the entrances has a large lobby area with immigration counters for international arriving passengers.

Arrival Passengers

At times of simultaneous domestic and international arrivals, the domestic arriving passengers will use the arrival bus gate on the left hand side of the building. Each section of the baggage claim halls is provided with one reclaim conveyor; both sections have access to ample toilet facilities. At peak times the halls can be combined and both reclaim belts can be dedicated to all domestic or international passengers. International passengers have access to a duty free concession on arrivals; prior to exiting the building the international passengers will require a last inspection by the customs department. In the case that domestic passengers use the international departure and arrival areas, duty free concessions there would be closed by shutters.



Arrival Baggage Claim

(3) Facade Design

The external facades of the passenger terminal building, enclosing the forced climate controlled public areas, are mostly glazed areas, usage of heat absorbing glazing and external horizontal louvers ensure that the heat gain and solar glare shall be kept to a minimum. Other areas of the external façades, which enclose areas which are climate controlled by means of natural ventilation, the structure will be of aluminum frames with horizontal louvers and insect screens. If practical and more cost effective the louvers are proposed to be manufactured from timber sections to symbolize the vernacular language of the Province of Bohol. Non-public facility areas such as technical premises, which do not require extensive vision panels or visual interaction with the surrounding, are proposed to be construction from concrete block-work with plaster and paint, plaster control joints are proposed to be executed in a waving pattern, imaging rolling hills and waves, allowing use of color variation in the external plaster/paint.

(4) Universal Design

a) Background

Recently, a good many public areas across the world have been designed as universal design so that it becomes very common for not only aged or handicapped, but also whole users to use public facilities conveniently.

Especially the airport is so integrated such as a traffic and convenience facility, i.e. restaurant, concession or entertainment that many flows are complicated there. Therefore, the airport would be necessary for the passenger to be planed and designed as universal design or improved barrier free design.

b) Principles to Universal Design

New Bohol Airport is to be located in the middle Philippines, 600km far from Manila, capital city, takes 1.5 hours flight. This airport would be used as a base area of transportation for the habitant and also be visited by many foreigners for sightseeing.

This airport shall be requested and designed to be friendly, well-understanding and easy to move where you go for all users, due to various aimed passengers.

In addition above, following laws in the Philippines shall be complied;

- Magna Carta for Disabled Persons (Republic Act No. 7277)
- An Act to Enhance the Mobility of Disabled Persons by Requiring Certain Building, Institutions, Establishments and Public Utilities to Install Facilities and Other Devices (Accessibility Law (Batas Pambansa Bilang 344) and its Amended Implementing Rules and Regulations- Philippines)

c) Realization for Universal Design

Passenger terminal building in new Bohol Airport is designed as one (1) story building for Phase 1, further two (2) stories for Phase 2. When operating in the beginning, passengers move horizontally only, merely 160m, that their movement might be quite short. That is why they could find their way easily without any efforts.

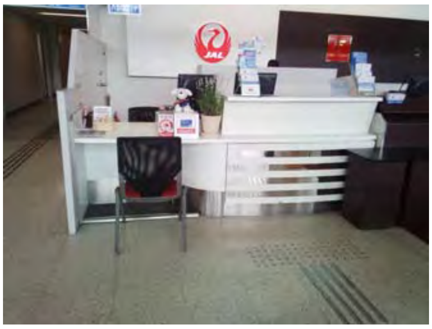
In order to realize the principles of universal design, following items are considered.

d) Slope for the gaps between walkways and road

Two (2) parking lots for handicapped passengers, especially using wheel chairs along Curb Side are to be identically marked, and the gaps between walkways and road are sloped.

e) Check-In Counter for Wheel Chairs

One (1) Check-In Counter is provided for the passenger by using wheel chair whose height shall be adequate for him. However, as same manner as ordinary airports, airlines staff assist him from Check-In Counter to the Gate and/or from Gate to the Curb Side.



f) Specification of Toilet Booth

Folding doors for the booths in the female & male toilets are installed in order to assist the passengers with big hold baggage.

With respect to the multi-purpose toilets, a diaper change shelf is to be provided and entry door shall be slight manual sliding door without user's effort. However, no electrical door is adopted due to the user's privacy.

Folding Doors

Sliding Door (Multi-Purpose Toilet)

In addition above, child's urinal is to be provided in the female toilets due to the convenience for his mother. Furthermore, baby seats are installed in the male and female toilets for their parent's convenience.

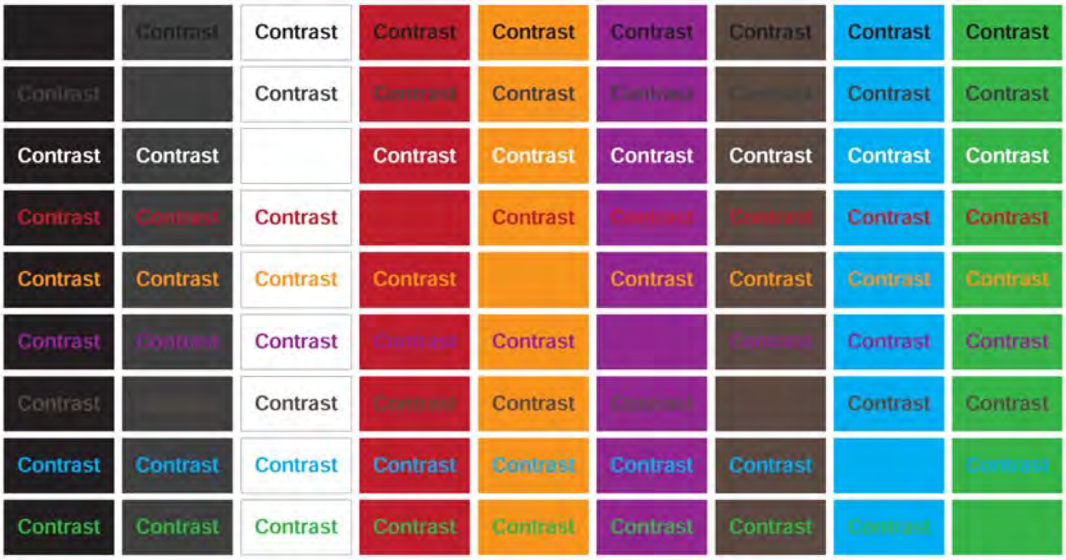
Child Urinal (in Female Toilet)

Baby Seat (Female & Male Toilet)

g) Signage

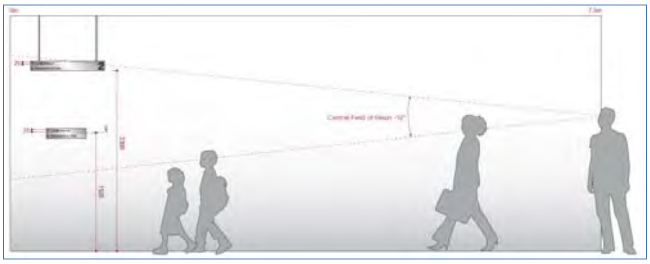
Signage shall be paid special attention to the appearance of well-finding, taking consideration of text size signage color and its contrast especially for a weak eye sight.

Pictograms are to meet the standard defined by EAAA (Eastern Asia Airport Alliance) so that foreigners can identify signage as the easiest.



Color Contrast Chart

Typography



Sign Height 2300 mm, Min. Letter Height 25 mm (at Maxi. Distance 7.5m)

Sign Height 2500 mm, Min. Letter Height 50 mm (at Maxi. Distance 15 m)

h) FIDS（Flight Information Display System）Design

Special attention shall be paid as signage above, the design of FIDS size, color and text size are to be considered for whole passengers who are able to get information easily.

The text order shall be departing time, destination, airlines, and flight number from the left.

i) Improvement of Universal Design

Universal design shall be so improving after starting operation that various needs or social requirement would upgrade the original design like spiral. Final target is more convenient, well-understanding and more easily well-finding based on considering the passengers safety.

It might not be the final goal that huge investments for the facilities or engineering in order to realize universal design in the airport are to be done. The best choice is to head for further users convenience with personal support system and well facilities.

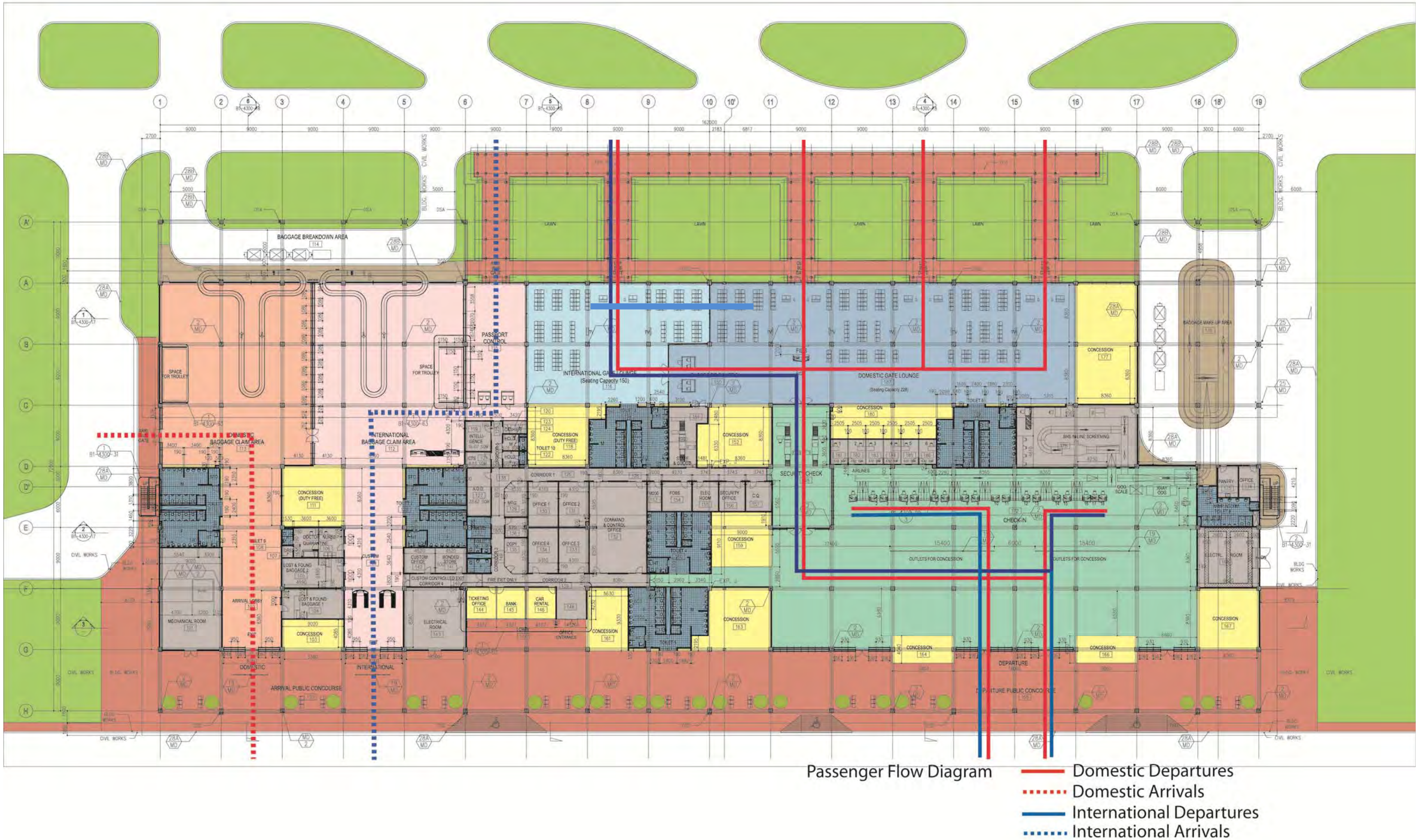
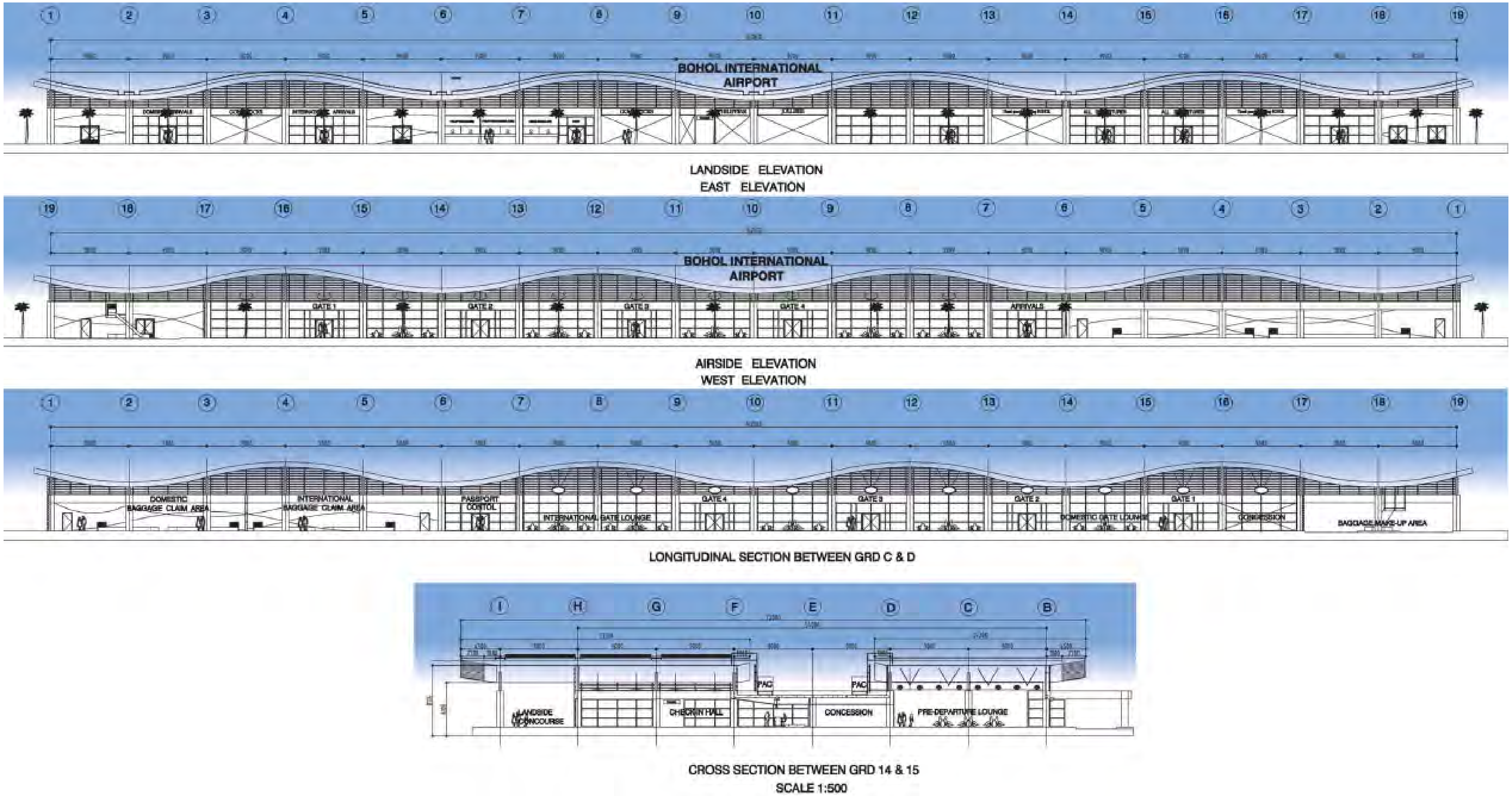


Figure 6.1-1 Ground Floor Plan of Passenger Terminal Building (With Passengers Flow Diagram)



Source: JICA Study Team

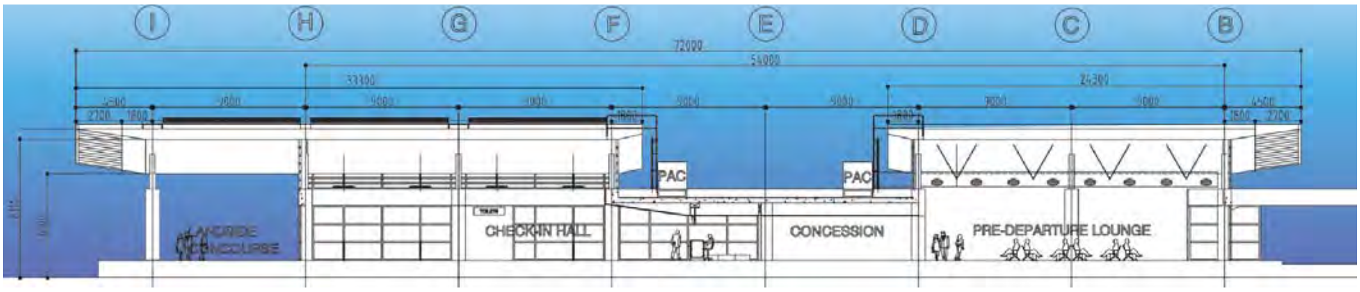
Figure 6.1-2 Airside Elevation of Passenger Terminal Building

(5) Roof Design

The passenger terminal building consists in principle of a simple single story rectangular structure with a modular design of a 9 by 9 meters structural grid, for ease of construction, expansion and economical considerations. A portion of the roof design consists of a multi curve structural steel deck covering the departure lounges, baggage claim halls and check-in hall. This multi curve roof is inspired by the profile of Bohol's chocolate mountains and the structure appears to be floating over the terminal building imitating the "Rolling Waves" surrounding the islands of Bohol and Panglao.

A similar multi curved roof structure covers the landside public concourse areas; this curved roof structure is carried through into the check-in hall providing a seamless integration of exterior and interior spaces.

The multi curved roof structure provides the interior design concept of the building with lofty and natural-lit public spaces for the large public areas such as check-in hall, baggage claim areas and pre-departure lounges. These areas have been designed with approximately 2-level high curved ceilings. The curved roofed areas are divided into two sections, in-between is a single story concrete structure mainly housing the concessions, offices and toilet areas. This single story "sandwich" structure allows for the installation of HVAC systems for selected climate controlled areas and allows for natural lighting and cross ventilation for areas which are not forced climate controlled.



Source: JICA Study Team

Figure 6.1-3 Cross Section of Passenger Terminal Building

(6) Eco-airport

The concept of the building is of a green building incorporating energy saving elements, such as the usage of solar panels, usage of LED lighting fixtures, an energy efficient HVAC system and naturally ventilated for areas with short passenger dwell times. The shape of the building is responsive to accommodate the requirements for a green building and allows for easy future expansion.

A large portion of the roof area is reserved for the installation of solar panels.

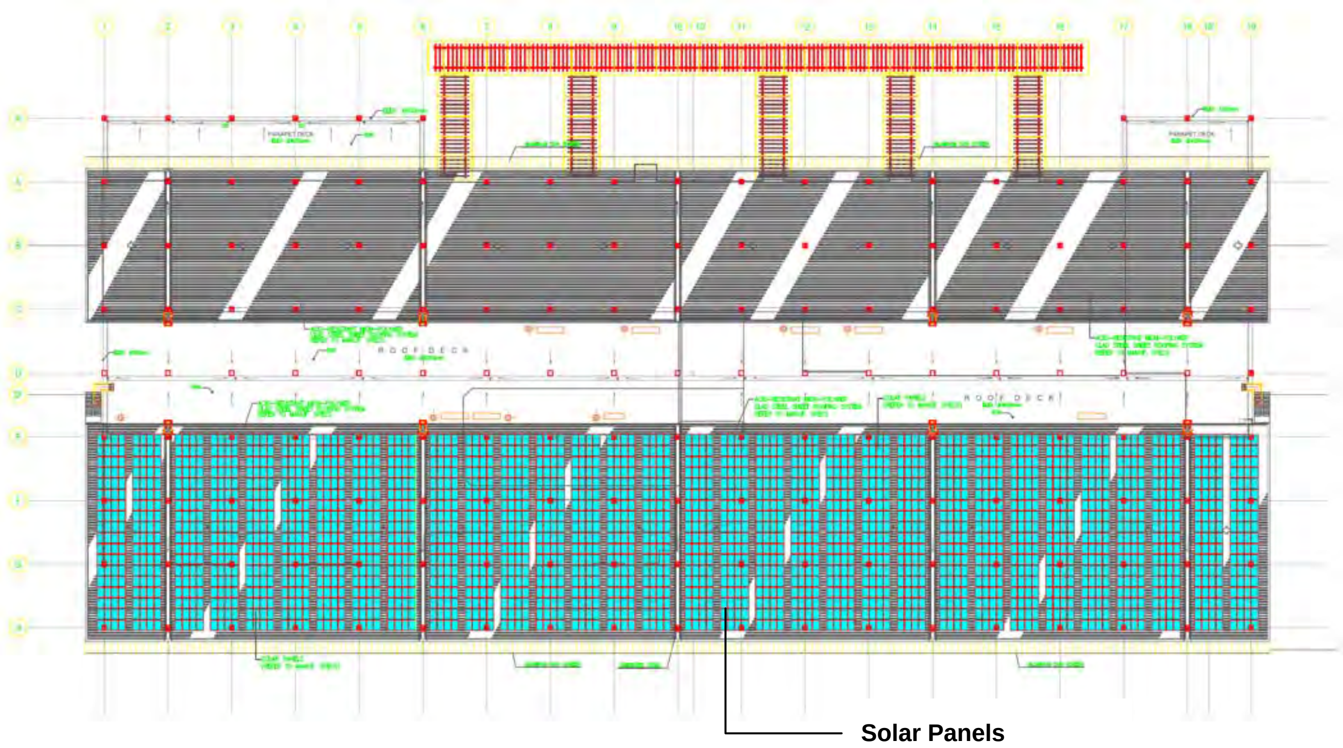


Figure 6.1-4 Roof Plan of Passenger Terminal Building

(7) Special Equipment

The basic requirements of special equipment for Terminal building are the Baggage Handling Systems (BHS), Security Equipment (X-Ray, Metal Detector), Flight Information Display System (FIDS) and Building Management System (BMS).

a) Baggage Handling System

The baggage handling system is provided as follows:

<u>Check-in counter to baggage make-up area:</u>

- Weighing conveyor: twelve (16) units
- Queuing conveyor: twelve (16) units,
- Departing Baggage Belt conveyer of approx. 112-m long
- Departing Baggage Make-up Carousel of 45 m. (total) length: one (1) unit
- Arriving Baggage Claim Carousel of approx. 61-m long: two (2) units

<u>In-Line Checked Baggage Security Equipment</u>

- Multi-view X-ray Explosive Detection System (EDS): one (1)
- Explosive Trace Detector (ETD): one (1)

b) Security System

The security system is provided as follows:

Hold Baggage Security Check Equipment:

- X-ray for Concession goods/foods at (staff) entrance to the pre-departure lounge: one (1)
- X-ray for Oversized baggage with weighing scale in check-in hall to make-up: one (1)
- X-ray for passenger hand luggage at the entrance to the pre-departure lounge: two (2)

Metal detectors:

- For staff at the (staff) entrance to the pre-departure lounge: one (1)
- For staff at the entrance to baggage make-up area (adjacent to the OS X-Ray): one (1)
- For passengers and staff at the entrance to the pre-departure lounge: two (2)

c) Flight information display system

Flight information displays are provided in the following locations:

Table 6.1-2 Location of Flight information display system

Location	Name of device and quantity	
Public concourses (Departure and Arrival)	• Flight Information Display	4
Concession	• Flight Information Display	4
Baggage claim areas	• Flight Information Display	3
Baggage breakdown areas	• Flight Information Display	2
Baggage Make-up area	• Flight Information Display	2
Airline Office	• Flight Information Display	6
BHS Control Room	• Flight Information Display	2
Gate Lounge	• Flight Information Display	1
Gates	• Flight Information Display	4
Check-in counters	• Flight Information Display	18
CCO	• Flight Information Display	2
	• Host processor system	1
	• PC for server system	1

d) Building Management System (BMS)

Building management system is a convenient tool for the end-users to make cost-effective and energy-saving operations and maintenance of the facilities. It will also assist operators and airlines to ensure operational safety and security.

- Remote control and monitoring of ventilation and air conditioning
- Remote control and monitoring of internal/external lighting, including apron floodlights/ road and car park lightings、
- Remote control and monitoring of power supply, generator and UPS
- Monitoring of sanitary equipment
- Monitoring of baggage handling system
- Monitoring of status of solar power generation

6.1.2. Electrical Works

(1) Power Supply Line

The basic design load of the passenger terminal building is 7000 KVA for 230 V, 3 Phase, single phase. Loads for 230 V consist of fresh air handling units, VRF unit, Baggage handling equipment, lighting, receptacle outlets and FCU's. Most of the total design load of the passenger terminal building will be covered by solar power energy if full performance of the photovoltaic panel (480 KVA) is attained. In case of lack of the power supply with a cloudy sky and night time, shall be made up with power from the commercial line. Around 35% of the total design load of the passenger terminal building will be energized by a stand-by generator during normal power failure.

(2) Internal Lights

Types of LED lighting fixtures to be used are as follows:

- LED Base Light Type (Equivalent to Fluorescent Lamps) – for Offices and Baggage Make-up Area and Technical Rooms
- LED Down light Type (Equivalent to Compact Fluorescent / Pin light) – for Toilets, Corridors and Hallways
- LED High Ceiling Type (Equivalent to Metal Halide lamp) – for Public Areas

In order to achieve the reduction of carbon dioxide as an Eco-Airport, sensor switches for toilets shall be installed.

(3) Emergency Light System

This system shall ensure a minimum illumination level and exit signing during total power failure. UPS will be powered during power failure and considered as part of the regular lighting system.

(4) Uninterruptible Power Supply (UPS)

The basic UPS shall consist of the following components:

- Rectifier/Charger
- Batteries
- Solid-State Inverter
- Static Transfer Switch

The UPS will be sized to ensure 30 minutes of supply of the connected load, this period will cover the maximum starting time of the emergency generators.

(5) Telephone and Data System

Telephone and Data System to be used are as follows:

- Private Automatic Branch Exchange (PABX) – for Entire airport facilities
- Main Distribution Frame(s) (MDF) – for Central incoming line
- Telephone Terminal Cabinet (TTC) – for Local incoming line
- Digital Multi-function Handset – for Office
- Cable, Conduit and Outlet for LAN – From CCO Room to Office

(6) Cable TV System

The Cable TV Signal shall be served by the Bohol Cable TV company. Cable TV System to be used is as follows:

- Channel Amplifier Modules – for Entire airport facilities
- TV Outlets – for Public Area
- Recording player – for Entire airport facilities
- Remote Control System – for Entire airport facilities

(7) Fire Alarm System

A microprocessor controlled, addressable, automatic fire alarm system, forming a complete operative and coordinated system will be provided. The system will include alarm-initiating devices, alarm notification appliances, control panels, auxiliary control devices, annunciators, power supplies and wiring.

The main fire alarm control panel will be provided with the following facilities, as a minimum:

- Indication of an activated automatic fire detector giving location and zone.
- Indication of an activated break glass manual call point.
- Fireman's microphone providing remote control of the emergency message unit, forming part of the public address/voice alarm system on a zone by zone basis.
- Fire officers broadcast to any combination of individual zones.

All wiring of the fire alarm system will be carried out using cables which are capable of maintaining circuit integrity for a prolonged period under fire conditions.

(8) Public Address System

The public address system shall be used to make flight information announcements and background music to passengers and staffs. In the passenger terminal building (PTB) and the concourse complex, the system shall be used as Flight Information Announcement System, i.e. the system shall provide boarding status, flight delays/cancellation and other relevant information. Besides the flight information announcements, it shall also provide the background music to selected areas.

The system also shall be used as a part of the evacuation systems. When an emergency situation occurs, the system shall broadcast necessary announcements to people to evacuate from the area.

(9) Master Clock System

Time signal is generated master clock system at control tower building which shall be distributed to each clock at the passenger terminal building.

Master clock system to be used is as follows:

- Digital Clocks

(10) Closed Circuit Television (CCTV) System

Monitoring the operation and use of the CCTV's will be handled under the centralized management at the command and control office (CCO) at the passenger terminal building.

Equipment with all cabling and conduits will be provided as follows:

- Color cameras (rotary, zoom type)
- Monitor control panels (color monitor)

6.1.3. Mechanical Works

Mechanical works are planned to be design according to the following concepts.

- Mechanical systems shall be safe and reliable.
- Operation and maintenance works shall be easily and safely done.
- Major equipment shall be duplicated for maintenance and emergency cases. Important equipment shall have its reserved one.
- Energy saving technology shall be adopted to match Eco-airport concept.

(1) Plumbing

a) Cold Water Supply System

Cold water shall be distributed from water pump house (WPH) to the passenger terminal building (PTB) by water supply pumps which shall consist of two duty pumps and one standby pump.

Both pumps and tanks shall be provided with automatic controls and monitoring system through the building management system (BMS).

b) Hot Water Supply System

Hot water supply to showers are given by solar water-heater in the passenger terminal building

c) Sewage Drainage and Vent System

Sewage Drainage

Sewage shall, in principle, be drained by gravity; however, the following drainage shall be lifted up by drainage pump:

- The section of external drainage pipes where it is difficult to keep the minimum inclination of the pipe.
- Drainage from underground levels.

Sewage drainage shall not be allowed to use for storm water drainage under any circumstance. Exclusive pipe and grease interceptors shall be installed for sewage from kitchens to prevent that grease fills the pipe and flows in the sewage treatment plant (STP).

Vent System

Water traps shall be used to prevent bad smell to escape or insects to enter the drainage pipes. Sewage flow increases the internal pressure of the sewage pipes. Vent pipes shall be connected to the drainage pipe to stabilize internal pressure of the pipe, to prevent blockage or breakage of the water trap-seal.

d) Storm Water Drainage

Storm drainage pipes shall be installed from the roof drainage (architectural works) to the outside of the building. External drainage piping shall be included in the civil works. Storm water shall be collected at the storm pits and shall be drained to the storm water drainage main. Condensation drains from the air conditioning system shall also be drained to the storm water pits.

(2) Air Conditioning

a) VRF (Variable Refrigerant Flow) Outdoor Unit

VRF outdoor units shall be located on the roof level and will consist of compressor, fan, condenser and other accessory.

VRF system shall facilitate more efficient, energy-saving, easy operation and maintenance. Refrigerant type used in VRF unit shall be R401.

Design Temperature

Outside Air	Designed Internal Temperature
35 DB	24±1 DB (target)
27.2 WB	45~ 55%

A rough estimation of cooling capacity for VRF system is as follows.

- Total cooling capacity = Air Conditioned Area 3,700m^2 x 225 kcal/m^{2}h = 832,500 kcal/h =968 kW/h =275 USRt/h
- VRF 121kw/h (=34.4 USRt/h) type x (8) units are required.

If cooling capacity lacks, to adjust the temperature of some air conditioning areas, or to cut off some unimportant air conditioning area is required.

b) VRF (Variable Refrigerant Flow) Indoor unit (FCU)

VRF Indoor unit (FCU) shall be used to departure gate lounge, departure passport control, security check, CCO, office, ramp ACCOM and some gates.

Conditioned air shall be distributed through air ducts or direct airflow (cassette type) and shall be in locations to suite airflow patterns. Architectural aesthetics shall be also considered in the design of exposed air duct and air outlets, etc. The indoor units (FCU) shall also be used for electrical rooms such as computer room etc.; in this case the FCUs shall be carefully located to avoid the possibility of damage due to possible water leakage.

Ceiling cassette indoor units can be considered for effective supply air distribution, better aesthetic quality and convenient temperature control.

c) Fresh Air Handling Unit (FAHU)

The fresh air handling unit (FAHU) shall be consists of fan, pre-filter, bag-filter and other accessories. FAHU shall operate with 100% of fresh air and fresh air shall be supplied to no air-conditioned area and air-conditioned area (VRF indoor units).

(3) Ventilation System

a) Toilet

All toilets shall be mechanically ventilated by the exhaust fan and internal space shall be maintained in negative pressure to avoid foul odor. The exhaust air inlet shall be installed at the ceiling above the water closets and urinals. Supply air for toilets shall enter through the door louvers, or via an under-cut of the doors.

b) Machine Rooms and Electrical Rooms

A cross airflow shall be formed by supply fans and exhaust fans for machine rooms and electrical rooms such as generator room, MV-LV electrical rooms, transformer rooms, etc. The supply and exhaust fans shall be controlled by thermostat switches to keep the room temperature.

c) Fresh Air

Fresh air shall be introduced to each room through air ducts.

For the make-up air, door louvers and door undercuts shall be provided for the entry of fresh air.

(4) Automatic Control System

The automatic control and monitoring dedicated to the air conditioning and ventilation system is integrated into the building management system (BMS).

The main air conditioning and ventilation equipment, except small equipment such as small fans or air cleaners, shall be operated at their respective motor control panel. An auto/off/manual selector switch shall be provided at the motor control panel. In the "auto" position, the equipment shall start and stop via the BMS. All equipment shall stop (in manual or auto mode) when the fire alarm system is activated. The necessary interface is part of the Fire Alarm and Detection System (FADS).

The room temperature, external air temperature and humidity, On/Off status and alarm status of main equipment, etc. shall all be monitored by the BMS.

All air conditioning and ventilation system's main control panels or main equipment shall be equipped with built-in programmable logic controller (PLC) allowing direct interface with the BMS. Such PLC shall receive a separated power supply ensured by UPS (part of Power Supply Section). The interface between the various PLCs shall be included in the BMS section.

(5) Fire Fighting

a) Water Supply

The water supply for the firefighting shall be fed from the site common water storage tank for general water usage and firefighting, which has one hour firefighting water storage permanently, located at the water tank and pump house.

The system shall be provided with its own fire pumps set consisting of;

- One (1) motor driven duty pump
- One (1) stand – by pump, driven by a diesel engine
- Two (2) motor driven jockey pumps, stand-by and duty

The independent firefighting water reserve capacity shall be capable of supplying water for the sprinklers, wet standpipes, and hose requirements. The design capacity of the fire reserve tank shall be dependent on the required flow – rate of the pump and must be able to feed the system for not less than one hour duration.

The control system is to be arranged so that when the pressure level drops below the preset pressure (activation of sprinklers or opening of the stand pipe system) the controller is to activate the pumps to provide the required water to the firefighting system.

b) Sprinkler System

The Sprinkler System is an integrated system of underground and overhead piping, designed in accordance with NFPA 13 standard.

The portion of the sprinkler system above ground is a network of hydraulically designed overhead piping, to which sprinklers are attached in a systematic pattern.

There shall be two (2) sprinkler risers located in both side of passenger terminal building. These sprinkler risers shall serve ground floor and roof deck level. Stand hose pipes and fire hose cabinets are integrated to these risers.

In accordance with NFPA 13, all areas with suspended ceilings shall be provided with pendent type sprinklers while areas with no ceiling shall be provided with upright sprinklers.

c) Stand Hose Pipe Connection and Fire Hose Cabinet System

The design of the Standpipe System shall be governed by the building height, floor area, occupancy classification, egress system design, required flow rate and residual pressure, and the distance of the hose connection from the source water supply where located at the Pump House.

Fire hose cabinets are provided throughout the entire passenger terminal building and are interconnected with the sprinkler system.

The fire hose cabinets shall be of class III system, having a 40 mm diameter for occupants use and a 65 mm diameter hose valves for fireman’s use.

Fire hose cabinets shall be located not more than 60 m travel distance and the hose nozzle shall be able to be taken into every room and within 6 meters of every part of a room.

d) External Fire Hydrant System

Fire hydrants shall be provided on both the ramp and street sides of the terminal building. The Fire hydrants are strategically located around the perimeter of the building, to provide protection to the structure from potential exposure to fires.

Hydrants shall be provided in sufficient number and be located in a manner that shall enable the needed flow to be delivered through hose lines to all exterior sides of the terminal building and other areas (around 500-800ft.) within 150m each to be protected.

The hydrants shall have a 65 mm diameter x 3 way outlet connection.

A 65 mm diameter x 45 m (150 ft.) double jacketed house shall be stored inside the hose cabinet that near each hydrant for ready accessibility, including a special wrench, a fire extinguisher.

As a primary mean to supply water to the system, a Fire Department Inlet Connection shall be provided and located at a designated fire truck station.

Each hydrant shall be provided with a manually operated isolating valve (normally closed).

e) FM 200 Gas System

FM200 fixed gas system shall be provided for CCO and FOBS. Each installation shall be a complete system and its status shall be indicated on the main addressable fire control panel.

The following FM 200 system components shall be provided for each room:

- Alarm Device System
- Air-tight Door Mechanism
- FM 200 Fire Suppression System
- Control Panel

f) Fire Extinguisher

Fire extinguisher requirements shall conform to the provisions indicated in NFPA–10 and by the local fire code. The capacity and type of extinguisher shall be based on the parameters stipulated by the “authority having jurisdiction”.

Carbon dioxide (CO2) systems shall be provided for Control Tower & ATC and power house, only carbon dioxide tank wheel types shall be allowed.

Mulch purpose fire extinguishers shall be strategically located to every 22 m (72 ft) of travel distance at any point throughout the passenger terminal building.

g) Water Mist System

This system shall protect the airside window glass from shattering due to intense heat in case of the outbreak of fire. The water mist sprays shall be located in the exterior of airside window glass.

When activated, water mist sprays shall cover all windows facing airside of airport. Special type water mist nozzles shall provide a total flooding mist effect that shall immediately reduce heat and extreme high temperatures.

The system to be used is a “Low Pressure Water Mist Atrium N-Pipe System (Deluge System). The standard atrium N-pipe system comes in 6 m lengths with integrated nozzles at every 1 m. spacing. The N-pipe system consists of SS316 diameter tubing with ¾” BSP/NPT thread at each end. The water pressure is 6 bars at the nozzles. The flow rate per 6 m. is 91 l/min at 6 bar pressure. A detection system shall interface with the building Fire Alarm System.

h) Control Panel

All the detected alarms from the Fire Alarm System shall be interfaced with followings;

- Fire Control Panel and the Sprinkler Supervisory Control Panel
- BMS located at CCO
- Pump Control Panel located at the Water Tank and Pump House.

6.2. Control Tower, ATC Operation & Administration Building (ATC)（Subcomponent B3)

6.2.1. Architectural Works

The effective provision of airport services requires a clear and unobstructed view of the entire movement area of an airport and air traffic in the vicinity of the airport. The airport control tower should therefore be so located and be of such a height that apron, taxiway, runway and the airspace surrounding the airport, particularly the approach and departure areas are clearly visible from the control room and that future development of the maneuvering area or future construction of buildings shall not restrict this view.

The control tower, ATC operation and administration building is located to the north of the passenger terminal building. This area is specifically assigned as the operations and administrative area and is separated from the passenger terminal area in order not to disrupt normal operations of the passenger terminal building and to provide optimum security for the ATC operations.

The building is a reinforced concrete structure consisting of a combination of a nine (9) story control tower and a two (2) story operation and administration building. Along both sides of the control tower are two office wings for operation and administration, connected by an access corridor to the control tower. An elevator and a staircase provide access to the VFR room which is located at the top of the control tower (9^{th} FL). The VFR room has a full sight glass screen sash around it, with a standard slanted angle of 15°. The ground floor right wing of the building contains support areas such as dining/kitchen, conference, briefing rooms and toilets while the second floor contains the air traffic control and navigational offices‘, areas for operations. Nap rooms, toilets and lockers are also provided to support the twenty-four hours monitoring of the air traffic control. The left wing contains the administration areas.

Control Tower & ATC

Control tower is required to be built with a height so that aprons, taxiways, runways, and the air space surrounding the airport are clearly visible from the VFR room. For the control tower, the eye level has been designed in accordance with the following calculation.

Calculation Formula for Control Tower Eye Level

Ee = Eas + D tan (0°35’ 00’’ ± GS)

Ee = Elevation of Eye Level

Eas = Runway Threshold Elevation

D=Distance from Eye Point to the Threshold

Gs=$\tan^{-1}$ (tan B cos C ± tan A sin C)

tan A = Transverse slope of the Runway

tan B = Longitudinal slope of the Runway

C = Crossing Angle of eye and runway center line

Table 6.2-1 Runway Threshold Elevation

	RWY 03 (South)	RWY21 (North)
1.0 Longitudinal Slope	0.15%	0.05%
Transverse Slope	1.3%	1.3%
Runway Threshold Elevation	7.4m	9.85m

Source: JICA Study Team

Table 6.2-2 Required Eye Level

	RWY 2,500m		RWY3,300m	
	RWY 03	RWY 21	RWY 03	RWY 21
2.0 Required Eye Level	19.00m	15.50m	31.5m	15.50m
Elevation of Eye Level	27.1m	23.6m	39.5m	23.6m
Control Tower Elevation	40.00 m			

Source: JICA Study Team

Zoning plan of control tower, ATC operation and administration building takes into account grouping of divisions or sub-divisions and each department. The operations area are located from ground to second floor at the south end or left wing while the administration area is located at the north end or right wing of the building.

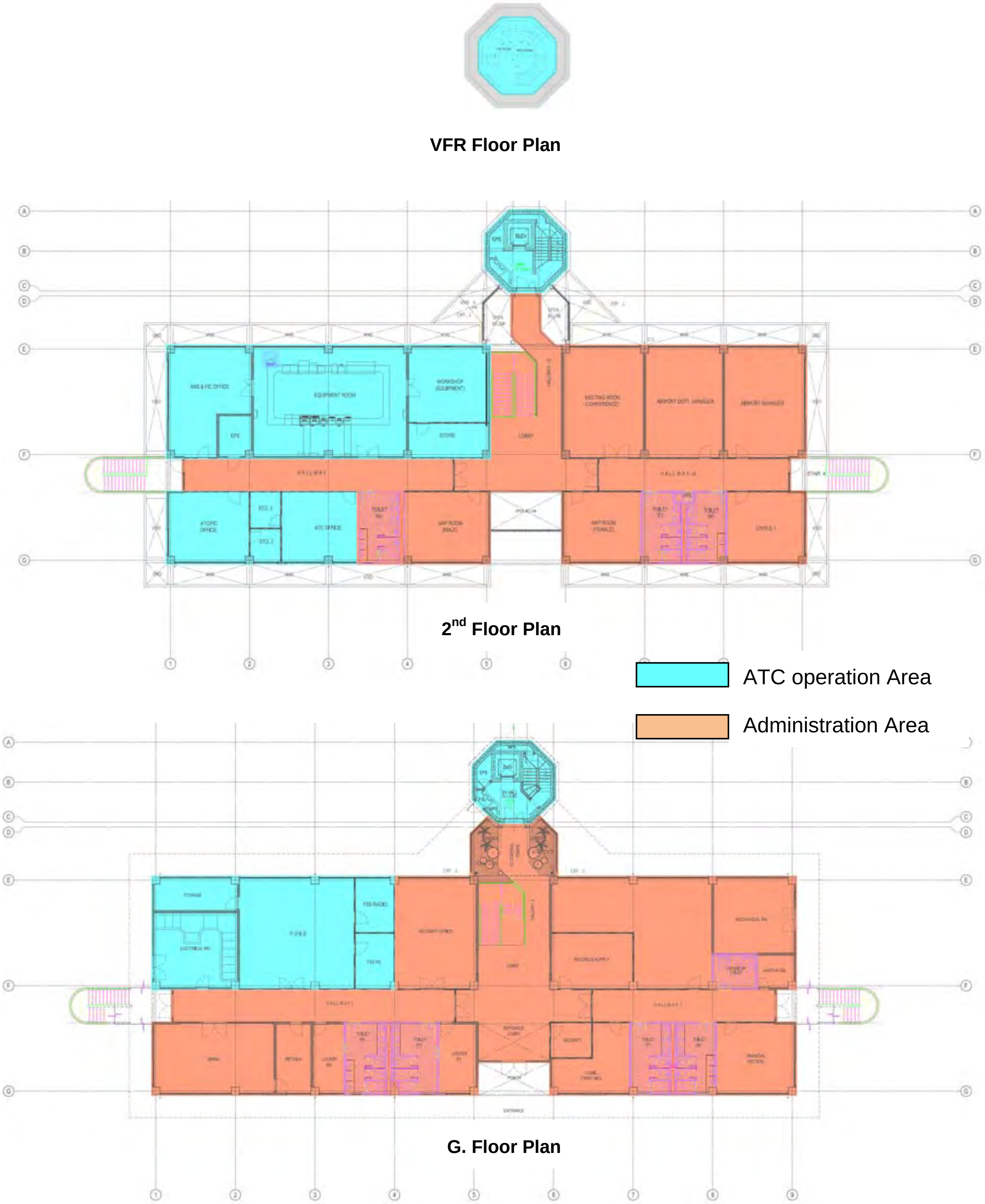
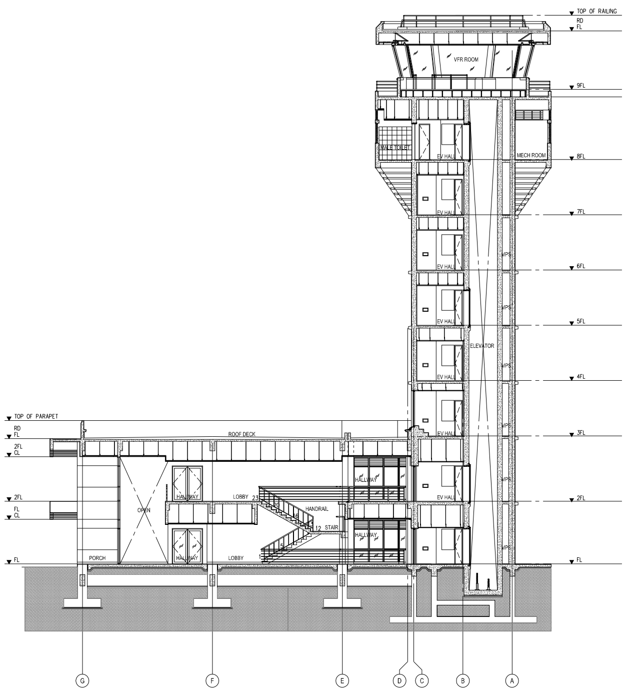


Figure 6.2-1 Floor Plan of ATO Facilities



Source: JICA Study Team

Figure 6.2-2 Elevation of ATO Facilities

The space requirements for the air traffic control tower, ATC operation and administration building were computed from the assumed number of personnel and sizes of required equipment for the airport operation. The floor areas are listed and shown in Table 6.2-3.

Table 6.2-3 Floor Area of Control Tower, ATC Operation and Administration Building

Item	Floor Area (m^2)	Item	Floor Area (m^2)	Item	Floor Area (m^2)
Control Tower		**ATC Operation**		**Administration**	
G FL.	22.29	G FL.		G FL.	
2nd FL.	21.76	FSS Radio	11.66	Dining & Kitchen	59.88
3rd FL.	22.74	FSS/FIC	11.88	Locker (M,F)	25.94
4th FL.	22.74	FOBS	71.32	Toilet (M,F)	58.80
5th FL.	22.74	Electrical Rm.	34.87	Toilet (H)	7.36
6th FL.	22.74	Storage	14.84	Record & Supply	24.87
7th FL.	22.74			Financial Section	30.42
8th FL.	81.22			Mechanical Rm.	33.70
9th FL.	41.71			Human Resources	73.15
				Clinic (First Aid)	22.23
				Security	7.90
				Security Office	49.97
				Janitor Rm.	6.46
				Hallway	104.77
				Lobby	58.80
				Porch	13.33

		Net Subtotal	**144.57**	**Net Subtotal**	**577.58**
		2nd FL.		2nd FL.	
		ATC/FIC Office	31.73	Toilet (M,F)	41.52
		Storage 1	6.21	Nap Room (M,F)	63.50
		ATC Office	29.90	Office 1	30.44
		Storage 2	5.54	Airport Dept. Mgr.	48.02
		ANS&FIC Office	42.83	Airport Manager	49.62
		EQ. Room	94.91	Meeting Rm.	49.68
		EPS	7.19	Hallway	103.13
		Workshop (EQ.)	33.95	Lobby	43.19
		Store	15.07		
		Net Subtotal	267.33	**Net Subtotal**	428.9
Net Total	**280.68**	**Net Total**	**411.9**	**Net Total**	**1006.48**
Gross Total	**385.24**	**Gross Total**			**1673.62**
Total Gross Floor Area					**2058.86**
Gross Covered Area					**66.40**

6.2.2. Electrical Works

(1) Power supply

The high voltage feeder cable runs from the power house passing through an underground cable duct to the electrical room of the operation building. The basic design load of these facilities is approximately 7000 KVA at 230V. When excess of solar power energy is generated on photovoltaic panel at passenger terminal building, the power shall be directly distributed to ATC operation and administration building. Around 40% of the total load of control tower for ATC operation and administration building will be energized by a stand-by generator during power failure. However, the navigation and communication equipment will be fully back-up during power failure. 100% of the design load of NAVAIDs and MET will be energized by a stand-by generator during power failure.

(2) Internal Lights

Ordinal Fluorescent lighting fixtures to be used:

- Fluorescent Lamps Base Light Type – for Offices and Equipment Rooms
- Compact Fluorescent Downlight Type – for Toilets, Corridors and Hallways

(3) Telephone and Data System

Telephone and data system to be used are as follows:

- Digital Multi-function Handset – for Office and Equipment Room
- Cable, Conduit and Outlet for LAN – From CCO Room to Office

(4) Cable TV System

Cable TV System to be used is as follows:

- TV Outlets – for Office

(5) Fire Alarm system

Fire alarm system to be used is as follows:

- Fire Alarm Control Panel FIRE – for Office
- Fire Alarm Terminal Cabinet – for Corridor
- Annunciator Panel – for Corridor
- Telephone Handset Panel – for Corridor

(6) Master Clock System

Master clock system to be used is as follows:

- Time Code Master Clock – for Entire airport facilities
- Global positioning system satellite (GPS) receiver antennae – for Time Code Master Clock
- Digital Clocks for VFR

In other rooms except VFR Analogue Clocks are to be installed

(7) Closed Circuit Television (CCTV) System

Monitoring information generated at CCO in PTB, and the image will be distributed to VFR Room where CCTV Monitor with Remote Controller is provided.

6.2.3. Mechanical Works

(1) Plumbing

Plumbing shall be designed in accordance with following service conditions.

Table 6.2-4 Service List of Plumbing

No.	Location	Cold Water	Hot Water	Drainage & Vent	Remarks
1	**Toilet** -Water Closet -Urinal -Lavatory (wash	○	○	○	Hot water shall be provided to shower & lavatory.

	basin) -Slop Sink -Floor Drain -Shower				
2	**Kitchen** -Kitchen Sink -Grease Interceptor	○	○	○	
3	**Mechanical Room** -Oil Interceptor -Floor Drain	－	－	○	

Source: JICA Study Team

a) Cold Water Supply System

Cold water for toilets and kitchen shall be provided from the water pump house (WPH). Due to its high location the cold water for control tower's toilet located in 8F requires a booster pump set which shall be installed in the mechanical room on the ground floor. The cold water supply piping system schematic diagram is shown in Figure 6.2-3.

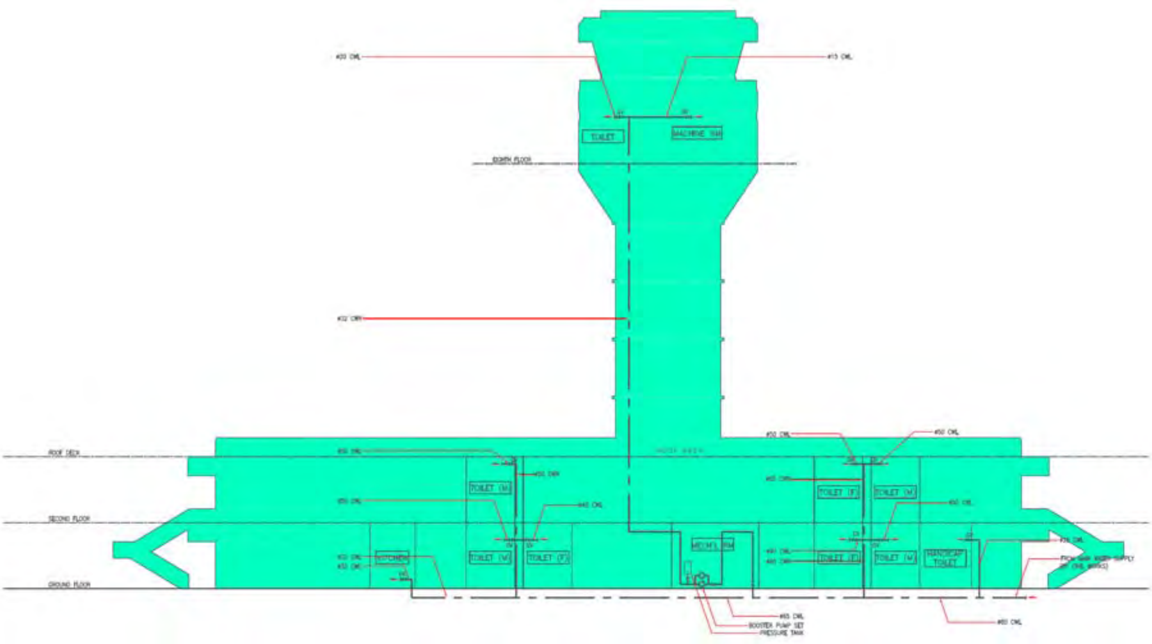


Figure 6.2-3 Cold Water Supply Piping System Schematic Diagram

b) Hot Water Supply System

Both solar water-heater and electrical water heaters shall be installed at each place as required. Hot water shall be used for kitchen, showers and lavatories' vanity basins.

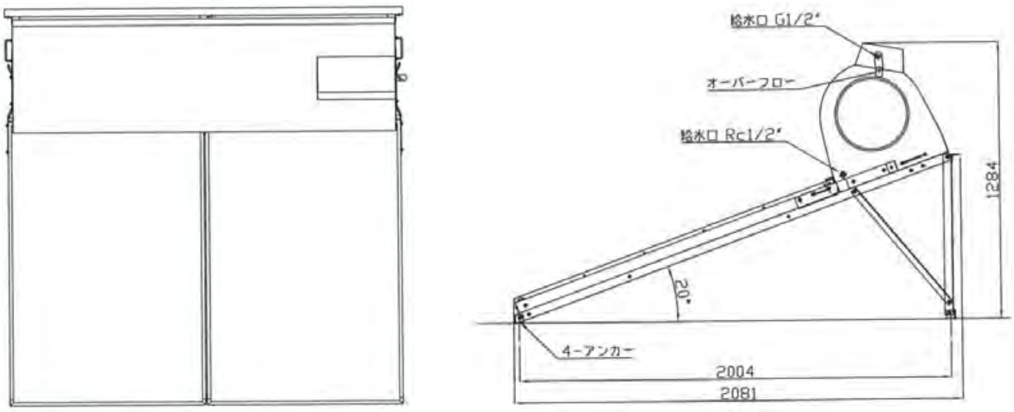


Figure 6.2-4 Solar Water Heater

c) Sewage Drainage and Vent System

All drainage water including sewage discharged from the control tower and the operations and administration building (CTO) shall be collected at the sewage pits and shall be discharged to the sewer main for treatment at the sewage treatment plant (STP).

A water trap shall be used to prevent bad smells to escape or insects to enter the drainage pipes.

Vent pipes shall be connected to the drainage pipes to stabilize internal pressure of the systems.

In addition grease traps shall be provided to the kitchen in order to separate grease from the drainage water before discharging to the building sewers. The sewer & vent piping system schematic diagram is shown in Figure 6.2-5.

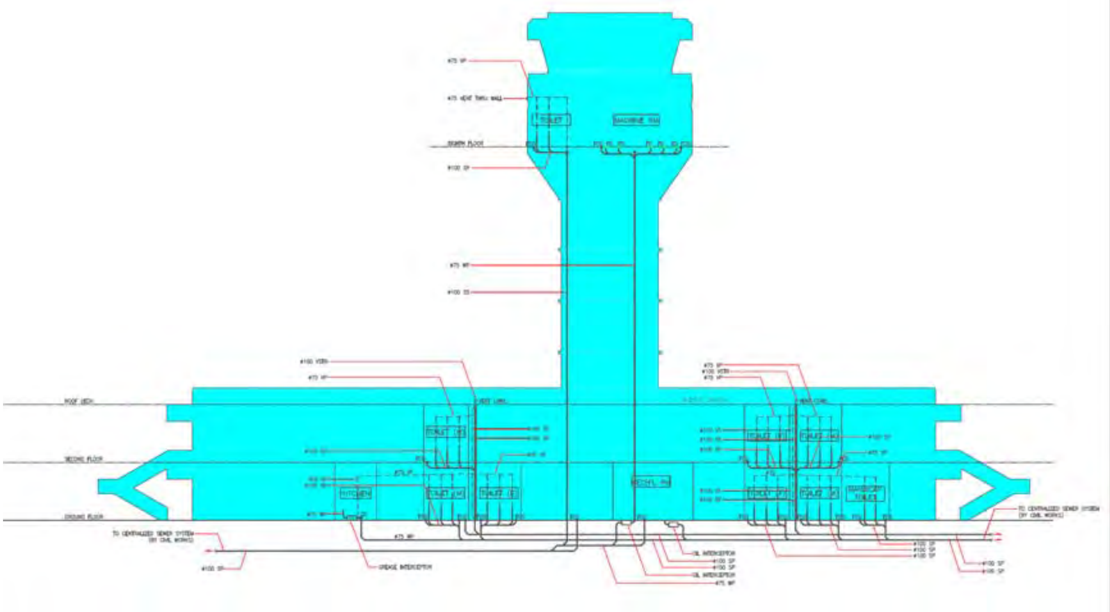


Figure 6.2-5 Sewer & Vent System Schematic Diagram

d) Storm Water System

Storm drainage pipes shall be installed from the roof drainage (architectural works) to the outside of the building. External drainage piping shall be included in the civil works. Storm water shall be collected at the storm pits and shall be drained to the storm water drainage main. Condensation drains from the air conditioning system shall also be drained to the storm water pits. The storm drainage piping system schematic diagram is shown in Figure 6.2-6.

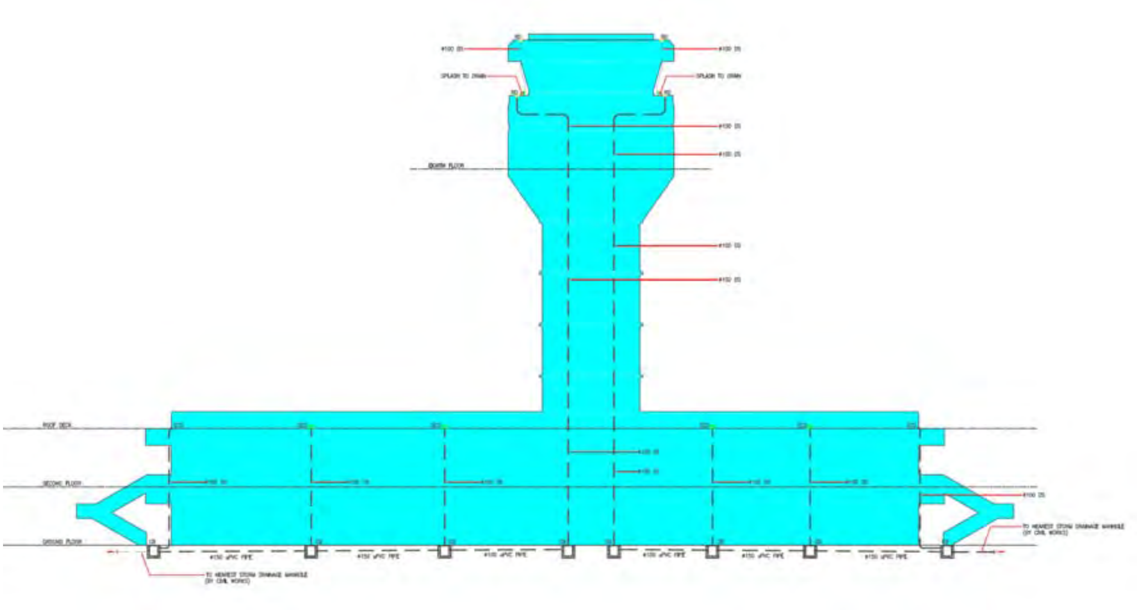


Figure 6.2-6 Storm Drainage Piping System Schematic Diagram

(2) Air Conditioning and Ventilation

a) Operation/Administration Building

Variable Refrigerant Flow (VRF) System due to energy saving purpose shall be provided for air-conditioned area. The fresh air shall be delivered to indoor unit from the Fresh Air Handling Unit where located in the mechanical room through ducting. Outdoor Unit shall be located on the roof level.

Conditioned rooms, except; hallway, ANS staff room, nap room and ANS, shall be have a back-up air-conditioning system by means of VRF indoor units for every room with two (2) VRF outdoor units located on the roof deck level.

FOBS, FSS Radio, and Equipment room shall have two (2) VRF indoor units, of 50% cooling capacity, which shall serve as back-up in case of maintenance of the other VRF indoor units.

The workshop and storage rooms shall be ventilated by in-line axial fans coming from exhaust grilles through ductworks.

All toilets shall be ventilated by in-line centrifugal fans coming from exhaust grilles through ductworks. The exhaust air inlet shall be installed at the ceiling above the water closets and urinals. The fresh air for toilet shall be supplied through door louvers, to ensure the internal space of toilet shall be maintained in negative pressure to avoid foul odor.

A cross airflow shall be formed by supply and exhaust fan for the machine room and electrical rooms. The supply and exhaust fans shall be controlled by thermostat switch to regulate the room temperature.

b) Control Tower

The VFR room and ready room shall be air-conditioned by individual split air conditioning systems. Two (2) duty and two (2) back-up split air conditioning units for the VFR room and one (1) duty and one (1) back-up for the Ready room. All six (6) outdoor units are located in the Mechanical Room in eighth floor with large louvers.

The EPS rooms shall be ventilated by in-line axial fans coming from exhaust grilles through ductworks.

The elevator halls shall be provided with fresh air by in-line axial fans coming from fresh air grilles through ductworks. Fan shall be in dual mode serving as pressurization fan and exhaust Fan.

The stairwells shall be pressurized by in-line axial fan from air grilles for every two (2) floors.

Ventilation for the stairwells shall be both ventilated, in normal condition, and pressurized for fire mode condition. Fans shall have two applications, as an exhaust fan and as a stairwell pressurization fan. The ventilation system shall be centralized particularly for the fresh and exhaust air.

(3) Fire Fighting

a) FM 200 Gas System

FM200 fixed gas system shall be provided for FOBS (Flight Operation Briefing Station). Installation shall be a complete system and its status shall be indicated on the main addressable fire control panel.

b) Portable Fire Extinguisher

The fire extinguisher requirements shall conform to the provisions indicated in the NFPA – 10 and by the local fire code. The capacity and type of extinguishers shall be based on the parameters stipulated by the “authority having jurisdiction”.

The type and capacity of portable fire extinguisher shall be in accordance of the following:

- Wheel type 23.0kg CO2 extinguishers shall be used in Electrical Room.
- Portable type 9.0 kg CO2 extinguishers shall be used for Machine Room.
- Portable type 4.5 kg ABC multi – purpose extinguishers shall be used for Equipment Room, offices, hallways, and utility rooms.

c) Stand Hose Pipe Connection and Fire Hose Cabinet

A stand hose pipe connection and fire hose cabinet shall be installed in the control tower.

6.3. Fire Station & Maintenance Building (FSM)（Subcomponent B4）

6.3.1. Architectural Works

The fire station and airport maintenance building has been located at the northern side of the control tower, ATC operation & administration building, next to the water tank and pump house.

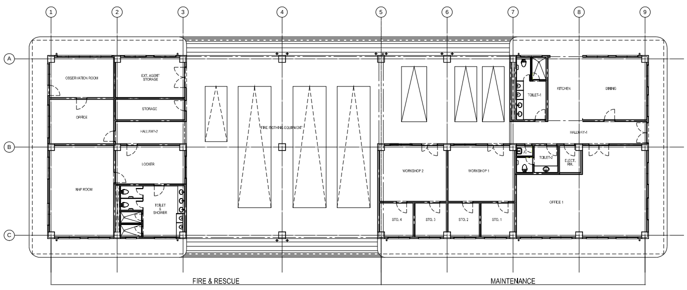
The requirements for the rescue and firefighting facility have been determined based on the annual aircraft movements projection and Part 1 of ICAO Service Manual, which states category 6 in the year 2020 (1^{st} Phase), then category 9 in the Year 2025-2030 (2^{nd} Phase) as being the minimum requirement for this size of airport. The building size for fire station is adapted as category 9.

The airport maintenance building will be adjoining the northern side of the station. It will serve as garage for airport maintenance equipment such as mower, tractor and dump truck, workshop areas, nap rooms, locker rooms, dining and kitchen to support the daily maintenance activities. Adequate storage facilities are also provided.

The space requirements for the fire station and airport maintenance building were computed from the assumed number of personnel and required equipment. The floor areas are listed and shown in Table 6.3-1.

Table 6.3-1 Floor Area for Fire Station and Maintenance Building

Item	Floor Area (m²)
1. Observation Room	22.80
2. Extinguishing Agent Storage	25.00
3. Storage	13.00
4. Office	25.30
5. Hallway-2	14.00
6. Locker	23.30
7. Toilet & Shower	31.00
8. Nap Room	51.00
9. Kitchen & Dining	53.00
10. Fire Fighting Equipment Garage	295.00
11. Maintenance Equipment Garage	96.00
12. Toilet-1 & Shower	19.15
13. Hallway-1	27.30
14. Toilet-2 & Janitor Room	10.20
15. Electrical Room	5.50
16. Office 1/ Secretary/Receptionist	85.00
17. Workshop 1	32.50
18. Workshop 2	32.25
19. Storage 1,2,3,4	40.00
Total	**901.30**



Source: JICA Study Team

Figure 6.3-1 Layout Plan of Fire Station and Maintenance Building

6.3.2. Electrical Works

(1) Power supply

The low voltage power feeder will come from the LV Panel at the ATC Operation and Administration Building. Around 40% of the total design load for the building will be energized by a stand-by generator during normal power failure.

(2) Internal Lights

Ordinal Fluorescent lighting fixtures to be used:

- Fluorescent Lamps Base Light Type – for Offices and Equipment Rooms
- Compact Fluorescent Downlight Type – for Toilets, Corridors and Hallways

(3) Telephone System

Telephone System to be used is as follows:

- Digital Multi-function Handset – for Office and Equipment Room

(4) **Cable TV** System

Cable TV System to be used is as follows:

- TV Outlets – for Office

(5) Fire Alarm system

Fire Alarm system to be used is as follows:

- Fire Alarm Terminal Cabinet – for Corridor
- Annunciator Panel – for Corridor
- Telephone Handset Panel – for Corridor

(6) Master Clock System

Master Clock System to be used is as follows:

- Analogue Clocks – for Office

6.3.3. Mechanical Works

(1) Plumbing

Plumbing shall be designed in accordance with following service conditions.

Table 6.3-2 Service List of Plumbing

No.	Location	Cold Water	Hot Water	Drainage & Vent	Remarks
1	**Toilet** -Water Closet -Urinal -Lavatory (wash basin) -Slop Sink -Floor Drain -Shower	○	○	○	Hot water shall be provided to shower & lavatory.

Source: JICA Study Team

a) Cold Water Supply

Cold water for toilets shall be provided from the water pump house (WPH).

b) Hot Water Supply System

Hot water shall be used for showers and lavatories. Instantaneous type electrical water heater shall be installed individually in each place as required.

c) Sewage Drainage and Vent System

Separate gravity drainage systems shall be provided for sanitary and storm water drainage throughout the building. All drainage water including sewage discharged from building shall be collected at the sewage pits and shall be discharged to the sewer main for treatment at the sewage treatment plant (STP).

A water trap shall be used to prevent bad smell to escape from or insects to enter the drainage pipe.

A vent pipe shall be connected to the drainage pipe to stabilize the internal pressure of the system.

d) Storm Water System

Storm drainage pipes shall be installed from the roof drainage (architectural works) to the outside of the building. External drainage piping shall be included in the civil works. Storm water shall be collected at the storm pits and shall be drained to the storm water drainage main. Condensation drains from the air conditioning system shall also be drained to the storm water pits.

(2) Air Conditioning & Ventilation System

- Offices, dining areas, kitchen and nap rooms shall be air-conditioned by individual split air-conditioning system.
- Extinguishing agent storage, electrical room, workshop and storage rooms shall be ventilated by in-line axial fans coming from exhaust grilles through ductworks.
- Toilets and lockers shall be ventilated by in-line centrifugal fans coming from exhaust grilles through ductworks

(3) Fire Protection System

The Fire Station & Maintenance Building shall be equipped with portable fire extinguisher. Fire extinguisher requirements shall conform to the provisions indicated in the NFPA – 10 and by the local fire code. The capacity and type of extinguishers shall be based on the parameters stipulated by the “authority having jurisdiction”.

Types and capacities of Portable Fire Extinguishers shall be in accordance to the following:

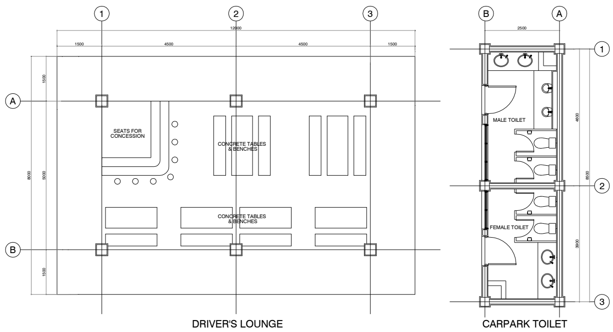
- Portable type 4.5 kg ABC multi – purpose extinguishers

6.4. Ancillary Buildings (ACB) (Subcomponent B5)

6.4.1. Architectural Works

The ancillary buildings consist of a Drivers' Lounge (B51), Car Parks Toilet (B52), Guard Houses (B53) and Tollbooths (B54). All these building structures are single story, reinforced concrete structures.

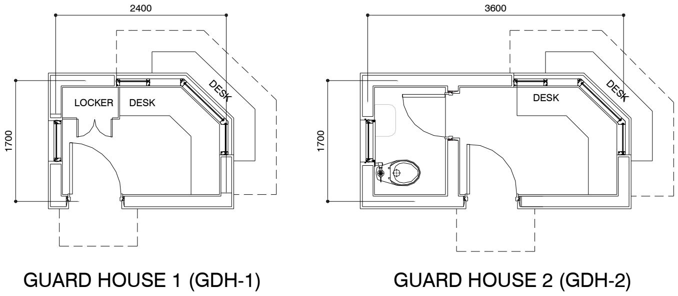
The drivers lounge is located at the land side car park area in front of the passenger terminal building, it is a roofed over open air facility with concrete benches and tables and space for a concessionaire to sell drinks. The floor area for this facility is 96m^2. Adjacent to the drivers lounge are public toilet facilities, a floor area 21m^2 for male with 2 toilets, 2 urinals and 2 vanity basins and for female with 2 toilets and 2 vanity basins.



Source: JICA Study Team

Figure 6.4-1 Layout Plan of Drivers Lounge and Car Park Toilets

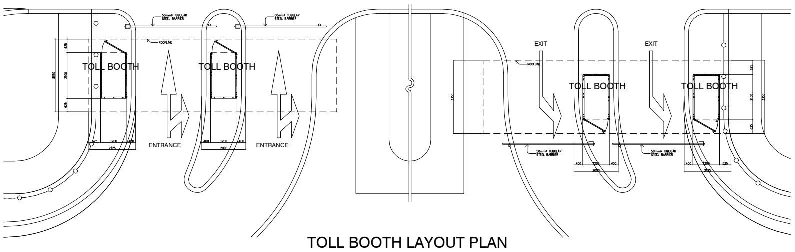
The guardhouses are located at various locations on the airport site, guarding entry into facilities such as sewage treatment plant, control tower, power house area and at the landside-airside entry points. The guardhouses, type 2, guarding the airside entry points are equipped with a toilet, and the gross floor area for this type is 6 m^2. The other guardhouses, type 1, consist of a room only; the gross floor area for this type is 4 m^2. There are in total five (5) Guardhouses of type 2 and three (3) guardhouse of type 1.



Source: JICA Study Team

Figure 6.4-2 Layout Plan of Guardhouses

The tollbooths are located at the eastern entrance and exit of the car parking, consisting of prefabricated units of 7m^2 each with 2 units per entry/exit. Each 2 units are roofed over with a steel canopy structure to provide shaded areas for workers and drivers collecting tickets and paying fees.



Source: JICA Study Team

Figure 6.4-3 Layout Plan of Tollbooths

6.4.2. Electrical Works

The low voltage power will be supplied through the LV Power of road and car parking to the driver's lounge & car park toilet, guard houses and toll booths.

6.4.3. Mechanical Works

Mechanical works for ancillary buildings shall be as follows:

Table 6.4-1 Service List of Mechanical Works

No.	System	Driver's Lounge	Car Parking Toilet	Guard House-1	Guard House-2	Toll Booth
1	**Plumbing System**					
	-Cold water supply	−	○	−	○	−
	-Sewage drainage & vent system	−	○	−	○	−
	-Storm water system	○	○	○	○	○
2	**Ventilation System**					
	-Mechanical Ventilation	−	○	○	○	○
3	**Fire Protection System**					
	-Portable fire extinguisher	○	○	○	○	○

(1) Plumbing

Cold water supply and sewage drainage works shall be provided for car parking & guard house-2 toilet.

(2) Ventilation System

a) Car park toilet

Toilets shall be ventilated by ceiling cassette exhaust fans. Outside fresh air shall enter through door louvers.

b) Guard House 1

Rooms shall be ventilated by wall mounted propeller exhaust fans.

c) Guard House 2

Rooms shall be ventilated by wall mounted propeller exhaust fans. The toilets shall be ventilated by wall mounted propeller exhaust fans. Fresh air shall enter through the door louvers.

d) Toll Booths

Rooms shall be ventilated by wall mounted propeller exhaust fans.

(3) Fire Protection System

Portable multi-purpose fire extinguishers shall be placed at the driver’s lounge, car parking toilets, guard houses and toll booths.

6.5. Utility Buildings (ULB)（Subcomponent B6)

6.5.1. Water Tank and Pump House (WPH) (Sub-component B61)

(1) Architectural Works

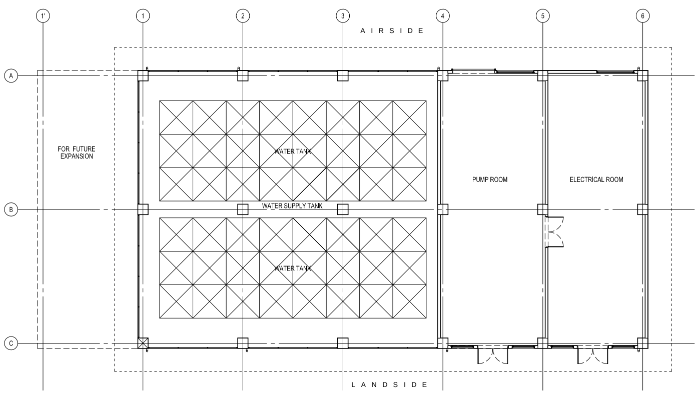
The water tank and pump house is located east of the fire station and maintenance building, adjacent to the area reserved for the future fuel farm. It is a single story reinforced concrete building with three (3) main areas, electrical room, pump room and tank area. The tank is sufficient for the domestic and firefighting requirements of the airport.

The space requirements for the water tank and pump house were determined from the total required storage capacity of 450m^3 for the water reservoir tank and necessary equipment. The floor areas are listed and shown in Table 6.5-1.

Table 6.5-1 Floor Areas of Water Tank and Pump House

Item	Floor Area (m²)
1. Electrical Room	98.00
2. Pump Room	105.00
3. Water Tank Area	297.00
Total	**500.00**

Source: JICA Study Team



Source: JICA Study Team

Figure 6.5-1 Floor Plan of Water tank and Pump House

(2) Electrical Works

a) Power supply

The high voltage (13.2 kV) power feeder will come from the power house through an underground cable in the pipe duct. The building will be supplied by a transformer approximately 250KVA in capacity at 460V, 3Phase. Around 45% of the total design load for these areas will be energized by a stand-by generator during normal power failure

b) Internal Lights

Ordinal Fluorescent lighting fixtures to be used:

- Fluorescent Lamps Base Light Type – for Offices and Equipment Rooms
- Compact Fluorescent Downlight Type – for Toilets, Corridors and Hallways

c) Telephone System

Telephone System to be used is as follows:

- Digital Multi-function Handset – for Office and Equipment Room

d) Fire Alarm System

Fire Alarm systems to be used are as follows:

- Fire Alarm Terminal Cabinet – for Corridor
- Annunciator Panel – for Corridor
- Telephone Handset Panel – for Corridor

(3) Mechanical Works

a) Water Supply System

Portable water shall be supplied to the each of the buildings inside the airport. Two above ground storage tanks (water receiving tanks) will be provided. The tanks will be equipped with high and low level alarms.

Water will be distributed to the passenger terminal building and other buildings by water supply pump units which will consist of three (3) duty pumps and one (1) standby pump.

Both pumps and tanks will be provided with automatic controls and monitoring systems through the building management system (BMS).

The water receiving tanks, water supply pump unit, pressure tank and the motor control panel will be located inside the water tank and pump house.

b) Drainage System

Drainage water from the water tank & floor drain water from the pump house shall be collected at the drainage pits via an oil interceptor and will be discharged to the drainage main.

c) Storm Water System

Storm drainage pipes shall be installed from the roof drainage (architectural works) to the outside of the building. External drainage piping shall be included in the civil works. Storm water shall be collected at the storm pits and shall be drained to the storm water drainage main. Condensation drains from the air conditioning system shall also be drained to the storm water pits.

d) Air Conditioning and Ventilation System

There is no air conditioning requirement for this building. The pump room and electrical room shall be ventilated by in-line axial fans, exhaust air shall be suctioned by exhaust grilles through ductworks and fresh air shall be delivered by in-line axial fans from fresh air grilles through ductworks.

e) Fire Protection System

Portable fire extinguisher shall be placed in the water tank & pump house as follows:

The fire extinguisher requirements shall conform to the provisions indicated in the NFPA – 10 and by the local fire code. The capacity and type of extinguishers shall be based on the parameters stipulated by the “authority having jurisdiction”.

The types and capacities of Portable Fire Extinguishers shall be in accordance to the following:

- Wheel type 23.0 kg. CO2 extinguishers shall be used in all Electrical Room
- Portable type 4.5 kg. ABC multi – purpose extinguishers shall be used in Water Tank and Pump Room

6.5.2. Power House (PWH)（Subcomponent B62）

(1) Architectural Works

The power house is located between the passenger terminal building and the control tower operation and administration building. It is a single story, reinforced building housing the transformers, switchgears, generator sets, etc. In addition to the technical spaces, the power house includes a workshop with storage area, a control room, office area, nap room, toilets, showers, locker room and a kitchen.

The space requirements of the power house were determined from the total required capacity of 2,000 KVA for the electrical supply. The floor areas are listed and shown in Table 6.5-2.

Table 6.5-2 Floor Area Power House

Items	Floor Area (㎡)
1. Hallway	41.52
2. Office	36.17
3. Control Room	26.38
4. AGL Equipment	86.88
5. Transformer	219.30
6. Workshop & Storage	50.90
7. Main Fuel Tank	15.40
8. Daily Fuel Tank	6.12
9. Generator Room	245.59
10. Dining & Kitchen	33.25
11. Locker Room	13.21
12. Toilet 1	7.72
13. Toilet 2	23.37
14. Janitor Closet	1.37
14. Nap Room	28.38
Net Total Floor Area	**835.56**
Gross Total Floor Area	**902.81**

Figure 6.5-2 Floor Plan of Power House

(2) Electrical Works

a) Power supply

Basic design load is approximately 100KVA at 230V, 3Phase. The loads represented are lighting, receptacle outlets, FCU's, road, car park lights and others. Around 25% of the design load will be energized by stand-by generator during power failure.

b) Internal Lights

Ordinal Fluorescent lighting fixtures to be used:

- Fluorescent Lamps Base Light Type – for Offices and Equipment Rooms
- Compact Fluorescent Downlight Type – for Toilets, Corridors and Hallways

c) Telephone and Data System

Telephone and Data System to be used are as follows:

- Digital Multi-function Handset – for Office and Equipment Room
- Cable, Conduit and Outlet for LAN – From CCO Room to Office

d) Fire Alarm system

Fire Alarm system to be used is as follows:

- Fire Alarm Terminal Cabinet – for Corridor
- Annunciator Panel – for Corridor
- Telephone Handset Panel – for Corridor

(3) Mechanical Works

a) Plumbing

Plumbing shall be designed in accordance with following service conditions.

Table 6.5-3 Service List of Plumbing

No.	Location	Cold Water	Hot Water	Drainage & Vent	Remarks
1	**Toilet** -Water Closet -Urinal -Lavatory (wash basin) -Slop Sink -Floor Drain -Shower	○	○	○	Hot water shall be provided to shower & lavatory.

Source: JICA Study Team

<u>Water Supply System</u>

Water from the water tank by water supply pump shall be provided for the toilets.

Hot Water Supply System

Hot water shall be used for showers and lavatories. Instantaneous type electrical water heaters shall be installed individually at each place as required.

Sewage Drainage and Vent System

Drainage water including sewage discharged from the Power House (PWH) shall be collected at the sewage pits and shall be discharged to the sewer main for treatment at the sewage treatment plant (STP).

Water traps shall be used to prevent bad smell to escape or insects to enter the drainage pipes. Vent pipes shall be connected to the drainage pipes to stabilize the internal pressure of the pipes.

Storm Water System

Storm drainage pipes shall be installed from the roof drainage (architectural works) to the outside of the building. External drainage piping shall be included in the civil works. Storm water shall be collected at the storm pits and shall be drained to the storm water drainage main. Condensation drains from the air conditioning system shall also be drained to the storm water pits.

b) Air Conditioning and Ventilation System

The office and control room, nap room and dining & kitchen shall be air-conditioned by individual split type air conditioning systems.

The Airfield ground lighting (AGL) equipment room shall be air-conditioned by a package window type air-conditioning system. Two (2) window type units shall serve as duty while one (1) window type unit shall serve as back-up.

The generator, transformer, workshop and storage rooms shall be ventilated by in-line axial fans coming from exhaust grilles through ductworks.

The toilets shall be ventilated by in-line centrifugal fans coming from exhaust grilles through ductworks.

c) Fire Protection System

Portable fire extinguisher shall be equipped in power house as follows:

Fire extinguisher requirements shall conform to the provisions indicated in the NFPA – 10 and by the local fire code. The capacities and types of extinguishers shall be based on the parameters stipulated by the “authority having jurisdiction”.

The types and capacities of Portable Fire Extinguishers shall be in accordance to the following:

- Wheel type 23.0 kg CO2 extinguishers shall be used in the Transformer Room, Generator Room and AGL Equipment Room
- Portable type 4.5 kg ABC multi – purpose extinguishers shall be used in hallways.

6.5.3. Sewage Treatment Plant Control Room (STP) (Subcomponent B63)

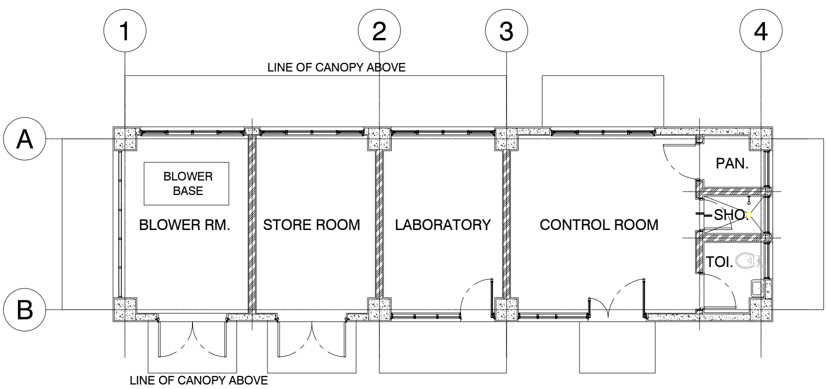
(1) Architectural Works

The sewage treatment plant (STP) control room is located within the STP area at the southeastern corner of the terminal facility. It is a single story, reinforced concrete structure. The building consists of blower room, store room, laboratory and control room with pantry, shower room and toilet.

Table 6.5-4 Floor Area STP

Item	Floor Area (m^2)
1. Blower Room	13.70
2. Store Room	13.05
3. Laboratory	13.05
4. Control Room	19.80
5. Toilet	3.00
6. Shower	1.80
7. Pantry	2.30
Total	**66.70**

Source: JICA Study Team



Source: JICA Study Team

Figure 6.5-3 Plan View of STP Control Room

(2) Electrical Works

a) Power Supply

The high voltage (4.06kV) power feeder will come from the power house through an underground cable in the pipe duct. The building will be supplied by a transformer approximately 100KVA in capacity at 230V, 3Phase.

b) Internal Lights

Ordinal Fluorescent lighting fixtures to be used:

- Fluorescent Lamps Base Light Type – for Offices and Equipment Rooms
- Compact Fluorescent Downlight Type – for Toilets, Corridors and Hallways

c) Telephone System

Telephone System to be used is as follows:

- Digital Multi-function Handset – for Office and Equipment Room

d) Fire Alarm system

Fire Alarm systems to be used are as follows:

- Fire Alarm Terminal Cabinet – for Corridor
- Annunciator Panel – for Corridor
- Telephone Handset Panel – for Corridor

(3) Mechanical Works

Plumbing shall be designed in accordance with following service conditions.

Table 6.5-5 Service List of Plumbing

No.	Location	Cold Water	Hot Water	Drainage & Vent	Remarks
1	**Toilet** -Water Closet -Lavatory (wash basin) -Pantry Sink -Floor Drain -Shower	○	○	○	Hot water shall be provided to shower & lavatory.

Source: JICA Study Team

a) Plumbing

Water Supply System

Water from the water tank by water supply pump shall be provided for the toilet.

Hot Water Supply System

Hot water shall be used for the shower and lavatory; an instantaneous type electrical water heater shall be installed.

Sewage Drainage and Vent System

Drainage water including sewage discharged from the toilet of sewage water treatment plant control room shall be discharged to the adjacent sewage treatment plant (STP) for treatment.

A water trap shall be used to prevent bad smell to escape or insects to enter the drainage pipe. A vent pipe shall be connected to the drainage pipe to stabilize internal pressure of the system.

Storm Water System

Storm drainage pipes shall be installed from the roof drainage (architectural works) to the outside of the building. External drainage piping shall be included in the civil works. Storm water shall be collected at the storm pits and shall be drained to the storm water drainage main. Condensation drains from the air conditioning system shall also be drained to the storm water pits.

b) Air Conditioning and Ventilation System

The Laboratory and Control Rooms shall be air-conditioned by individual split type air conditioning systems.

Blower room, store room, pantry, toilet and shower rooms are ventilated by ceiling cassette exhaust fans, fresh air shall enter through door louvers.

c) Fire Protection System

Portable fire extinguisher shall be at the sewage water treatment plant.

The fire extinguisher requirements shall conform to the provisions indicated in the NFPA – 10 and by the local fire code. The capacities and types of extinguishers shall be based on the parameters stipulated by the "authority having jurisdiction".

The types and capacities of Portable Fire Extinguishers shall be in accordance to the following:

- Wheel type 23.0 kg CO_2 extinguishers shall be used in the Control Room
- Portable type 4.5 kg ABC multi – purpose extinguishers shall be used in Blower Room, Store Room and Laboratory.

6.5.4. Material Recovery Facility (MRF)（Subcomponent B64）

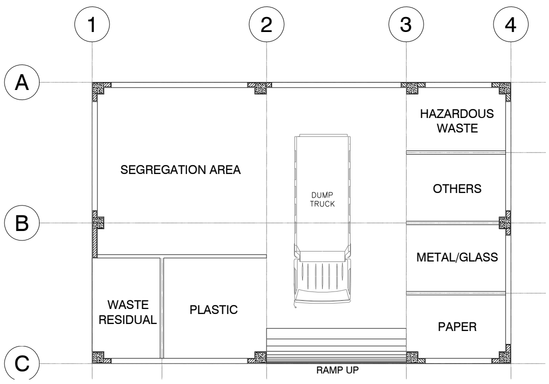
(1) Architectural Works

The material recovery facility is located south west of the STP area. It is a single story, reinforced concrete structure with metal roofing. It serves the purpose to segregate solid waste material, in accordance to the DENR (Department of Environment and Natural Resources) guidelines to implement waste reduction.

Table 6.5-6 Floor Area MRF

Item	Floor Area (m^2)
1. Segregation area	55.70
2. Waste residual	5.70
3. Plastic	8.90
4. Paper	5.85
5. Metal/Glass	5.85
6. Others	5.85
7. Hazardous waste	5.65
Total	**93.50**

Source: JICA Study Team



Source: JICA Study Team

Figure 6.5-4 Floor Plan of MRF

(2) Electrical Works

The low voltage power is provided from the LV Panel of the sewage treatment plant.

(3) Mechanical Works

a) Plumbing

Cold Water Supply System

Cold water from the water tank by a water supply pump shall be provided for the washing and cleaning at the segregation area.

Sewage Drainage and Vent System

Drainage water from floor drains shall be collected at the drainage pits and will be discharged to the drainage main.

Storm Water System

Storm drainage pipes shall be installed from the roof drainage (architectural works) to the outside of the building. External drainage piping shall be included in the civil works. Storm water shall be collected at the storm pits and shall be drained to the storm water drainage main. Condensation drains from the air conditioning system shall also be drained to the storm water pits.

6.6. Navaids Buildings (NAV)（Subcomponent B7）

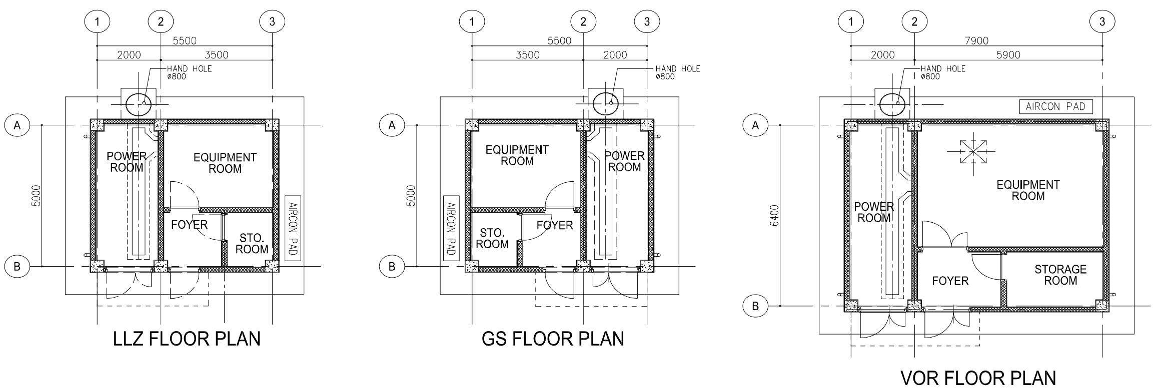
6.6.1. Architectural Works

The navaids buildings are composed of a LLZ (Localizer) building, a GS (Glide Slope) building and a VOR building (VHF Omni-Range). These are single story, reinforced concrete structures, providing shelter and house power equipment for the various Navaids equipment.

Table 6.6-1 Summary of Floor Areas for Navaids Building Structures

Item	Floor Area (m²)
B71: LLZ Building (LLZ)	
1. Equipment Room	11.33
2. Power Room	11.16
3. Foyer	4.25
4. Storage	3.45
Subtotal	**30.19**
B72: GS Building (GS)	
1. Equipment Room	11.33
2. Power Room	11.16
3. Foyer	4.25
4. Storage	3.45
Subtotal	**30.19**
B73: VOR Building (VOR)	
1. Equipment Room	27.26
2. Power Room	14.13
3. Foyer	5.95
4. Storage	6.85
Subtotal	**54.19**
Total	**114.57**

Source: JICA Study Team



Source: JICA Study Team

Figure 6.6-1 Basic Plans of 3 Facilities

6.6.2. Electrical Works

(1) Power supply

The basic design load is 15KVA at 230V, 3Phase for VOR/DME, GS and LLZ Building. 3 Step-Down Transformer, 13.2KV/230V, 3-phase shall be prepared for the low voltage power distribution to VOR/DME, GS and LLZ facilities. In case power failure is occupied, 100% of the design load will be energized by the generator.

(2) Internal Lights

Ordinal Fluorescent lighting fixtures to be used:

- Fluorescent Lamps Base Light Type – for Equipment Rooms
- Compact Fluorescent Downlight Type – for Hallways

(3) Telephone System

Telephone System to be used is as follows:

- Digital Multi-function Handset – for Equipment Room

(4) Fire Alarm system

Fire Alarm systems to be used are as follows:

- Fire Alarm Terminal Cabinet – for Equipment Room
- Annunciator Panel – for Equipment Room
- Telephone Handset Panel – for Equipment Room

6.6.3. Mechanical Works

Mechanical works for Navaids Buildings shall be as follows:

Table 6.6-2 Service List of Mechanical Works

No.	System	LLZ Building	GS Building	VOR Building
1	Plumbing System			
	-Storm Water System	○	○	○
2	Air Conditioning System			
	-Air Conditioning (PAC)	○	○	○
	-Mechanical Ventilation	○	○	○
3	Fire Protection System			
	-Portable Fire Extinguisher	○	○	○

Source: JICA Study Team

(1) Plumbing System

Only a storm water system shall be provided at each of the 3 buildings.

(2) Air Conditioning and Ventilation System

The equipment rooms of the 3 buildings shall be air-conditioned by individual split air-conditioning system, One (1) duty and One (1) stand-by. Each power room at the 3 buildings shall be ventilated by in-line axial fans; exhaust air shall be suctioned by exhaust grilles. Fresh air shall enter through door louvers. The storage rooms shall be ventilated by wall mounted exhaust fans.

(3) Fire Protection System

Portable fire extinguisher shall be placed in the above 3 Buildings.

The fire extinguisher requirements shall conform to the provisions indicated in the NFPA - 10 and by the local fire code. The capacities and types of extinguishers shall be based on the parameters stipulated by the “authority having jurisdiction”.

CHAPTER 7

DESIGN OF BUILDING STRUCTURES

TABLE OF CONTENTS

Chapter 7 Design of Building Structures

7.1. Basis of Design

7.1.1. Codes & Standards and Design References

a) Uniform Building Code (UBC) 1997 Edition

b) National Structural Code of the Philippines (NSCP) Volume 1,6th Edition 2010

c) Building Code Requirements for Reinforced Concrete and Commentary – American Concrete Institute (ACI 318) 1999 Edition

d) Concrete Reinforcing Steel Institute (CRSI)

e) Manual of Steel Construction – American Institute of Steel Construction (AISC) 9th Edition

f) Earthquake Resistant Design of Structures, ASEP Guide, 1991 Edition

g) Foundation Analysis and Design, Fourth Edition, by Joseph E. Bowles

h) Final Geotechnical Evaluation Report, by Industrial Inspection Inc., 2009

i) Draft Engineering Report for the Panglao Airport Project GPR Survey, Panglao, Bohol, 2009, by EM^{2}A Partners & Co.

j) Conduct of Topographic Survey & Geotechnical Investigation for the New Airport Construction and Sustainable Environmental Protection Project at Panglao, Bohol, of the geotechnical investigation conducted in 2013 by Universal testing laboratory and inspection, Inc.

7.1.2. Materials

(1) Concrete

Items	Fc' Mpa	Buildings
Footing	28	Passenger Terminal Building
	21	Other than Passenger Terminal Building
Footing Tie Beams	28	Passenger Terminal Building, ATC Operation and Administration Building, Fire Station and Airport Maintenance Building, Water Tank & Pump Station, Power Houses, STP Control Room, Material Recovery Facility
	21	LLZ Building, VOR Building, Driver's Lounge, Car Parks Toilet
Suspended slab, Columns & Beams, Stairs	35	Control Tower
	28	Passenger Terminal Building, ATC Operation and Administration Building, Fire Station and Airport Maintenance Building, Water Tank & Pump Station,

		Power Houses, Material Recovery Facility
	21	Driver's Lounge, Car Parks Toilet, Guard House, Toll Booth, STP Control Room, LLZ Building, GS Building, VOR Building
Slab on Grade	21	Control Tower, ATC Operation and Administration Building, Fire Station and Airport Maintenance Building, Driver's Lounge, Car Parks Toilet, Toll Booth, Water Tank and Pump Station, STP Control Room, Material Recovery Facility, LLZ Building, GS Building, VOR Building
Parapet walls	21	All buildings other than Passenger Terminal Building and Control Tower

Fc = Specified Compressive Strength at 28 days

(2) Steel Reinforcement

Type	Specification
Deformed Bars 16 mm dia. and larger 10mm dia. and 12 mm dia. (PTB) 10 mm dia. and 12mm dia. (other than PTB)	 ASTM A615 Grade 60 (fy=420 MPa) ASTM A615 Grade 60 (fy=420 MPa) ASTM A615 Grade 40 (fy=280 MPa)
Welded Wire Fabric	ASTM A185

(3) Structural Steel

Type	Specification
Trusses	ASTM A36 (fy= 250 MPa)
Built-up & Rolled Shapes	ASTM A36 (fy=250 MPa)
Plates	ASTM A36 (fy= 250 MPa)
Bolts	ASTM A325 / A490
Anchor Bolts	ASTM F1554 Grade 105

7.2. Design Considerations and Analysis

7.2.1. Deign Loadings

a) Density

Reinforced Concrete	24 kN/m^3
Steel	77 kN/m^3

b) Superimposed Dead Loads

150mm THK masonry / CHB with 20mm plastered	4.14 kPa
Ceiling / Fixtures	0.50 kPa
Mechanical / Electrical / Utilities	0.50 kPa
Floor finishes (30mm topping + 20mm stone tile)	1.20 kPa
Waterproofing + concrete topping + floor finish	2.00 kPa

Metal roofing sheet + insulation	0.30 kPa
Struts + bracing	0.10 kPa
Steel purlins	0.10 kPa

c) Live Loads

Metal roof	0.60 kPa
Corridor / stairways	4.80 kPa
Office	4.80 kPa
Mechanical areas	6.00 kPa
Roof deck	4.80 kPa

d) Wind Load

The evaluation of the effects of wind on an object in its path is complex problem in aerodynamics. When the wind blows against a structure, it exerts a pressure on the windward side and suction on the leeward side. Every structure shall be designed and constructed to resist the wind effects. Wind load design provisions of the revised code are included in Chapter 2, Section 207 of the National Structural code of the Philippines, 6^{th} Edition. This was based on the ASCE Code Provisions for wind and adapted to Philippines conditions.

Design approach according to NSCP is as follows:

(i) Section 207.5 Method 2 Analytical Procedure

$P=qGC_p - q_i(GC_{pi})$

Where:

P = Design Pressure, the equivalent static pressure to be used in the determination of wind loads for building, kPa.

q = velocity pressure, kPa, denotes as:

q_z for windward walls evaluated at height z above the ground, and

q_h for leeward walls, side walls and roofs evaluated at height h.

z = height above ground level, m.

h = mean roof height of a building or height of other structure, except that the eaves height shall be used for roof angle θ of less than or equal to 10°, m.

q_i = velocity pressure for internal pressure determination, kPa, denotes as:

q_h for windward walls, side walls, leeward walls, and roofs of enclosed buildings and for negative internal pressure evaluation in partially enclosed buildings, kPa.

q_z for positive internal pressure evaluation in partially enclosed buildings where height z is defined as the level of the highest opening in the building that could affect the positive internal pressure. For positive internal pressure evaluation, qi may conservatively be evaluated at height h ($q_i = q_h$), kPa.

G = qust effect factor for rigid buildings; also called “simplified dynamic response factor” and is equivalent to G_f with R (resonant response factor) assumed as zero. For rigid building, the gust effect factor shall be taken as 0.85.

C_p = external pressure coefficient to be used in the determination of wind loads for buildings.

(GC_{pi}) = product of internal pressure coefficient and gust effect factor to be used in the determination of wind loads for buildings.

Velocity Pressure qz, in kilopascals, shall be calculated from the equation.

$q_z = 47.3x10^{-6} K_z K_{zt} V^2 I_w$

Where:

V = 200 kph, is basic wind speed, a three second gust speed at ten (10) meters above the ground in Exposure “C” and associated with annual probability of two percent (2%) of being equaled or exceeded (50 year mean recurrence interval), and selected in accordance with the wind zone for the different provinces of the Philippines as Zone 2.

I_w = 1.15, is importance factor in accordance with Occupancy Category I as Essential.

K_z is velocity pressure exposure coefficient evaluated at height z in accordance with exposure category “C”, with case and building height as follows:

Building	Case	z (m)	K_z
Passenger Terminal Building	1	8.77	1.0*
Control Tower	1	32.39	1.28

*Conservative value

K_{zt} = 1.0 is topographic factor according to the topographical feature of the site.

The numerical coefficient, 47.3 x 10-6, shall be used except where sufficient climatic data are available to justify the selection of the different value of this factor for a specific design application.

(ii) Section 207.5.12 Design Wind Loads on Enclosed and Partially Enclosed Buildings

(iii) (Section 207.5.12.2 Main Wind-Force Resisting System (MWFRS)

(iv) Section 207.5.12.2.1 Rigid Buildings of All Heights

e) Earthquake Load

Seismic Code : National Structural Code of the Philippines, Volume 1, 6th Edition, 2010

Seismic Zone : Zone 4, Z=0.40

Importance Factor : 1.5

Site Profile : S_c

Building Base : Level 1, Foundation Level

Design Earthquake Load, $\mathbf{E = \rho E_h + E_v}$

Where:

E=The earthquake load on an element of the structure resulting from the combination of the horizontal component, Eh, and the vertical component, E_v

E_h= The earthquake load due to the base shear, V or the design lateral force, F_p.

E_v= The load effect resulting from the vertical component of the earthquake ground motion and is equal to an addition of $0.5C_aID$ to the dead load effect, D, for Strength Design, and may be taken as zero for Allowable Stress Design.

ρ = Reliability/Redundancy factor as given by the following equation:

$$\rho = 2 - \frac{6.1}{r_{max}\sqrt{A_B}}$$

Where: r_{max} = The maximum element-story shear ratio. For a given direction of loading, the element-story shear ratio is the ratio of the design story shear in the most heavily loaded single element divided by the total design story shear.

AB=The ground floor area of the structure in square meter. For any given Story Level i, the element-story shear ratio is denoted as r_i. The maximum element-story shear ratio r_{max} is defined as the largest of the element story shear ratios, ri, which occurs in any of the story levels at or below the two-thirds height level of the building

Design Base Shear for Static Force Procedure:

Where:

$$V = \frac{C_v I}{RT} W \quad \leq \frac{2.5 C_a I}{R} W$$
$$\geq 0.11 C_a I W$$
$$\geq \frac{0.8 Z N_v I}{R} W$$

V = Total Design Lateral Force or Shear at the Base

Z = Seismic Zone Factor

I = Importance Factor

T = $C_t(h_n)^{3/4}$, Elastic Fundamental Period of Vibration of the Structure, in seconds, in the direction under consideration.

C_t = Numerical Coefficient for Structure

C_a = Seismic Coefficient for Structure

C_v = Seismic Coefficient for Structure

C_a and C_v for all structures is 1.0 since there is no active fault near the project area

N_a = Near Source Coefficient used in the determination of C_a in Seismic Zone 4 related to both the proximity of the building or structure to known faults.

N_v = Near Source Coefficient used in the determination of C_v in Seismic Zone 4 related to both the proximity of the building or structure to known faults.

R = Numerical Coefficient Representative of the Inherent Overstrength and Global Ductility Capacity of the Lateral-Force-Resisting System

Building / Structure	R	I
All buildings other than Control Tower	8.5	1.5
Control Tower	4.5	1.5

W = Total Seismic Dead Load

7.2.2. Load Combinations

(1) For Ultimate Strength Design of Reinforced Concrete

a) Dead Load + Live Load

1.4 x D

1.2 D + 1.6L + 0.5 Lr

b) Dead Load + Live Load + Wind Load

1.2 D + 1.6 L + 0.8W

$1.2\,D + 0.5\,Lr + 1.6\,W + f_1L$

$0.9\,D + 1.6\,W$

c) Dead Load + Live Load + Seismic Load

$0.9\,D + 1.0\,E$

$1.2\,D + 1.0\,E + f_1L$

Where:

D = Dead Load

L = Live Load

L_r = Roof Live Load

W =Wind Load

E = Earthquake Load

f_1 = 1.0 for floors in places of public assembly, for live loads in excess of 4.8 kPa, and for garage live load.

= 0.5 for other live loads

7.3. Analysis

The analysis has been carried out in accordance with the Uniform Building Code (UBC) 1997 and the National Structural Code of the Philippines (NSCP) 2010 6th Edition.

7.3.1. Vertical Load Analysis

Vertical load analysis has been carried out on the foregoing basis of the loads.

Procedure is as follows:

(1) Choose a structural framing system considering the material chosen, use or occupancy and height.

a) Layout the moment resisting framing system.

b) Layout the floor framing system.

c) Use effective (Effective Moment of Inertia) of structural members as 0.70Igross for columns, 0.35Igross for beams.

d) Determine floor slab dead and live load.

e) Analyze and determine required thickness of floor slab.

f) Distribute floor loads to beam using method recommended by ACI.

g) Use a three dimensional model for the structural analysis and apply the corresponding dead and live loads.

7.3.2. Lateral Load Analysis

When code-prescribed wind design produces greater effects, the wind design shall govern, but detailing requirements and limitations prescribed in the Earthquake Design Guidelines of the Uniform Building Code (UBC) shall be followed.

(1) Wind Load Analysis

Wind load analysis has been carried out on the basis of the loads given in 3.2.8. Wind was assumed to come from any horizontal direction. No reduction in wind pressure for shielding effect of adjacent structures.

The base overturning moment for the entire structure, or for any one of its primary lateral-resisting elements, was checked and shall not exceed two thirds of the dead-load-resisting moment. For an entire structure with a height-to-width ratio of 0.5 or less in the wind direction and a maximum height of 60 feet (18,290 mm), the combination of the effects of uplift and overturning was reduced by one-third as allowed by NSCP / UBC. The weight of earth superimposed over footings was used to calculate the dead-load-resisting moment.

Procedure is as follows:

a) Determine design wind pressure at each level.

b) Apply wind load to the three dimensional model.

(2) Earthquake Load Analysis

For all the buildings other than Control Tower are analyzed in ordinary elastic state, while Control Tower is analyzed in elastic design response spectrum for dynamic analysis because of its slender structural profile.

Computer modeling was used in determining the lateral force of the structure where the physical structure including columns and beams and slab are modeled with their true physical size and defined strength so as to get the stiffness of the structure.

Earthquake load analysis has been carried out on the basis of the loads given in 3.2.8. An equivalent static seismic analysis (NSCP C101-10 Section 208.5) was carried out to obtain the scaling factors for the dynamic lateral forces. The dynamic analysis was performed as required by NSCP C101-10 Section 208.6 and the detailed procedure illustrated in NSCP C101-10 Section 208.8. The forces from the dynamic analysis multiplied by the scaling factor have been used throughout the design.

a) Upper bound Analysis (for checking of strong column – weak beam requirements)

The effective moment of inertia of uncracked sections was used for all structural members (columns and beams).

$I_{effective} = I_{gross}$

b) Lower bound Analysis (for comprehensive analysis and design requirements)

Below are the effective moment of inertia used for the structural members.

Columns	:	$I_{effective} = 0.70 * I_{gross}$
Beams	:	$I_{effective} = 0.35 * I_{gross}$

c) Procedure is as follows:

(i) Determine building mass.

(ii) Determine design base shear for static force procedure (NSCP C101-10 Section 208.5).

(iii) Determine minimum accidental torsion as required by NSCP C101-10 Section 208.5.6.

(iv) Perform dynamic lateral response spectrum analysis.

d) Description of Dynamic Analysis Procedure:

(i) Perform the dynamic analysis using the normalized response spectra shapes given by UBC 1997 / NSCP 2010 using an initial acceleration of one (1) g.

(ii) Determine number of modes shapes required to attain a mass participation of at least 90%. UBC requires that at least 90 percent of the participating mass of the structure should be included in the calculation of response for each principal horizontal direction.

(iii) Check base shear from dynamic analysis using an acceleration of one (1) g. Scale the results as required by NSCP C101-10 Section 208.6.5.4.

(iv) Rerun dynamic analysis using the scaled acceleration from Step iii).

(v) Apply minimum accidental torsion requirements.

(vi) Determine requirements for orthogonal effects

(vii) Perform design for structural members.

(viii) Determine the fundamental period (T_B) using the structural properties and deformational characteristics of the resisting elements (Method B).

(ix) Check approximate T of Method A (T_A) versus Method B (T_B). If T_B is smaller than T_A, use T_B and recalculate the minimum required base shear and redo the analysis. If T_B is larger than T_A, we can use T_B and reduce the minimum required base shear. The value of T_B shall not be over 30 percent greater than the value of T_A presented in NSCP C101-10 Section 208.5.2.2.

(x) Check the story drift using forces required in NSCP C101-10 Section 208.5.9.

e) Story Drift Limitation

Calculated story drift using Δm shall not exceed 0.025 times the story height for structures having fundamental period of less than 0.7 second. For structures having a fundamental period of 0.7 second or greater, the calculated story drift shall not exceed 0.020 times the story height.

The maximum inelastic response displacement, Δ_m shall be computed as follows:

$$\Delta_m = 0.7 \text{ x } R \text{ x } \Delta_s$$

7.4. Design of Reinforced Concrete Frame Members

The design has been carried out in accordance with the Uniform Building Code (UBC) 1997, ACI 318-1999 and the National Structural Code of the Philippines (NSCP) 2010 6th Edition.

7.4.1. Design of Frame Beams

a) Determine maximum factored beam loads from DL, LL, WL and EQ analysis.

b) Determine required flexural and shear reinforcement from maximum factored loads.

c) Check beam shear capacity considering the probable moment capacity of the beam using a steel yield strength overstrength factor of 1.25.

7.4.2. Design of Beam-Column Joints

a) Determine maximum shear stress at joints.

b) Check shear stress with allowable shear stress.

In low rise ductile reinforced concrete frames, particularly in those with long-span beams, and also in the top stories of multistory frames, often gravity load rather than seismic force requirements will govern the design strength of beams.

When the strength of the beams is substantially in excess of that required by the seismic lateral forces specified an indiscriminate application of the capacity design philosophy can lead to unnecessary or indeed absurd conservatism, particularly in the design of the columns.

(Reference: Seismic Design of Reinforced Concrete and Masonry Buildings, by T. Paulay and M.J.N. Priestly, 1992, John Wiley & Sons, Inc.)

7.4.3. Design of Columns

a) Determine maximum factored column loads from DL, LL, WL and EQ analysis.

b) Determine required flexural and shear / confinement reinforcement from maximum factored loads.

c) Check beam-column strength ratio (strong column – weak beam principle).

At roof level or the columns in the top story, gravity loads will generally govern the design of beams. Moreover, plastic hinges in columns should be acceptable because ductility demands on columns, arising from a column sway mechanism in the top story, are not excessive. Further, axial compression on such columns are generally small, and hence rotational ductility in plastic hinges can readily be achieved with amounts of transverse reinforcement similar to those used in plastic hinges of beams. Thus at roof level, strength design procedures for flexure are appropriate. Hinge formation at the bottom end of top-story columns is also acceptable. However, in this case transverse reinforcement in the lower end region must also be provided to ensure adequate rotational ductility, and lapped splices of column rebars should then be located at midstory.

(Reference: Seismic Design of Reinforced Concrete and Masonry Buildings, by T. Paulay and M.J.N. Priestly, 1992, John Wiley & Sons, Inc.)

7.4.4. Design of Shear Walls

a) Determine maximum factored from DL, LL, WL and EQ analysis.

b) Check if boundary elements are required.

c) Determine minimum longitudinal and transverse reinforcement's requirements.

d) Determine reinforcement requirements for shear.

e) Check adequacy of boundary elements acting as a short column under factored vertical forces due to gravity and lateral loads.

f) Determine lateral (confinement) reinforcement requirements for boundary elements.

g) Check adequacy of shear wall section at base under combined axial load and bending in the plane of the wall.

Note: The above procedure was used in the design of shearwalls for the Control Tower.

7.4.5. Soil Bearing Capacity for Design

The following geotechnical survey and soil investigation reports are referred to determine the soil design capacity for the detailed design of the foundation system.

a) Final Report on Geotechnical Investigation for the New Panglao-Bohol Airport Development Project prepared by Industrial Inspection (Int'l) Inc. on May 2009 was used for the detailed design of the foundation system and also the following

b) Conduct of Topographic Survey & Geotechnical Investigation for the New Airport Construction ands Sustainable Environment Protection Project at Panglao, Bohol by Universal Testing Laboratory and Inspection, Inc. conducted on 2013.

c) Draft Engineering Report for the Panglao Airport Project GPR Survey, Panglao, Bohol, 2009, by EM^{2}A Partners & Co.

Based on the reports and its considerations/conclusions, the soil bearing capacity for design has been determined as 250 kPa for shallow spread footings for the buildings other than Control Tower and mat footing for Control Tower. Special consideration has been taken to the essential buildings, i.e. Passenger Terminal Building and Control Tower, ATC Operation and Administration Building, for the depth of footings. As recommended in the soil investigation report, for the purpose to bypass the possible cavities/sinkholes that are often found in the Karst terrain, the elevation of the bottom of footings of the abovementioned buildings are set at EL + 4.50m, which is 2.50m below an reference natural ground line established as El + 7.00m taking the results of topographic survey into consideration. Moreover, the initial soil survey at footing points of those buildings and the subsequent soil improvement in case that the cavities/sinkholes are encountered during the survey, are included in the requirements of technical specifications.

7.5. Section Size of Main Structural Elements for Major Buildings

Buildings	Elements	Location	Dimensions	Remarks
Passenger Terminal Building	Columns	Ground Floor	600 x 600	reinforced concrete
		Roof deck level	250 x 250	steel square hollow section
	Beams	Roof deck level	360 x 1000	reinforced concrete
			400 x 800	reinforced concrete
			360 x 580	reinforced concrete
		Roof	H-300 x 250	steel
Control Tower	Shear Wall	shaft	400mm THK	reinforced concrete
	Column	cabin	300 x 300	built-up steel
	Beam	cabin roof	H-460 x 190	steel

CHAPTER 8

DESIGN OF AIR NAVIGATION FACILITIES

TABLE OF CONTENTS

Chapter 8 Design of Air Navigation Facilities

8.1. General

The facility requirements for navigation aids are determined from the following planning parameters and the results are summarized in Table 8.1-1.

Operational Requirements

New Bohol Airport is:

- To be utilized for domestic and international flights;
- To be utilized in after-dark-operation;
- To require Precision Approach Category 1; and
- To meet ICAO standards and recommended practices.

Air Navigation Aids Facility Layout Plan is shown in Figure. 8.1-1.

8.1.1. Facilities for Basic Design

(1) Radio Navigation and Visual Aids Facilities

D-VOR/DME (Doppler-VHF Omnidirectional Range / Distance Measuring Equipment) is required to provide pilots with navigational signals to determine their position continuously to maintain the assigned flight path while flying to or from the Panglao, Bohol Airport.

ILS, PALS, RWL, etc. are required to operate and be maintained adequately as essential navaids to conduct precision approach Category-I and landing to the main runway.

(2) Visual Aids Facilities

Visual Aids Facilities shall consist of the Cat-I Precision Approach Runway at RWY 21 side, non-precision approach runway at RWY 03 side, and runway and taxiway lights for night operation. Visual Aids Facilities shall be designed in accordance with ICAO Annex 14.

(3) ATS (Air Traffic Services) and Telecommunication Facilities

These facilities, services and operational procedures are required to form an integrated system designed to meet the requirements of all civil aircraft operations in the airport.

Also, each component of these facilities is required to operate and to be maintained at an adequate performance level of ICAO standards and recommended practices.

(4) Meteorological Facilities

These facilities and their services are required to meet the requirement of precision approach Category- I and all civil aircraft operation at the airport.

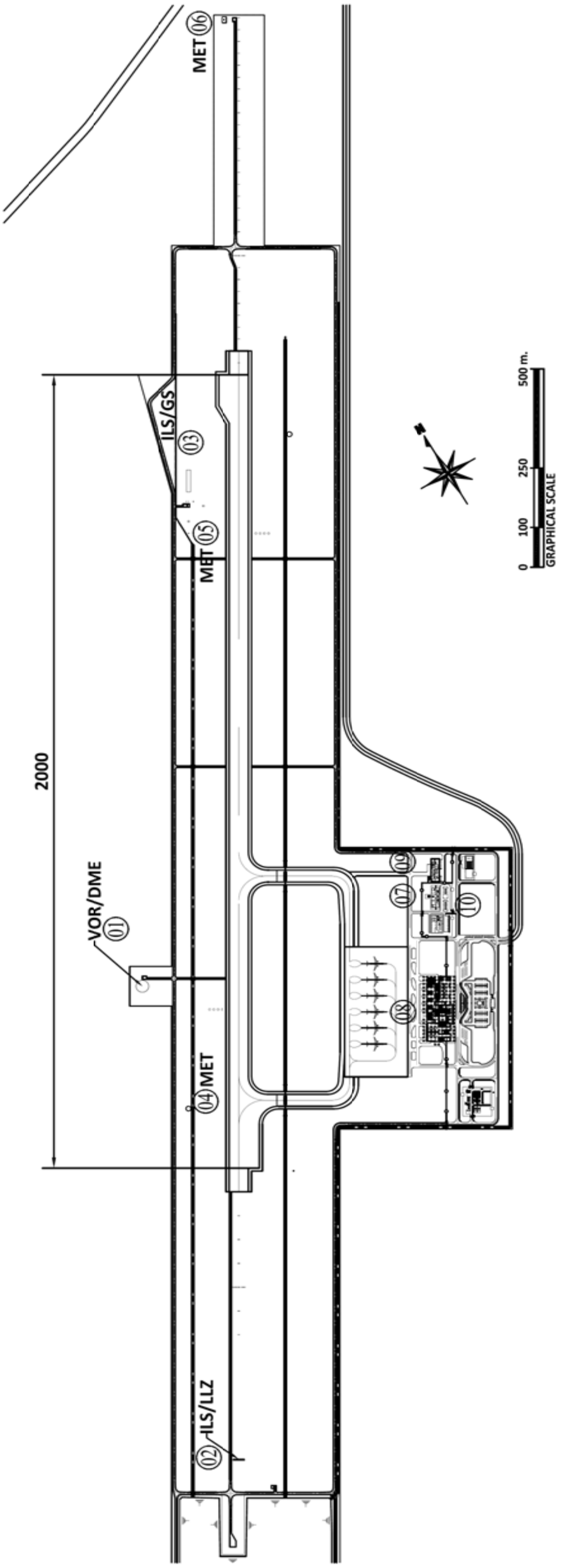
Also, each component of these facilities is required to operate and be maintained at an adequate performance level to meet ICAO and WMO standards for Aeronautical Weather Observation and Data delivery.

Table 8.1-1 Facility Requirements for Air Navigation Aids

FACILITY	ITEM	GENERAL REQUIREMENT	
		DESCRIPTION	REMARKS
Radio Navaids	ILS	ILS Cat-I	Landing Aids for RWY 21/Facility Performance Cat-I
	VOR/DME	D-VOR/DME	Landing and Take off Aids
Visual Aids	AGL	PALS	RWY 21
		SALS	RWY 03
		PAPI	RWY 03/21
		REDL	RWY
		RTHL/ RENL	RWY 03/21
		WBRL	RWY 21
		TEDL	TWY
		TXGS	TWY
		Turning Point Indicator	RWY 03/21
		WDIL	RWY 03/21
		Apron Flood	Apron
ATS Facilities	ATC Consoles	ATC Consoles	Approach, Aerodrome/Ground, FD/AUX and Supervisor
	VCCS	VCCS	ATC A/G and Fixed Communications
		Voice Recorder (Recorder/Reproducer)	ATC Communication Recording
	Signaling Light	Light Gun	Emergency system
	Siren	Alarm Signal	Alarm for Runway Clearance
Telecommunication Facilities	Air to Ground	VHF TX 2 freq.	Aerodrome and Emergency A/G Communications
		VHF RX 2 freq.	Ditto
		TRCV Multi channels	Ditto for Back up (for each Frequency)
	*AMHS	*AMHS Server	ATS Fixed Communications
		*Terminal	User Terminals for AMHS
	*AIS	*Terminal	AIS Terminal
	Ground to Ground	HF Transceiver	ATS G/G Communications
	*Ground to Ground	*VSAT	ATS G/G Communications
Meteorological Facilities	Observation System	Transmissometer	RVR observation
		Ceilometer	Ceiling Sensor
		Anemometer	Wind Sensor
		Barometer	Atmospheric Pressure Sensor
		Thermometer	Temperature Sensor
		Hygrometer	Dew Point Sensor
		Wx Data Processing and Display System	Weather data logging, processing and Weather data Display

*Note: The System implementation is not included in the scope of design. This is designed to be executed by others under a separate contract.

Source: JICA Study Team



No.	Facility	Work section	Remarks
1	ILS LLZ Antenna	ILS	LLZ site
2	ILS GS/TDME Antenna	ditto	GS/TDME site
3	VOR/DME Antenna	VOR/DME	VOR/DME site
4	MET WS/WD Sensor	MET	MET site (Runway 03 side)
5	MET WS/WD, Dew point, Temperature, Pressure Sensor and RVR	ditto	MET site (Runway 21 side)
6	MET Ceilometer	ditto	Near to end of PALS
7	Cotrol Tower, Operation and Admin. Building	ATS/ILS/VOR/MET	
8	Passenger Terminal Building	ATS	
9	Fire Station and Maintenance Building	ATS/MET	
10	HF Antenna Tower	ATS	

Source: JICA Study Team

Figure 8.1-1 ANS, ATS and MET Facilities Layout Plan

8.2. Radio Navigation Aids

The radio navigation facilities aids required for Cat-I ILS operation are outlined hereunder.

Figure. 8.2-1 shows the schematic system diagram of the radio navigation aids.

8.2.1. ILS

ILS will be installed at the airport and will be operated for Cat-I precision approach.

Figure 8.2-2 and Figure 8.2-3 show the ILS facility layout plan, consisting of the following components.

(1) LLZ

LLZ transmitter shall be 2-frequency type to prevent future interference caused by the vicinity of future buildings.

LLZ shall have the secondary engine generator power source to prevent power failure caused by commercial power.

LLZ equipment is planned to be installed in the LLZ building in consideration of the tropical condition and ease of maintenance.

LLZ building shall not be installed in the LLZ critical area.

(2) GS

GS system shall be 2-frequency Capture Effect type to provide good signal performance.

GS shall have a secondary engine generator power source to prevent power failure caused by commercial power. This shall also supply the secondary power to T-DME equipment.

GS equipment is planned to be installed in the building with T-DME in consideration of the tropical condition and ease of maintenance.

GS antenna shall be set at 120m west of the runway centerline and approximately 300m away from the RWY 21 threshold. This position shall require recalculation using the final runway strip design.

GS building shall not be installed in the GS critical area.

(3) T-DME

At the airport, T-DME is planned to be used as ILS distance information facility instead of markers in consideration of the ease of operation and maintenance.

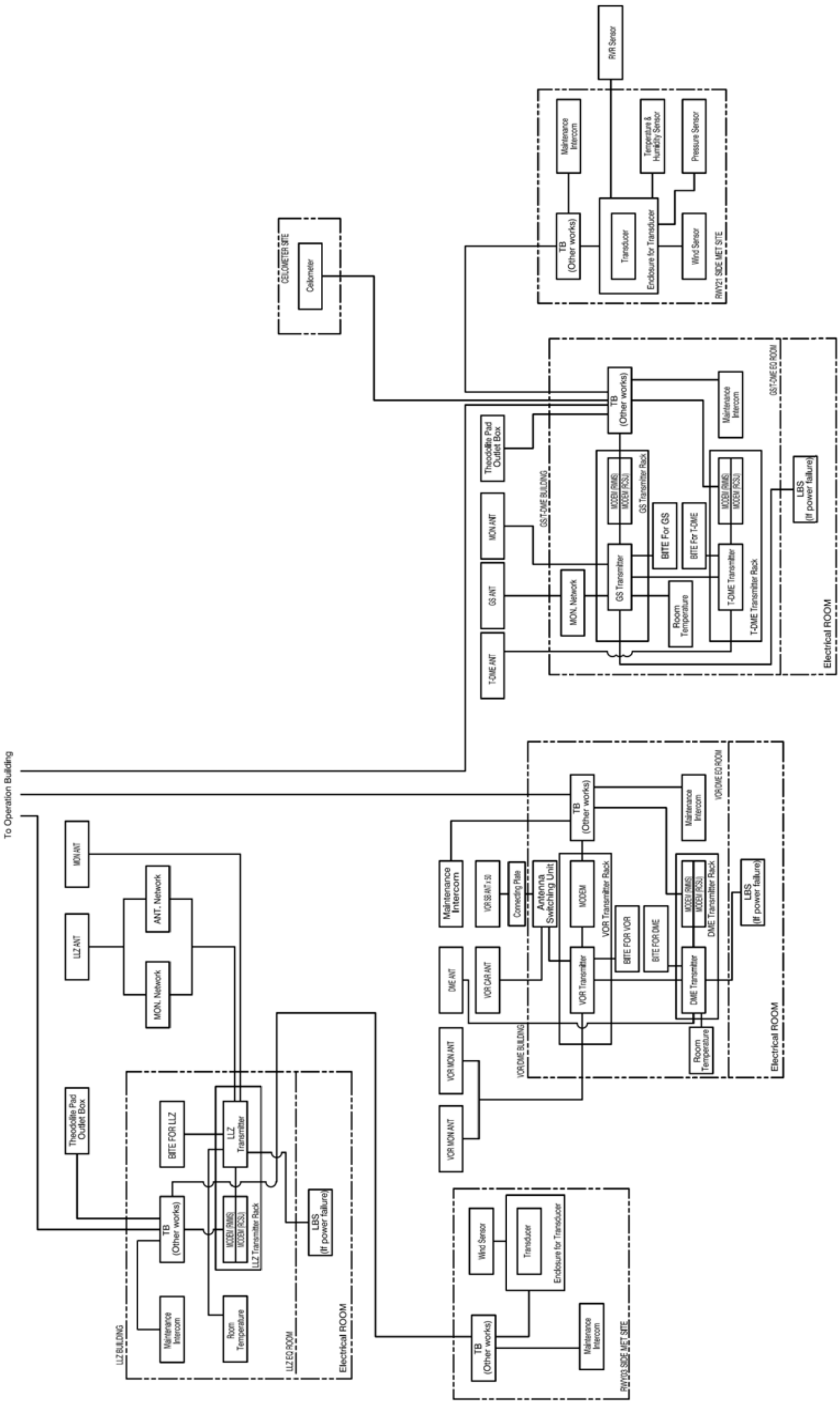
T-DME equipment shall be installed in the GS building and the T-DME antenna shall be set at 10m west of the GS antenna and approximately 300m away from the RWY 21 threshold.

Table 8.2-1 shows the basic specifications of ILS.

Table 8.2-1 Basic Specifications of LLZ, GS & T-DME

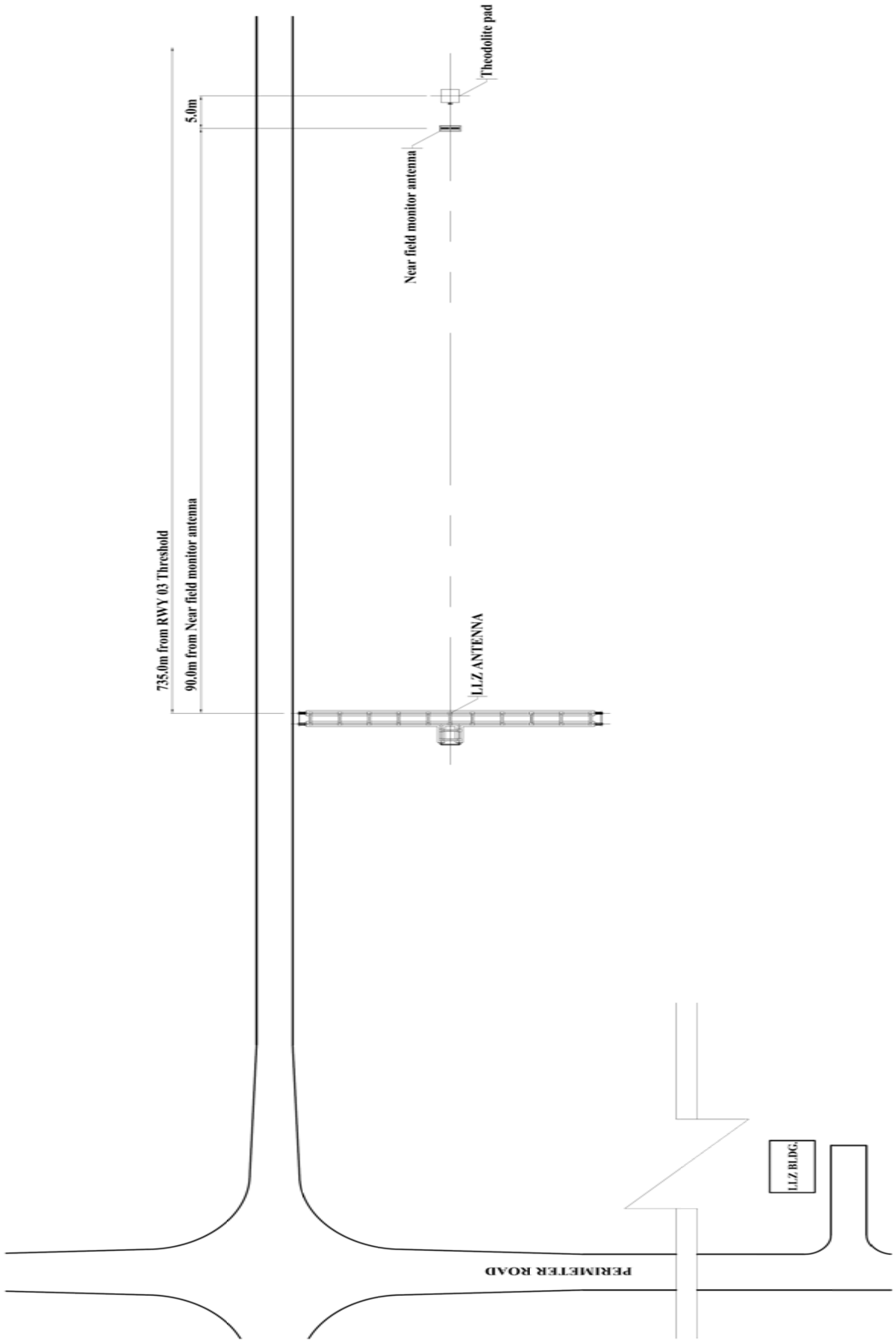
ITEM	SPECIFICATIONS
LLZ	Cat- I operation
Transmitter	Dual Configuration 2-Freq. Type
Antenna	LPDA 24 elements
Building	With dual air conditioner
Power Supply	With Battery
GS	Cat- I operation
Transmitter	Dual Configuration 2-Freq. Type
Antenna	2-Freq. Capture Effect Type
Building	With dual air conditioner
Power Supply	With battery
T-DME	Cat- I operation
Receiver	Dual Configuration
Transponder	Dual Configuration 100W
Antenna	Directional type. (Mutual Interference with VOR/DME shall not be expected)
Power Supply	With battery
RMMS	Number of monitoring and control items shall meet the requirement for its operation and maintenance. Remote Monitoring and Maintenance System can send the signals to the Manila Center.
Navaids Monitor	To monitor the status of radio navaids

Source: JICA Study Team



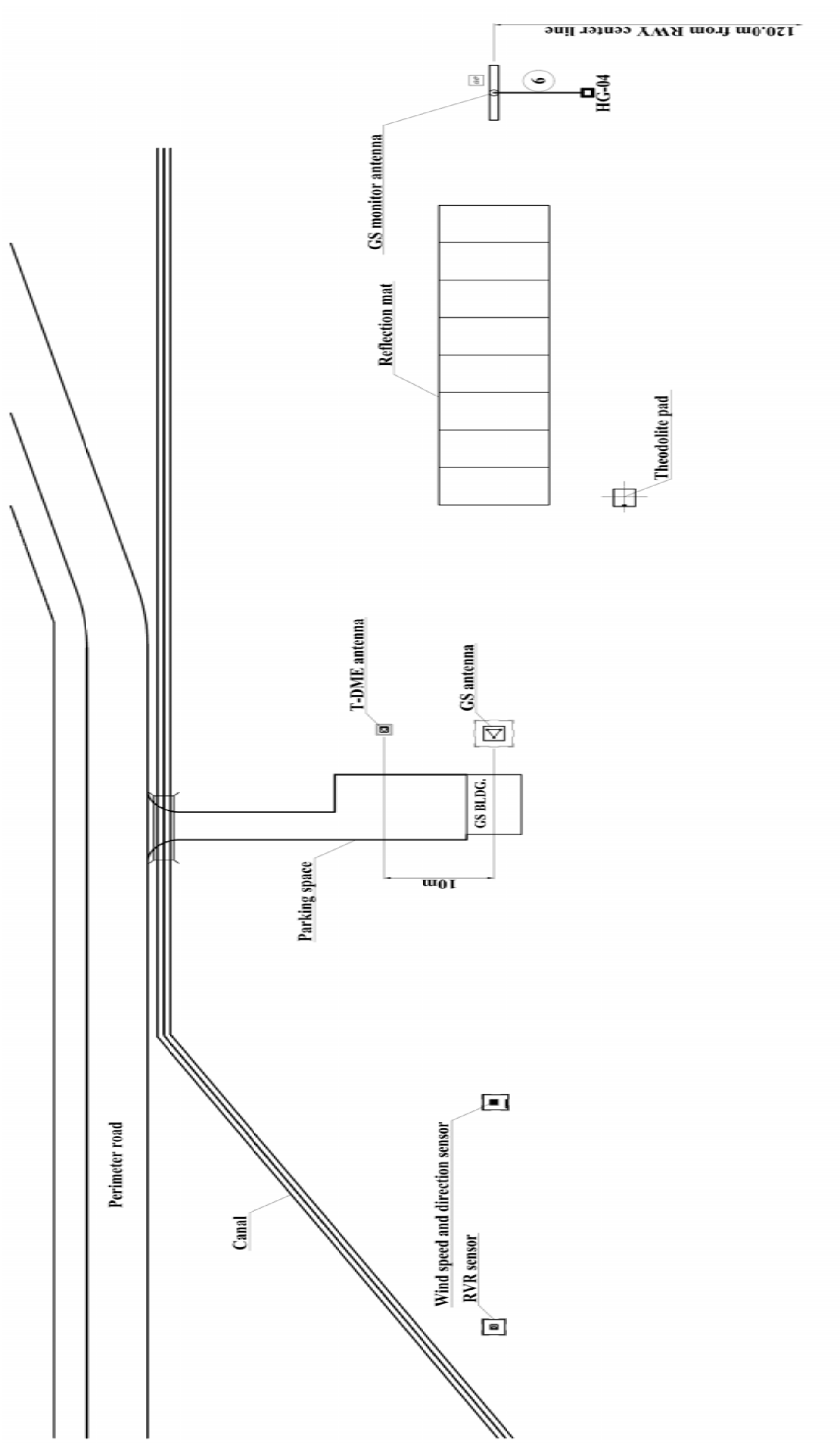
Source: JICA Study Team

Figure 8.2-1 Radio Navigation Aids System Diagram



Source: JICA Study Team

Figure 8.2-2 LLZ Site Layout Plan



Source: JICA Study Team

Figure 8.2-3 GS/T-DME Site Layout Plan

8.2.2. VOR/DME

D-VOR/DME will be installed at the airport and will consist of D-VOR and DME.

Power Feeder to D-VOR/DME is planned to be installed via the underground piping from power house.

Figure 8.2-4 shows the VOR/DME Facility Layout Plan.

(1) D-VOR

VOR shall be D-VOR Type.

Output Power of VOR is 100W.

VOR is planned to be installed to the west of the runway.

(2) DME

Output Power of DME is 1 kW.

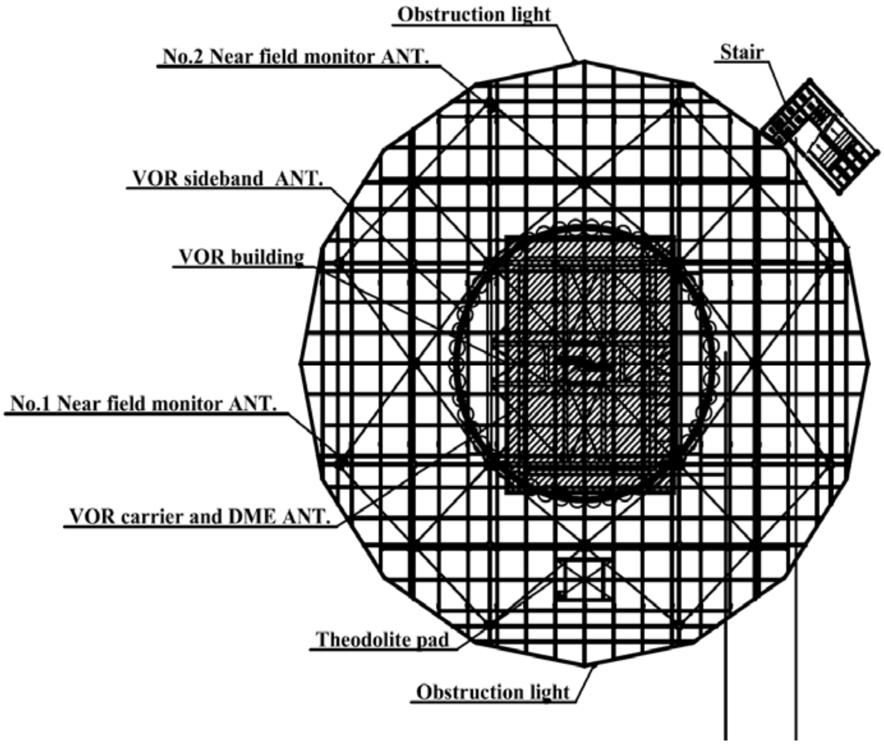
DME Antenna shall be coaxial installation with VOR Antenna system.

Table 8.2-2 shows the basic specifications of VOR/DME.

Table 8.2-2 Basic Specifications of VOR / DME

ITEM	SPECIFICATIONS
D-VOR	
Transmitter	Dual Configuration 100W
Antenna	Alford Loop elements
	SB 48 elements
Field Monitor	Two monitor system
Counterpoise	30m in diameter
Power Supply	With battery (Uninterrupted power source)
DME	
Receiver	Dual Configuration
Transponder	Dual Configuration 1 kW
Antenna	Non-directional type.
Power Supply	With battery (Uninterrupted power source)
RMMS	Number of monitoring and control items shall meet the requirement for its operation and maintenance. Remote Monitoring and Maintenance System can send the signals to the Manila Center.
Navaids Monitor	To monitor the status of radio navaids Prepared by ILS portion.

Source: JICA Study Team



Source: JICA Study Team

Figure 8.2-4 VOR/DME Facility Layout Plan

8.3. ATS and Telecommunication Facilities

ATS and Telecommunication System for the new airport shall consist of control consoles with VCCS (Voice Communication Control System) and telecommunications facilities.

Figure 8.3-1 shows the ATS and telecommunication schematic system diagram.

8.3.1. Control Consoles and VCCS

Control console shall consist of the following:

- Approach Control Console
- Aerodrome Control Console
- F/D and Aux. Console
- Supervisor Console
- Others

VCCS shall consist of following components.

- VCCS
- Voice Recorder/Reproducer
- Master Clock

Table 8.3-1 shows the basic specifications of control consoles and VCCS.

Table 8.3-1 Basic Specifications of Control Consoles and VCCS

ITEM	SPECIFICATIONS
Aerodrome Control Console	A/G Frequency Emergency Frequency Direct Speech Circuits for MANILA ACC and MACTAN TMA Emergency Frequency Inter Console Channels Flight Strip Holder (SMC VHF FM Transceiver) (Crash Phone) (Signaling Light) (Weather Data Display) (Siren) (Slave Clock)
F/D and Aux. Console	Direct Speech Circuits for MANILA ACC and MACTAN TMA Inter Console Channels Flight Strip Holder (Slave Clock) (Navaids Monitor) (HF SSB Control and Speaker)
Approach Control Console	A/G Frequency Emergency Frequency Direct Speech Circuits for MANILA ACC and MACTAN TMA Inter Console Channels Flight Strip Holder (Weather Data Display) (Slave Clock)
Supervisor Console	All Frequency Direct Speech Circuits for Manila ACC and MACTAN TMA Inter Console Cannel with override function (Slave Clock)
Others	Crash Phone with Fire Station Signaling Light at Aerodrome Control Position Siren for Runway Clearance
VCCS	To control Radio Channels, Fixed Voice Channels for ATC Control Consoles Radio channel: 6ch Direct Speech Circuits: 6ch Intercom: 24ch

Voice Recorder/ Reproducer	Voice recorder shall be dual configuration and shall record all ATC communications among controllers and pilots without missing time. Digital 40ch is required.
Master clock	Master clock shall distribute the time to each slave clock for ATC operation.

Source: JICA Study Team

8.3.2. Telecommunication

Telecommunication facilities consist of the following.

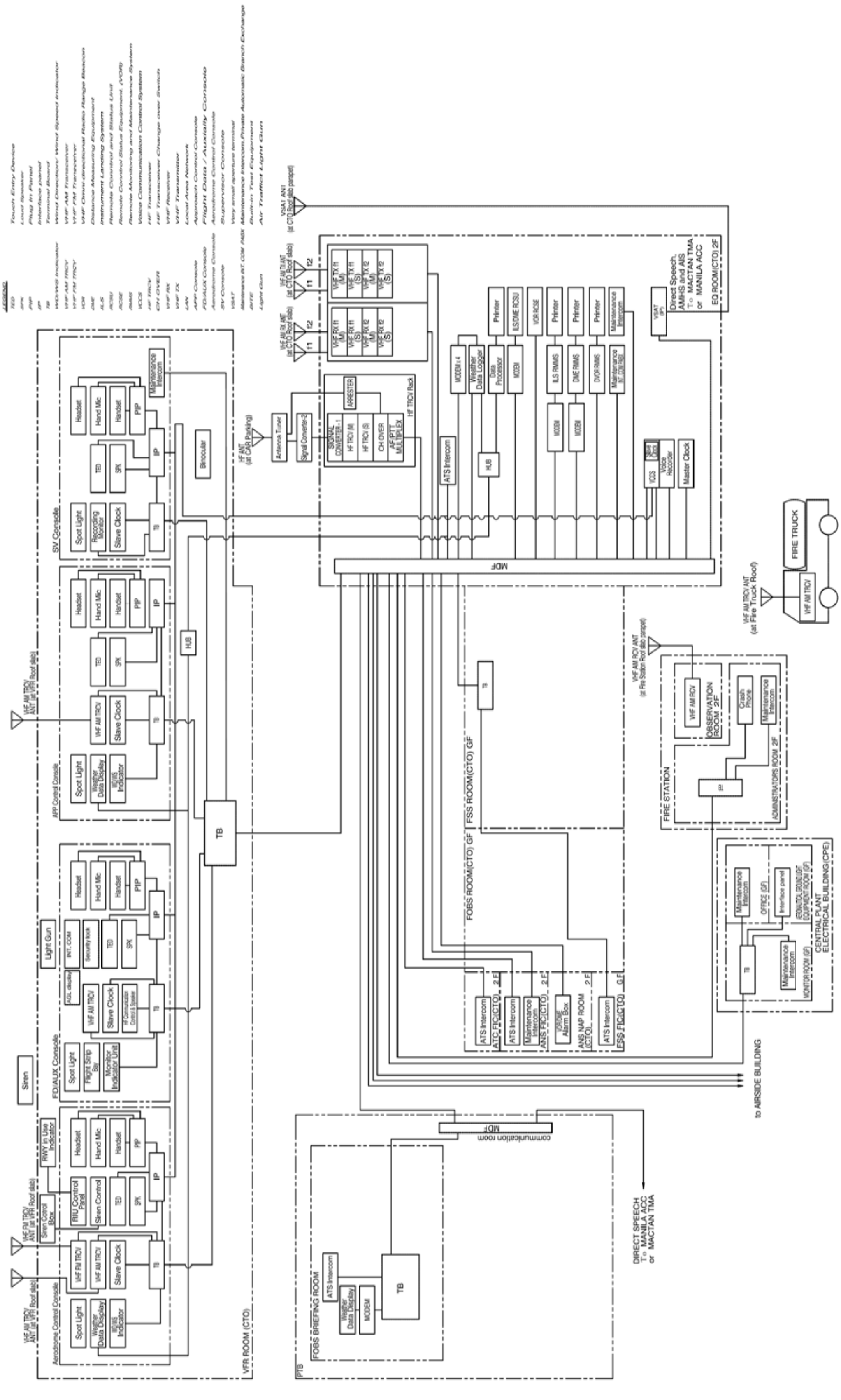
- VHF AM Air to Ground Communications Facility
- VHF FM Airport Surface Movement Control Facility
- Direct speech Circuits Facility (Including VCCS function)
- HF communications Facility
- Intercom for maintenance

Table 8.3-2 shows the Basic Specifications of Telecommunication Facilities.

Table 8.3-2 Basic Specifications of Telecommunication Facilities

ITEM	SPECIFICATIONS
VHF AM A/G	50W TX dual configuration (Dual 2 Freq.) RX dual configuration (Dual 2 Freq.) VDL Mode 2 Air Band (117.975 to 137 MHz) Band Separation: 25 kHz Antenna shall be installed on the rooftop of Operation Building.
	Single configuration Base Station Type 10W TRCV for 2 frequencies at VFR Room. (total 2 sets) 1 Single configuration Mobile Type 10W TRCV for Fire Engine.
VHF FM SMC	Single configuration 10W TRCV at VFR Room. 6 Handy talky type TRCV.
Direct Speech Circuits	Including VCCS and Console System
HF Comm.	100W HF TRCV (dual) at EQ room. HF communication control & speaker at VFR Room. HF Antenna at field.
Inter Comm.	Intercom for maintenance shall be provided so as not to disturb the ATS operations whenever some equipment is under maintenance.

Source: JICA Study Team



Source: JICA Study Team

Figure 8.3-1 ATS and Telecommunication Schematic System Diagram

8.4. Meteorology Facilities

Meteorology facilities consist of Aeronautical Weather Observation System and Weather Data Processing and Display System.

8.4.1. Aeronautical Weather Observation System

Aeronautical Weather Observation System shall consist of following:

- Transmissometer with RVR converter
- Ceilometer
- Anemometer
- Thermometer
- Hygrometer

All weather data shall be treated as digital data.

Figure 8.4-1 shows the Aeronautical Weather Observation System Schematic System Diagram.

Table 8.4-1 shows the Aeronautical Weather Observation System Specifications.

Table 8.4-1 Basic Specifications of AWOS

ITEM	SPECIFICATIONS
Transmissometer	RVR Sensor shall be installed near the touch down point of Precision Runway 21. RVR Sensor will be scattered type.
Ceilometer	Ceilometer shall be installed near the cat-I decision point, and shall not penetrate the PALS light plane. Ceilometer shall be laser transmission type.
Anemometer	Anemometer shall be installed near the touch down point of both Runway (03,21) Runway 03 Anemometer shall be supersonic type sensor as required by CAAP.
Thermometer	Thermometer shall measure the typical airport temperature. Thermometer shall be installed at Runway 21 Weather observation field.
Hygrometer	Hygrometer shall measure the typical airport humidity to find out dew point temperature. Hygrometer shall be installed at Runway 21 Weather observation field.
Barometer	Barometer shall measure the QFE and QNH. Hygrometer shall be installed at Runway 21 Weather observation field.

Source: JICA Study Team

8.4.2. Weather Data Processing and Display System

Weather Data Processing and Display System (WDPDS) consists of the following.

(1) Weather Data Processing System

Weather Data Processing System shall collect the weather data from the weather observation system, edit to the METAR and SPECI format and store this data.

Processed Data shall be distributed to each Weather Data Display Terminal using LAN and/or modem interface.

(2) Weather Data Display system

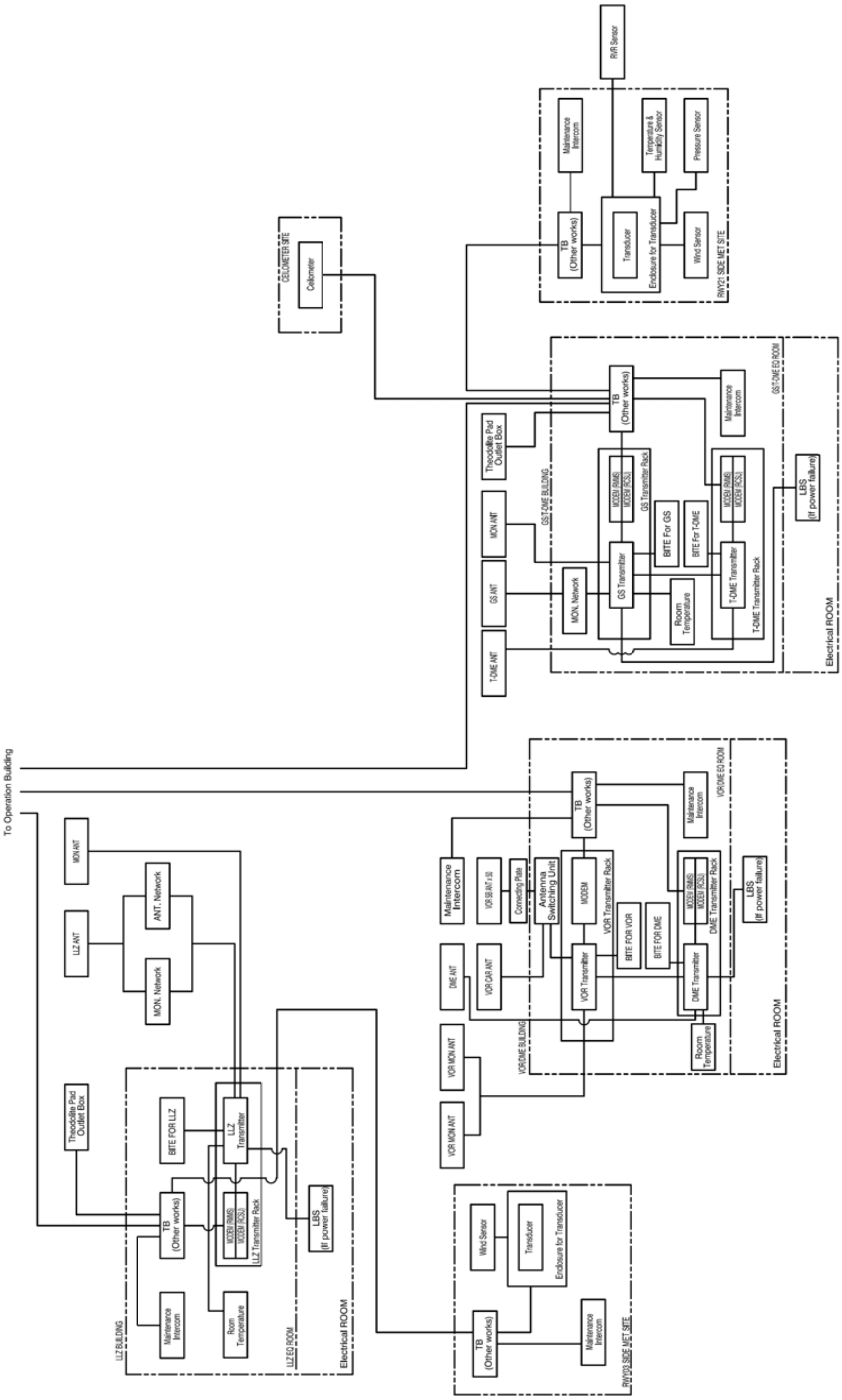
Weather Data Display system shall display the weather data from the weather data processing system.

Table 8.4-2 shows the Aeronautical Weather Data Processing and Display System Specifications.

Table 8.4-2 Basic Specifications of WDPS

ITEM	SPECIFICATIONS
Weather Data Processing System	Weather Data Processing System shall use PC type Processor. Weather Data Processing System shall be installed at EQ Room.
Weather Data Display system	PC based weather display terminal shall display the following data: - Wind speed - Wind direction - Atmospheric Pressure in QNH and QFE - Runway Visual Range - Ceiling Height - Temperature - Dew point - Runway in use Weather Data Display Terminal shall be installed in the following Rooms: - FOBS Office (PTB) - VFR Room ✓ Approach Control Position ✓ Aerodrome Control Position

Source: JICA Study Team



Source: JICA Study Team

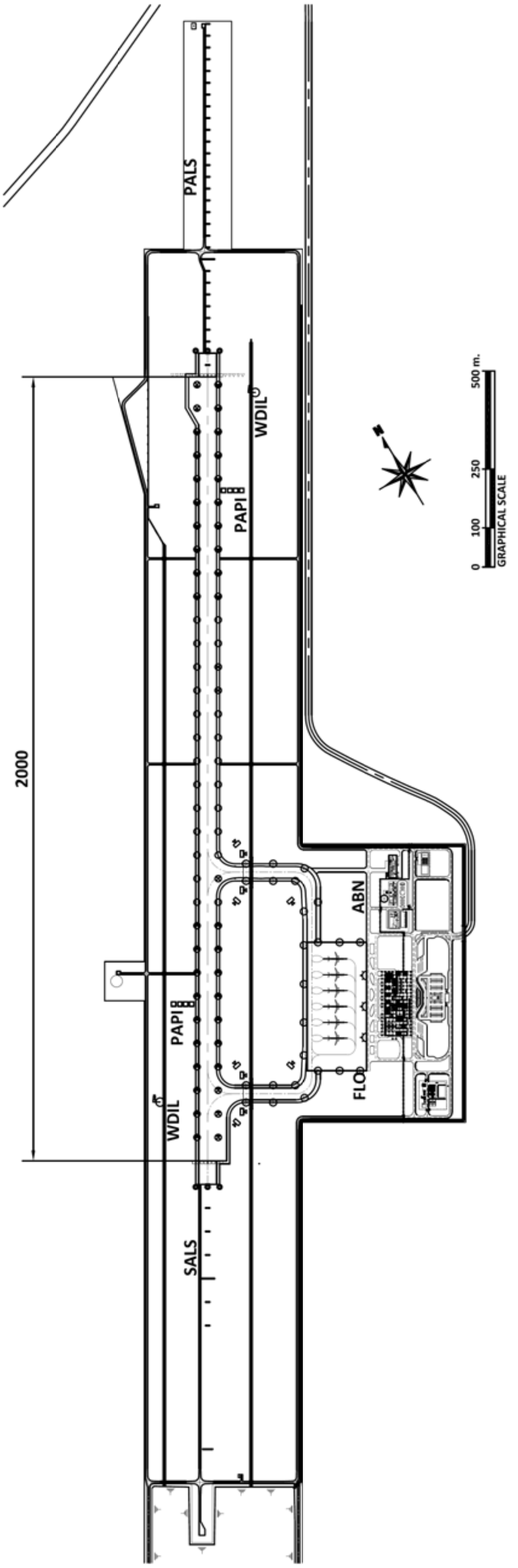
Figure 8.4-1 Schematic Diagram for Aeronautical Weather Observation System

8.5. Visual Aids

The light system shall provide necessary lights for precision approach runway, Cat-I for RWY 21 side and non-precision approach runway for RWY 03 side and for night operation and usage in accordance with ICAO Annex 14. (Refer to Figure 8.5-1)

- Precision approach lights system for Cat – I (RWY 21 side)
- Simple approach lights system (RWY 03 side)
- PAPI System (RWY 21 and 03 sides)
- Runway edge lights
- Runway threshold lights (RWY 21 and 03 sides)
- Threshold wing bar lights (RWY 21 side)
- Stop way lights (RWY 21 and 03 sides)
- Taxiway edge lights
- Taxiing guidance signs (Mandatory instruction signs and information signs)
- Wind direction indicators (RWY 21 and 03 sides)
- Aerodrome beacon (Roof top of control tower)
- Obstacle lights
- Apron floodlighting

Approach lights system, runway edge lights, runway threshold and wing bar lights are high-intensity lights with suitable intensity control system.



SYMBOL	ABREVIATION	LIGHTS	LIGHTING FIXURE	
			COLOR	TYPE
	PALS	PRECISION APPROACH LIGHTING SYSTEM	WHITE	ELEVATED UNIDIRECTION
	PALS	PRECISION APPROACH LIGHTING SYSTEM	WHITE	SURFACE UNIDIRECTION
	SALS	SIMPLE APPROACH LIGHTING SYSTEM	WHITE	ELEVATED UNIDIRECTION
	PAPI	PRECISION APPROACH PATH INDICATOR	WHITE/RED	ELEVATED UNIDIRECTION
	REDL	RUNWAY EDGE LIGHTS	WHITE/YELLOW, WHITE/WHITE	ELEVATED BIDIRECTION
	REDL	RUNWAY EDGE LIGHTS	WHITE/YELLOW, WHITE/WHITE	SURFACE BIDIRECTION
	STWL	STOPWAY LIGHTS	RED	ELEVATED UNIDIRECTION
	TPEL	TURNING PAD EDGE LIGHTS	BLUE	ELEVATED UNIDIRECTION
	RTHL	RUNWAY THRESHOLD LIGHTS	GREEN	ELEVATED UNIDIRECTION
	RENL	RUNWAY END LIGHTS	RED	ELEVATED UNIDIRECTION
	WBAR	WING BAR LIGHTS	GREEN	ELEVATED UNIDIRECTION
	TEDL	TAXIWAY EDGE LIGHTS	BLUE	ELEVATED OMNIDIRECTION
	TXGS	TAXIING GUIDANCE SIGN	WHITE LETTER W/ RED BACKGROUND OR BLACK W/ YELLOW BACKGROUND	
	WDIL	WIND DIRECTION INDICATOR LIGHTS	WHITE	
	ABN	AERODROME BEACON	GREEN / WHITE	
	FLO	APRON FLOOD LIGHT	WHITE	

Source: JICA Study Team

Figure 8.5-1 Visual Aids Facilities Layout Plan

8.5.1. Precision Approach Lighting System (PALS) (RWY 21 side)

PALS consists of a row of lights on the extended centerline of the runway extending over a distance of 900m from the runway threshold, with a row of lights forming a crossbar 30m in length at a distance of 300m from the runway threshold.

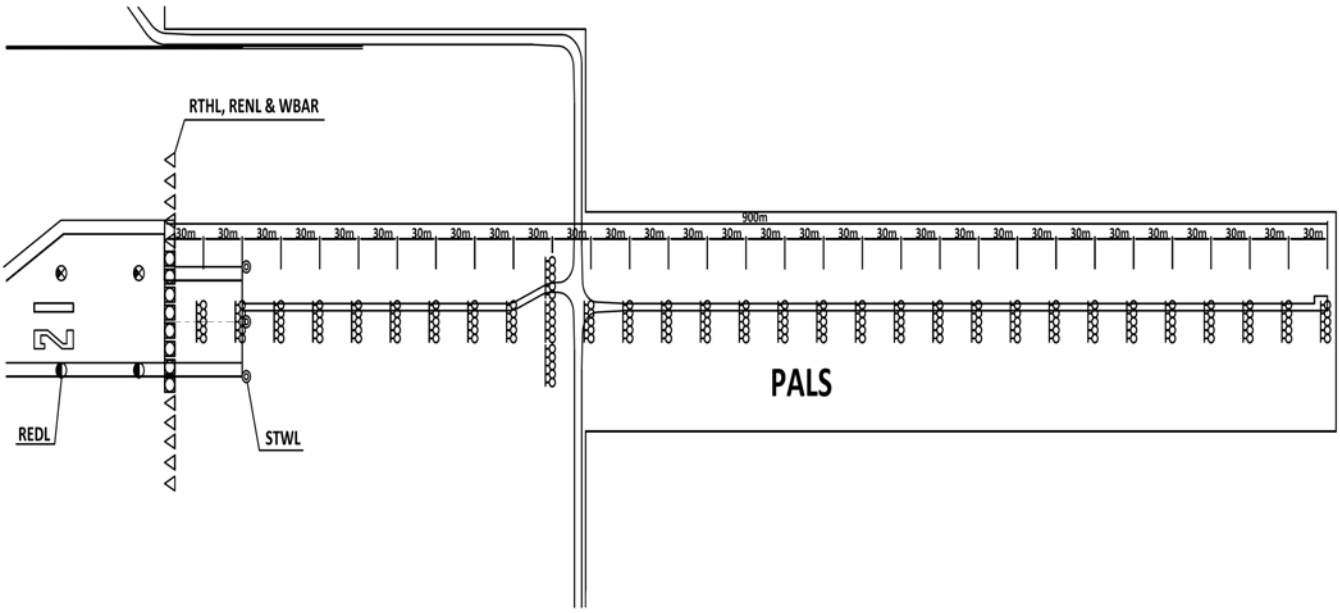
The lights forming the centerline are placed at longitudinal intervals of 30m with the innermost light located 30m from the threshold.

The centerline barrettes consist of 5 lights 4m in length spaced at intervals of 1m.

The crossbar consists of 16 lights 30m in length spaced at intervals of 1.5m with a gap of 9m.

Five (5) surface lights will be installed in the pavement of the runway outside.

The lights in the area which is beyond approximately 180m from the end of a runway will be installed on poles of 1.8m or appropriate height to avoid obscuring or shielding the pilot's view of features such as trees, houses and building outside of the boundary line of the approach lighting land area of 120m width. (Refer to Figure 8.5-2)



Source: JICA Study Team

Figure 8.5-2 PALS Layout Plan

8.5.2. Simple Approach Lighting System (SALS) (RWY 03 side)

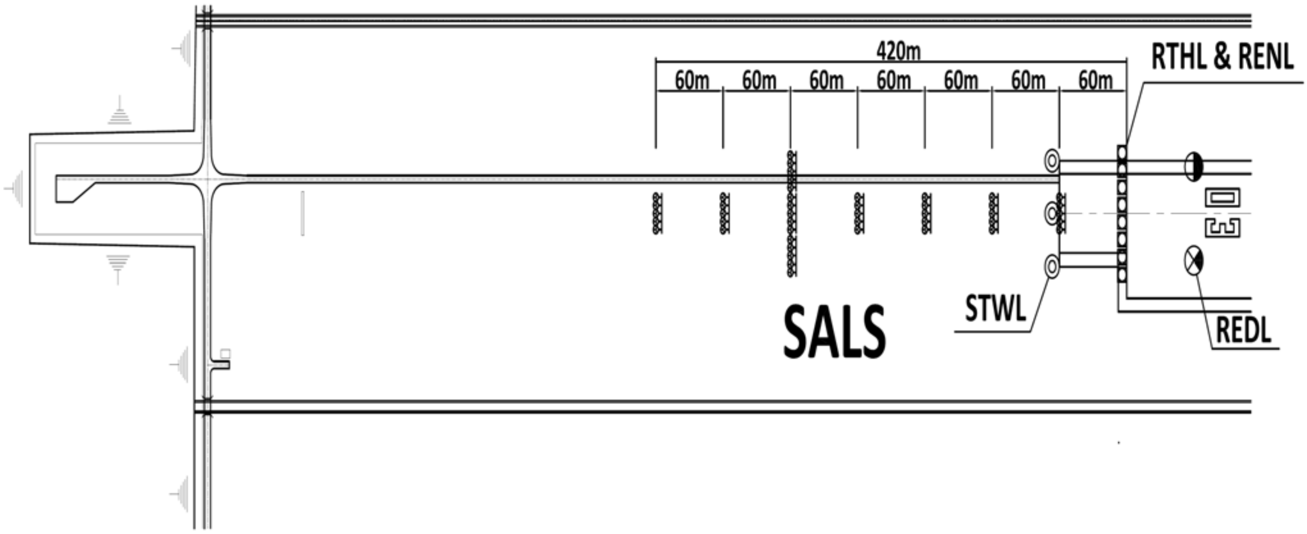
SALS consists of a row of lights on the extended centerline of the runway extending over a distance of 420m from the runway threshold, with a row of lights forming a crossbar 30m in length at a distance of 300m from the runway threshold.

The lights forming the centerline are placed at longitudinal intervals of 60m with the innermost light located 60m from the threshold.

The centerline barrettes consist of 5 lights 4m in length spaced at intervals of 1m.

The crossbar consists of 16 lights and 30m in length spaced at intervals of 1.5m with a gap of 9m.

The lights in the area which is beyond approximately 200m from the end of a runway will be installed on poles of 1.8m or appropriate height to avoid obscuring or shielding the pilot's view of features such as trees, houses and buildings outside of the boundary line of the approach lighting land area of 120m width. (Refer to Figure 8.5-3)



Source: JICA Study Team

Figure 8.5-3 SALS Layout Plan

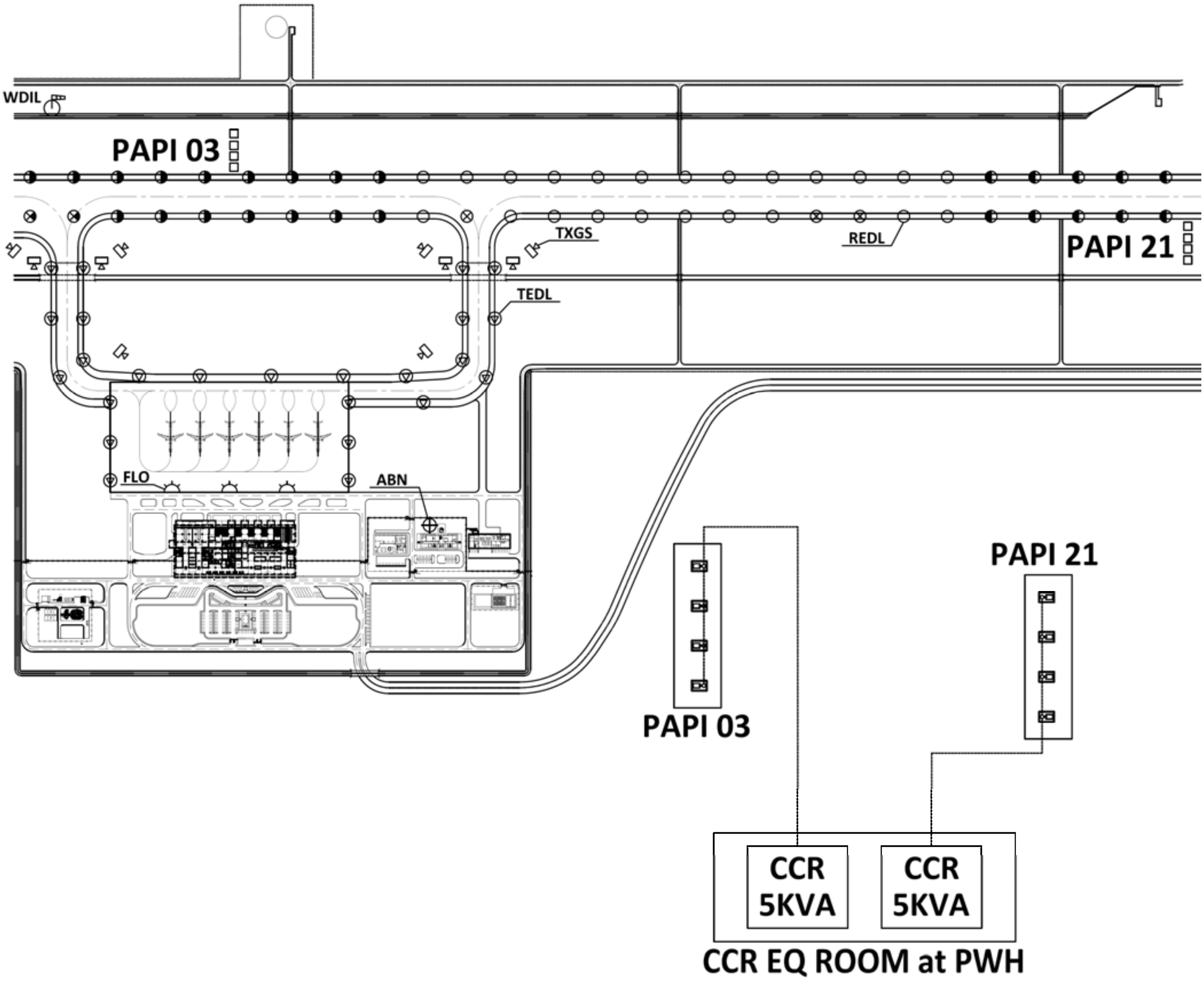
8.5.3. PAPI System

The PAPI system consists of a wing bar of 4 sharp transition 3 single lamps units equally 9m spaced. The first wing bar will be located on the left side of the runway and the second one provided on the opposite side of runway. (Refer to Figure 8.5-4)

The light units will be located to allow for the wheel clearance over the threshold of 9m for the most large aircraft model regularly using runway. (i.e. Airbus A320)

The location of light units will be adjusted to compensate for difference in elevation between the lens center of the light units and the runway threshold.

The light units of PAPI system for RWY 21 side will be located so that its on-slope signal will coincide with that for the ILS glide path down to the minimum range from the system. Normally height of beam of ILS glide path is 15m plus 3m / minus 0m over the threshold.



Source: JICA Study Team

Figure 8.5-4 PAPI Layout Plan

8.5.4. Runway Edge Lights

Runway edge lights will be placed along the outside edges of the runway area at a distance of 3 m.

The lights will be uniformly spaced in rows at intervals of 60 m.

8.5.5. Runway Threshold and Wing Bar Lights, Runway End Lights

The threshold lights will be located in a row at right angles to the runway axis as not more than 3.0m outside the extremity.

The elevated lights will be installed symmetrically disposed about the runway centerline in two groups, with the lights uniformly space in each group. (Refer to Fig. 8.5-5).

The wing bar lights shall be symmetrically disposed about the runway centerline at the threshold on two groups.

Each wing bar will be formed by 5 lights extending at least 10m outward from, and at right angles to, the line of the runway edge lights, with the innermost light of each wing bar in line with the runway edge lights.

The runway end lights will be placed in a row at right angles to the runway axis as 0.5m outside the extremity.

The elevated lights will be installed symmetrically disposed about the runway centerline in two groups, with the lights uniformly spaced in each group. (Refer Figure 8.5-5)

8.5.6. Stopway Edge Lights

The stopway edge lights will be placed across the end of the stopway on a line at right angles to the stopway (runway overrun) axis as 2.5m outside the end.

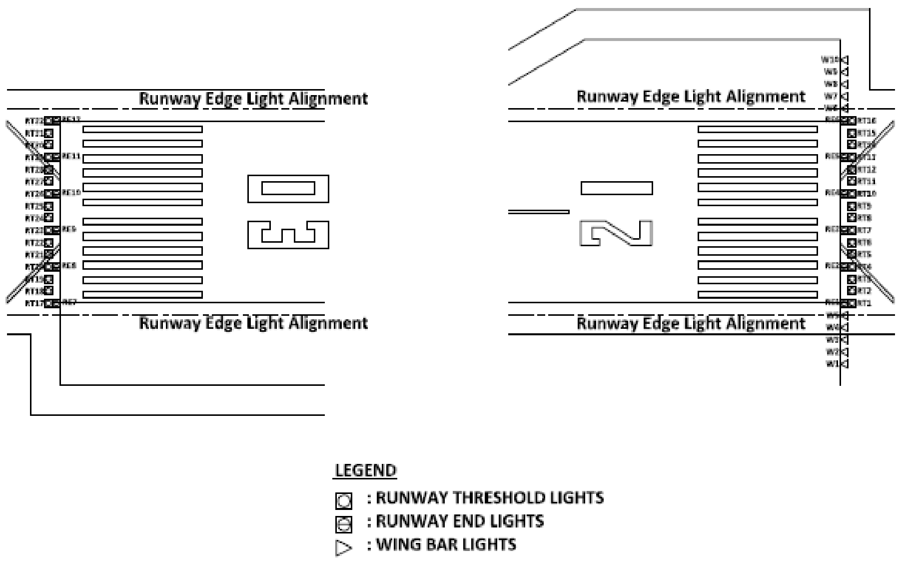
The elevated lights shall be fixed unidirectional lights showing red in the direction of the runway.

8.5.7. Turning Point Indicator Lights

The turning point indicator lights consist of guideline bar lights to provide necessary guidance to a pilot taxiing at an intersection, in two extended rows of the both bars, to judge the turning points on maneuvering markings for the turning and elevated lights are located for clear indication of the edge of the turning pads.

The turning point indicator lights will be placed along the outside edges of the turning pads at a distance of 3m.

The turning point indicator lights shall be fixed lights showing blue, but to be shielded as far as practicable to avoid glare to pilots on final approach and landing.



Source: JICA Study Team

Figure 8.5-5 Threshold and End Lights Layout Plan

8.5.8. Taxiway Edge Lights

Each light fitting shall employ a LED Type which will be placed along the outside edges of the taxiway at a distance of 3m.

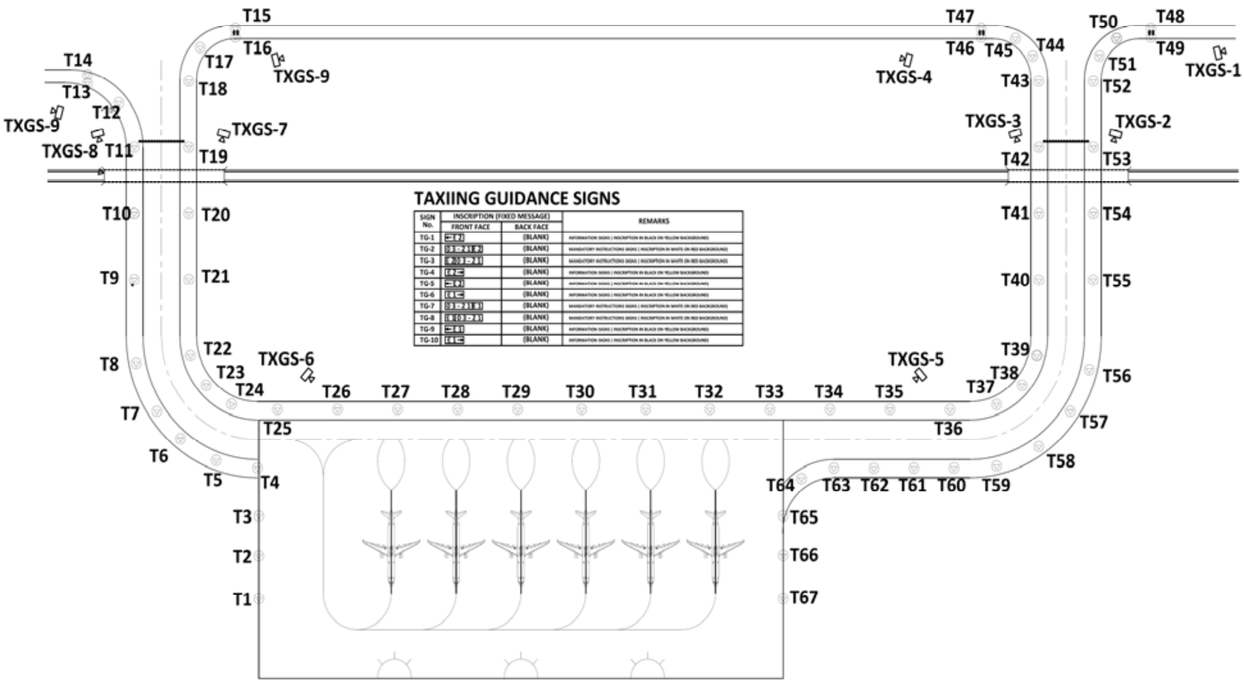
The taxiway edge lights on a straight section of a taxiway will be uniformly spaced at a longitudinal interval of not less than 60 m.

The lights on a curve will be spaced at intervals less than 60m so that a clear indication of the curve is provided (Refer to Figure 8.5-6).

8.5.9. Taxiing Guidance Signs

The illuminated mandatory instruction signs for the runway designation will be installed outside of the taxiway shoulder near to the intersection of runway and exit taxiways.

The illuminated information signs for direction, location, destination and intersection take off will be provided at the required location which will be determined by operational needs. (Refer to Figure 8.5-6)



Source: JICA Study Team

Figure 8.5-6 Taxiway Edge Lights and Taxing Guidance Signs Layout Plan

8.5.10. Apron Floodlighting

The average horizontal illuminance will be at least 20 lux with a uniformity ratio (average to minimum) of not more than 4 to 1 for aircraft stands during aircraft parking.

The average horizontal illuminance will be 50% of the average illuminance with a uniformity ratio (average to minimum) of not more than 4 to 1 for other apron areas.

The average horizontal illuminance will be at least 10 lux on the GSE road and parking.

The average horizontal illuminance will be approx. 5 lux for the emergency lighting with back up standby generator during power failure.

The arrangement and aiming of floodlights should be such that an aircraft stand receives light from two or more directions to minimize shadows.

The apron floodlights will be installed at the top of the mast tower (approx 25m) with a minimum of glare to pilots of aircraft and ATC controllers.

The preliminary number apron floodlighting will comprise a mixture of high pressure sodium lamps and tungsten halogen.

Stand lighting per one mast tower will used 4 floodlights of high pressure sodium lamps 1000W each and 2 tungsten halogen 1000W each.

Emergency lighting will use 50% of floodlights of high pressure sodium lamps and tungsten halogen.

ON-OFF control of apron floodlights will be possible from the remote control console at the remote control room in the power house or VFR room in the control tower.

8.5.11. Aerodrome Beacon

Aerodrome beacon will be installed on the roof of the control tower avoiding glare to ATC controllers and pilots of aircraft in flight.

An obstacle lights will be installed and be illuminated when the lamp of beacon fails.

The effective intensity of the flash shall be not less than 2000 cd.

The frequency of total flashes will be from 20 to 30 per minute.

8.5.12. Wind Direction Indicators Light

Two of illuminated wind direction indicators (LED Type) will be installed near each end of the runway.

The wind directional indicator will comprise an illuminated wind cone made of nylon fabric resistant to mildew, mold and fungus attack.

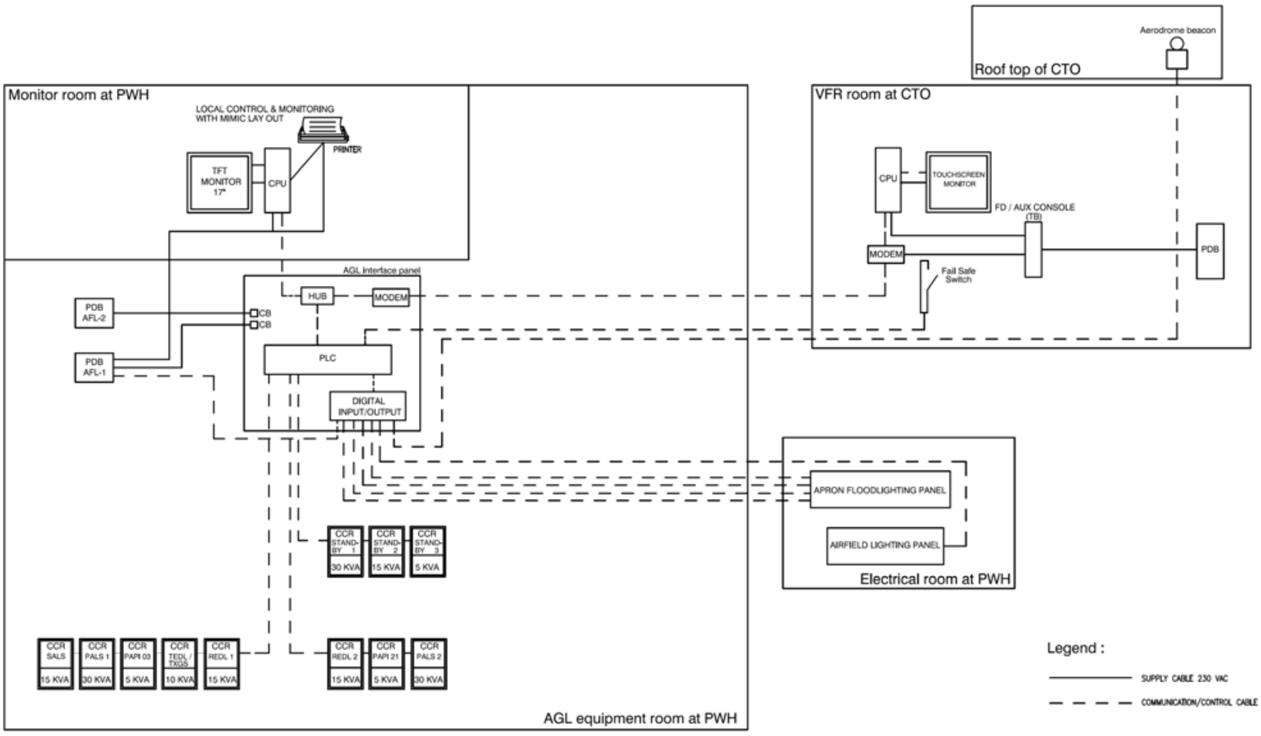
The cone will be aviation orange and white in color and designed to give clear indication of the wind direction and wind speed when viewed from a height of not less than 300m.

The indicator will be marked by a circular band 15m in diameter and 1.5m wide.

8.5.13. Monitoring and Control System

The remote control and monitoring system to be provided will comprise a system for control of all the airfield lighting, apron floodlighting and taxiing guidance signs, except the signaling lamp at the control tower. (Refer Figure 8.5-7)

Remote operation of this system will be carried out from the remote control console at the VFR room and from the local control console at control room in the power house.



Source: JICA Study Team

Figure 8.5-7 Schematic Diagram for Aeronautical Weather Observation System

CHAPTER 9

DESIGN OF EXTERNAL WATER SUPPLY

TABLE OF CONTENTS

Chapter 9 Design of External Water Supply

9.1. Design Conditions

9.1.1. Method of Water Supply to the Airport

(1) Target Service Area

The new water supply system shall not only provide the required water amount to the new airport but also to the nearby resettlement area and the airport construction site.

(2) Water Source Plan

The water company which will provide water source and operate and maintain the water supply facilities for the airport and the resettlement area will be selected through a proposal competition. The main criteria for evaluating the proposals should include but should not be limited to water source reliability and sustainability, water fee, and operation and maintenance capability. The company will be selected before beginning the airport construction.

(3) Transmission Pipe Route

With the receiving tank construction plan at Dauis, the central highway which has less undulations and shorter length would be the best route to install the transmission pipes. It will be more cost effective and practicable.

9.1.2. Water Supply System Development Plan

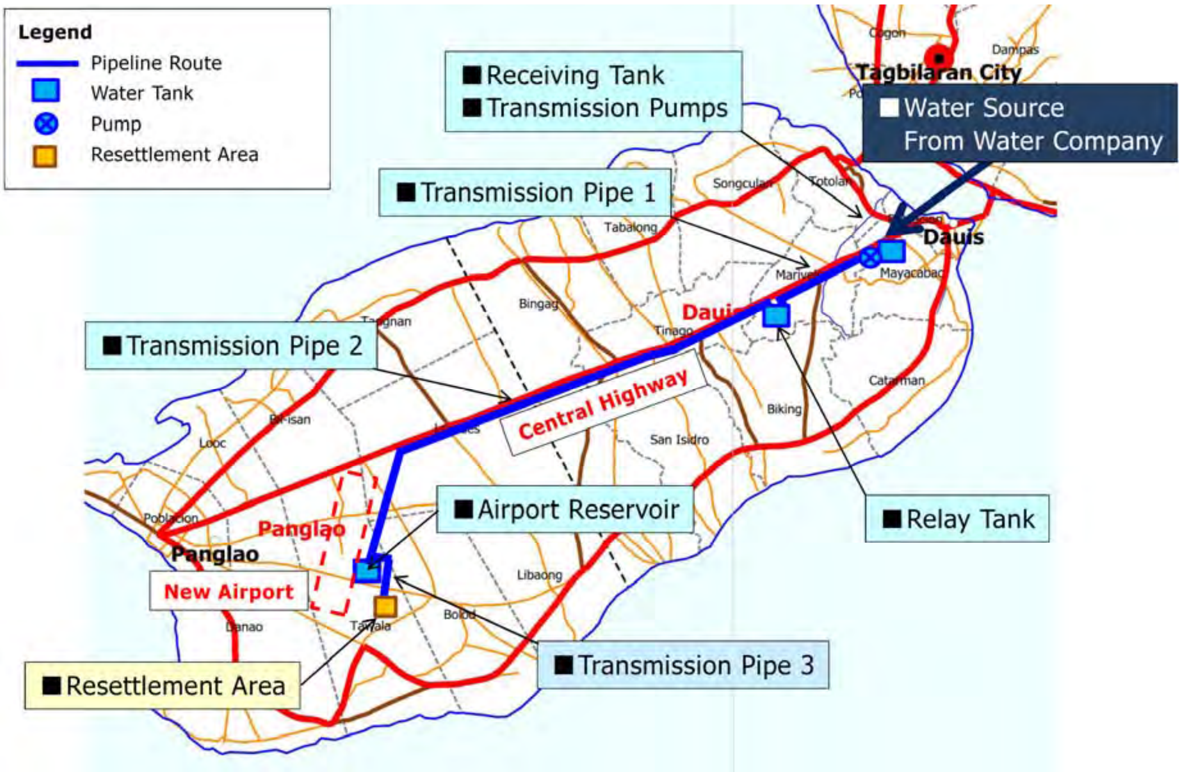
(1) Water Supply Scheme for the Airport

Figure 9.1-1 shows the proposed water supply development plan toward the airport and the resettlement area. The receiving tank will be constructed at Dauis to receive water from the Water Company. The received water then will be pumped up to the relay tank. Finally, the water will be supplied to the airport and the resettlement area.

- Water source for the airport : Water from the selected water company
- Transmission Pipe route : Central highway route

(2) Water Supply Scheme for the Resettlement Area

In order to reduce the construction cost, a reservoir will be installed in the resettlement area which will receive water form relay tank



Source: JICA Study Team

Figure 9.1-1 Water Supply Scheme to Airport and Resettlement Area

9.2. Water Demand

9.2.1. Designed Water Demand for the Airport

The water demand for the airport was computed based on the water consumption volume of the airport by considering 10% of water loss. The adopted values are shown in Table 9.2-1.

Table 9.2-1 Designed Water Demand for the Airport

Item		Unit	2020	2030	2040	Remarks
A	Daily maximum water consumption	m^3/day	383	522	651	
B	Daily average water consumption	m^3/day	333	454	566	
C	Daily maximum water supply (Qdmax)	m^3/day	420	574	716	A x 1.1
D	Daily average water supply (Qdave)	m^3/day	366	499	623	B x 1.1
E	Daily minimum demand (Qmin)	m^3/day	293	399	498	Set as D x 0.8

Source: JICA Study Team

9.2.2. Designed Water Demand for Resettlement Area

(1) Summary of the Resettlement Area Plan

Planned water supply demand of the resettlement area that is added newly from the stage of preparatory study will be set. The resettlement area plan was prepared by PGB with the following features:

- Area per 1 lot : $250m^2$ x 43 lots, $100m^2$ x 28 lots
- Lots to be developed : 71 lots(household)
- No. of family member : 4 - 6 person/household

(2) Designed Water Demand for the Resettlement Area

The water demand for resettlement area was calculated by the following formula and the result is shown in Table 9.2-2.

- Qdave = Household number × family member × per capita water consumption
  ÷ revenue rate
- Qdmax = Qdave × Loading Factor
- Where:

  No. of Households : 71 HH

  No. of Family Member : 6.0 person/household (design criteria)

  Per capita Water Consumption : 120 Liter/capita/day

  Revenue Rate : 90% (LWUA Standard)

  Loading Factor : 1.3 (LWUA Standard)

Table 9.2-2 Design Water Supply Amount for Resettlement Area

Items	Water Amount	Remarks
Qdave	57 m^3/day	
Qdmax	74 m^3/day(3.1m^3/hour)	Qdave × 1.3
Qdmin	44m^3/day	Set as Qdave / 1.3

Source: JICA Study Team

9.3. Premise for Facility Plan

9.3.1. Facility Plan

(1) Designed Water Supply Amount

The airport facilities and the resettlement area's water supply are designed as initial phase facilities. Due to the overtime increase of water demand, the future expansion of the facilities is also considered in the design.

Table 9.3-1 Designed Water Supply Amount

User	Design water supply amount(m^3/day)	
	2020	2040
Airport	420	716
Resettlement Area	74	74
Sum	494	790

Source: JICA Study Team

(2) Water Supply System

Figure 9.3-1 shows the water supply system for the new airport and resettlement area.

(3) Facility Plan

a) Receiving Tank and Relay Tank

(i) Capacity and number of tanks

It is targeted that half of the daily maximum water demand is stored in the external water supply system. Each water tank, receiving tank and relay tank, has a capacity of storing water for 6 hours demand.

Two or more tanks are planned considering O&M functions such as cleaning and repair.

(ii) Anti-corrosion and waterproofing works for tanks

As an anti-corrosion and waterproofing measure, cementitious water proofing is applied inside the tanks. Asphalt waterproofing is also conducted on roof to prevent the rainwater intrusion to the tanks.

b) Piping Works at the Site

Incoming pipe, effluent pipe, overflow pipe, drain pipe and vent pipe are installed at the tanks. Pipe material for in-tank piping and pump room piping shall be steel and the flange- type joint shall be adopted. Pipe material for yard piping shall be HDPE-EF.

9.3.2. Equipment Plan

(1) Flow Meter

Flow meter installed at receiving tank measures the receiving water amount from the water company. Relay tank is equipped with two (2) flow meters at incoming pipe from receiving tank and at transmission pipe in order to monitor the incoming/transmission water amount. Another flow meter is placed at the incoming pipe for the resettlement area.

Turbine flow meter which is economically and used prevalently is selected.

(2) Incoming Flow Control Valve and Water Level Control Valve

At receiving tank, some valves should be installed to control inflow and stop when inflow becomes HWL. At relay tank, some valves should be installed to stop inflow when water level exceeds HWL as a backup for trouble of control signal for pump operation. A mechanical system used frequently by in local will be adopted considering easy operation and economical efficiency. In particular, manual flow control valve is placed at medium-opening position. In addition, a float valve is installed inside of the tank to terminate the incoming flow at HWL.

(3) Transmission Pump Equipment

Transmission pump which is placed at receiving tank transmits water to relay tank. The pump operation configuration is two (2) units on normal duty and one (1) unit stand-by. Furthermore, the space for another pump unit will be kept in case of an increase in water demand in the future. ON/OFF pump operation is conducted depending on the in-tank water level of relay tank. The transmission pump will automatically stop its operation when water level of relay tank reaches to the HWL and starts its operation again when of the water in relay tank falls to the start-up level.

(4) Additional chlorine injection equipment

To secure residual chlorine at the airport reservoir and in the resettlement area, receiving tank is supplied with additional chlorine injection equipment. Granular calcium hypochlorite is applied as disinfection chemical and it is directly injected to effluent pipe by a pump after dissolution/dilution. The diaphragm titrating pump, generally applied in the existing facilities, is adopted as chemical injection pump.

(5) Emergency power generation equipment

Since the proposed water supply system serves the airport as the new entrance of Bohol the system is quite important. Therefore, emergency power generation equipment is provided for the transmission pumps at the receiving tank site. The generator shall be ATS type which automatically operates at power failure and the fuel tank capacity must afford 24 hours operation.

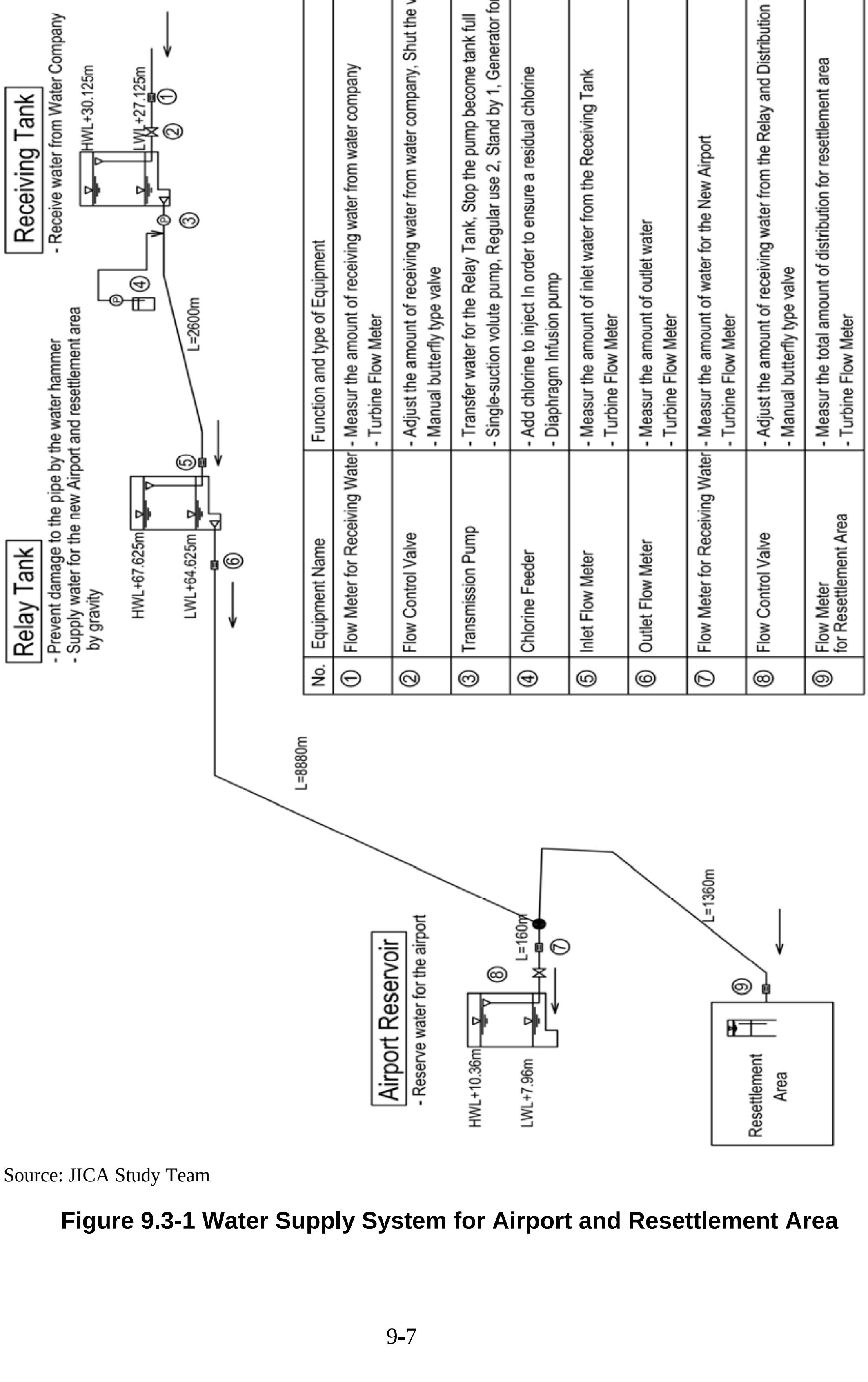
(6) Water level meter

Water level gauges are installed at both receiving tank and relay tank. Since the water level of receiving tank is not used to control the water supply facilities, the float-type gauge is adopted which is also similar to the existing facilities. For relay tank, a combination of float-type and capacitance-type water level gauges is adopted. The reason is that the tank's water level is used for on/off control of the transmission pumps installed at receiving tank.

(7) Monitoring system

Operation and maintenance of the water supply facilities will be conducted by the water company selected through a proposal competition. Therefore, basic monitoring equipment will be installed.

And electrical room has a space for installation of additional monitoring equipment suited for O&M staff organization of the selected water company.



No.	Equipment Name	Function and type of Equipment
①	Flow Meter for Receiving Water	- Measur the amount of receiving water from water company - Turbine Flow Meter
②	Flow Control Valve	- Adjust the amount of receiving water from water company, Shut the valve become HWL - Manual butterfly type valve
③	Transmission Pump	- Transfer water for the Relay Tank, Stop the pump become tank full - Single-suction volute pump, Regular use 2, Stand by 1, Generator for the pumps
④	Chlorine Feeder	- Add chlorine to inject In order to ensure a residual chlorine - Diaphragm Infusion pump
⑤	Inlet Flow Meter	- Measur the amount of inlet water from the Receiving Tank - Turbine Flow Meter
⑥	Outlet Flow Meter	- Measur the amount of outlet water - Turbine Flow Meter
⑦	Flow Meter for Receiving Water	- Measur the amount of water for the New Airport - Turbine Flow Meter
⑧	Flow Control Valve	- Adjust the amount of receiving water from the Relay and Distribution Tank - Manual butterfly type valve
⑨	Flow Meter for Resettlement Area	- Measur the total amount of distribution for resettlement area - Turbine Flow Meter

Source: JICA Study Team

Figure 9.3-1 Water Supply System for Airport and Resettlement Area

9.4. Facility Design

9.4.1. Pipeline Design

(1) Pipe diameter

Figure 9.4-1 shows schematic drawing for the pipe hydraulic calculation modeling. The calculated pipe diameters are tabulated in Table 9.4-1. The hydraulic calculation is attached in Appendix -1.

Table 9.4-1 Pipe Diameter

Pipe Location	Target year		Adopted Diameter
	2020	2040	
Receiving Tank to Relay Tank	φ150 mm	φ150 mm	φ150 mm
Relay Tank to Airport Junction	φ150 mm	φ150 mm	φ150 mm
Airport Junction to Airport Receiving Tank	φ150 mm	φ150 mm	φ150 mm
Airport Junction to Resettlement Area	φ75 mm	Φ75 mm	Φ75 mm

Source: JICA Study Team

(2) Pipe materials

a) Transmission pipes material for Airport

Since it is a major water transmission pipe going to the airport, HDPE-EF pipes with higher reliability are adopted.

b) Transmission pipes material for the Resettlement Area

The pipes supply water to the resettlement area. Since the calculated effective water pressure is not so high, the uPVC pipes are utilized due to economic efficiency.

(3) Supplementary facility

a) Gate Valves

Gate valves will be installed at the appropriate location such as the start point of the pipeline, branch point, the crossing point of the waterway and near the blow-off drain. In addition, the gate valve is installed within every 2km.

b) Air valve

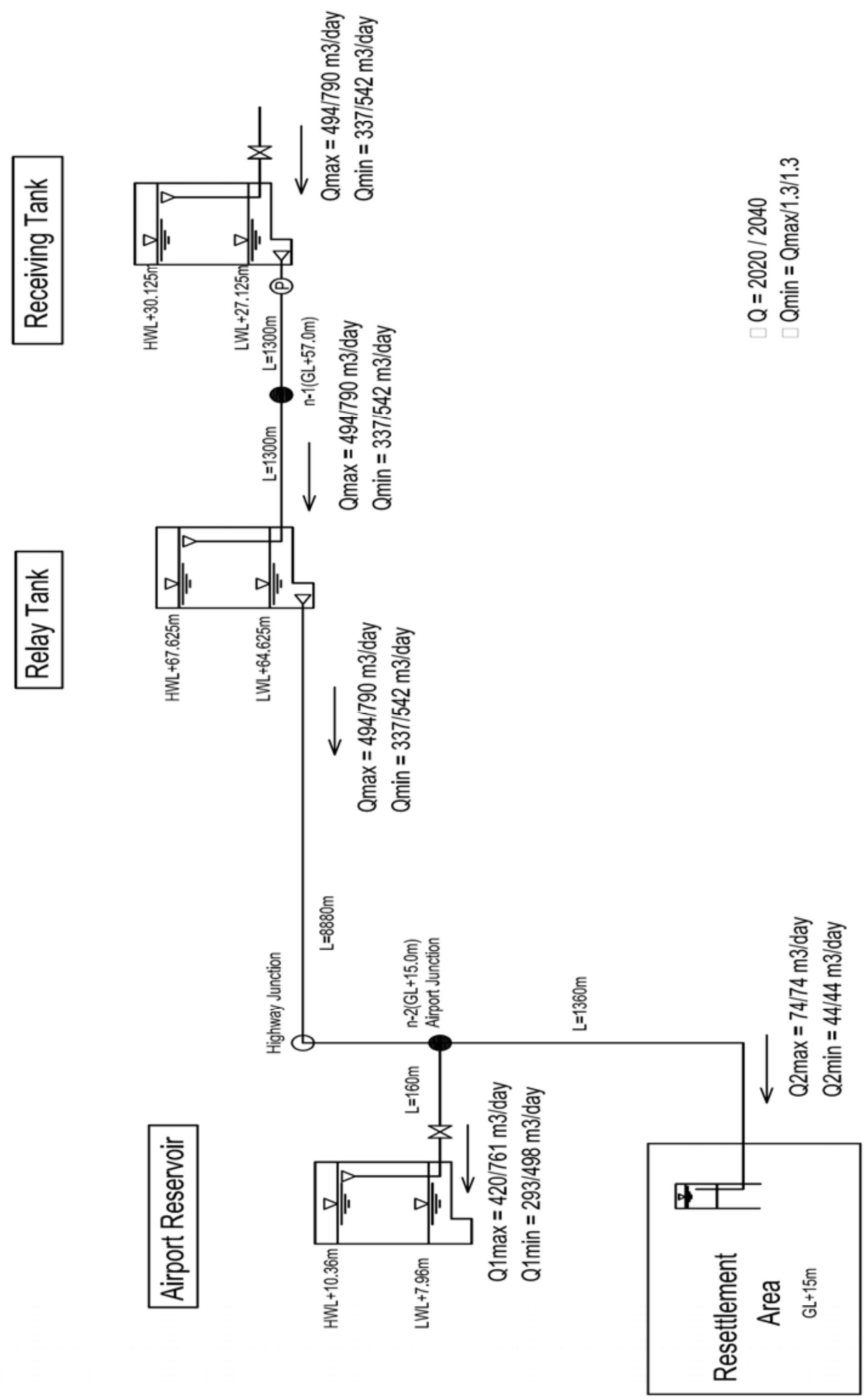
An air valve is installed at the high points of the pipeline. Considering the pipe filling work, at least one air valve is installed between the valves.

c) Drainage facility

The drainage facility is installed at the low elevation point of the pipeline and near the drainage destination such as a river or drainage.

d) Water Supply Port for the Airport Construction

A 150 mm branch pipe is provided to connect temporary pipes by the contractor for the airport construction. And, a fire hydrant is provided to supply water to the water-trucks for the construction.



Source: JICA Study Team

Figure 9.4-1 Schematic Drawing for Hydraulic Calculation Modeling

9.4.2. Receiving Tank and Relay Tank

(1) Tank capacity

a) Receiving Tank capacity

Number of tanks constructed in the first phase will be 2 tanks (150 m^3) and the remaining 1 tank (75 m^3) is planned to be constructed in the future.

- Transmission Amount from Receiving Tank : 790 m^3/day (year 2040)
- Retention Time : 6 hours or more
- Required Tank Volume : 790 m^3/day×6/24＝198 m^3
- Receiving Tank Capacity : 75 m^3/tank×2 tanks
  (Construct 3 tanks 225 m^3 in the future plan)

b) Relay Tank capacity

Number of tanks constructed in the first phase will be 2 tanks (150 m^3) and the remaining 1 tank (75 m^3) is planned to be constructed in the future.

- Transmission Amount from Relay Tank: 790 m^3/day
- Retention Time : 6 hours or more
- Required Tank Volume : 790 m^3/day×6/24＝198 m^3
- Receiving Tank Capacity : 75 m^3/tank×2 tanks
  (Construct 3 tanks 225 m^3 in the future plan)

(2) Effective water depth

Shallow water tank depth needs wider site area and deep water depth needs a structural water-tightness examination. Considering the tank capacity and the available land area, tank effective water depth is set at 3.0m.

(3) Anti-corrosive paint and waterproofing works

Cementitious water proofing shall be applied inside of the tanks for anti-corrosion and waterproofing measure for reinforced concrete (RC). Asphalt waterproofing is also conducted on the roof to prevent rainwater intrusion into tanks.

9.4.3. Structural Plan

(1) Standard

Structural analysis complies with “NATIONAL STRUCTURAL CODE OF THE PHILIPPINES 2010” (hereinafter referred to as "NSCP").

(2) Structural type

a) Structural type of water tank

As mentioned earlier, the capacity of receiving tank and relay tank is 75m^3 per tank which means they both are small-scaled structures, and thus, reinforced concrete structure is applied for economic efficiency reasons.

b) Structural type of architectural structure

The pump house, emergency generator house, chlorine feeder room and guard house will be built at the receiving tank site.

All buildings are one-story houses with small-scale and a concrete block construction is adopted considering the construction costs.

(3) Concrete cover for reinforcement

Table 9.4-2 shows the minimum concrete cover.

Table 9.4-2 Minimum Concrete Cover

Parts	Concrete cover for reinforcement
Slab and joists	・Top and bottom bars for dry conditions: 36mmφ bars and smaller 20mm ・Formed concrete surfaces exposed to earth, water or weather, and over or in contact with sewage and for bottoms bearing on work mat, or slabs supporting earth cover: 16mmφ bars and smaller 40mm, 20mmφ bars and bigger 50mm
Beams and columns	・For dry conditions Stirrups, spirals and ties: 40mm, Principal reinforcement: 50mm ・Exposed to earth, water, sewage and weather Stirrups, spirals and ties: 50mm, Principal reinforcement: 65mm
Wall	・For dry conditions: 36mmφ bars and smaller 20mm ・Formed concrete surfaces exposed to earth, water, sewage, weather or in contact with ground 50mm
Footing and base slabs	・At formed surfaces and bottoms bearing on concrete work mat: 50mm ・At formed surfaces and bottoms in contact with earth: 75mm ・Top of footings – same as slabs: over top of piles 50mm

Source: NSCP

9.4.4. Transmission Pump

(1) Discharge amount

The designed water supply amount is 494 m^3/day and 790 m^3/day for the future. The ratio of the designed and the future water amount is 2 to 3. Therefore, two (2) units of transmission pumps and one (1) unit of stand-by pump are installed. One (1) pump unit will be installed in the future.

- Discharge amount per pump: 790 m^3/day ÷ 3 units ÷ 1440 min/day = 019 m^3/min

(2) Pump head

According to the hydraulic calculation, the required pump head is calculated at 60 m.

(3) Pump motor output

Pump motor output is determined based on the pump discharge amount-pump head curve issued by manufactures and set at 7.5 kW.

(4) Pump specification

The pump specifications are as follows:

- Single suction centrifugal pump 0.19 m^3/min×60m×7.5kW×3 units (1 unit stand-by)
- One (1) unit will be installed in the future.

9.4.5. Outline of Major Facilities

Following Table 9.4-3 shows major project facilities to be constructed. Figure 9.4-2 shows the layout plan of the facilities in the first phase. Figure 9.4-3 to Figure 9.4-8 show drawings of main facilities.

Table 9.4-3 Outline of Major Facilities

Facility	Structure/ Dimension/ Specification	Reference
1. Pipe		
1.1. Transmission Pipe -1	HDPE-EF, φ150mm, L= 2,600m	Receiving Tank to Relay Tank
1.2. Transmission Pipe -2	HDPE-EF, φ150mm, L= 6,100m	Relay Tank to Highway JCT
1.3. Transmission Pipe -3	HDPE-EF, φ150mm, L= 2,780m	Highway JCT to Airport JCT
1.4. Transmission Pipe -4	HDPE-EF, φ150mm, L= 160m	Airport JCT to Airport Reservoir
1.5. Distribution Pipe	uPVC, φ75mm, L= 1,360m	Airport JCT to Resettlement Area
2. Receiving Tank		
<Civil/ Architecture>		
2.1 Receiving Tank	RC, HWL+30.125m, LWL+27.125m	
	Width 5.0m×Length 5.2m×Depth 3.0m×2 tanks	
2.2 Pump Room/ Electrical Room	CB, 1F	
	Width 13.0m×Length 5.0m Pump Room: 35m^2, Electrical Room: 30m^2	

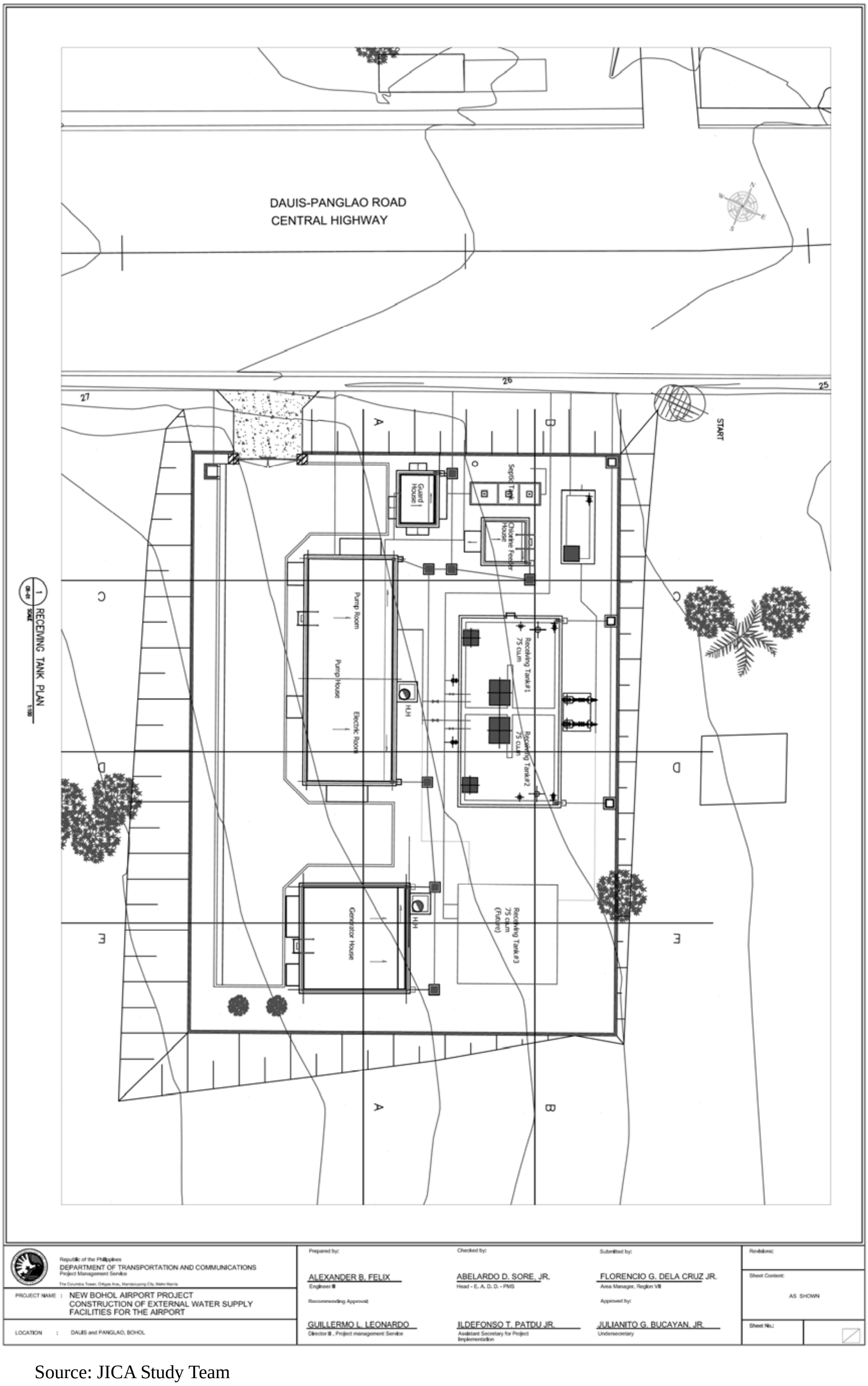
Facility	Structure/ Dimension/ Specification	Reference
2.3 Chlorine Feeder Room	CB, 1F Width 6.0m×Length 6.0m	
2.4 Generator Room	CB, 1F Width 2.5m×Length 2.5m	
2.5 Guard House	CB, 1F Width 3.0m×Length 2.2m	
2.6 Yard Pipe	Yard Pipe Work: 1 Ls	
2.7 Yard Work	Yard Work: 1 Ls	
<Mechanical Equipment>		
2.8 Receiving Water Meter	Turbine Type Flow Meter, φ100mm×1	
2.9 Flow Control Valve	Manual Type Butterfly Valve, φ100mm×1	
2.10 Float Valve	Float Valve, φ150mm×1	
2.11 Transmission Pump	Single-Suction Centrifugal Pump, $0.19m^3$/min×60m×7.5kW×3 units (included 1 stand by)	
2.12 Chlorine Feeder	Hypochlorite Feed Pump×1 unit	
2.13 Hoist Block	Manual Operated Chain Block, 1 ton×1	For Pump
2.14 Hoist Block	Manual Operated Chain Block, 1 ton×1	For Generator
<Electrical Equipment>		
2.15. Power receiving equipment	Pole-mounted type (Wh meter panel)	The installation by the power company including utility poles. Bear only the cost.
2.16 Feeder Panel	Indoor wall hang type 1000W×2300H×1000D×1 panel	For MMC
2.17. Distribution Panel	Indoor wall hang type 1000W×2300H×1000D ×1 panel	
2.18. Power Panel	Indoor wall hang type 1200W×2300H×1000D ×1 panel	For pump house
2.19. Power Panel	Indoor wall hang type 1200W×2300H×1000D ×1 panel	For generator house
2.20. Power Panel	Indoor wall hang type 1200W×2300H×1000D ×1 panel	For guard house
2.21. Emergency Generator	75kVA× 1 set	
2.22. Magnetic flow meter	Φ100mm× 1 set	
2.23. Pressure gauge	1 set	
2.24. Electrode	2 sets	
3. Relay Tank		
<Civil/ Architecture>		
3.1 Relay Tank	RC Width 5.0m×Length 5.2m×Depth 3.0m×2 tanks	
3.2 Yard Pipe	Yard Pipe Work: 1 Ls	
3.3 Yard Work	Yard Work: 1 Ls	
<Mechanical Equipment>		
3.4 Inlet Flow Meter	Turbine Type Flow Meter, φ100mm×1	
3.5 Outlet Flow Meter	Turbine Type Flow Meter, φ100mm×1	

Facility	Structure/ Dimension/ Specification	Reference
<Electrical Equipment>		
3.6. Power receiving equipment	Pole-mounted type (Wh meter panel)	The installation by the power company including utility poles. Bear only the cost.
3.7. Electrodes	2 sets	

Source: JICA Study Team

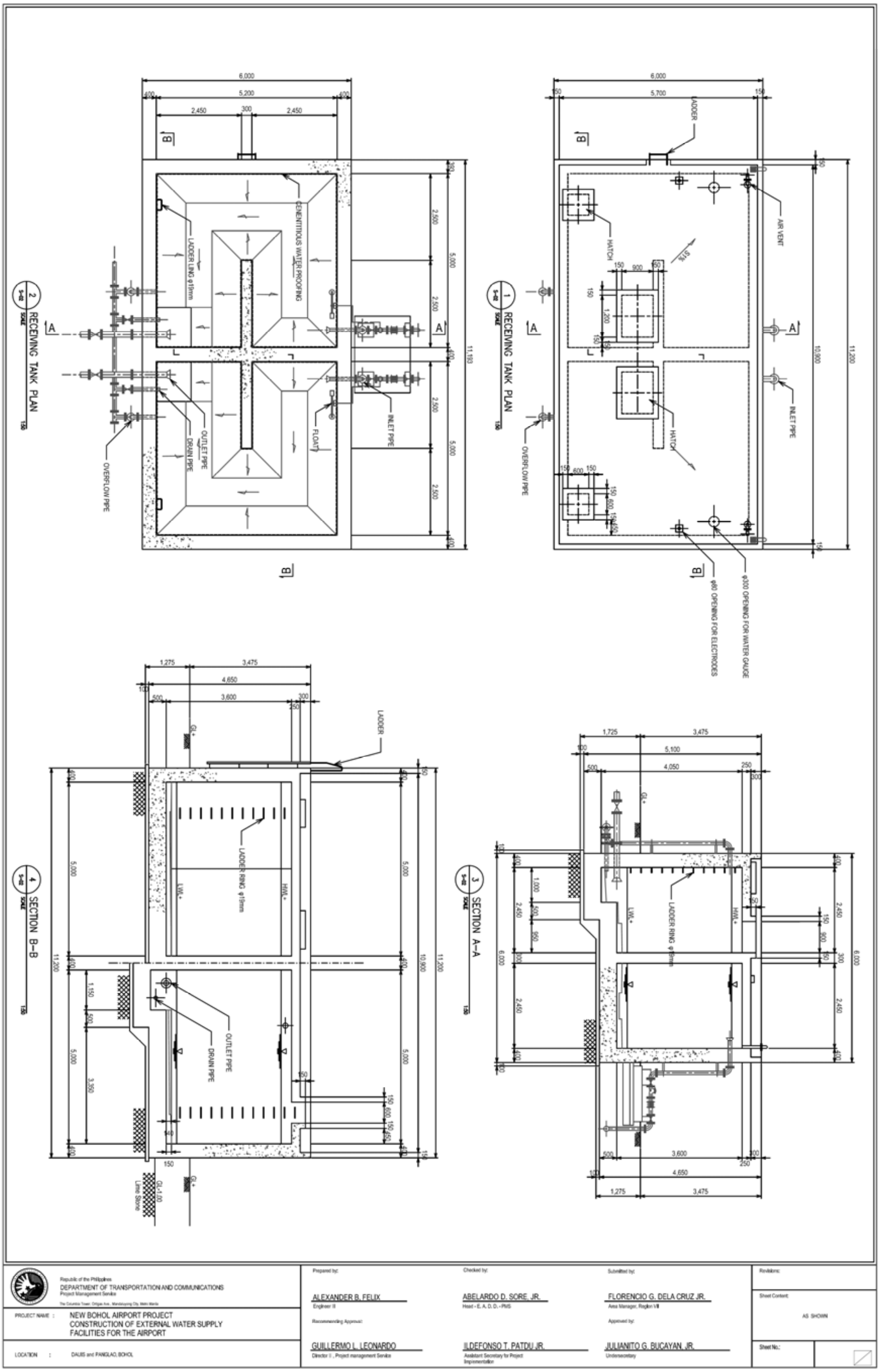
Source: JICA Study Team

Figure 9.4-2 Water Supply Facilities Plan



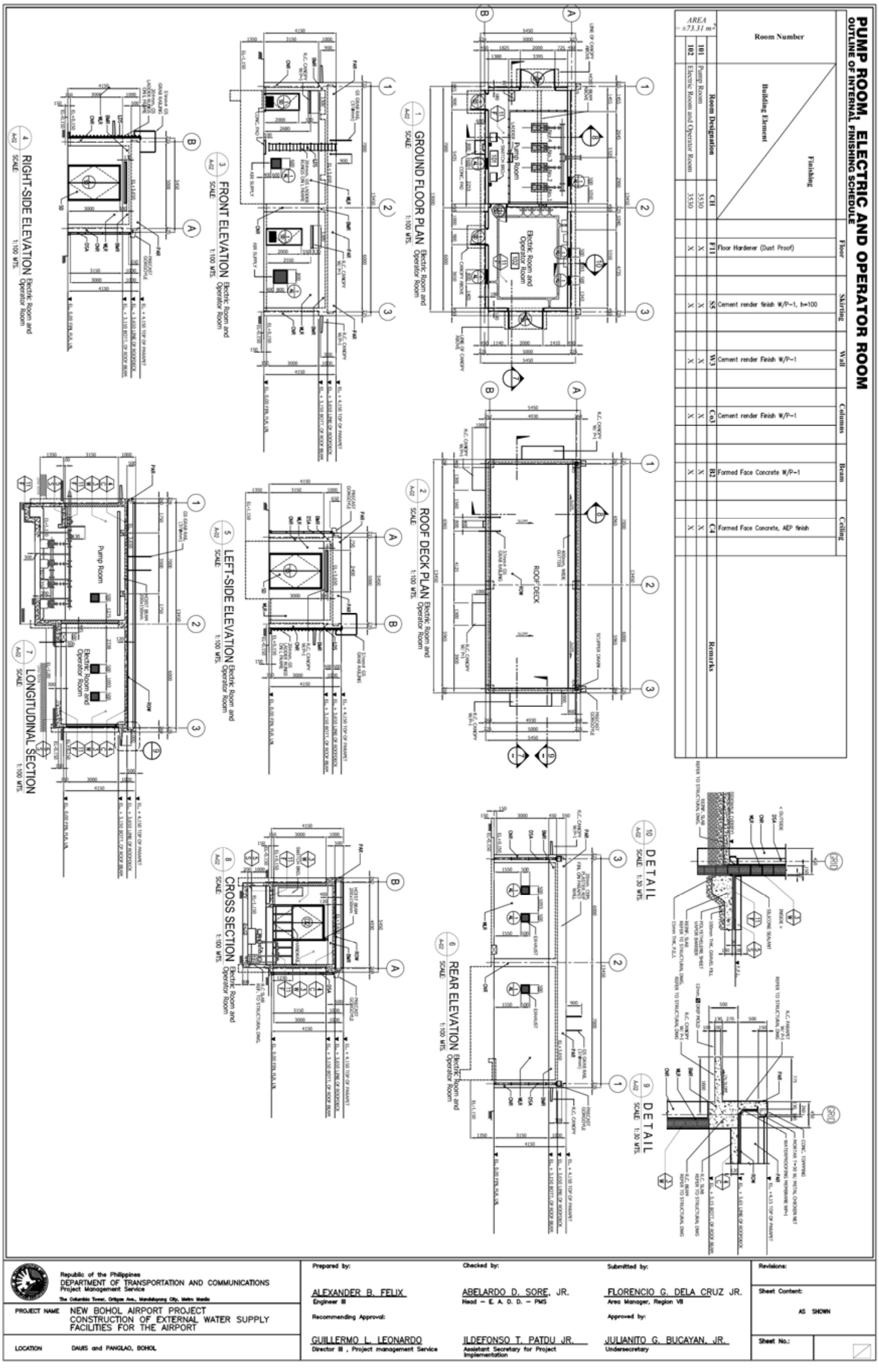
Source: JICA Study Team

Figure 9.4-3 Receiving Tank General Arrangement Drawing



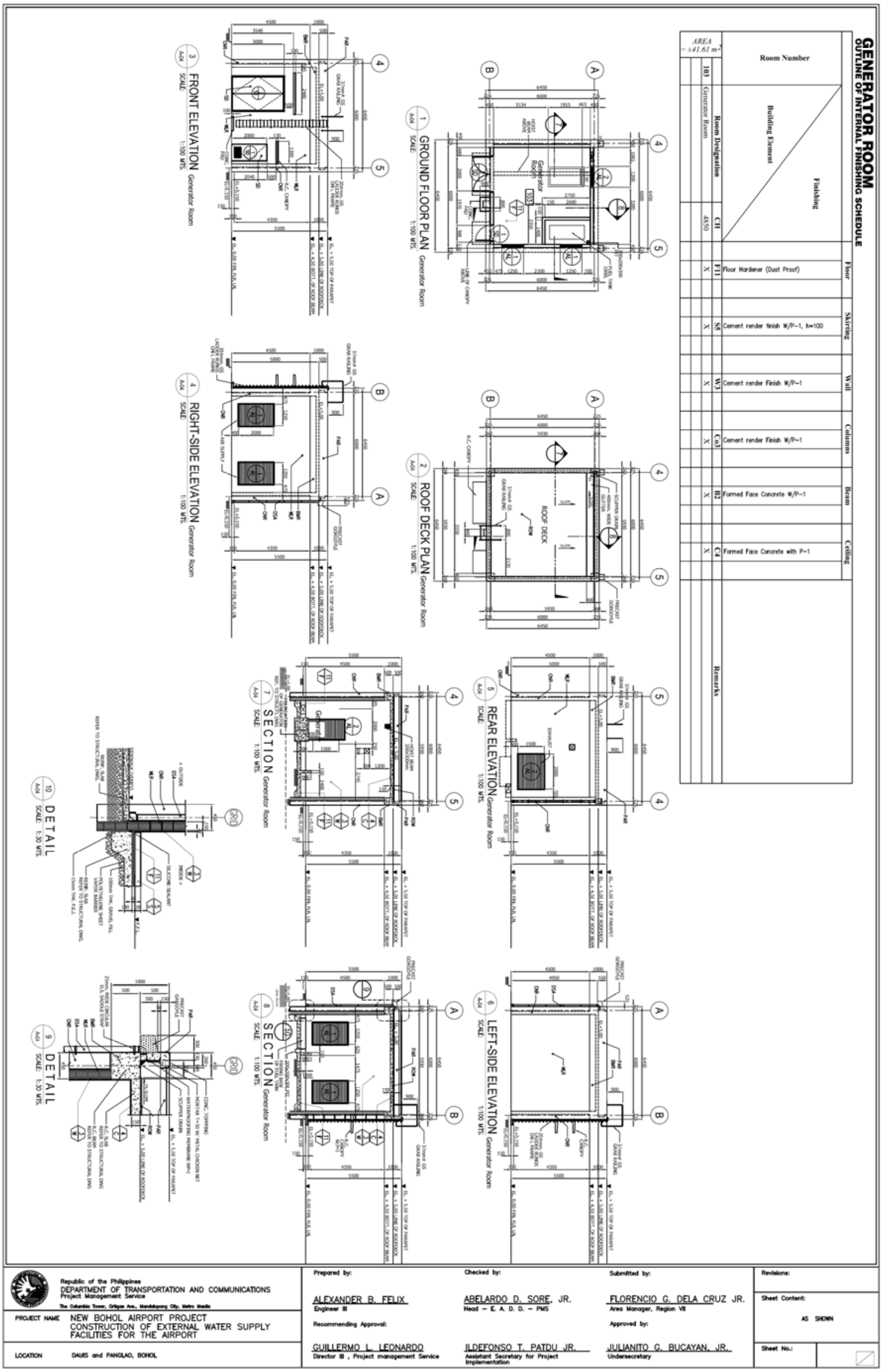
Source: JICA Study Team

Figure 9.4-4 Receiving Tank General Drawing



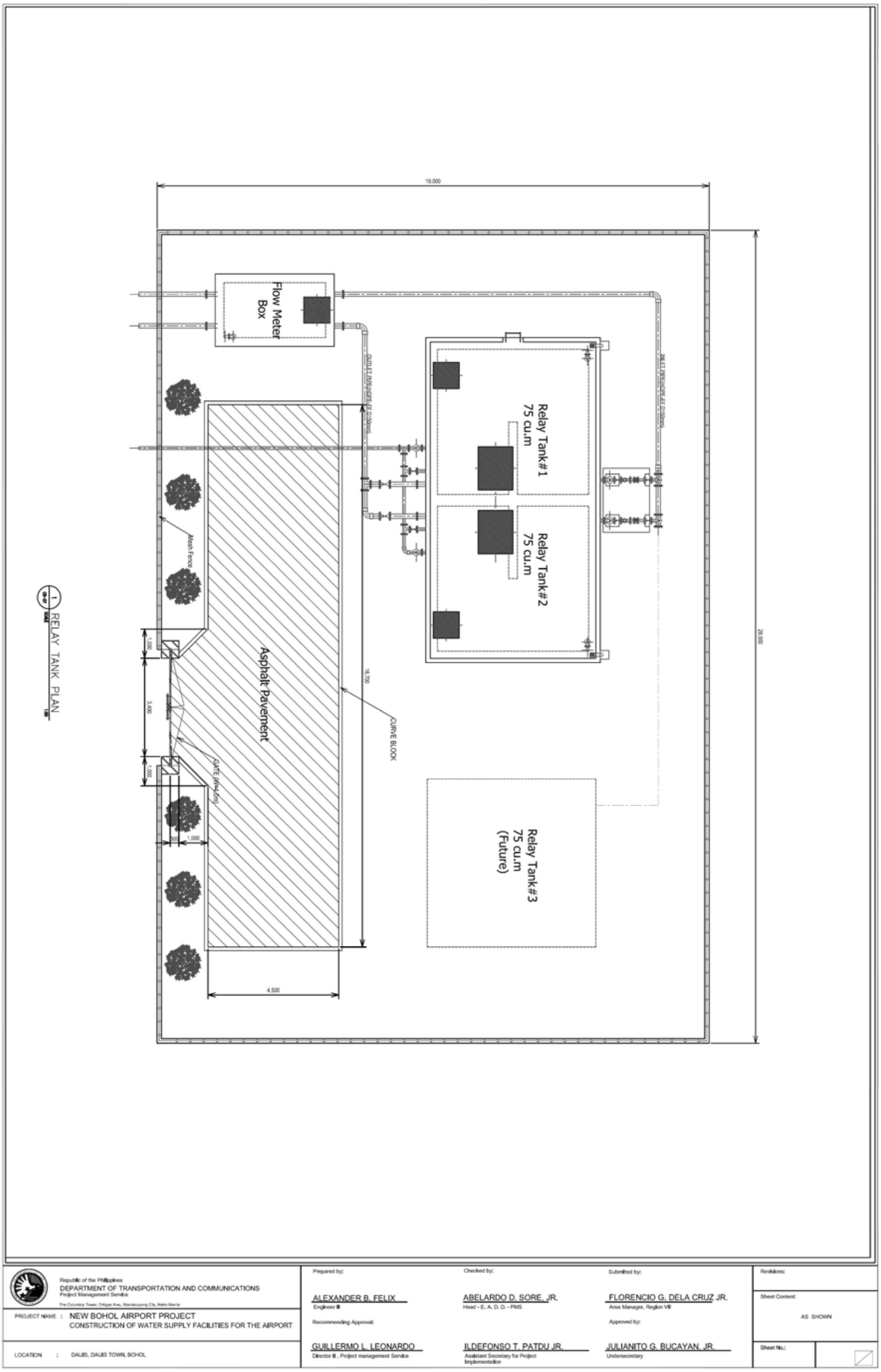
Source: JICA Study Team

Figure 9.4-5 Pump House General Drawings



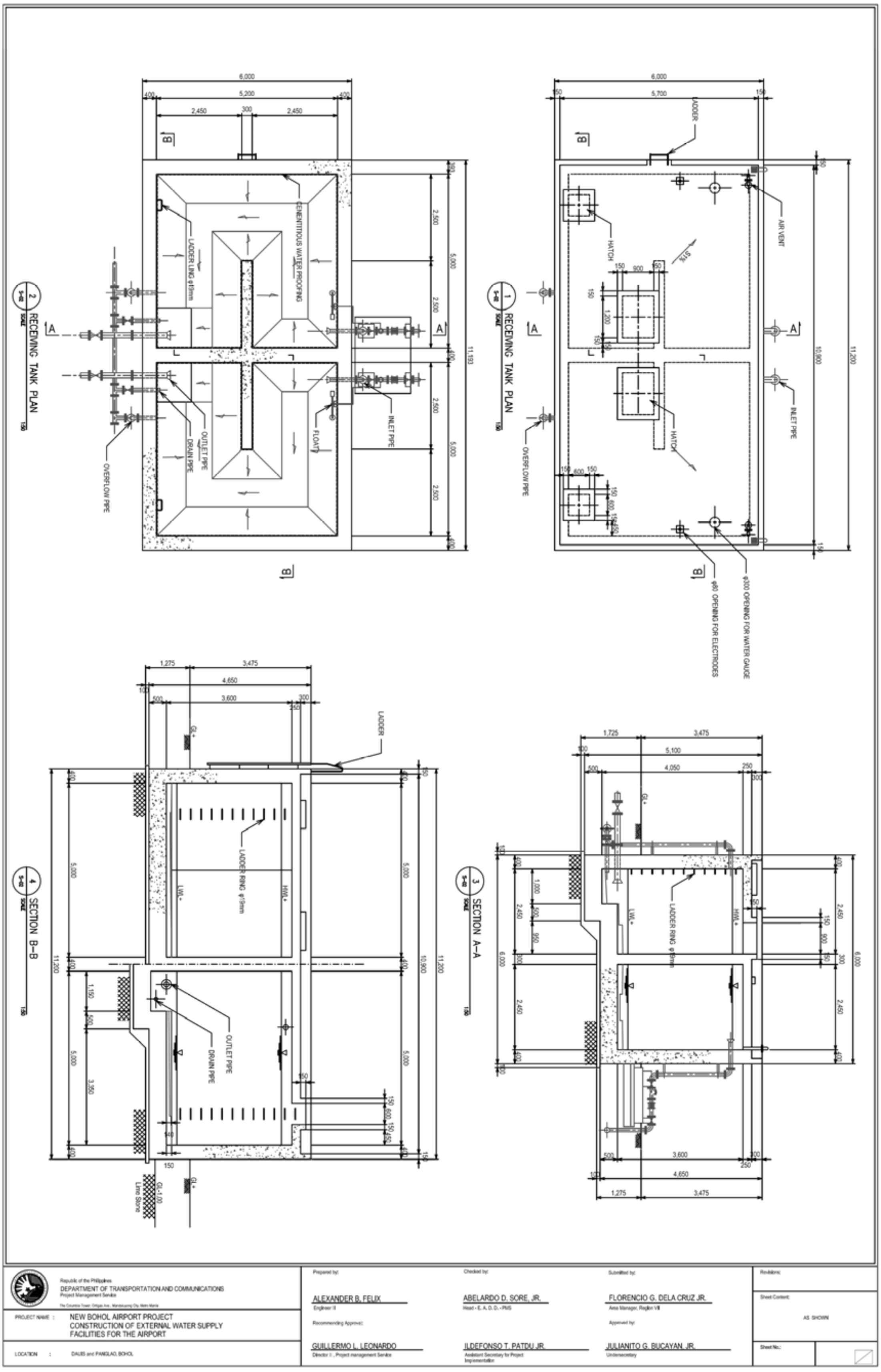
Source: JICA Study Team

Figure 9.4-6 Emergency Power Generator House General Drawing



Source: JICA Study Team

Figure 9.4-7 Relay Tank General Arrangement Drawing



Source: JICA Study Team

Figure 9.4-8 Relay Tank General Drawing

9.5. Construction Sites for Receiving Tank and Relay Tank

9.5.1. Receiving Tank Construction Site

The location of receiving tank site is a privately owned vacant land. It is located along the central highway, 700m from the Dauis municipal hall building. The flat land area for construction is 850 m^2, but the necessary required area is 1,120 m^2 due to the earth cut and embankment. (Refer to Figure 9.5-1)

Source: JICA Study Team, Background photograph data was scraped by Google Earth

Figure 9.5-1 Receiving Tank Site

9.5.2. Relay Tank Construction Site

Relay tank is planned to be sited in a high elevation land between receiving tank and airport reservoir. The location of Relay Tank site is a vacant land. It is located along the central highway, 3200 m from Dauis municipal hall building. The land is owned by Bohol Beach Club. The flat land area for construction is 370m^2. (Refer to Figure 9.5-2).

Source: JICA Study Team, Background photograph data was scraped by Google Earth

Figure 9.5-2 Relay Tank Site

Although DOTC is preparing the tender based on this design, PGB faces difficultly of acquiring the proposed land for receiving tank and relay tank from the landlord. In addition, PGB negotiates to acquire an alternative land adjacent to the proposed land with the landlord. In case of changing the location of proposed land for the facility after the tender, the proposed facility is constructed on the same alignment with the original design. Therefore, inequalities between the tenders may not occur.

9.6. Concept of Cost Estimate

Inquiry for material cost shall be investigated from local trading companies or manufacturers. The lowest price shall be used for cost estimation. In the BOQ (Bill of Quantity) only main work item quantity is shown. For example, the transmission pipe installation work is shown with only length but such work includes all necessary work such as excavation, filling and pressure test. The bidder should show a cost breakdown for such works.

9.7. Procurement and Implementation Schedule

9.7.1. Procurement Plan

The bidding shall be divided into four (4) packages which are shown in section 9.7.2. The transmission installation work from the highway junction to the airport receiving tank will be carried out through ICB (International Competitive Bidding). The remaining works are carried out through LCB (Local Competitive Bidding).

ICB should follow the FIDIC (The International Federation of Consulting Engineers) standard tender document and implement the project under the FIDIC contract.

LCB should follow the PBD (Philippine Bidding Documents), 4th Edition, December 2010 standard tender document which consist of Invitation to Bid, Instructions to Bidders, Bid Data Sheet, General Conditions of Contract, Special Conditions of Contract, Specifications, Drawings, Bill of Quantities, and Bidding Forms.

Cement and ready mixed concrete are available in Bohol Island. Other construction materials are procured from Cebu Island or other area.

9.7.2. Implementation Plan

(1) Construction Procedures

In order to supply water for the airport construction work, water pipes will be laid prior to the construction start. However, the water pipes of the access road toward the airport need to be laid after carrying out the road reclamation. The reason is that the access road construction requires earth cut and embankment from the connection point of central highway.

Water pipes from the connection point to the airport must be laid in a constant depth from the finish surface on the southern side of the access road. It should be done after the site preparation of the access road is completed by the airport construction work.

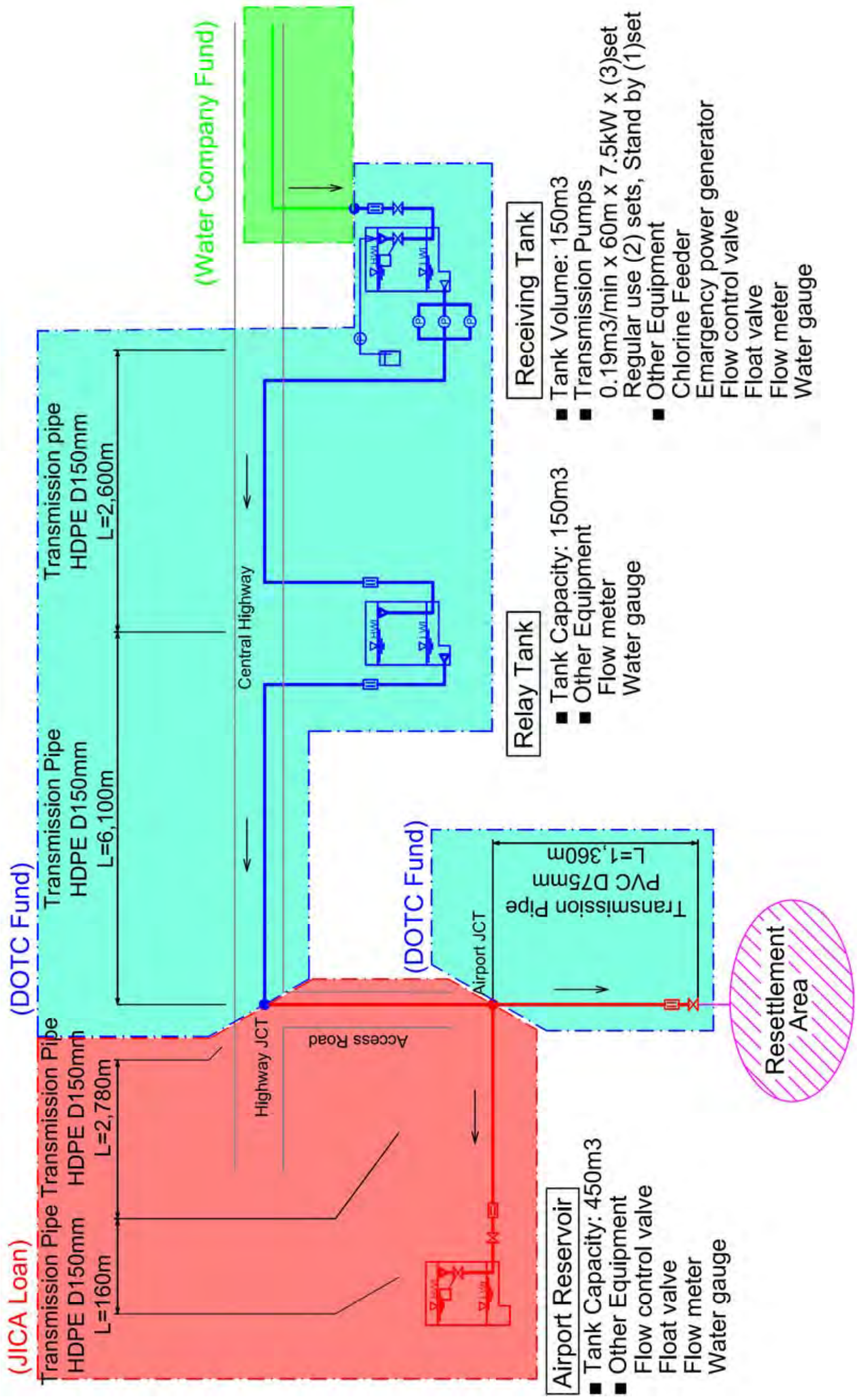
In conclusion, the advance implementation of water supply construction work under DOTC fund will terminate at the junction of central highway and the airport access road. Provision for the future connection with the remaining portion will be installed. The installation of the 2.20 km x 150 mm dia. transmission pipe along the access road is included in the construction work under the JICA loan. In the meantime, the contractor has to install temporary pipes from the tapping point to the work office and construction plants.

In addition, the transmission water pipe to the resettlement area will be developed by the DOTC fund.

(2) Scope of Project Division

As shown in Figure 9.7-1, the project division is based on the construction procedures. The construction work division for the resettlement area's branches shall be finalized by discussion between DOTC and JICA.

- To Receiving Tank : Water Company Fund
- Receiving Tank to High Junction : DOTC Fund
- Highway Junction to Airport Reservoir : JICA Loan
- Airport Reservoir to Resettlement Area : DOTC Fund

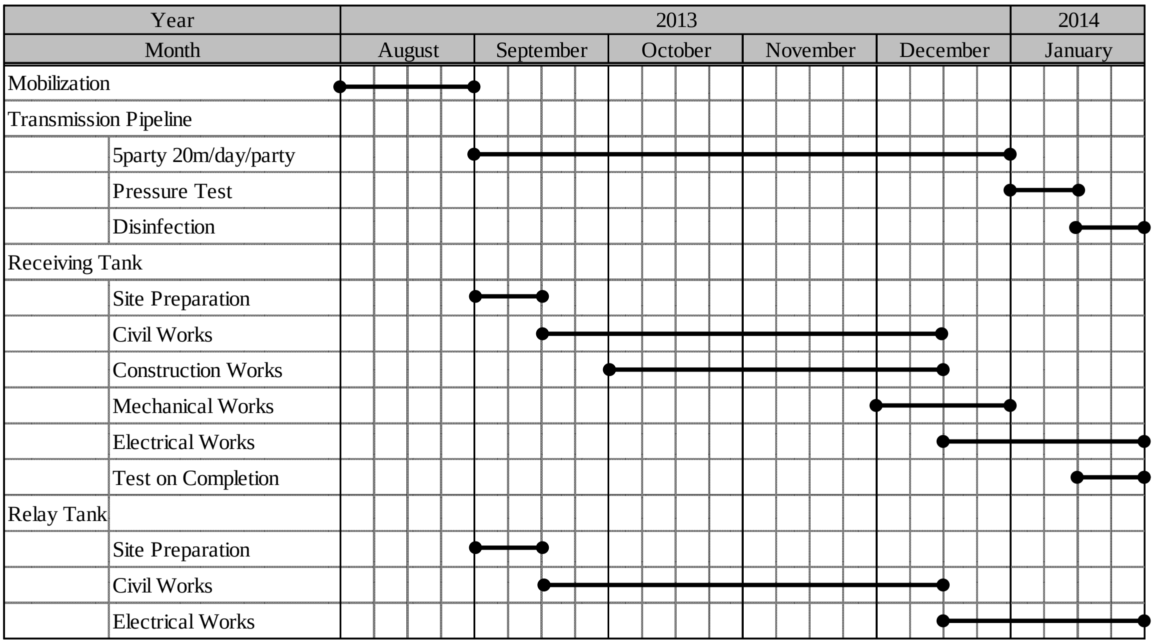


Source: JICA Study Team

Figure 9.7-1 Scope of Project Division

(3) Construction Schedule

Construction schedule for DOTC Fund is shown Figure below.



Source: JICA Study Team

Figure 9.7-2 Construction Schedule (DOTC Fund)

CHAPTER 10

CONSTRUCTION PLAN

TABLE OF CONTENTS

Chapter 10 Construction Plan

10.1. Activity Schedule before Commencement of Construction

The GOP, through Department of Transportation and Communications (DOTC), plans to execute by its own fund, the following activities:

a) Preparatory Works (boundary fence, clearing and grubbing of construction site). Local bidding was called in March 2013 and closed in May. The lowest bidder was selected in June and awarded in September 2013. The work is assumed to start in October and to be completed in March 2014.

b) Construction of external water supply which consists of construction of a water receiving tank in Dawis, a relay tank at the highest elevation (65 m above MSL) and 8.7-km long piping network along the national highway until the intersection of the new airport access road (based on the detailed design and bidding documents prepared earlier through the course of this JICA Study). Local bidding was called in June and closed in July 2013, but failed. Rebidding is being conducted in September 2013. This work is a critical element for supplying vast water required for the new airport construction and is now expected to commence in December 2013 and to be completed by June 2014. DOTC intends to select a private water company through a separate bidding for supplying water including operation and maintenance of the completed water tanks and pipelines.

c) Embankment of soaking yard perimeter. This work was initially included in the above a) (Preparatory Works). However, DOTC intends to select contractor through a separate bidding. If its local bidding is called in September, closed in October and awarded in December 2013 through the normal process, the works can be executed from January to June 2014. This work is critical for starting with the temporary drainage and earthworks for the new airport construction.

Meanwhile, DOTC intends to complete all the process to procure a consultant for the construction management services before the end of October 2013. Then the selected consultant can start from November 2013, with his initial services for assistance in Bidding for the construction contract.

Now, the draft detailed design and bidding documents have been approved by JICA and are being reviewed by DOTC. When the same are approved by DOTC, the International Competitive Bidding (ICB) could start from October 2013. Hence, in the earliest case, those various activities mentioned above are possibly processed as shown in Table 10.1-1.

Table 10.1-1 Activity Schedule before Commencement of Construction of the Project

Activity		2013 (6–12) / 2014 (1–12)
A. DOTC-funded Project		
1 Preparatory Works		
1 Bidding	Jun 2013	
2 Contract signing	Sep 2013	
3 Construction	Oct 2013	6 months
2 External Water Supply		
1 Bidding	Jul 2013	
2 Contract signing	Nov 2013	
3 Construction	Dec 2013	6 months
3 Embankment of Soaking Yard Perimeter		
1 Bidding	Oct 2013	
2 Contract signing	Dec 2013	
3 Construction	Jan 2014	6 months
B. JICA funded New Bohol Airport Construction Project		
0 Selection of CMS Consultants		
1 Bidding	Aug 2013	
2 Contract signing	Oct 2013	
1 Bidding		
Advertisement	Sep 2013	
Issuance of Bid Documents	Oct 2013	
Pre-bid Conference	Nov 2013	
Bidders' Proposal/Submission	Dec 2013	
Technical Evaluation	Jan 2014	
Financial Evaluation	Feb 2014	
Clarification/Negotiation/Award	Mar 2014	
Preparation of Performance Security	Apr 2014	
2 Contract Signing	May 2014	
Mobilization of Contractor	May 2014	
Advance Payment	Jun 2014	
3 Constuction	Jul 2014	

Source: JICA Study Team

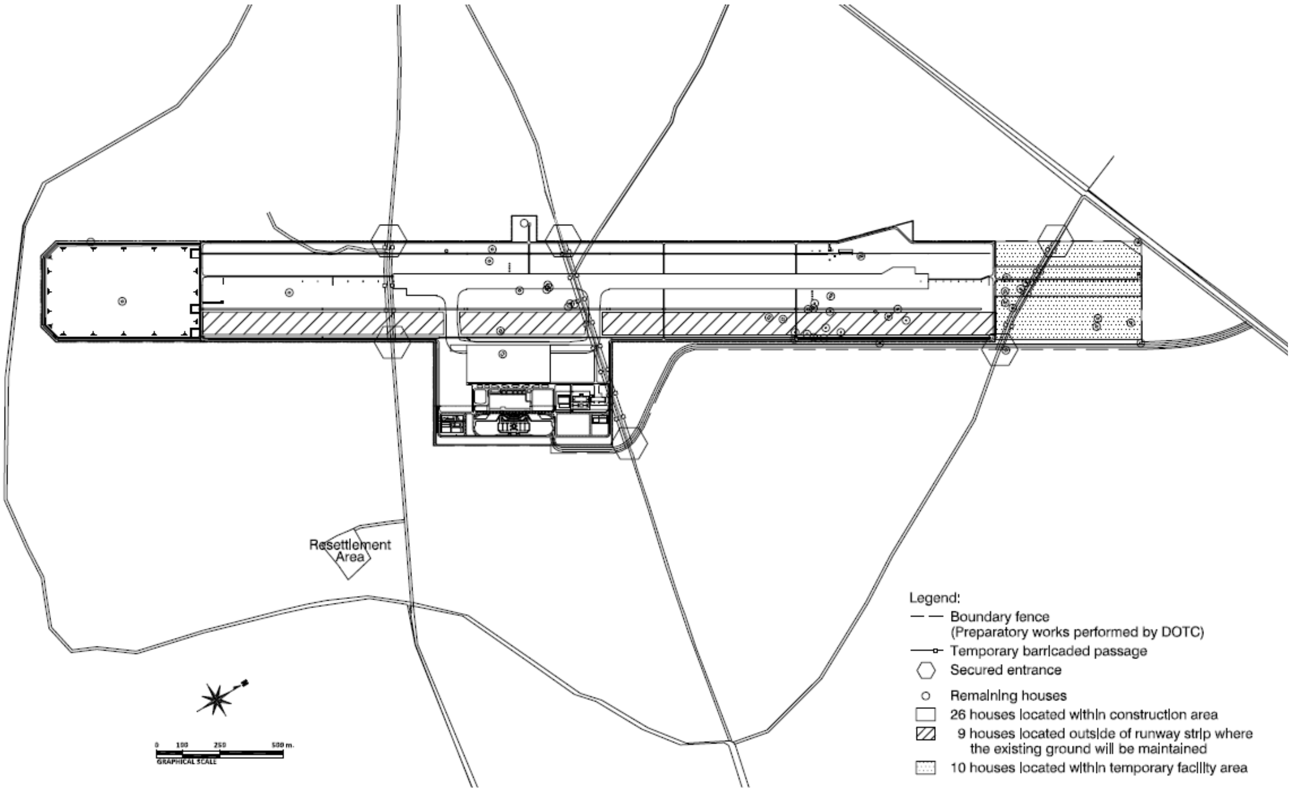
Resettlement of 45 houses for the Project Affected Families (PAFs) is targeted to be completed before commencement of the new airport construction.

10.2. Temporary Works

10.2.1. Access to Construction Site and Care of Habitants

There are three (3) Barangay roads laterally crossing the construction site. Those unpaved roads currently connecting the national highway with houses scattered in the vicinity are passable even when it is raining because of the durable ground surface made of coralline limestone.

DOTC intends, through the course of Preparatory Works aforesaid, to erect a barbed-wire boundary fence soon to enclose the entire construction site. However, DOTC announced to the public that the Barangay roads are initially kept accessible with a provision of six (6) openings, where the fence is replaced by mobile barricades. The openings would be closed upon completion of the permanent airport access road that would give more convenient access to those who live at the south of the new airport. Those who live at the north of the new airport are already given convenient access to the highway.



Source: JICA Study Team

Figure 10.2-1 Remaining Houses and Barangay Road

The new airport construction could not be entirely worked without closure of those three (3) Barangay roads crossing the site. Therefore, the completion and taking-over of the permanent access road within a year is mandated in the Particular Conditions of the Construction Contract.

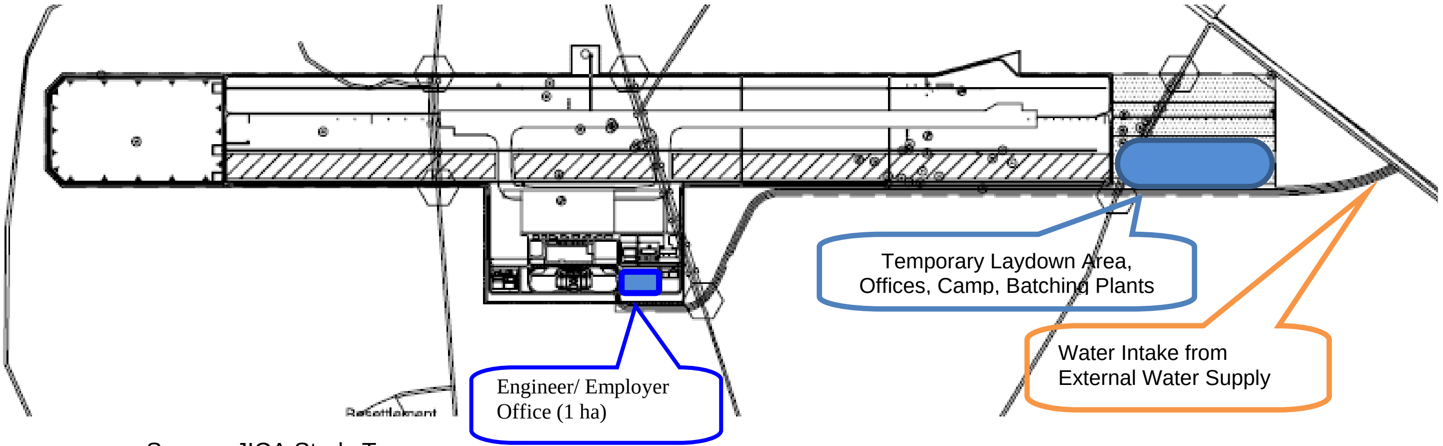
As of June 2013, 45 households are still living in the project site and most of them opt for moving to the resettlement site, once it is prepared. The transfer of these households and demolishing of vacant houses are scheduled prior to commencement of the airport construction.

However, assuming the worst case scenario wherein the construction of the resettlement site is delayed, provision of temporary fence and security guards are incorporated in the proposed specifications and BOQ in order to protect safety of project affected households remaining in the project site.

10.2.2. Temporary Construction Yard

An area of approximately 10 ha (200 m x 500 m) is available for a temporary yard as shown in Figure 10.2-2. This area is intended to cater for Contractor’s laydown area, offices, camp, batching plants, equipment and loading yard. The area is conveniently located in the entry point of the access road to the national highway, where water tapping point is planned to be constructed by DOTC before commencement of the construction.

The Employer and Engineers' office and laboratory for future storage of construction record such as approved shop-drawings, as-built drawings, request for approval of materials and equipment , which are pay items for General Requirement, are desirable to be constructed at a location where those can remain un-demolished as long as possible similar to the case of Iloilo Airport Project. The 1-ha area in front of the proposed Control Tower/Administration Building is vacant at a moment for future car park and/or concessions. This area is situated along the existing Barangay road where electricity is currently provided. Hence, it is earmarked as the proposed site for the Employer and Engineers' office and laboratory



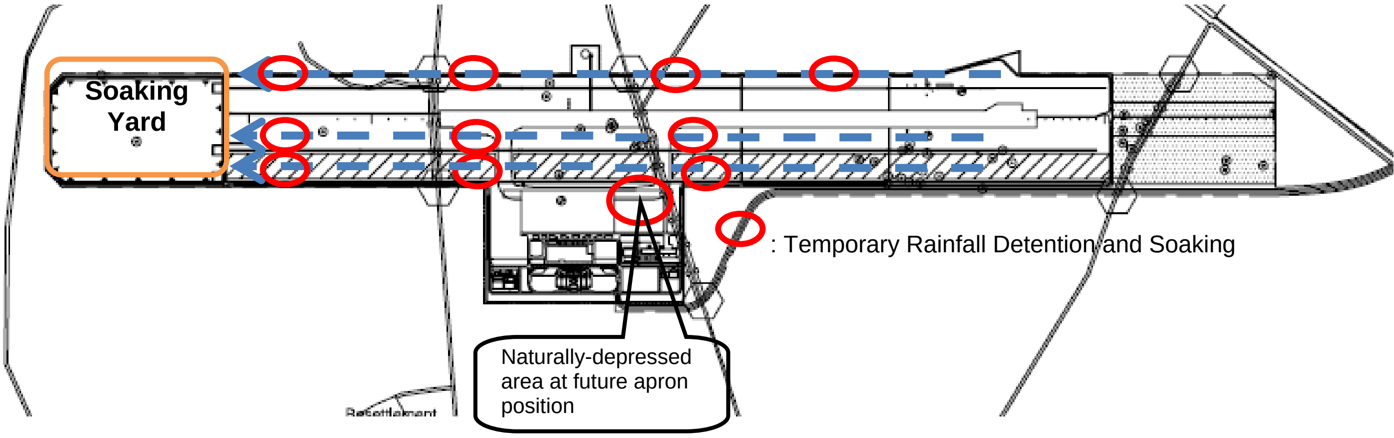
Source: JICA Study Team

Figure 10.2-2 Proposed Temporary Construction Yard

10.2.3. Temporary Drainage

The site of the proposed airport is generally flat with a moderate slope (0.1% to o.15%) in the general direction from north-east to south-west. Permanent drainage facilities are designed to follow this natural slope.

Following the natural terrain of the site, prior to any cut/fill operations, temporary drainage should be constructed, alignment of which may be recommended to be along the position of permanent rip-rapped open ditch. The temporary ditch should be, before crossing the Barangay roads, provided with numbers of temporary detention or soaking yard. Where necessary, pipe culvert should be temporarily placed under the Barangay road, so that the road passage is maintained. Naturally-depressed area (e.g. beside aircraft parking apron in front of control tower) should be utilized as temporary soaking area where applicable.



Source: JICA Study Team

Figure 10.2-3 Temporary Ditch, Rainfall Detention and Soaking Yard

10.3. Geological Conditions of the Site

10.3.1. Summary of Geotechnical Survey

Chapter 2 (2.1.1) summarized the results of 49 borehole investigations with depth of only 5 m since the primary purpose was to ascertain whether any shallow cavity might exist underneath the airport pavement and buildings or not. As the results shows no major cavity was found but porous nature appeared on an undisturbed core sample in Picture 10.3-1.

Picture 10.3-1 Core Sample Recovered

Standard Penetration Test (STP) by means of 63.5 kg automatic hammer with tripping device (free drop from the height of 76 cm) at every 1 m depth at 48 boreholes could have been achieved without coring (except below 3 m at BH-13). The N-value is measured at generally 50 to 100. This means that the dense soil strata are generally of porous non-plastic coralline limestone and permeable nature, which results in less vegetation or tree grow, can be excavated by Bulldozer (D8 or D9 class) with a use of ripper.

Humus topsoil layer is small and in many areas coral stone is exposed to the surface. The soils at an elevation of subgrade are fragmented coralline limestone and meet the particle size standard for granular sub-base course materials.

Below a typical soil example for the north-east side of the runway (Borehole No.13) of brown likely-humus coarse soil on the surface, which even meets gradation of granular sub-base materials and is unlikely to flow away with storm water, are shown.

FINAL BOREHOLE LOG AND SUMMARY OF TEST RESULTS

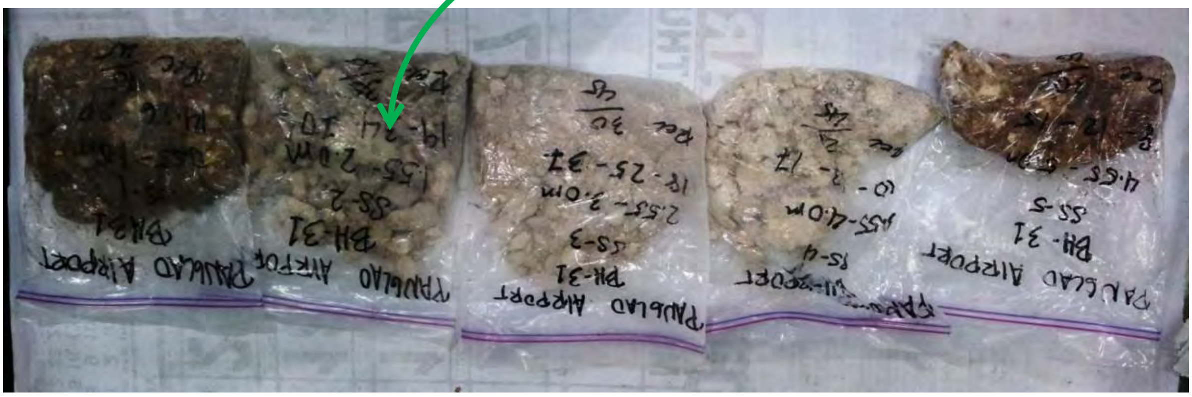
PROJECT: Geotechnical Investigation for the Proposed New Bohol Airport Construction & Sustainable Environmental Protection Project
HOLE NO.: BH-31
DEPTH: 5.0 m
LOCATION: Panglao, Bohol
DATE DRILLED: 2/24/2013 DATE FINISHED: 2/24/2013 WATER TABLE: DWT

DEPTH, m	SAMPLE NUMBER	% RECOVERY	% RQD	SAMPLE TYPE	UNIFIED CLASSIFICATION	DESCRIPTION	N-VALUES SPT 15 cm	15 cm	15 cm	MOISTURE CONTENT	ATTERBERG LIMITS LL (%)	PI (%)	SIEVE ANALYSIS % PASSING SIEVE NO. 1 1/2	1	3/4	1/2	3/8	4	10	40	200
						Ground Surface															
1	1	100	-	SS	SM	Light brown, dense silty sand with gravel (broken corals with limestone) of no plasticity	14	26	20	11.65	NP	NP	100	88	83	58	52	44	36	26	17
2	2	78	-	SS	SM	Light brown, very dense silty sand with gravel (broken corals with limestone) of no plasticity	19	34	70	13.04	NP	NP		100	71	64	58	50	44	31	17
3	3	67	-	SS	SM	Light brown, very dense silty sand with gravel (broken corals with limestone) of no plasticity	18	25	37	16.05	NP	NP		100	91	73	60	44	35	24	16
4	4	67	-	SS	SM	Light brown, dense silty sand with gravel (broken corals with limestone) of no plasticity	10	13	17	17.06	NP	NP			100	97	91	80	69	53	35
5	5	67	-	SS	SM	Light brown, medium dense silty sand with gravel (broken corals with limestone) of no plasticity	8	22	15	17.50	NP	NP				100	92	83	72	55	37

GRAPH: 10 20 30 40

Subgrade Cut 1.6m

END OF BOREHOLE

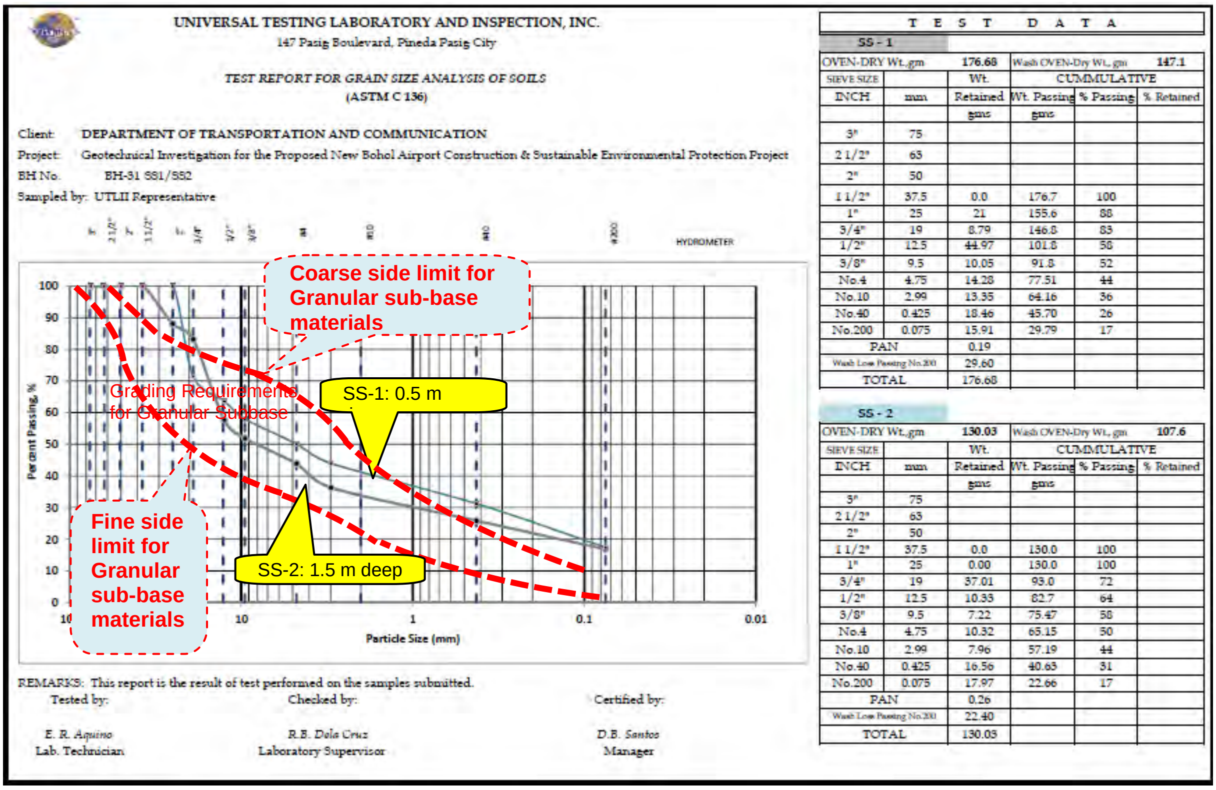


Moisture contents of disturbed soil samples

Location	SS1	SS2	SS3	SS4	SS5
Can Number	1	2	3	4	5
Weight of can & wet soil, g.	221.94	166.83	170.29	131.04	183.41
Weight of can & dry soil, g.	201.35	149.87	149.06	114.59	159.14
Weight of water, g.	20.59	16.96	21.23	16.45	24.27
Weight of can, g.	24.67	19.84	16.80	18.19	20.49
Weight of dry soil, g.	176.68	130.03	132.26	96.40	138.65
Moisture Content, %	11.65	13.04	16.05	17.06	17.50

Source: JICA Study Team

Figure 10.3-1(1) Typical Soil at North-east side of Runway (Borehole BH-31)



UNIVERSAL TESTING LABORATORY AND INSPECTION, INC.
147 Pasig Boulevard, Pineda Pasig City

TEST REPORT FOR GRAIN SIZE ANALYSIS OF SOILS
(ASTM C 136)

Client: DEPARTMENT OF TRANSPORTATION AND COMMUNICATION
Project: Geotechnical Investigation for the Proposed New Bohol Airport Construction & Sustainable Environmental Protection Project
BH No. BH-31 SS1/SS2
Sampled by: UTLII Representative

REMARKS: This report is the result of test performed on the samples submitted.

Tested by: E. R. Aquino, Lab. Technician
Checked by: R.B. Dela Cruz, Laboratory Supervisor
Certified by: D.B. Santos, Manager

TEST DATA

SS - 1

OVEN-DRY Wt.,gm		176.68	Wash OVEN-Dry Wt., gm		147.1
SIEVE SIZE		Wt.	CUMMULATIVE		
INCH	mm	Retained	Wt. Passing	% Passing	% Retained
		gms	gms		
3"	75				
2 1/2"	63				
2"	50				
1 1/2"	37.5	0.0	176.7	100	
1"	25	21	155.6	88	
3/4"	19	8.79	146.8	83	
1/2"	12.5	44.97	101.8	58	
3/8"	9.5	10.05	91.8	52	
No.4	4.75	14.28	77.51	44	
No.10	2.99	13.35	64.16	36	
No.40	0.425	18.46	45.70	26	
No.200	0.075	15.91	29.79	17	
PAN		0.19			
Wash Loss Passing No.200		29.60			
TOTAL		176.68			

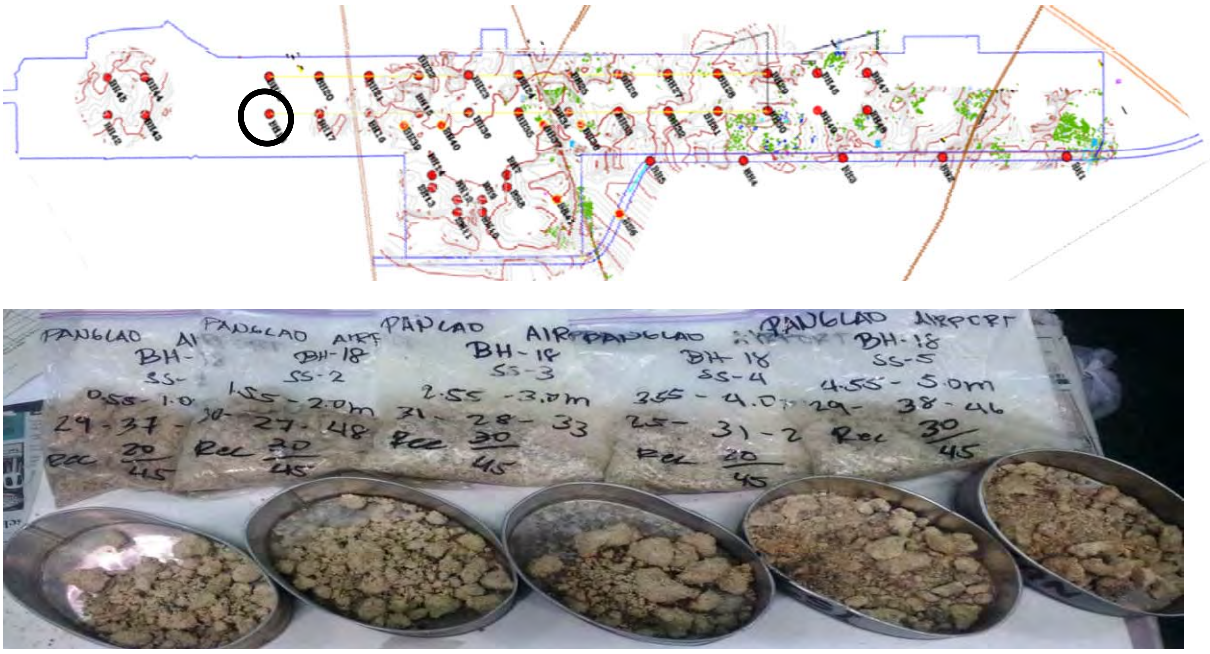
SS - 2

OVEN-DRY Wt.,gm		130.03	Wash OVEN-Dry Wt., gm		107.6
SIEVE SIZE		Wt.	CUMMULATIVE		
INCH	mm	Retained	Wt. Passing	% Passing	% Retained
		gms	gms		
3"	75				
2 1/2"	63				
2"	50				
1 1/2"	37.5	0.0	130.0	100	
1"	25	0.00	130.0	100	
3/4"	19	37.01	93.0	72	
1/2"	12.5	10.33	82.7	64	
3/8"	9.5	7.22	75.47	58	
No.4	4.75	10.32	65.15	50	
No.10	2.99	7.96	57.19	44	
No.40	0.425	16.56	40.63	31	
No.200	0.075	17.97	22.66	17	
PAN		0.26			
Wash Loss Passing No.200		22.40			
TOTAL		130.03			

Source: JICA Study Team

Figure 10.3-1(2) Typical Soil at North-east side of Runway（Borehole BH-31）

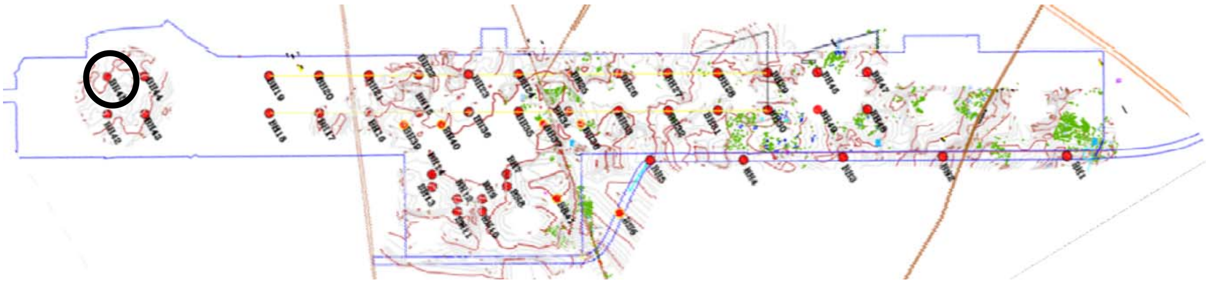
On the other hand, a typical soil for the south-west side of the runway (Borehole No.18), where no topsoil exists, consists of fragmental coral from the top of surface.



Source: JICA Study Team

Figure 10.3-2 Typical Soil at South-west side of Runway（Borehole BH-18）

The lowest bottom of the Soaking Yard（Borehole BH-45）is made of stone with no humus topsoil, where rainwater seems to be fast absorbed into the ground because the natural moisture content is extremely low.



FINAL BOREHOLE LOG AND SUMMARY OF TEST RESULTS

PROJECT: Geotechnical Investigation for the Proposed New Bohol Airport Construction & Sustainable Environmental Protection Project
HOLE NO.: BH-45
DEPTH: 5.0 m
LOCATION: Panglao, Bohol
DATE DRILLED: 3/4/2013 DATE FINISHED: 3/4/2013 WATER TABLE: DWT

DEPTH, m	SAMPLE NUMBER	% RECOVERY	% RQD	SAMPLE TYPE	LOG SYMBOL	UNIFIED CLASSIFICATION	DESCRIPTION	N-VALUES SPT 15 cm	15 cm	15 cm	GRAPH	MOISTURE CONTENT	ATTERBERG LIMITS LL (%)	PI (%)	SIEVE ANALYSIS % PASSING SIEVE NO. 1 1/2	1	3/4	1/2	3/8	4	10	40	200
							Ground Surface				Cut 0 m												
	1	44	-	SS		GM	Brown, very dense silty gravel with sand (broken corals with limestone) of no plasticity	40	63	57		8.73	NP	NP	100	81	81	78	64	45	36	28	23
1	2	78	-	SS		GM	Brown, very dense silty gravel with sand (broken corals with limestone) of no plasticity	37	43	29		9.00	NP	NP		100	77	62	51	39	31	25	21
2	3	56	-	SS		GM	Brown, very dense silty gravel with sand (broken corals with limestone) of no plasticity	28	31	[illegible]		6.54	NP	NP	100	83	75	61	53	37	29	22	18
3	4	67	-	SS		SM	Brown, very dense silty sand with gravel (broken corals with limestone) of no plasticity	33	[illegible]	26		3.73	NP	NP			100	97	86	61	42	26	16
4	5	67	-	SS		GP-GM	Brown, very dense poorly graded gravel with silt and sand (broken corals with limestone) of no plasticity	32	23	25		4.49	NP	NP		100	90	62	40	19	13	11	9
5							END OF BOREHOLE																

Moisture contents of disturbed soil samples

Location	SS1	SS2	SS3	SS4	SS5
Can Number	1	2	3	4	5
Weight of can & wet soil, g.	200.92	208.80	187.66	172.70	187.43
Weight of can & dry soil, g.	186.85	193.33	177.71	167.21	180.49
Weight of water, g.	14.07	15.47	9.95	5.49	6.94
Weight of can, g.	25.70	21.50	25.66	20.08	26.05
Weight of dry soil, g.	161.15	171.83	152.05	147.13	154.44
Moisture Content, %	8.73	9.00	6.54	3.73	4.49

Figure 10.3-3 Typical soil at Soaking Yard（Borehole BH-45）

In general speaking, the subsoil under the new airport construction is very dense (N-value of 50~100) and humus topsoil is very limited. The topsoil is generally coarse enough to meet gradation of granular sub-base course which do not easily flow away.

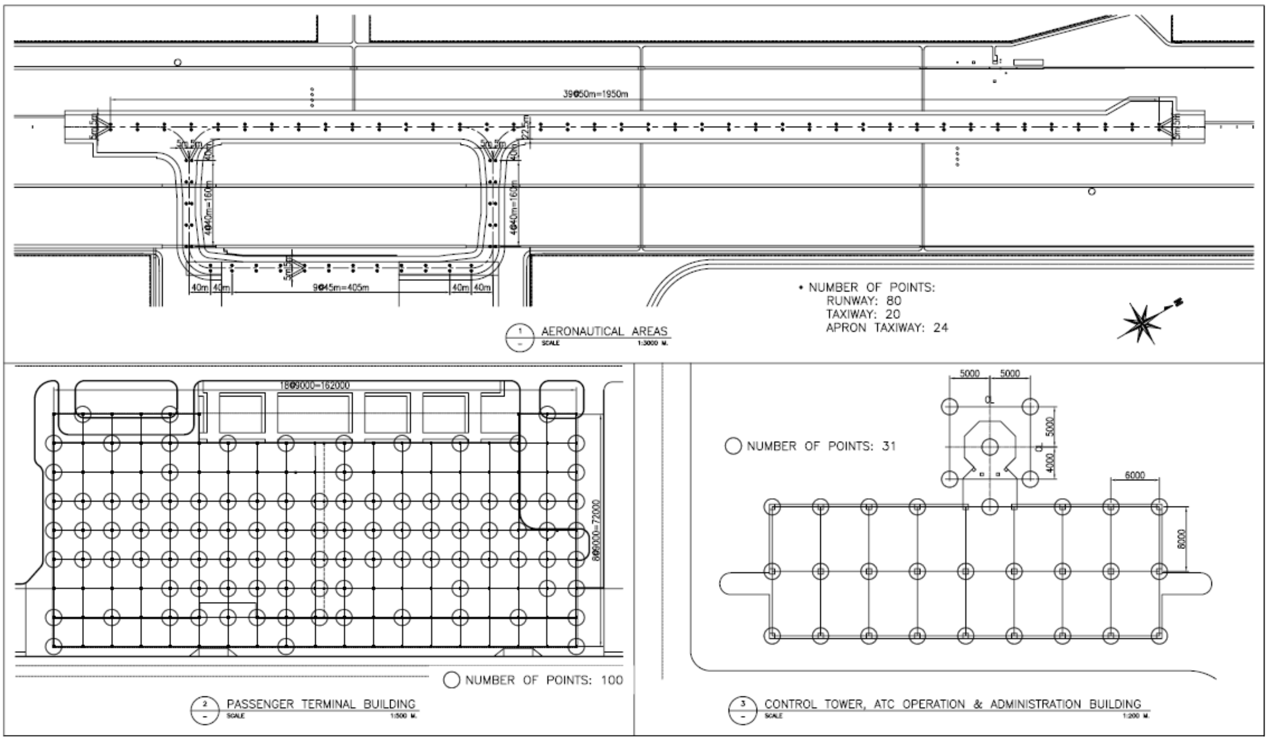
Great majority of the 49 boreholes indicated moisture contents of less than 10%, which are extremely low values compared with the value of normal soil of hard strata, e.g. 10% to 20%. This leads to the conclusion that rainwater quickly penetrates into the porous ground, which results in less tree or bush grow on site.

10.3.2. Further Investigation for Possible Cavity

Through the previous investigations, i.e. more than 90 boreholes in total (in 2009 and 2013), only one (1) cavity was found by accident.

To make sure that no major cavities exist directly under pavement or footing of buildings, further borehole investigations are proposed to be implemented just after commencement of the construction, as follows:

- At footing for PTB: 100 boreholes of 5-m deep
- At footing for control tower/ administration building: 31 boreholes of 5-m deep
- 5 m on both side of centerline of Runway/ taxiway: 124 boreholes of 2-m deep



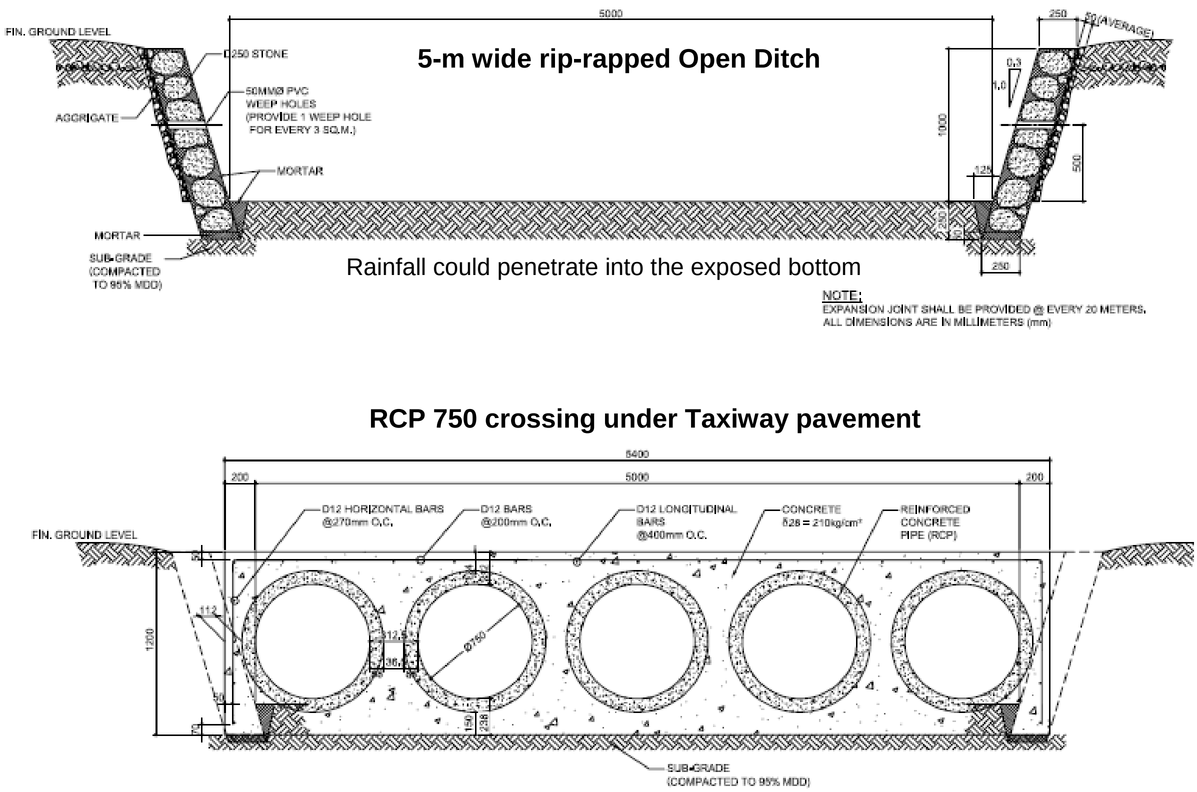
Source: JICA Study Team

Figure 10.3-4 Location for Further Borehole Investigations

10.4. Airport Drainage

10.4.1. Aeronautical Area

As stated in Chapter 4 (4.4-2), one of the prerequisite conditions for environmental protection is that any dirty water should not overflow from the new airport to the ocean. Towards this objective, storm water along airfield is planned to be collected through a riprapped open ditch. The bottom of the open ditch is exposed ground, so that storm water is locally detained and absorbed into the ground as much as possible and only a minimal volume would flow into the soaking yard.

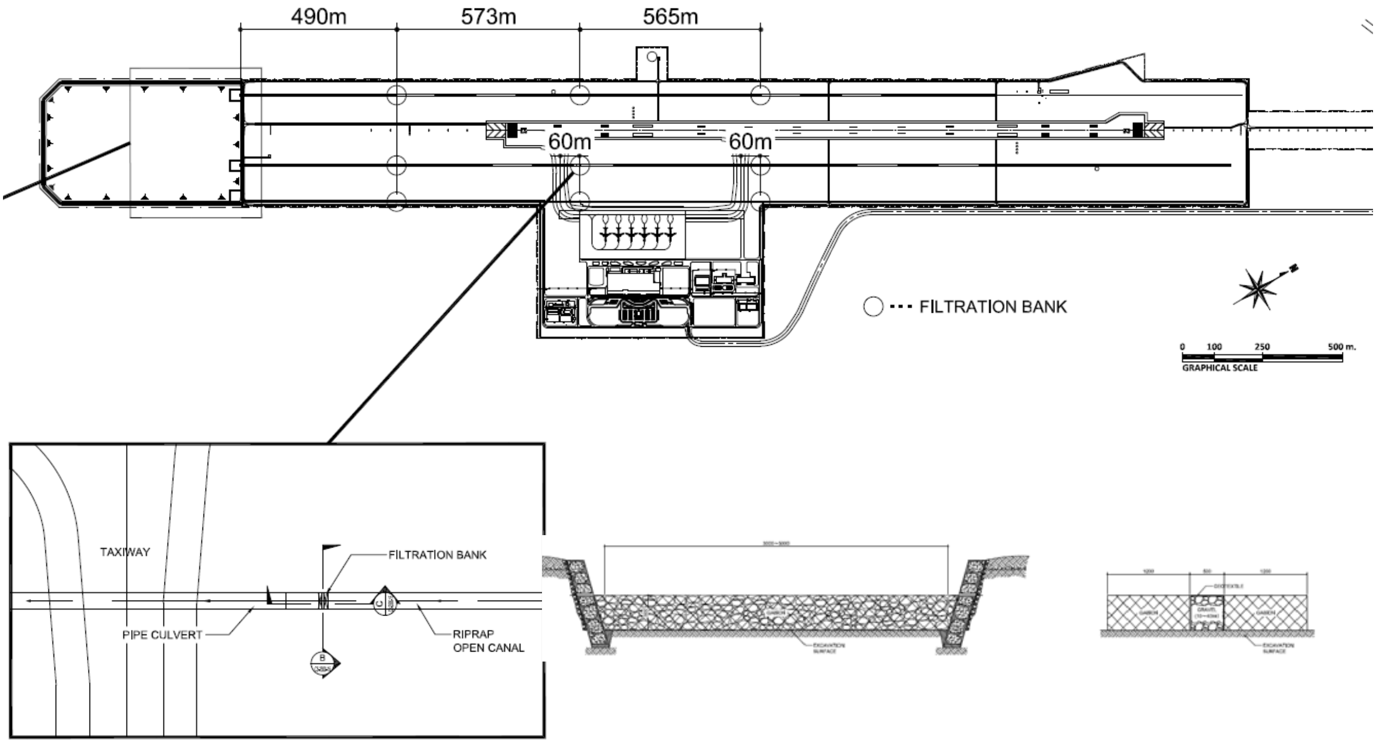


Source: JICA Study Team

Figure 10.4-1 Drainage Facilities at Aeronautical Area

The width of the riprapped open ditch of 5 m is more than what was computed as required drainage capacity, but cost of the riprap-wall is the same irrespective of their separation and widely-exposed bottom of the natural ground can locally absorb more rainfall.

Before the storm-water was flowing into the RCP, now a filtration bank of stone covered with gabion is proposed to be made so that it prevents fine silt from flowing into the soaking yard.



Source: JICA Study Team

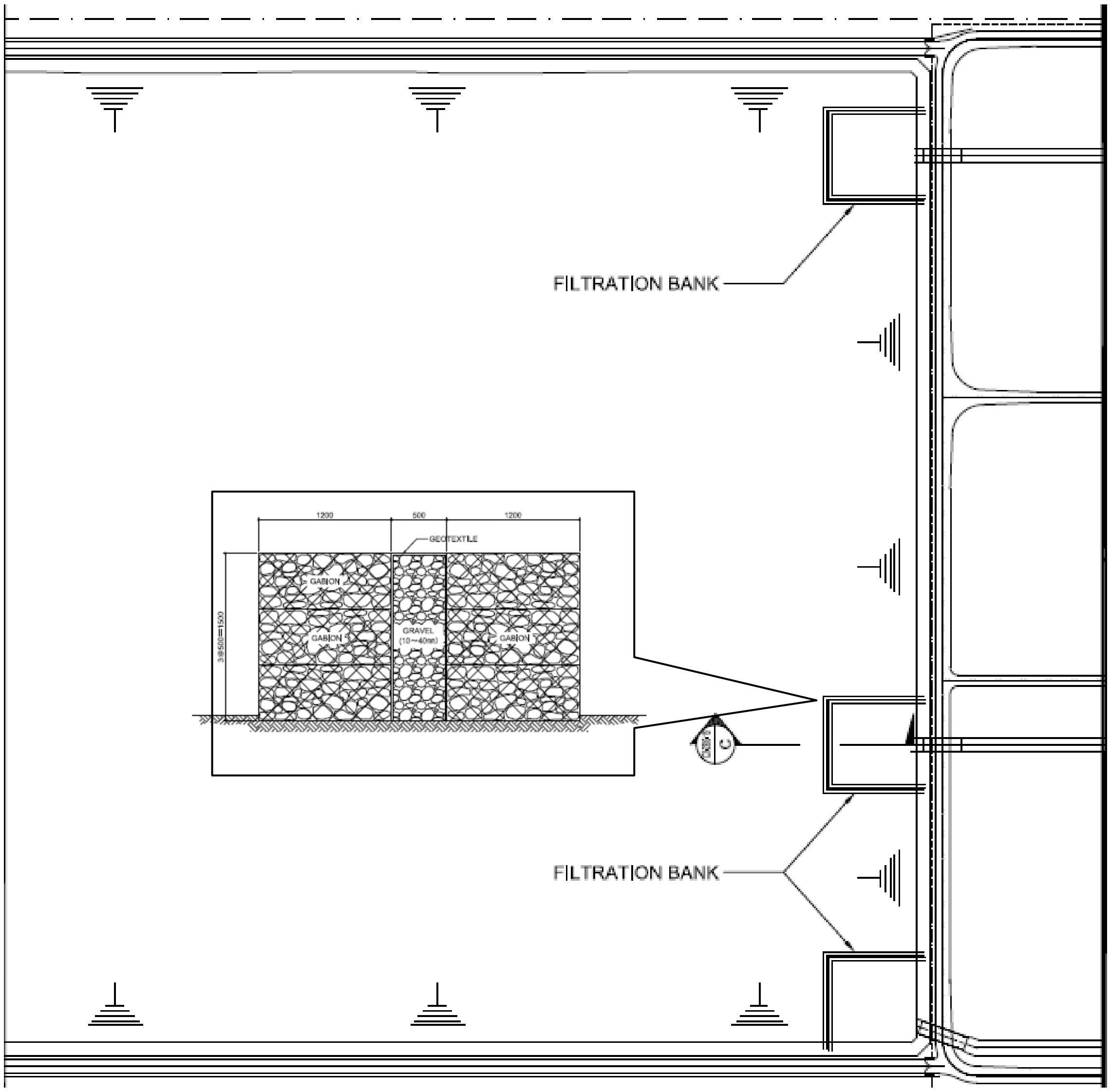
Figure 10.4-2 Filtration Bank at Aeronautical Area

10.4.2. Soaking Yard

Normally, airport storm drainage system is designed based on the rainfall intensity of its return period of 5 years (by FAA) or 10 years (by JCAB). However, as JICA's Advisory Committee of Environmental and Social Considerations advised that the area of soaking yard should cope with extraordinary weather condition recently encountered worldwide, the capacity of the soaking yard is so designed that any storm water would not overflow from the airport property for long future.

Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA) analyzed based on their 29-year record, that daily maximum rainfall could be 143 mm for the return period 10 year, 197 mm for that of 50 years and 219 mm for that of 100 years. Assuming 50 % of the rainfall is naturally absorbed into the ground of approximately 200 ha, the reservoir capacity of the detention pond (soaking yard) for the return period of 100 years should not be less than 220,000 tons of water (i.e. 50% x 0.219 m x 2,000,000 m^2). In addition, maximum 420 tons in total of water used for the building complex will be discharged via sewage treatment plant to the same soaking yard, which culminate a total of 220,420 ton of water. In the meanwhile, the dimension of the soaking yard is planned to be of 20 ha as area and 2.5 m in depth, where 500,000 tons of reservoir capacity is available.

DOTC intends to proceed with the embankment of the soaking yard perimeter by its own fund. It should be instructed to the local contractor in charge that the final elevation of the bottom of soaking yard should not be exposed nor compacted during construction, so as to maintain natural permeability.



Source: JICA Study Team

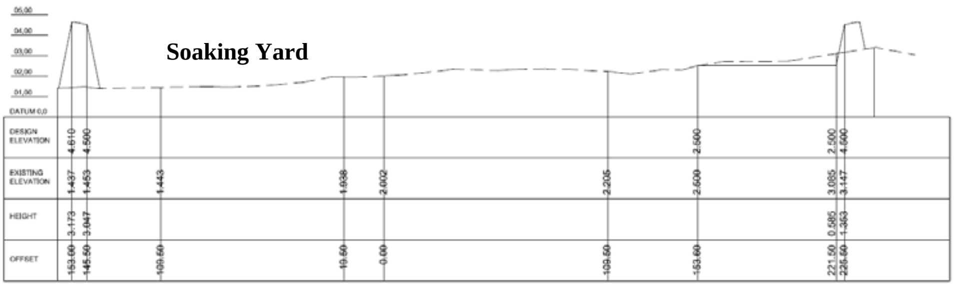
Figure10.4-3 Filtration Bank at Soaking Yard

To preserve the soaking function in the open ditch, filtration bank of stone covered with gabion should be made. It was further designed that the bottom of the soaking yard will be covered by geo-textile materials so that the fine sand can not plug the natural underground-watercourse.

10.5. Earthwork

It was decided by DOTC, that the airfield earthworks should be carried out only to the extent of runway strip for instrument operations (i.e. 150 m on both sides of runway centerline) and taxiway strip (i.e. 47.5 m on both sides of taxiway centerline for Code E). The existing ground for the future parallel taxiway should remain untouched.

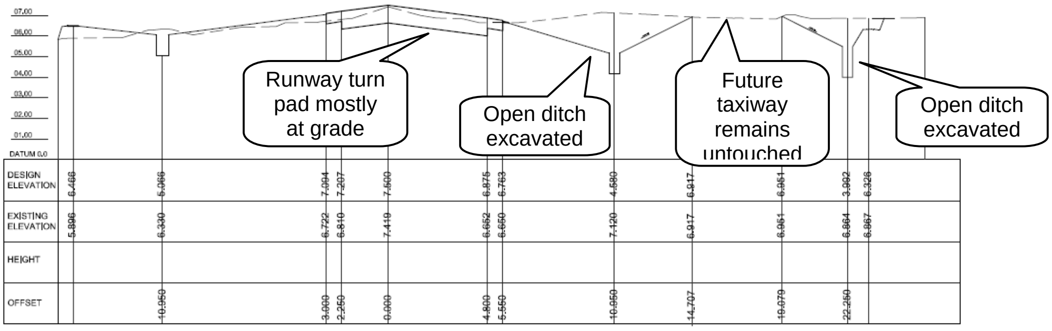
The runway cross section has been so designed that cut and fill volumes are balanced as shown below:



Airport storm water will drain into the Soaking Yard of 20 ha. Its bottom elevation varies from 1.4 m to 2.5 m and the perimeter is embanked to be 4.5 m above MSL, where 500 thousand tons of water will be stored.

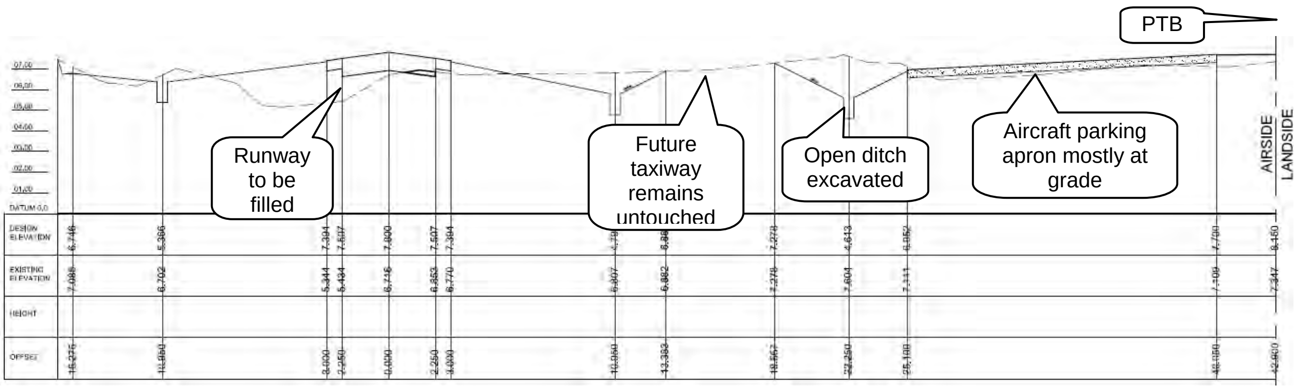
Source: JICA Study Team

Figure 10.5-1 Typical Cross Section - Sta. 0-900 (Soaking Yard)



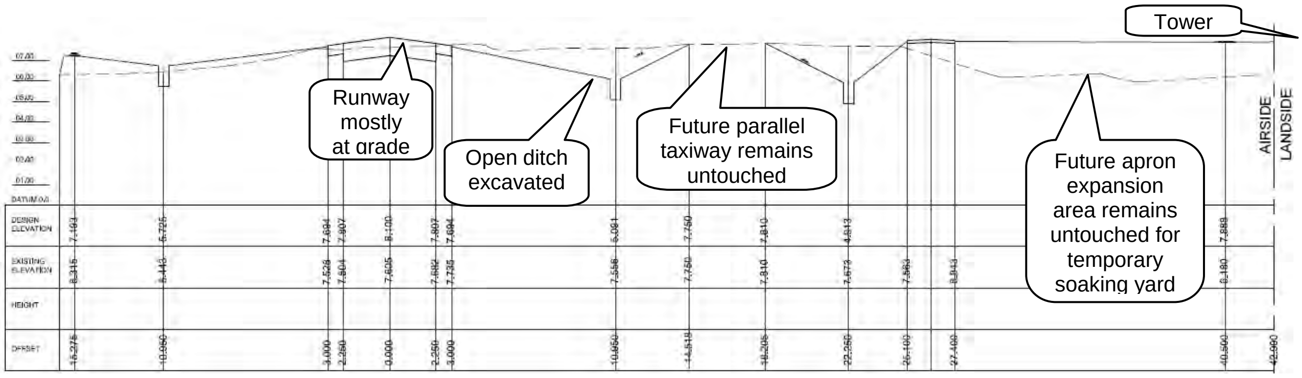
Source: JICA Study Team

Figure 10.5-2 Runway Cross Section - Sta. 0+500 (Runway03 Threshold)



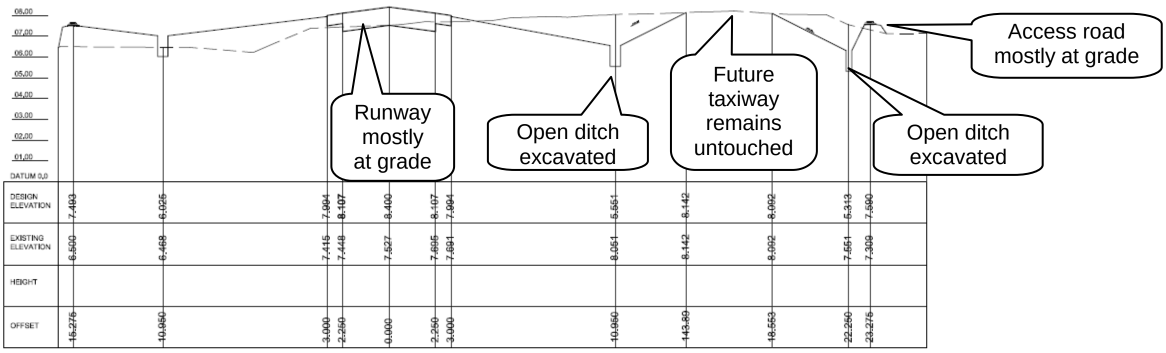
Source: JICA Study Team

Figure10.5-3 Runway Cross Section - Sta.0+800 (PTB Area)



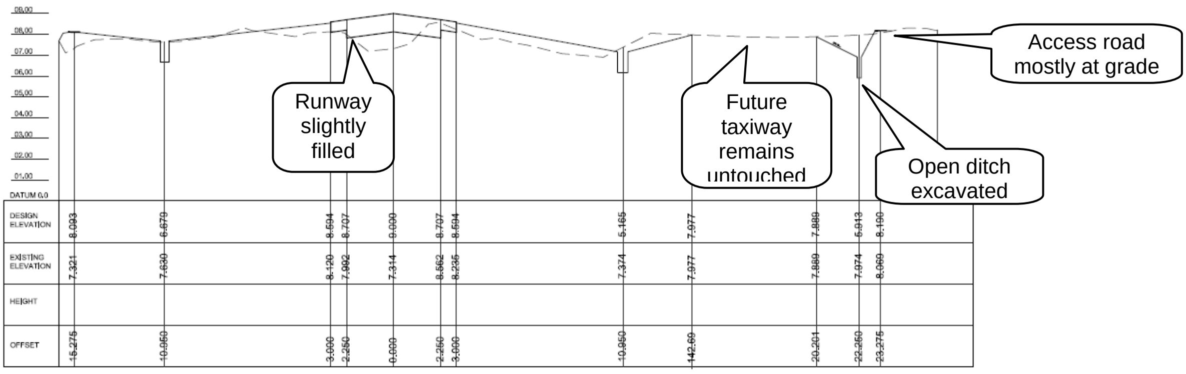
Source: JICA Study Team

Figure 10.5-4 Runway Cross Section - Sta.1+100 (Area in front of Tower)



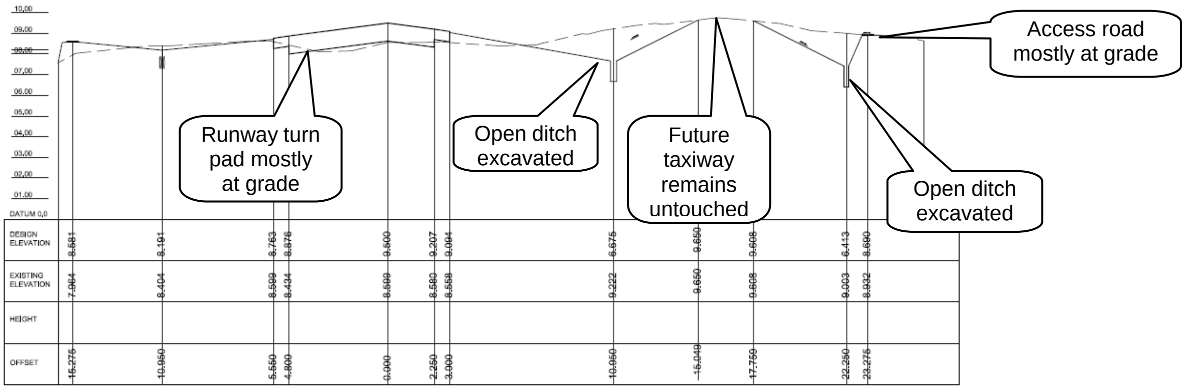
Source: JICA Study Team

Figure10.5-5 Runway Cross Section - Sta.1+400 (around middle of Runway)



Source: JICA Study Team

Figure10.5-6 Runway Cross Section - Sta.2+000 (Touchdown Area for Runway 22)



Source: JICA Study Team

Figure10.5-7 Runway Cross Section - Sta.2+500 (Runway22 Threshold)

Topsoil of a constant depth of 0.30 m from the original ground elevation had been planned to be excavated and stored. However, it was found through additional soil investigation that the volume of top soil is very minimal. At any rate, humus topsoil if found should be stored beside the runway strip as much as possible for later use for landscaping.

As a result, earthwork volume has been re-computed to be 460 thousand m^3 for excavation and 290 thousand m^3 for embankment (surplus of 170 thousand). This computation of earthwork volumes revealed that savings of some 200 thousand m^3 for excavation and 300 thousand m^3 for embankment from those previously computed through JICA Preparatory Survey (i.e. 660 thousand m^3 of excavation and 580 thousand m^3 for embankment) can be made. Those earthwork volumes include additional 50 cm deep excavation of subgrade in cut and same volume to replace and re-compact thereof (i.e. embankment) if and when suspected cavity or weak soil appears on the ground.

The excess excavation volume of 170 thousand m^3 may be utilized as sub-base materials for pavement works after crushing and blending, if the quality and quantity are met, which will be subject to laboratory tests during the construction stage.

10.6. Execution Plan

10.6.1. Delivery of Raw Materials

The construction requires 7,800 m^3 of building structural concrete, 22,800 m^3 of apron pavement concrete, 500 m^3 of drainage and other miscellaneous concrete, 45,240 m^3 of asphalt concrete, 125,900 $m^3$of pavement base-course materials and 167,700 $m^3$of sub-base materials.

With the exception of sub-base material that may possibly be obtained from the excavated rock within the site, it is estimated that approximately 200,000 m^3 in total of sand and aggregate should be outsourced from other islands, such as Leyte, Cebu or

Mindanao, since Bohol and Panglao Islands are mostly made of limestone which is not suitable for concrete or asphalt concrete. Diligent and quick marketing effort to select suppliers and careful examination of material quality is essentially required by the contractor beforehand.

When delivery duration 600 days are assumed to be available for shipping, daily average of more than 350 $m^3$of sand and aggregate should be constantly delivered by barge ship and dump-truck to the site. The adequate size and capacity of barge ship and dump-truck should be carefully allocated in consideration of the conditions of Tagbilaran Port and road in Panglao Island. Considering the fact that a round trip of a barge ship between islands takes 3~4 days, 150 round trips (in 600 day) only are counted, hence required numbers of barge ships should be carefully examined.

In addition, delivery of 14,000 tons of cement, 6,000 tons of asphalt, 600 tons of structural steel, 8,000 tons of re-bar and architectural finishing materials, which however is less frequent compared with the aggregates mentioned above.

Delivery of those raw materials is one of the critical elements in the construction activities on such a remote island.

10.6.2. Batching Plants

There is no major commercial batching plant producing such considerable quantity available in Bohol (both for concrete and asphalt).

It is practical that at least one (1) concrete batching plant and one (1) asphalt concrete batching plant, both of reasonable production capacity should be erected on site immediately upon commencement of the construction.

As the case may be, an extra concrete batching plant may be necessary exclusively for apron concrete pavement because it requires hard concrete mixture of low-slump (i.e. 2 to 5 cm only) and quick transportation by dump truck (only dump truck is allowed no transportation by agitating-truck).

It normally takes at least 6 month to deliver on site, erect, commission and calibrate a batching plant, together with trial mix of materials to satisfy the specified quality (e.g. strength, slump).

In addition, rock crushing plants is assumed to be strategically located so as to produce subgrade and or sub-base materials.

10.6.3. Major Quantities of Building Works

Construction of building works consists of a series of activities, e.g. excavation and backfill of foundation, concreting of footing, concrete slab on grade, and columns, scaffolding, structural steel, roofing, electro/mechanical works and architectural finishing works.

Although the quantities of works have to be defined through the course of detailed design, the major quantities of building works are roughly estimated as enumerated in Table10.6-1.

Table 10.6-1 Quantity of major Building Works

Building Components				floor area (m^2)	%	Concrete (m^3)	%	Footings nos.	%
Part 4: Building Works									
	B1	Passenger Terminal Building (PTB)		8,361	64.8%	3,817	49.0%	161	47.8%
	B3	Control Tower & Admin. (ATO)		1,945	15.1%	1,976	25.3%	27	8.0%
	B4	Fire Station and Maintenance (FSM)		864	6.7%	567	7.3%	27	8.0%
	B5	Ancilliary Buildings)ACB)							
	B	51	Drivers Lounge (DRL)	45	0.3%	104	1.3%	6	1.8%
	B	52	Car Park Toilet (CPT)	22	0.2%	40	0.5%	6	1.8%
	B	53	Guard Houses (GDH)	38	0.3%	141	1.8%	28	8.3%
	B	54	Toll Booth (TLB)	24	0.2%	9	0.1%		0.0%
	B6	Utility Building (ULB)							
	B	61	Water Tank/ Pump Room (WPH)	480	3.7%	344	4.4%	18	5.3%
	B	62	Power House (PWH)	864	6.7%	574	7.4%	28	8.3%
	B	63	STP Control Room (STP)	60	0.5%	92	1.2%	8	2.4%
	B	64	Material Recovery Facilitiy (MRF)	96	0.7%	10	0.1%	10	3.0%
	B7	Navaids Buildings (NAV)							
	B	71	LLZ Building (LLZ)	28	0.2%	37	0.5%	6	1.8%
	B	72	GS Building (GSB)	28	0.2%	37	0.5%	6	1.8%
	B	73	VOR Building (VOR)	51	0.4%	47	0.6%	6	1.8%
			Total	12,906	100%	7,795	100.0%	337	100%

Source: JICA Study Team

The above table shows that PTB works involves 65% of total building floor areas, 50 % of total building concrete volume and 48 % of the number of footings, consequently the critical path in the construction schedule of the building is for PTB.

It is economical for the contractor that concrete works for major buildings are scheduled in a sequential manner according to the volume of concrete, so that one (1) concrete batching plant can effectively deliver the required quantities of concrete. However, those buildings which necessitate installation of major equipment (for utilities and air navigation) subsequently after the concreting works are also given priority.

Priority of the sequence of building construction is assumed based on the concrete volume as follows:

priority 1.	B1: Passenger Terminal Building (PTB):	3,817 m^3
priority 2.	B3: Control Tower & Admin. Building (ATO):	1,976 m^3
priority 3.	B61 Water Tank/ Pump Room (WPH):	344 m^3
priority 4.	B62: Power House (PWH):	574 m^3
priority 5.	B4: Fire Station and Maintenance Building (FSM):	567 m^3
priority 6.	Navaids Buildings (NAV):	121 m^3

10.7. Preliminary Construction Schedule

Upon commencement of the construction, temporary works (e.g. temporary road, drainage, construction of offices, camp, etc.) are assumed to start immediately.

Meanwhile, construction of major civil works consists of earthworks, pavement works, and drainage works, which are assumed to start in general sequence.

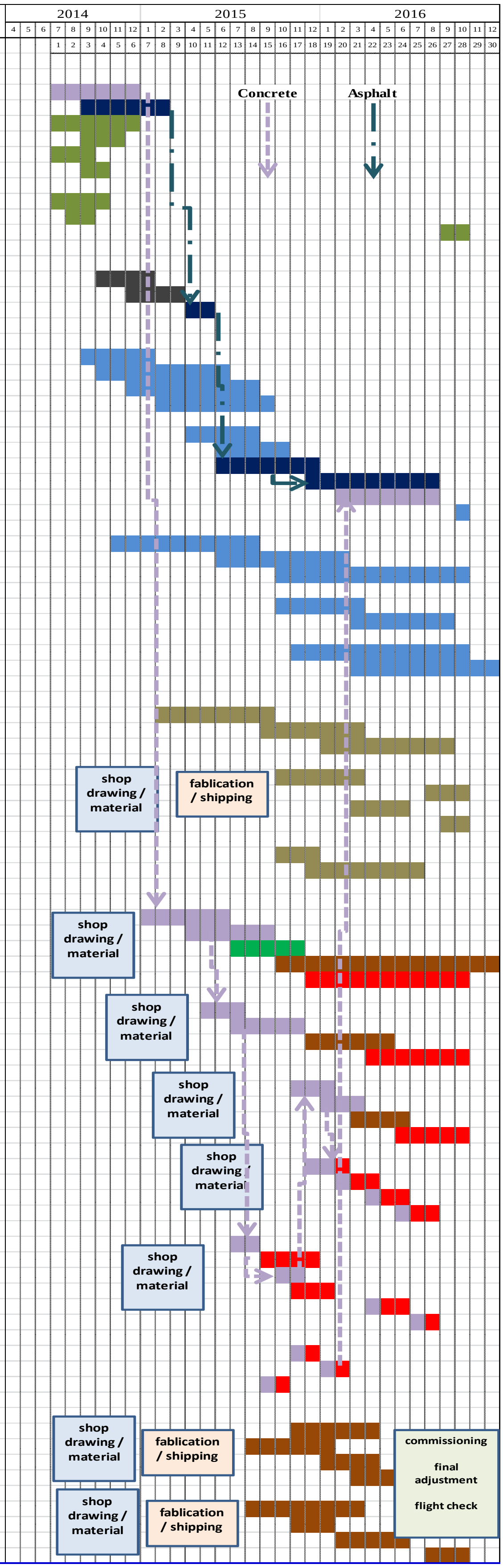
Erection of the concrete batching plant is assumed to take at least 6 month together with all temporary works. By the time, land preparation at the finishing elevation for PTB area is assumed to be completed through the civil works as the first priority, with necessary measures taken for subsoil strengthening and filling-up or grouting of cavity if any. After concreting of all building works, apron concrete pavement works are assumed to be commenced.

Erection of asphalt batching plant is also of primary importance to execute such vast quantity of asphalt concrete pavement comprising 2 layers of 3 km long access road, 4 layers of 2,000 km long runway, perimeter road and necessary maintenance road.

On this basis, construction is assumed to be generally implemented likely in the manner shown in Table 10.7-1. It is concluded that it would take 12 months to complete the access road and 30 months to complete all airport infrastructure, including PTB and runway.

Table 10.7-1 Preliminary Construction Schedule

Activity	Remarks: works	Remarks: quantity	daily progress	days required
Construction				
Part 0: Temporary Works				
Batching Plant				
Concrete Batching Plant/trial mix				
Asphalt Batching Plant/trial mix				
Temporary Drainage				
Temporary Road				
Offices & Camp				
Temporary Utility				
Part 1: General Requirements				
Employer/Engineers' Office				
Project Vehicle				
Maintenance Equipment				
Part 2: Civil Works				
Access Road				
Earthworks		12,000 m^3	100 m^3	120 days
Subbase and Basecourse		16,500 m^3	200 m^3	90 days
Asphalt Pavement Surface		3,980 m^3	100 m^3	40 days
Airport Site				
C1 Earthworks				
Topsoil Removal		130,000 m^3	1,500 m^3	90 days
Excavation		900,000 m^3	5000 m^3	180 days
Embankment		760,000m^3	5000 m^3	160 days
Subgrade Preparation		370,000 m^3	3000 m^3	120 days
C2 Pavement Works				
Subbase Course		93,900 m^3	800 m^3	120 days
Base Course		45,600 m^3	400 m^3	120 days
Treated Basecourse		28,400 m^3	200 m^3	150 days
Asphalt Pavement Surface		27,900 m^3	150 m^3	200 days
Concrete Pavement Surface		22,300 m^3	150 m^3	150 days
Marking		13,5000 m^2		
C3 Stormwater Drainage				
Airfield Drainage (CHB 600mm)	CHB wall	12,000 m^2	50 m^2	240 days
Terminal Area Drainage	con. pipe	4,000 m	30 m	150 days
Soaking Yard	area	20 ha		
C4 Miscellaneous				
Curbstone	length	13,000 m	100 m	130 days
Fence & Gate	length	10,700 m	75 m	150 days
C5 Landscaping				
Airfield Sodding	area	1,060,000m^2		
Landside tree/ bushes/ sodding	area	90,000 m^2		
Part 3: Utility Works				
U1 Water Supply				
Water Supply Piping Network	length	4,800 m	30 m	160 days
Water Storage				
Water Distribution	length	5,300 m	30 m	180 days
U2 Electrical Spply & Distribution				
Power Supply				
Stanby Generator				
Power Distribution				
Road and Car Park Lighting				
U3 Sewage Treatment				
Sewer Piping/ Manhole	length	820 m	20 m	40 days
Sewage Treatment Plant				
Part 4: Building Works				
B1 Passenger Terminal Building (PTB)				
Excavation/Footing/Backfilling	footings	152 nos.	1no	150 days
Structural Concrete	concrete	4,710 m^3	30 m^3	150 days
Structural Steal & Roof				
Electrical/ Mechanical Works				
Internal/External Finishing Works	floor area	8,361 m^2		
B3 Control Tower & Admin. (ATO)				
Excavation/Footing/Backfilling	footings	27 nos.	1no	30 days
Structural Concrete	concrete	1,947 m^3	30 m^3	
Electrical/ Mechanical Works				
Internal/External Finishing Works	floor area	1,945 m^2		
B4 Fire Station and Maintenance (FSM)				
Excavation/Footing/Backfilling	footings	27 nos.	1no	30 days
Structural Concrete	concrete	644 m^3	30 m^3	
Electrical/ Mechanical Works				
Internal/External Finishing Works	floor area	864 m^2		
B5 Ancilliary Buildings)ACB)				
B 51 Drivers Lounge (DRL)	floor area	45 m^2		
B 52 Car Park Toilet (CPT)	floor area	22 m^2		
B 53 Guard Houses (GDH)	floor area	38 m^2		
B 54 Toll Booth (TLB)	floor area	24 m^2		
B6 Utility Building (ULB)				
B 61 Water Tank/ Pump Room (WPH)	concrete	390 m^3	15 m^3	40 days
	floor area	480 m^2		
B 62 Power House (PWH)	concrete	649 m^3	15 m^3	50days
	floor area	864 m^2		
B 63 STP Control Room (STP)	floor area	60 m^2		
B 64 Material Recovery Facilitiy (MRF)	floor area	96m^2		
B7 Navaids Buildings (NAV)				
B 71 LLZ Building (LLZ)	floor area	28 m^2		
B 72 GS Building (GSB)	floor area	28 m^2		
B 73 VOR Building (VOR)	floor area	51 m^2		
Part 5: NAVAIDS				
A1 Air Navigation/Meteorological Works				
ILS				
VOR/DME				
ATS & Telecomunication				
Meteorological Observation				
A2 Aeronautical Ground Lightsing Works				
Approach Lighting System				
PAPI				
Runway/Taxiway Lighting				
Apron Floodlighting				



Source: JICA Study Team

CHAPTER 11

PROJECT COST AND PROCUREMENT PLAN

TABLE OF CONTENTS

Chapter 11 Project Cost and Procurement Plan

11.1. Project Cost

According to the Final Report for the JICA Preparatory Survey, in consideration of the exchange rate at that time (i.e. 1.00 US$ = 82.43 Yen = 43.6 Peso or 1.00 Peso = 1.89 Yen) and escalation rate of 1.6% for Yen and 4.0 % for Peso, the basic construction costs excluding VAT, contingency, price escalation, consultancy services, land acquisition and administration cost were estimated to be 4.63 Billion Pesos (equivalent to 8.75 Billion Yen), as shown in the Table below.

Table 11.1-1 Base Construction Cost Estimate at JICA Preparatory Survey

Description		Exchange	Peso	= Yen	= US $	
		Rate	43.6	82.43	1.00	
Cost Saving Scenario	Runway: 2000 m/ with ILS		**Local**	**Foreign**		**Total**
	Single-story PTB/ no Cargo		**Peso**	**Yen**	**in US$**	**in Peso**
A	**Construction**					
	Part 1 : General Requirements		76,797	119,148	1,445	139,818
	Section 1120 : Employer's and Engineer's Facilities		67,281		0	67,281
	Section 1210 : Project Equipment		9,366	56,568	686	39,287
	Section 1220: Fire Fighting Vehicle				0	0
	Section 1230: Maintenance Equipment		150	62,580	759	33,251
	Part 2: Civil Works		813,017	2,467,127	29,930	2,117,963
	Section C1-2100 : Earth Works		64,817	627,322	7,610	396,629
	Section C1-2200 : Pavement Works		503,608	1,353,200	16,416	1,219,361
	Section C1-2300 : Drainage System		104,387	333,924	4,051	281,011
	Section C1-2400 : Miscellaneous		62,682	77,965	946	103,920
	Section C1-2500 : Landscaping		77,523	74,716	906	117,043
	Part 3 : Utility Works		160,598	461,034	5,593	404,454
	Division 1 : (U1) Water Supply and Distribution System		54,807	138,455	1,680	128,041
	Division 2 : (U2) Electrical Supply and Distribution System		100,112	277,144	3,362	246,703
	Division 3 : (U3) Sewerage and Sewage Treatment Plant System		5,679	45,435	551	29,711
	Part 4 : Building Works		460,909	1,673,821	20,306	1,346,249
	Division 1 : Passenger Terminal Building (PTB)		306,039	1,161,319	14,089	920,300
	Division 2 : Cargo Terminal Building (CTB)				0	0
	Division 3 : (B3) Control Tower, Operation and Admin.Building (ATC)		80,888	298,128	3,617	238,578
	Division 4 : (B4) Fire Station and Airport Maintenance Building (FSM)		18,886	33,754	409	36,740
	Division 5 : (B5) Ancillary Buildings (ACB)		6,935	14,328	174	14,514
	Sub-division 51 : (B51) Drivers Lounge (DVL)		1,876	1,976	24	2,921
	Sub-division 52 : (B52) Car Park Toilet (CPT)		1,381	2,133	26	2,509
	Sub-division 53 : (B53) Guard Houses (GDH)		2,780	4,929	60	5,387
	Sub-division 54 : (B54) Toll Booths (TLB)		898	5,290	64	3,696
	Division 6 : (B6) Utility Buildings (ULB)		43,270	142,193	1,725	118,481
	Sub-division 61 : (B61) Water Tank & Pump House (WPH)		8,289	12,302	149	14,796
	Sub-division 62 : (B62) Power House (PWH)		30,462	117,523	1,426	92,624
	Sub-division 63 : (B63) STP Control Room (STP)		3,356	10,335	125	8,823
	Sub-division 64 : (B64) Material Recovery Facility (MRF)		1,163	2,033	25	2,238
	Division 7 : (B7) Navaids Buildings (NAV)		4,891	24,099	292	17,638
	Sub-division 71 : (B71) LLZ Building (LLZ)		1,298	6,621	80	4,800
	Sub-division 72 : (B72) GS Building (GS)		1,528	8,465	103	6,005
	Sub-division 73 : (B73) VOR Building (VOR)		2,065	9,013	109	6,832
	Part 5 : Navaids Works		176,843	836,276	10,145	619,178
	Division 1 : (N1) Radio Navigation Aids amd Meteorogical Facility (RAM		42,040	580,867	7,047	349,280
	Division 2 : (N2) Aeronautical Ground Lighting (AGL)		134,803	255,409	3,098	269,897
					0	0
	Total Base Cost of Construction Works (Part 1 to 5)		1,688,164	5,557,406	67,420	4,627,663

Source: JICA Preparatory Survey

Afterwards, during the time for JICA Appraisal Mission in August 2012, DOTC expressed its intention to execute the Preparatory Works (i.e. for clearing and grubbing of the proposed site, erection of temporary barbed-wire boundary fence, and embankment of the perimeter of soaking yard) by its own fund prior to the main works.

With an exchange rate of 1.00 US$ = 79.7 Yen = 42.76 Peso or 1.00 Peso = 1.86 Yen and an escalation rate defined by JICA to be 2.1% for Yen and 2.5 % for Peso, the basic construction costs excluding VAT, contingency, price escalation, consultancy services, land acquisition and administration cost, were estimated to be 4.68 Billion Pesos (equivalent to 8.7 Billion Yen). To cover 100 % of the basic construction costs, together with contingency, price escalation and consultancy services, a Loan Agreement for the JICA STEP Loan of 10.78 Billion Yen was signed in March 2013.

During the kick-off meeting held between DOTC, JICA and its study team in March 2013 an additional amount required for revisions to the previously-agreed master plan discussed at a subsequent meeting on Basic Design between DOTC and JICA Study Team should be expended by DOTC as follows:

a) ILS/GS antenna site was necessitated to be relocated due to the earlier decision that the originally-planned 2500-m long runway was shortened by 500 m. However, the newly-earmarked ILS/GS site was occupied by a church. To avoid complication on land acquisition, the entire airfield has been decided to shift back to the place where 2500-m long runway had been originally planned. (refer to Chapter 3; additional cost of 158 million Peso)
b) Check-in hall was decided to be open for public visitors and well-wishers, due to the removal of the initial security at the entrance of the check-in hall, an inspection through an in-line screening system, which requires installation of sophisticated X-ray, e.g. EDS and ETD, has become an necessity(refer to Chapter 6; additional cost of 50 million Peso)
c) Location and alignment of the airport access road was decided to be changed, that required additional length of 1.6 km (Chapter 3).
d) External water supply to the airport reservoir tank had been earlier decided to be undertaken by DOTC. However, because the piping route was finally selected alongside the airport access road, which needs considerable volumes of earthworks beforehand, the 3-km long water pipeline has been decided to be included in the scope of airport construction works. (refer to Chapter 9)

11.1.1. Construction Cost estimated through the Detailed Design

For the purpose of this Detailed Design Study, the total basic construction costs have been estimated to be 4.615 Billion Peso as given in Table 11.1-2.

Table 11.1-2 Construction Cost estimated through the Detailed Design

Component	Exchange Rate: US$1.0 =Peso 43.0=Yen 98.9	Local	Foreign	Total
	Description	Peso	Yen	in Peso
Component-1: General Requirements (G) - Summary		110,662	154,610	177,884
General Conditions of Contract		6,468	21,714	15,909
Section G-1115: Contractor's Facilities		5,473	0	5,473
Section G-1120 : Employer's and Engineer's Facilities		52,728	15,455	59,447
Section G-1130: Environment Management		11,108	1,744	11,866
Section G-1165: Contractor's Submission		1,000	0	1,000
Section G-1170: Daywork		3,765	16,966	11,141
Section G-1175: Soil Investigation		7,224	0	7,224
Section G-1210: Project Equipment		21,860	31,098	35,380
Section G-1230: Maintenance Equipment		1,037	67,634	30,443
Component 2: (C) Civil Work Summary		1,041,156	1,812,521	1,829,208
Subcomponent 2-	(C1) Access Road	124,986	200,537	212,177
Subcomponent 2-	(C2) Airport Infrastructure	916,169	1,611,984	1,617,032
Component-3: (U) Utility Works Summary		166,952	1,091,407	641,476
Subcomponent 3-	(U1) Water Supply System	29,914	67,460	59,244
Subcomponent 3-	(U2) Power Supply System	113,660	758,439	443,417
Subcomponent 3-	(U3) Sewage Treatment System	23,377	265,508	138,816
Component-4: (B) Building Works		636,299	1,391,916	1,241,480
Subcomponent 4-	(B1) Passenger Terminal Building (PTB)	448,623	1,222,335	980,073
Subcomponent 4-	(B3) Control Tower, ATC Operation & Administration Building	97,784	105,588	143,692
Subcomponent 4-	(B4) Fire Station and Airport Maintenance Building	24,660	18,338	32,633
Subcomponent 4-	Ancillary Buildings (ACB)	11,856	5,215	14,124
	(B51) Driver's Lounge (DRL)	2,122	1,024	2,568
	(B52) Car Parks Toilet (CPT)	2,079	1,023	2,524
	(B53) Guard House (GDH)	4,182	2,743	5,375
	(B54) Tollbooths (TLB)	3,473	424	3,657
Subcomponent 4-	Utility Buildings (ULB)	47,528	35,435	62,935
	(B61) Water Tank & Pump Houses (WPH)	11,574	7,410	14,796
	(B62) Power House (GDH)	28,169	20,195	36,949
	(B63) STP Control Room (STP)	6,381	6,085	9,027
	(B63) Material Recover Facility (MRF)	1,404	1,745	2,163
Subcomponent 4-	Navaids Buildings (NAV)	5,847	5,005	8,023
	(B71) LLZ Building (LLZ)	1,788	1,659	2,509
	(B72) GS Building (GSB)	1,843	1,693	2,580
	(B73) VOR Building (VOR)	2,215	1,653	2,934
Component-5: (N) Air Navigation Facilities		109,568	725,585	425,040
Subcomponent 5-1:	(N0) General	10,011	78,445	44,117
Subcomponent 5-1:	(N1) ILS	27,569	190,046	110,198
Subcomponent 5-2:	(N2) VOR/DME	18,608	128,271	74,378
Subcomponent 5-3:	(N3) ATS and Telecommunications	41,635	257,615	153,641
Subcomponent 5-4:	(N4) Meteorological Observation System	11,746	71,208	42,706
Component-6: (L) Aeronautical Ground Lighting Works		90,453	481,035	299,599
Subcomponent 6-0:	(L0) General	6,786	36,382	22,604
Subcomponent 6-1:	(L1) Approach Lighting System	14,335	76,855	47,750
Subcomponent 6-2:	(L2) Precision Approach Path Indicator	2,916	15,636	9,715
Subcomponent 6-3:	(L3) Runway Lighting System	15,846	84,960	52,785
Subcomponent 6-4:	(L4) Taxiway Lighting System	9,241	49,544	30,782
Subcomponent 6-5:	(L5) Other Aeronautical Lighting	1,786	9,578	5,951
Subcomponent 6-6:	(L6) Apron Floodlights	13,003	66,176	41,775
Subcomponent 6-7:	(L7) Underground Cable Ducts	13,004	69,728	43,321
Subcomponent 6-8:	(L8) Control and Monitoring System	13,535	72,176	44,916
Tolat Base Construction Cost (Components 1 to 6)		2,155,090	5,657,074	4,614,687

Source: JICA Study Team

Comparison of the cost estimate against those previously estimated through the course of JICA Preparatory Services is shown in Table 11.1-3.

Table 11.1-3 Comparison the Base Construction Cost Estimate against those estimated through the course of JICA Preparatory Survey

			Preparatory Survey in July 2012			Detailed Design in July 2013		
Description		US$	Peso	Yen	Peso/Yen	Peso	Yen	Peso/Yen
		1.0	43.6	82.43	1.89	43.0	98.9	2.3
Cost Saving Scenario	Runway: 2000 m/ with ILS		Local	Foreign	Total	Local	Foreign	Total
	Single-story PTB/ no Cargo		Peso	Yen	in Peso	Peso	Yen	in Peso
A	**Construction**							
	Part 1 : General Requirements		76,797	119,148	139,818	110,662	154,610	177,884
	Section G-1120 : Employer's and Engineer's Facili		67,281		67,281	52,728	15,455	59,447
	Section G-1210 : Project Equipment		9,366	56,568	39,287	21,860	31,098	35,380
	Section G-1220 : Fire Fighting Vehicle							
	Section G-1230 : Maintenance Equipment		150	62,580	33,251	1,037	67,634	30,443
	Section G-1115 : Contractor's Facilities					5,473		5,473
	Section G-1130 : Environment Management					11,108	1,744	11,866
	Section G-1165 : Contractor's Submission					1,000		1,000
	Section G-1170 : Daywork					3,765	16,966	11,141
	Section G-1175 : Soil Investigation					7,224		7,224
	General Conditions of Contract					6,468	21,714	15,909
	Part 2: Civil Works		813,017	2,467,127	2,117,963	1,041,156	1,812,521	1,829,208
	Section C-2100 : Earth Works		64,817	627,322	396,629	73,630	405,483	249,927
	Section C-2200 : Pavement Works		503,608	1,353,200	1,219,361	632,139	983,066	1,059,559
	Section C-2300 : Drainage System		104,387	333,924	281,011	160,640	315,213	297,689
	Section C-2400 : Miscellaneous		62,682	77,965	103,920	53,067	75,348	85,827
	Section C-2500 : Landscaping		77,523	74,716	117,043	93,753		93,753
	Section U-3100 : Access Road Water Supply					10,498	87	10,536
	Section U-3290 : Access Road Lighting					17,428	33,324	31,916
	Part 3 : Utility Works		160,598	461,034	404,454	166,952	1,091,407	641,476
	Division 1 : (U1) Water Supply and Distribution System		54,807	138,455	128,041	29,914	67,460	59,244
	Division 2 : (U2) Electrical Supply and Distribution Syste		100,112	277,144	246,703	113,660	758,439	443,417
	Division 3 : (U3) Sewerage and Sewage Treatment Plant S		5,679	45,435	29,711	23,377	265,508	138,816
	Part 4 : Building Works		460,909	1,673,821	1,346,249	636,299	1,391,916	1,241,480
	Division 1 : Passenger Terminal Building (PTB)		306,039	1,161,319	920,300	448,623	1,222,335	980,073
	Division 2 : Cargo Terminal Building (CTB)							
	Division 3 : (B3) Control Tower, Operation and Admin.Bu		80,888	298,128	238,578	97,784	105,588	143,692
	Division 4 : (B4) Fire Station and Airport Maintenance Bu		18,886	33,754	36,740	24,660	18,338	32,633
	Division 5 : (B5) Ancillary Buildings (ACB)		6,935	14,328	14,514	11,856	5,215	14,124
	Sub-division 51 : (B51) Drivers Lounge (DVL)		1,876	1,976	2,921	2,122	1,024	2,568
	Sub-division 52 : (B52) Car Park Toilet (CPT)		1,381	2,133	2,509	2,079	1,023	2,524
	Sub-division 53 : (B53) Guard Houses (GDH)		2,780	4,929	5,387	4,182	2,743	5,375
	Sub-division 54 : (B54) Toll Booths (TLB)		898	5,290	3,696	3,473	424	3,657
	Division 6 : (B6) Utility Buildings (ULB)		43,270	142,193	118,481	47,528	35,435	62,935
	Sub-division 61 : (B61) Water Tank & Pump House ('		8,289	12,302	14,796	11,574	7,410	14,796
	Sub-division 62 : (B62) Power House (PWH)		30,462	117,523	92,624	28,169	20,195	36,949
	Sub-division 63 : (B63) STP Control Room (STP)		3,356	10,335	8,823	6,381	6,085	9,027
	Sub-division 64 : (B64) Material Recovery Facility (M		1,163	2,033	2,238	1,404	1,745	2,163
	Division 7 : (B7) Navaids Buildings (NAV)		4,891	24,099	17,638	5,847	5,005	8,023
	Sub-division 71 : (B71) LLZ Building (LLZ)		1,298	6,621	4,800	1,788	1,659	2,509
	Sub-division 72 : (B72) GS Building (GS)		1,528	8,465	6,005	1,843	1,693	2,580
	Sub-division 73 : (B73) VOR Building (VOR)		2,065	9,013	6,832	2,215	1,653	2,934
	Part 5 : Navaids Works		176,843	836,276	619,178	200,022	1,206,620	724,639
	Division 1 : (N1) Radio Navigation Aids amd Meteorogic		42,040	580,867	349,280	109,568	725,585	425,040
	Division 2 : (N2) Aeronautical Ground Lighting (AGL)		134,803	255,409	269,897	90,453	481,035	299,599
	Total Base Cost of Construction Works (Part 1 to 5)		1,688,164	5,557,406	4,627,663	2,155,090	5,657,074	4,614,687

Source: JICA Study Team

Differences in the amounts for each individual part of the works and their main reasons are briefly explained as follows:

(1) Part 1: General Requirements: Increase of 38 Million Peso

Those increases are not for additional permanent works in nature but are the provision of separate pay items for Bidders' necessary indirect expenditures to support their construction activities. Those are, among others, mainly as follows:

a) Insurance of the works, including third party liability, is included in accordance with GCC18 of FIDIC Conditions of Contract: equivalent to 16 million Peso

b) Temporary fencing along 3 Barangay roads that cross the site with a provision of 2 security guards each to protect totally 6 entry gates for initial 1-year period until completion of the airport access road: equivalent to 5.5 million Peso

c) Additional boreholes to detect any cavity possibly exist under runway, taxiway, PTB, control tower and administration buildings: equivalent to 7.2 million Peso.

d) Provision for Daywork in accordance with FIDIC GCC 13.6, which may be used for work of a minor or incidental nature or in case of emergency or calamity: equivalent to 11 million Peso.

(2) Part 3: Civil Works: Decrease of 288 Million Peso

a) Cost of earthwork is reduced as a result of balancing of cut and fill.

b) Re-examination of gradation of excavated coralline limestone, which can be used as sub-base materials.

c) Cost for Japanese construction equipment has been reduced owing to EN commitment of tax free importation.

d) Increases in the length of access road and external water supply pipeline are assumed to be absorbed within the cost for Civil Works as a whole.

(3) Part 4: Building Works: Decrease of 105 Million Peso

a) Originally (in Preparatory Survey) solar panels had been planned to be installed on (B1) PTB, (B3) Administration buildings, and (B62) Power House, (B7) and Navaids buildings. Now solar panels are planned to be installed only on the PTB roof and electricity for individual buildings are supplied as grid connection within the airport as a whole.

b) Therefore, the costs for the solar power generation have been shifted to the Part 3 Utility Works (equivalent to 150 million Peso).

c) Additional costs for In-line Screening BHS are assumed to be absorbed within the costs for Building Works as a whole.

(4) Part 3: Utility Works: Increase of 237 Million Peso

a) As mentioned above, the costs for solar power generation (equivalent to 150 million Peso) has now been included in the Utility Works.

b) The costs of sewage treatment increased, because aircraft sewage disposal functions are added to cater for possible international shuttle operations of domestic airline companies and a new function of recycling treated water for irrigation of landscaping has been added (equivalent to 110 million Peso).

(5) Part 5: Air Navigation Facilities：Increase of 105 Million Peso

a) Quotations from Japanese manufacturers are duly appreciated.

b) LED lights are planned to be used for the purpose of dramatic reduction of future electricity costs and CO2 emission.

Meanwhile, value of Yen has been depreciated by about 20 % since the time of JICA Project Appraisal.

As of submission date of this Final Report (September 2013), the exchange rate is 1.00 US$ = 98.9 Yen = 43 Peso or 1.00 Peso = 2.3 Yen, the basic construction costs being valued in Peso appeared to be less than the originally estimated 4.65 Billion Peso, but in turn the amount valued in Yen appeared to be raised up from 8.7 Billion Yen to 10.6 Billion Yen, as shown in the Table below. If such depreciated value of Yen continues, DOTC may have to shoulder certain portion of the construction costs, in addition to the payment of VAT, tax and duties.

Table11.1-4 Base Construction Cost Estimate with fluctuation of Exchange Rate

Time of estimate	Exchange Rate	Local Portion	Foreign Portion	Combined Total	
	Peso 1.0 =	Peso	Yen	in Peso	in Yen
July 2012_ Preparatory Survey	Yen 1.89	1,688,164	5,557,406	4,627,663	8,748,036
August 2012_JICA Appraisal	Yen 1.86	1,688,164	5,557,406	4,676,017	8,697,391
July 201_Detailed Design Study	Yen 2.3	2,155,090	5,657,074	4,614,687	10,613,780

Source: JICA Study Team

On the other hand, the above cost estimated through the course of Detailed Design Study is based on the quotations of manufactures submitted quickly upon the request from study team without any obligation or commitment, which therefore is not competitive at all.

11.2. Procurement Plan

Material, equipment and services assumed to be procured from Japanese origin are assumed as shown in Table 11.2-1

Table 11.2－1 Material, equipment and services assumed as Japanese origin

Pay Item		Amount (Yen)
Component 1: General Requirements		
	Project Vehicle	30 million
	Maintenance Equipment	40 million
Component 2: Civil Works		
Drainage	Geotextile for bottom of Soaking Yard	15 million
Access Road	LED lights for Road lighting	15 million
Earthworks	Contractors' equipment	200 million
Pavement	Contractors' equipment	700 million
Component 3: Utility Works		
Power Supply	Switchgear, Transformer, Panelboard	250 million
	Emergency Generators	90 million
	Solar power generation system	300 million
	LED lights for Car park	8 million
Sewage Treatment	Sewage treatment equipment	110 million
Component 4: Building Works		
PTB Structure	Structural Steel	100 million
PTB Facade	Curtain wall	50 million
architectural	Roofing	150 million
air-conditions	Heat-pump VRF type air-condition	57 million
Sanitary	Public toilet water closet	10 million
Electrical	Public Address System	15 million
Special Eq	Baggage Handling System	100 million
Special Eq	Flight Information Display System	40 million
Control Tower	Heat-pump VRF type air-condition	25 million
Special Eq	Elevator	7 million
Component 5: Air Navigation Facilities		
	ILS,	120 million
	VOR/DME/	70 million
	ATS/ Telecom	100 million
Component 6: Aeronautical Ground Light		
	Approach Lights	50 million
	RWY/ TWY (LED)	100 million
	Floodlights	30 million
Indirect cost; Japanese technology transfer and enhancement		500 million
Total		3,282 million

Source: JICA Study Team

In addition to those tabulated above, there are numerous Japanese materials, e.g. for plumbing, pipes, electrical wires, architectural finishing and computer related, which are commonly used in the Philippines because of their high quality and competitive price.

Therefore, as one of the prerequisite conditions of STEP Loan, procurement of goods and services of Japanese origin should be more than 30 % of the total construction cost, which is incorporated in the Bidding Documents.

CHAPTER 12

IMPACT ASSESSMENT ON CLIMATE CHANGE MITIGATION

TABLE OF CONTENTS

Chapter 12 Impact Assessment on Climate Change Mitigation

12.1. Objectives of the Assessment

Eco-Airport Guideline issued by the Japanese Ministry of Land, Infrastructure, Transport and Tourism, defines the basic philosophy of Eco-Airport as follows:

- An airport with a global environmental perspective;
- An airport that is integrated with the local environment; and
- An airport that can achieve sustainable development with recycling-based activities.

In development of an airport, the guideline recommends to consider the seven basic environmental factors summarized in the table below.

Table 12.1-1 Environmental Factors Considered in Development of Eco-Airport

No.	Item	Purpose
1	Atmosphere	Minimize impact on air quality by reducing volume of air pollutions generated or discharged from airport operation
2	Noise and vibration	Minimize impact on airport and its environments by reducing level of noise and vibration generated or discharged from airport operation
3	Water	Prevent pollution and contamination of waterways and groundwater by drainage generated during airport operation, and seek to reduce water consumption as well as reuse and preserve water resources at airport
4	Soil	Prevent ground pollution from oil, chemicals and agents and other materials used in airport operations
5	Waste	Encourage reuse of waste products generated at airport as resources, reduce volume of waste generated and promote recycling
6	Energy	Reduce energy consumption in airport operation to reduce GHG emissions
7	Natural environment	Conserve and create ecosystems within airport to integrate it into its surroundings and to maintain healthy natural environments

Source: Eco-Airport Guideline

The new Bohol Airport is the first airport in the Philippines aiming to be developed under the eco-airport concept. One of the most important components of the eco-airport is the above Item 6, ‘Energy’. It is expected to reduce greenhouse gas (GHG) emissions throughout the operations of the new Bohol Airport upon completion.

Described hereunder is to evaluates the amount of GHG emission reduction in the development of new Bohol Airport, especially focusing on the GHG emissions from the airport facilities.

12.2. Relevant Framework to Climate Change Mitigation in the Philippines

12.2.1. Laws and Regulations

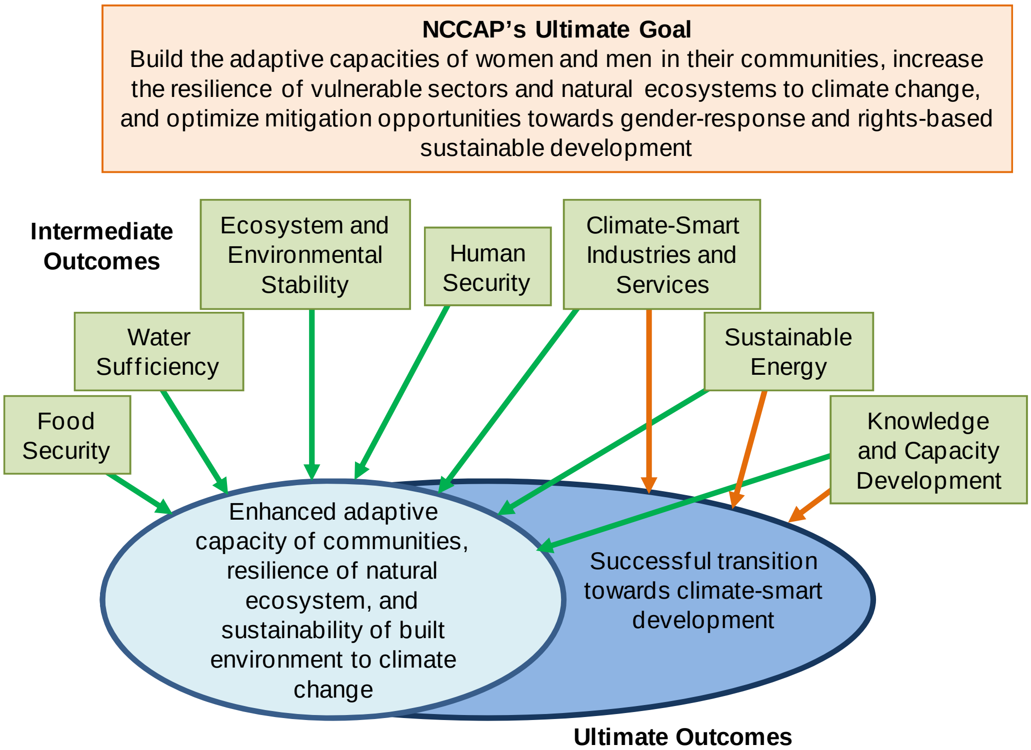
The Government of Philippines ratified the United Nations Framework Convention on Climate Change in 1994, and ratified the Kyoto Protocol in 2003.

The foundation for policies to the climate change is established by the Republic Act 9729, known as the Climate Change Act of 2009, issued in 2009. It establishes the Climate Change Commission (CCC) which is an independent and autonomous body with the same status as that of a national government agency. It is in charge of coordinating, monitoring and evaluating the programs and action plans for the climate change.

Under the Climate Change Act of 2009, in 2010 the CCC prepared the National Framework Strategy on Climate Change 2010-2022 which articulates the roadmap for the mitigation and adaptation to climate change for the sake of natural ecosystems and human communities.

In 2011, the National Climate Change Action Plan (NCCPA) was issued as the detail proposal to realize the National Framework Strategy on Climate Change 2010-2022. It outlines agendas for climate change adaptation and mitigation from 2011 to 2028, and sets seven strategic priorities, i.e. 1) food security; 2) water sufficiency; 3) ecosystem and environmental stability; 4) human security; 5) climate-smart industries and services; 6) sustainable energy; and 7) knowledge and capacity development.

The figure blow summarizes the framework of NCCPA.

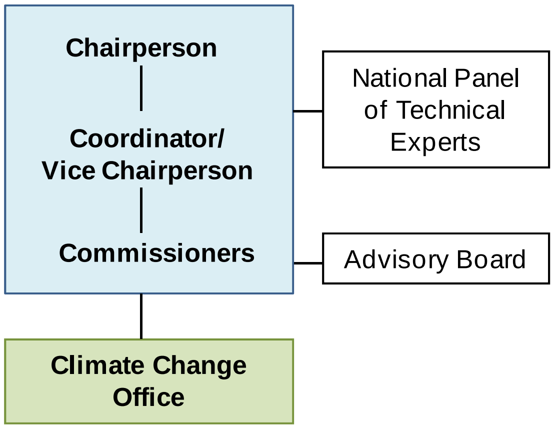


Source: Accomplish Report 2011 (the Climate Change Commission)

Figure 12.2-1 Framework of the National Climate Change Action Plan

12.2.2. Responsible Organizations

The figure below shows the organizational structure of the CCC. Being the committee for decision-making for climate change, the Climate Change Office is created to coordinate among the Department of Environment and Natural Resources (DENR) offices as well as with other governmental agencies, NGOs and local government units (LGUs). LGUs as frontline agencies in formulation, planning and implementation of climate change action plans in their respective areas, formulate their Local Climate Change Action Plans.



Source: Web-site of the Climate Change Commission (http://www.climate.gov.ph/)

Figure 12.2-2 Organizational Structure of the Climate Change Commission

On the other hand, based on the Executive Order No. 320 issued in 2004, the DENR plays a crucial role as the designated national authority (DNA). It major responsibilities are as follows:

1. Formulate and develop national Clean Development Mechanism (CDM) policies;
2. Develop criteria, indicators, standards, systems and procedures, and evaluation tools for the review of CDM projects;
3. Undertake assessment and approval of CDM projects to be submitted to the United Nations Framework Convention on Climate Change (UNFCCC);
4. Monitor of implementation of CDM projects; and
5. Perform other functions related to and in pursuance of the development of CDM.

12.3. Renewable Energy and Energy Efficiency

12.3.1. Overall Policies

As the umbrella polity for energy sector development towards 2030, the Department of Energy (DOE) published the Philippine Energy Plan 2009-2030 (PEP 2009-2030).

It addresses the five prioritized actions as follows:

1. Exploration/development of conventional fuels;
2. Developing clean and green energy;
3. Promoting effective use of energy;
4. Ensuring developments in power and electrification sector; and
5. Pursuing reforms in the power and downstream oil and gas industries.

12.3.2. Renewable Energy

In 2001, Republic Act 9136, Electric Power Industry Reform Act (EPIRA) was issued aiming at promoting competition and efficiency in the power sector. It leads the private sector participation in large scale renewable energy, particularly hydropower and geothermal. It accelerated the privatization of transmission assets through concession.

In 2003, the Renewable Energy Policy Framework (REPF) was published. It articulates the over-all objectives, policies and strategies for the DOE to promote further development and utilization of renewable energy.

Republic Act 9513, known as the Renewable Act promulgated in 2008 provides the policy framework towards the development, utilization and commercialization of renewable energy sources. It sets several incentives for introduction of renewable energy such as 1) income tax holiday for seven years from the start of commercial operations; 2) reduction of corporate tax rate; 3) duty-free importation of machinery, equipment and materials for renewable facilities, etc.

Following the Renewable Act of 2008, the framework of the Feed-in Tariff (FIT) for power generation by means of wind, solar, ocean, hydro and biomass was proposed in 2010, and the Rules Governing the Establishment of Renewable Portfolio Standards in the Philippines, known as the Philippine RPS Rule, was introduced in 2011. In 2012, and the FIT rates were approved as 5.90 pesos/kWh for hydro, 6.63 pesos for biomass, 8.53 pesos for wind, and 9.68 pesos for solar power generations.

12.3.3. Energy Efficiency

The Energy Efficiency and Conservation Law was promulgated in the Philippines in 1980 as a temporary legislation, which was expired in 1987. Since then, there have been no relevant laws establised. Under the circumstances, the government of the Philippines promotes energy efficiency and conservation through administrative orders or programs. Not only DOE but also other ministries and private organizations are promoting energy efficiency through various activities.

One of the programs the DOE has launched is the National Energy Efficiency and Conservation Program (NEECP). It covers several programs, projects and activities as follows:

- Government Energy Management Program (GEMP);
- Philippine Energy Efficiency Project (PEEP);
- Energy Management Services/Energy Audit;
- Voluntary Agreement for Energy Conservation Activities;
- Information, Education and Communication (IEC);
- Standards & Labeling Program;
- Fuel Economy Program;
- Recognition Award; and
- Philippine Industrial Energy Efficiency Project.

In the Government Energy Management Program (GEMP), each government entity aims at reducing annual consumption on electricity by at least ten percent (10%) based on their Energy Conservation Program (ECP). As the specific measures, a government entity limits operations of air-conditioning system, replace incandescent bulbs with compact fluorescent lamps (CFLs), etc.

The Philippine Energy Efficiency Project (PEEP) was conducted from 2010 to 2011 supported by the Asian Development Bank. It promoted to retrofit about 40 government-owned office buildings with efficient lighting, procure 13 million compact CFLs for distribution to residential or other power consumer to reduce peak power demand, establish an energy service company (ESCO) to support ESCO development, etc.

12.3.4. Responsible Organizations

The leading agency as a policy making and planning body for energy exploration, development, utilization, distribution and conservation is the DOE. It has responsibility to annually update the Philippine Energy Plan as well as to prepare the Power Development Plan.

In terms of renewable energy, under the Renewable Act of 2008, the National Renewable Energy Board (NREB) was established. It is tasked to make recommendation of policies to the DOE, to supervise the implementation of relevant acts, and to approve the FIT rates for the renewable energy technologies.

12.4. Profile of Power Supply in the Philippines

12.4.1. Power Generation

In 2011, the total of power generation was 69,176 GWh. Around 37 % was generated by combustion of coal. On the other hand, around 29 % came from renewable energy. Their details are shown below.

Table 12.4-1 Power Generation in 2011

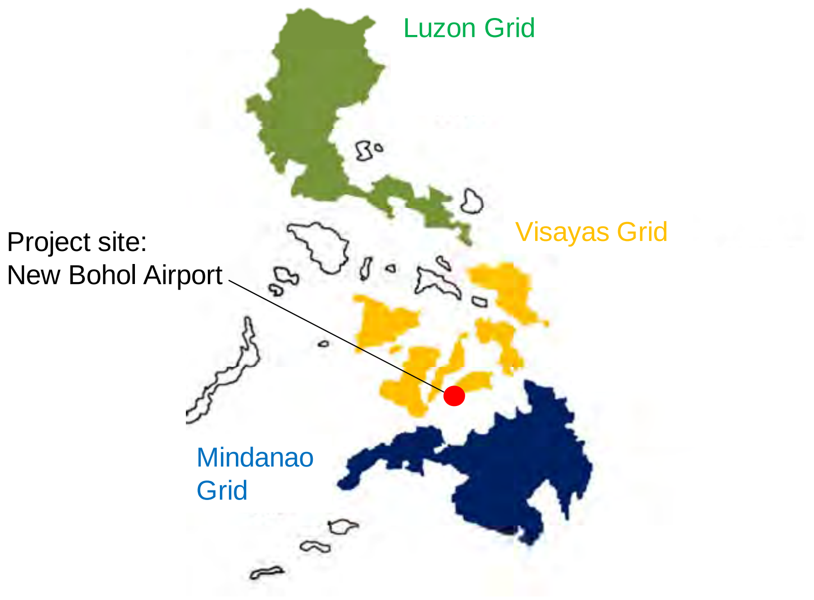
Type		Generation (GWh)	Percentage (%)
Coal Fired		25,342	36.63
Oil Based		3,398	4.91
	Combined Cycle	124	0.18
	Diesel	2,762	4.00
	Gas Turbine	0	0
	Oil Thermal	512	0.74
Natural Gas		20,591	29.77
Geothermal Power		9,942	14.37
Hydroelectric		9,698	14.02
Wind		88	0.13
Solar		1	0.001
Biomass		115	0.17
Total		69,176	-

Source: Department of Energy (DOE)

12.4.2. Grid Profile

The power transmission system in the Philippines is comprised of three grids, i.e. for Luzon, Visayas and Mindanao Grids. The Luzon and Visayas Grids are connected with the undersea cable. The project site for the new Bohol Airport Construction is located in the Visayas Grid as shown the figure below.

As of 2011, the assets had the total of 19,822 circuit kilometres (ckt-km) half of which , i.e. 9,482ckt-km are in the Luzon Grid. 4,979ckt-km are in the Visayas Grid and the remaining 5,361 ckt-km are in the Mindanao Grid. Those profiles are summarized in the table below.



Source: Transmission Development Plan 2012, National Grid Corporation of the Philippines (NGCP)

Figure 12.4-1 Location of Three Grids

Table 12.4-2 Summary of Facilities in 2011

Grid	Substation Capacity (MVA)	Transmission Line Length (ckt-km)
Luzon	20,870	9,482
Visayas	3,414	4,979
Mindanao	3,092	5,361
Total	27,376	19,822

Source: Transmission Development Plan 2012, National Grid Corporation of the Philippines (NGCP)

12.4.3. Luzon Grid

As of end of 2011, the Luzon Grid had the gross power generation of 50,017 GWh. More than half of them are generated by the fossil-fuel, coal-fired (39%), and natural gas (41%). The hydro accounted for around 10%, and geothermal around 7 %.

Table 12.4-3 Power Generation in Luzon Grid in 2011

Type		Generation (MWh)	Percentage (%)
Coal Fired		19,681	39.35
Oil Based		1,291	2.58
	Combined Cycle	124	0.25
	Diesel	890	1.78
	Gas Turbine	0	0
	Oil Thermal	277	0.55
Natural Gas		20,591	41.17
Geothermal Power		3,486	6.97
Hydroelectric		4,836	9.67
Wind		88	0.18
Solar		-	-
Biomass		44	0.08
Total		50,017	-

Source: Department of Energy (DOE)

12.4.4. Visayas Grid

As of end of 2011, the Visayas Grid had the gross power generation of 10,456 GWh. The noticeable feature is that geothermal covered more than half of the generated amount, around 54%. The coal and oil based fired accounted for around 45%.

Table 12.4-4 Power Generation in Visayas Grid in 2011

Type		Generation (GWh)	Percentage (%)
Coal Fired		4,032	38.56
Oil Based		683	6.53
	Combined Cycle	-	-
	Diesel	449	4.29
	Gas Turbine	0	0
	Oil Thermal	235	2.25
Natural Gas		-	-
Geothermal Power		5,616	53.71
Hydroelectric		53	0.51
Wind		-	-
Solar		-	-
Biomass		72	0.69
Total		10,456	-

Source: Department of Energy (DOE)

12.4.5. Mindanao Grid

As of end of 2011, the Mindanao Grid had the gross power generation of 8,703 GWh. The hydro accounted for more than half, around 55%, and geothermal did around 10%. The coal and oil based fired accounted for around 35%.

Table 12.4-5 Power Generation in Mindanao Grid in 2011

Type		Generation (GWh)	Percentage (%)
Coal Fired		1,629	18.72
Oil Based		1,424	16.36
	Combined Cycle	-	-
	Diesel	1,423	16.35
	Gas Turbine	-	-
	Oil Thermal	0	0
Geothermal Power		841	9.67
Hydroelectric		4,808	55.25
Natural Gas		-	-
Wind		-	-
Solar		1	0.01
Biomass		-	-
Total		8,703	-

Source: Department of Energy (DOE)

12.5. Greenhouse Gas Emissions in the Philippines

According to the first National Communication on Climate Change, the national greenhouse gas (GHG) total of 100,739 ktCO2-eq were emitted from the sectors of energy, industry, agriculture, and wastes in 1994. The emitted amount from each sector is shown in the table below.

The energy sector alone emitted 50,038 ktCO2-eq in 1994. Most of them (about 82%) are emitted from three major end users of fuel: the power generating industries; transportation; and manufacturing industries.

Table 12.4-6 GHG Emissions in 1994

Sector	Emission (ktCO2-eq)	Percentage (%)
Energy	50,038	50
Industry	10,603	11
Agriculture	33,130	33
Wastes	7,094	7
LULUCF	-126	-
Total	100,739	-

Source: First National Communication on Climate Change (1994)

12.6. Facility Conditions of Airports in the Philippines

12.6.1. Solar Power System

As yet, there have been no airports with a solar power system in the Philippines. The new Bohol Airport may deserve the first airport in the Philippines where solar power system is adopted.

12.6.2. Air Conditioning System

There are two major types of air conditioning system: individual air conditioning system and central air-conditioning system. The individual air conditioning system is more common in the Philippines. With a set of outdoor units and indoor units, it provides cooled air to several spaces in a building. On the other hand, the central air-conditioning system with an electric chiller is installed in some airports recently. As of July 2013, there are six airports with a central air-conditioning system as shown in the table below.

Table 12.6-1 Airports Using Central Air-Conditioning System (Chiller)

<table>
<tr><th>No.</th><th colspan="2">Name</th><th>Classification</th><th>Starting Year of Operation</th><th>Cooling System *1</th><th>Manufacturer *1</th></tr>
<tr><td>1</td><td colspan="2">Mactan-Cebu International Airport</td><td>International</td><td>1997</td><td>Water-cooled</td><td>McQuay</td></tr>
<tr><td>2</td><td colspan="2">Davao International Airport</td><td>International</td><td>2005</td><td>No information</td><td>No information</td></tr>
<tr><td>3</td><td colspan="2">Bacolod-Silay International Airport</td><td>Principal Class 1</td><td>2008</td><td>No information</td><td>No information</td></tr>
<tr><td>4</td><td colspan="2">Iloilo International Airport</td><td>Principal Class 1</td><td>2008</td><td>Air-cooled</td><td>Hitachi</td></tr>
<tr><td rowspan="3">5</td><td rowspan="3">Ninoy Aquino International Airport</td><td>Terminal 1</td><td rowspan="3">International</td><td>1980</td><td>Water-cooled</td><td>York</td></tr>
<tr><td>Terminal 2</td><td>1999</td><td>Air-cooled</td><td>Trane</td></tr>
<tr><td>Terminal 3</td><td>2008</td><td>Water-cooled</td><td>Carrier</td></tr>
<tr><td>6</td><td colspan="2">Laguindingan International Airport</td><td>International</td><td>2013 (plan)</td><td>No information</td><td>No information</td></tr>
</table>

*1: Information from hearings at CAAP and Manila International Airport Authority (MIAA), and data the project team has

Air conditioning system in Tagbilaran Airport (top: indoor unit, bottom: outdoor unit)

Central air-conditioning system in Ninoy Aquino International Airport, Terminal 2

Photo Examples of Air-Conditioning System in Airports

12.6.3. Water Heating System

In the Philippines, a conventional type of electric storage water heater is installed in some airports as they shown in the table below.

Table 12.6-2 Water Heating System in Airports

No.	Name		Classification	Starting Year of Operation	Water Heating System *1	Manufacturer *1
1	Iloilo International Airport		Principal Class 1	2008	Conventional electric storage water heater	No information
2	Ninoy Aquino International Airport	Terminal 2	International	1999	Conventional electric storage water heater in some spaces such as VIP area	Lochinvar
		Terminal 3		2008	No water heating system	-

*1: Information from hearings at MIAA, and data the project team has

Photo. Conventional Electric Water Heater Installed in the Ninoy Aquino International Airport, Terminal 2

12.6.4. Lighting System

The DOE promotes installation of energy efficient bulbs in the Philippines, and CFLs have been installed in some airports. Although LED lamps have yet become common , the Ninoy Aquino International Airport Terminal 3 has started to replace high intensity discharge (HID) lamps in the parking and access roads to LED lumps since July 2013. Subsequently, it plans to replace CFLs in buildings to LED in near future.

Left: CFLs installed in the passengers' waiting room in Tagbilaran Airport. Above: CFLs installed in the restaurants area in Ninoy Aquino International Airport, Terminal 3

Photo. CFLs Installed in Airports

12.6.5. Energy Efficient Facilities in the Bohol Airport

In the light of improving energy efficiency and CO2 emission reduction, the Bohol Airport embodies an eco-airport by introducing several technologies as follows:

1. Solar power system;
2. Energy conservation type (heat-pump VRF) split air-conditioning system;
3. Solar water heating system; and
4. Lighting system using LED lamps.

The overall system of power supply and installed energy efficient equipment in the Bohol Air Port is summarized in the figure below.

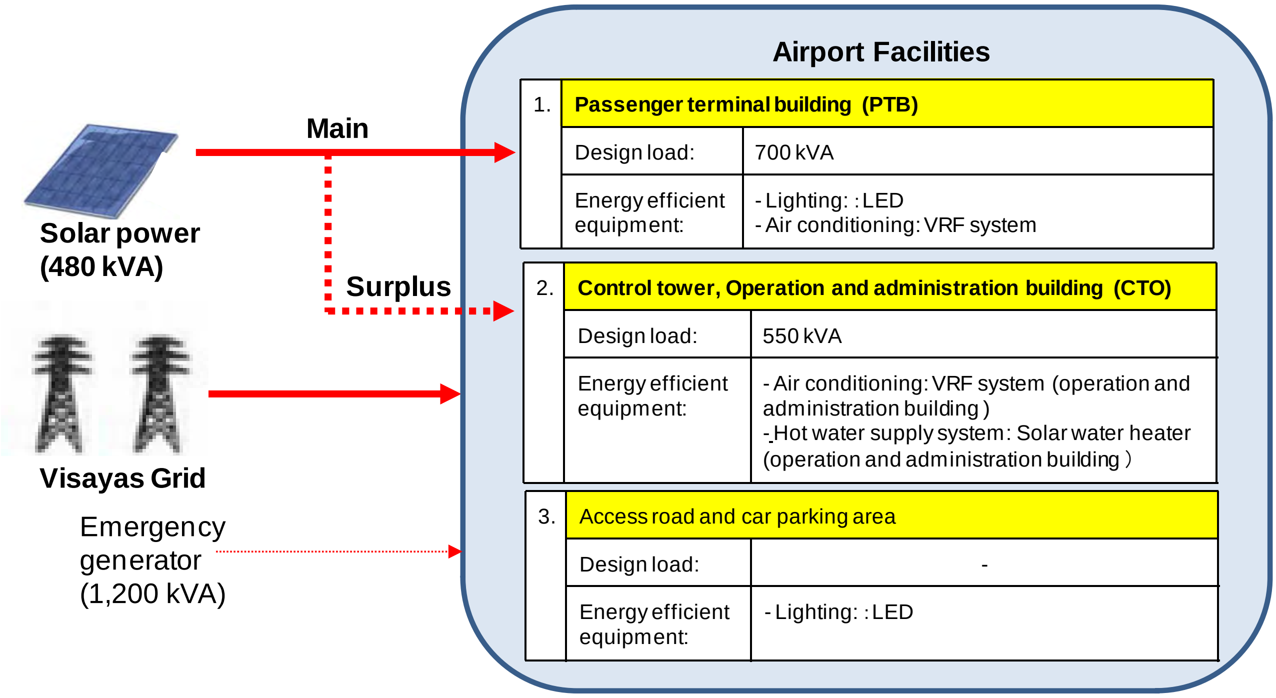


Figure 12.6-1 Power Supply and Energy Efficient Equipment in the Bohol Airport

A solar power energy module of 480 kVA will be installed on the passenger terminal building (PTB). The solar powered electricity is supplied to the PTB mainly. In case that the power will be surplus, it goes to the control tower, operation & administration building and fire station, and maintenance building. It will not be supplied to the Visaya Grid.

The detail design of the airport shows, even though amount of consumed electricity varies depending on peak and/or off-peak times, that the solar power system will not be able to provide all electricity consumed in the PTB. Thus, in addition to the solar power system, the PTB receives electricity from the Visayas Grid through the power supply line of 13.2 kV. It will be distributed by underground lines from a last receiving poll of the electric service company, Bohol I electric Cooperative (BOHECO 1), to a power house in the airport. Besides, the emergency generator will be installed for operation in case of normal power failures. Its load is a total of 1200 kVA at 4.16 kV (3 phases).

The VRF (Variable Refrigerant Flow) air conditioning system can facilitate more efficient, energy-saving, easy operation and maintenance. The VRF outdoor units are located on a lower roof level and consist of a compressor, fan, condenser and other accessories.

Hot water demands are very limited to such facilities as showers, lavatories or kitchens. However, for the sake of energy efficiency, not only an electrical water heater but also a solar water-heater is installed.

As the lighting system, LED lamps are installed in the PTB, and access road and car parking area. As of July 2013, their specification and numbers are designed as the table below shows.

Table 12.6-3 Specification and Quantity of LED Lamps

Facility	Name	Watt (W)	Lumen (lm)	Quantity
Passenger terminal building (PTB)	Down light 1	8	590	8
	Down light 2	24	2,000	24
	Down light 3	28	2,100	28
	Down light 4	31	3,100	31
	Wall light 1	120	12,500	120
	Wall light 2	50	2,398	50
Access road and car parking area	Road light	120	11,987	120

Source: JICA Study Team

12.7. Estimation of Emission Reduction in the Bohol Airport

12.7.1. Emission Boundary in Estimation of Emission Reduction

Sources of CO2 emissions in an airport can be classified into three categories, i.e. from: 1) airport facilities such as a terminal building; 2) ground support equipment (GSE) operating in an airport; and 3) aircrafts. In line with the purpose of the captioned Study that entails design and construction of airport facilities, this assessment report evaluates the emissions from the airport facilities only.

In the Bohol Airport, the CO2 emission reduction can be promoted by means of 1) Solar power system; 2) VRF air-conditioning system; 3) Solar water heating system; and 4) Lighting system. The amounts of CO2 emission reductions are calculated from the viewpoints of those four functions.

12.7.2. Baseline Scenario in Estimation of Emission Reduction

(1) Installation of Solar Power System

All airports in the Philippines other than the Bohol Airport used electricity supplied through the power transmission grids mentioned above. The Bohol Airport is the first-ever project to install the solar power system as an airport’s facility in the Philippines.

Thus, the baseline scenario is that electricity generated by the solar power system and used in the Bohol Airport would have otherwise been generated by operation of grid-connected power plants. It is summarized in the figure below.

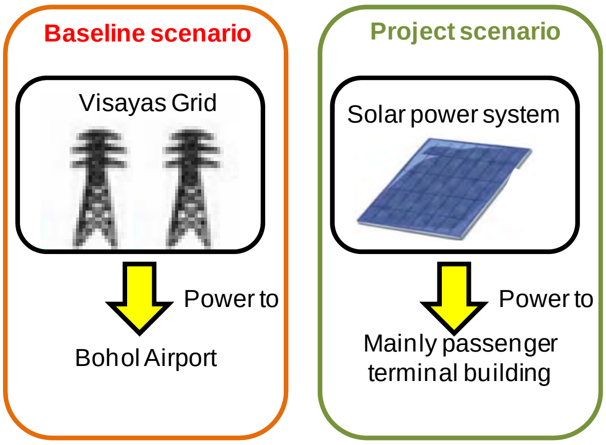


Figure 12.7-1 Baseline and Project Scenarios of Solar Power System

(2) Installation of VRF Air-Conditioning System

A central air-conditioning system with a chiller gradually becomes popular among relatively larger airports, classification of international and principal class 1.

A chiller has two types, air-cooled and water-cooled. In the Philippines, the Iloilo International Airport and the Ninoy Aquino International Airport, Terminal 2 are equipped with the former, and the Mactan-Cebu International and Ninoy Aquino International Airport, Terminal 1 and 3 are the latter.

A cooling efficiency rate of water-cooled type is better than one of air-cooled. However, generally speaking, operation and maintenance of air-cooled type is easier than those of water-cooled type. As a result, an air-cooled type is more common in the developing countries.

Therefore, the baseline scenario is set as cooled air generated by the VRF system in the Bohol Airport had otherwise been generated by a central air-conditioning system with an air-cooled type chiller. It is summarized in the figure below.

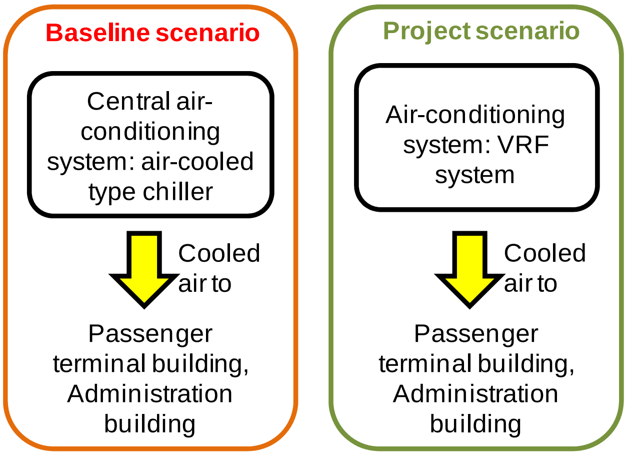


Figure 12.7-2 Baseline and Project Scenarios of Air-Conditioning System

(3) Installation of Solar Water Heating System

Though the number is not large, some of airports install and use a conventional electric storage water heater to provide hot water. The Bohol Airport is the first one to install a solar water heating system in the Philippines.

Thus, the baseline scenario is that hot water generated by a solar heating system and used in the Bohol Airport had otherwise been generated by a conventional electric storage water heater with electricity from the grid. It is summarized in the figure below.

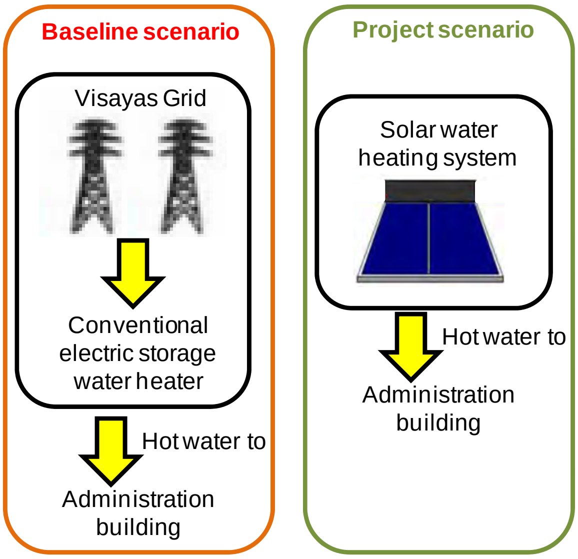


Figure 12.7-3 Baseline and Project Scenarios of Solar Water Heating System

(4) Installation of Energy Efficient Lighting System

Installation of CFLs has been common in airports, but LED lamps have yet to be common. Recently, the Ninoy Aquino International Airport, Terminal 3 has started to install LED lamps in the parking and access roads. The Bohol Airport would be the second case for an airport to install them. Thus, the baseline scenario is set as instead of LED lamps, CFLs had been installed and used in the Bohol Airport.

However, in general, there are no CFL fixtures applied to a wall light and road light. So, conventional fixture, a HID lamp which is currently used in the Ninoy Aquino International Airport, Terminal 3, is set as the baseline scenarios for a wall light and road light, respectively.

The baseline scenario is summarized in the figure below.

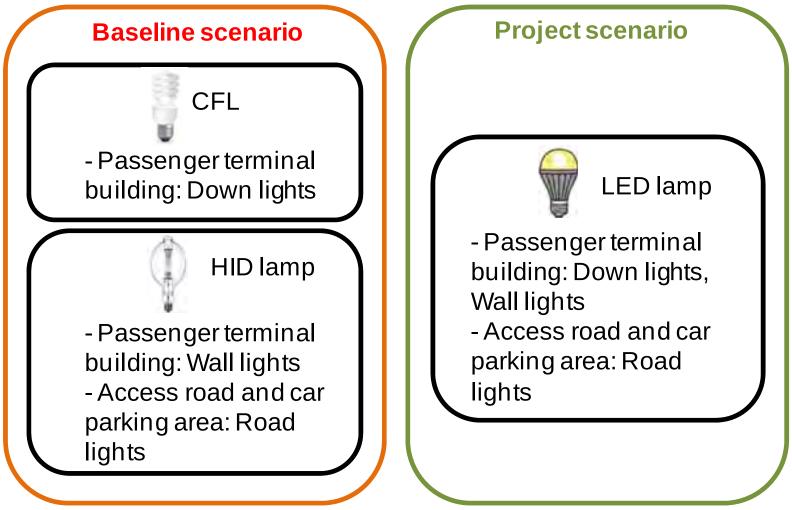


Figure 12.7-4 Baseline and Project Scenarios of Energy Efficient Lighting System

12.7.3. Reduced Amount of Electricity Consumption

(1) Installation of Solar Power System

It is planned to install a 480 kW photovoltaic array in the Bohol Airport. By applying the conditions in the table below, the generated electricity with the solar power system is estimated to be 559,962 kWh/year. It can be the replacement of electricity from the grid.

Table 12.7-1 Conditions in Estimation of Generated Electricity with Solar Power system

No.	Item	Contents
1	Calculation method	JIS C 8907:2005 Estimation method of generating electric energy by PV power system is referred. But some different parameters from those set in JIS C 8907:2005 are used for more practical estimation. For instance: - Inverter efficiency is 90% in JIS. But 95% is used; - Temperature coefficient of crystalline silicon solar module is 0.5%/℃; and - Temperature of solar cell is 60 ℃, equal to ambient temperature plus 30℃
2	Insolation intensity	It is assumed that solar irradiance on inclined surface is equal to horizontal insolation intensity.
3	Peak power	-0.5%/K
4	Yearly average of solar insolation per day	4.85 (kWh/m2/day) published by NASA

Source: JICA Study Team

(2) Installation of VRF Air-Conditioning System

The VRF air-conditioning systems are to be installed in the PTB and administration building. Compared to the baseline scenario, installation of air-cooled chiller system, 1,235,777 kWh/year can be saved with the VRF air-conditioning system in 2020. The details of calculation are presented in the table below.

Table 12.7-2 Details in Estimation of Conserved Electricity with VRF Air-Conditioning system

Scenario	Facility	System	Capacity in 2020 (RT)	Item	kW/ unit	Quantity	Comsumed Power per Year (kWh/day) *2					Grand Total (kWh/year)
							Morning	Day Time	Night Time	Midnight	Sub-Total	
Baseline *1	Passenger terminal building	Air-cooled chiller system	300	Chiller	352	1	1,059	4,767	742	1,589	8,157	**3,721,805**
				Pump and others	177.7	1						
	Administration building	Air-cooled chiller system	75	Chiller	88	1	265	1,192	185	397	2,039	
				Pump and others	44.4	1						
Project	Passenger terminal building	VRF system	300	Outdoor unit	316.8	1	708	3,185	495	1,062	5,450	**2,486,028**
				Indoor unit	19	1						
				Others	18.1	1						
	Administration building	VRF system	75	Outdoor unit	79.1	1	177	795	124	265	1,361	
				Indoor unit	4.8	1						
				Others	4.5	1						

*1: Consumed power (kW/unit) in the baseline scenario is set referring to the specification of general air-cooled chiller from manufacturer of
*2: Operation output and hours are assumed as follows: Morning: full operation, 2 hours; Day time: 90% operation, 10 hours; Night time: 70% operation, 2 hours; Midnight: 30% operation, 10 hours

(3) Installation of Solar Water Heating System

a) Amount of Heated Water

Designed specification of the solar water heating system in the Bohol Airport is shown in the table below.

Table 12.7-3 Designed Specification of Solar Water Heating System in the Bohol Airport

No.	Item	Contents	Remarks
1	Area of solar heat collector (m2)	16.32	4.08 (m2) * 4 sets
2	Solar heat collector efficiency (%)	50	The efficiency can be 50 to 60%. Considering conservativeness, 50% is applied.

Source: JICA Study Team

Using the formula below, the amount of heated water generated by the solar water heating system in the project scenario is calculated as 632 L/day, and it is assumed that all of it is consumed.

$$\underline{m_d = (3{,}600 * T_1) / 4.186\ (T_2 - l_d * A * \eta\ )}$$

m_d : Heated water consumed per day (kg)	: Equal to litter
l_d : Yearly average solar insolation per day (kWh/m2/day)	: 4.85 (kWh/m2/day) published by NASA
A : Area of solar heat collector (m2)	: 16.32 (m2)
η : Solar heat collector efficiency (%)	: 50%
T_1 : Water temperature flowing into solar water heating system (℃)	: Set as 15 ℃
T_2 : Water temperature flowing out from solar water heating system (℃)	: Set as 60 ℃
4.186 : Specific heat of water (kJ/kg/℃)	
3,600 : Conversion factor (kJ/kWh)	

b) Reduced Amount of Electricity Consumption by Solar Water Heating System

Using the formula below, the energy consumption in the project scenario is 43,452,000 kJ/year.

$\underline{Q_{PJ} = m_d * d * 4.186 * (T_2 - T_1)}$

Q_{PJ} : Energy consumption in the project scenario (kJ/year)
m_d : Heated water consumed per day (kg) : 632 (kg)
d : Operation days of solar water heating system per year (day) : 365 (day)
T_1 : Water temperature flowing into solar water heating system (℃) : Set as 15 ℃
T_2 : Water temperature flowing out from solar water heating system (℃) : Set as 60 ℃
4.186 : Specific heat of water (kJ/kg/℃)

In the baseline scenario, instead of a solar water heating system, a conventional electric storage water heater is installed and used. Using the formula below, it consumes electricity of 12,573 kWh/year to generate 43,452,000 kJ/year. It can be the replacement of electricity from the grid.

$\underline{EC_{BL} = Q_{PJ} * 100/\varepsilon_{BL} / 3{,}600}$

EC_{BL} : Electricity consumption in the baseline scenario (kWh/year)
Q_{PJ} : Energy consumption in the project scenario (kJ/year) : 43,452,000 kJ/year
ε_{BL} : Efficiency of conventional electric storage water heater in the baseline scenario (%) : Set as 96%. An electric heater manufactured by Lochinvar is used in the Ninoy Aquino International Airport, Terminal 2. Referring to the Lochinvar's website, the thermal efficiency of some products can be 80 to 96%. Considering conservativeness, 96% is selected.
3,600 : Conversion factor (kJ/kWh)

(4) Installation of Energy Efficient Lighting System

The LED lamps are to be installed and used in the PTB and the access road and car parking areas in the Bohol Airport. Energy consumption in the project scenario is estimated as 1,669 kWh/year, and 2,361 kWh/year in the baseline scenario. 692 kWh/year can be saved with the installation of LED bulbs. The details of calculation are presented in the table below.

Table 12.7-4 Details in Estimation of Consumed Electricity in Lighting System

Facility	Name	Scenario							Quantity	Consumption (kWh/year) *3			
		Baseline				Project				Baseline		Project	
		Lamp Type	Watt (W)		Lumen (lm)	Lamp Type	Watt (W)	Lumen (lm)		Each	Total	Each	Total
Passenger terminal building (PTB)	Down light 1	Compact Fluorescent Lamp (CFL)	8	*1	590	LED	8	590	8	35	1,923	35	1,669
	Down light 2		27	*1	2,000		24	2,000	24	118		105	
	Down light 3		28	*1	2,100		28	2,100	28	123		123	
	Down light 4		41	*1	3,200		31	3,100	31	180		136	
	Wall light 1	High Intensity Discharge (HID) lamp	150	*2	12,700		120	12,500	120	657		526	
	Wall light 2		35	*2	1,900		50	2,398	50	153		219	
Access road and car parking area	Road light		150	*2	13,700		120	11,987	120	657		526	

*1: Calculated as 1 lumen = 75 W based on the specification of FHTxxEX series (Toshiba Lighting & Technology Corporation)
*2: Selected typical products based on lumen equivalent to specifications in the project
*3: Lamps in PTB are used 50% in morning and daytime for 10 hours (from 7.00 to 17.00), 100% in night time for 4 hours (from 17.00 to 21.00), and 30% in mid-night for 10 hours (from 21.00 to 7.00). Lamps in access road and car parking area are used in only night time for 12 hours

12.8. Reduced Amount of CO2 Emissions

12.8.1. Reduction by Installation of Solar Power System

(1) Grid Emission Factors

In May 2013, the DENR issued the latest grid emission factors of the three grids. They are summarized in the table below. The factor of the Luzon-Visayas Grid where the project site is located, for solar power projects is 0.5535 tCO2/MWh.

Table 12.8-1 Grid Emission Factors in the Philippines (tCO2/MWh)

Grid	Operating Margin	Build Margin	Combined Margin
Luzon-Visayas	0.6032	0.4044	0.5535(*1), 0.5038(*2)
Mindanao	0.2864	0.7057	0.3912(*1), 0.4960(*2)

Source: Published in May 2013 by Department of Environmental and Natural Resources (DENR) (http://www.emb.gov.ph/portal/Portals/0/download/News/Emission%20factor%20And%20Grid%20Gen%202011-2015.pdf)
*1: Wind and solar power generation project activities for the first crediting period and for subsequent crediting period; *2: All other projects for the first crediting period

(2) Emission Reductions

The estimated power generated by the solar power system is 559,962 kWh/year. The CO2 emission reduction is calculated as 310 tCO2/year as it is shown in the table below.

Table 12.8-2 Emission Reduction by Installation of Solar Power System in the Bohol Airport

Scenario	Energy Consumption (kWh/year)	CO2 Emission (tCO2/year)	CO2 Emission Reduction (tCO2/year)
Baseline	559,962	310	310
Project	0	0	

12.8.2. Reduction by Installation of VRF Air-Conditioning System

The VRF air-conditioning systems contribute to reduce 1,235,777 kWh/year. Applying the emission factor for all other projects than wind and solar power projects, 0.5038 tCO2/MWh, the CO2 emission reduction is calculated as 623 tCO2/year as it is shown in the table below.

Table 12.8-3 Emission Reduction by Installation of VRF Air-Conditioning System in the Bohol Airport

Scenario	Facility	Energy Consumption (kWh/year)	CO2 Emission (tCO2/year)	CO2 Emission Reduction (tCO2/year)
Baseline	Passenger terminal building (PTB)	3,721,805	1,875	623
	Administration building			
Project	Passenger terminal building (PTB)	2,486,028	1,252	
	Administration building			

12.8.3. Reduction by Installation of Solar Water Heating System

The solar water heating system contributes to reduce 12,573 kWh/year. Applying the emission factor for all other projects than wind and solar power projects, 0.5038

tCO_2/MWh, the CO_2 emission reduction is calculated as 6 tCO_2/year as it is shown in the table below.

Table 12.8-4 Emission Reduction by Installation of Solar Water Heating System in the Bohol Airport

Scenario	Energy Consumption (kWh/year)	CO2 Emission (tCO2/year)	CO2 Emission Reduction (tCO2/year)
Baseline	12,573	6	6
Project	0	0	

12.8.4. Reduction by Installation of Energy Efficient Lighting System

The LED lamps installed and used in the PTB and the access road and car parking area contribute to reduce 692 kWh/year. Applying the emission factor for all other projects than wind and solar power projects, 0.5038 t CO_2/MWh, the CO_2 emission reduction is calculated as 0.13 tCO_2/year as it is shown in the table below.

Table 12.8-5 Emission Reduction by Installation of Energy Efficient Lighting System in the Bohol Airport

Scenario	Facility	Energy Consumption (kWh/year)	CO2 Emission (tCO2/year)	CO2 Emission Reduction (tCO2/year)
Baseline	Passenger terminal building (PTB)	1,923	0.97	0.13
	Access road and car parking area			
Project	Passenger terminal building (PTB)	1,669	0.84	
	Access road and car parking area			

12.8.5. Leakage Emissions (Emissions from Diesel Generator)

The Bohol Airport is equipped with standby engine generators (total of 1200 kVA load capacity) fuelled with diesel oil to supply electricity in case of emergency black out. This assessment does not count the CO_2 emissions from the generators because it can be considered as negligible amount.

At this stage, it is not easy to predict how many times the diesel generator works after operation. So, this assessment refers to a record in the Tagbilaran Airport. As Table 7.10 shows, the Tagbilaran Airport faced commercial power failure for 79.15 hours in 2012. If the generators installed in the Bohol Airport works for same hours as those in the Tagbilaran Airport, they consumes 2,258 L of diesel per annum (refer to Table 7.11). According to the Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories, 2006, the CO_2 emission factor of diesel is $2.7 * 10^{-3}$ tCO_2/L. Thus, the generators in the Bohol Airport emit 6.1 tCO_2/year. Compared to the project emission, 1,252.84 tCO_2/year (refer to Table 7.12), this amount is relatively small, around 0.5 % of the project emission. As a result, this is negligible in this assessment.

Table 12.8-6 Commercial Power Failure in the Tagbilaran Airport in 2012

Month	Duration
January	2 hours
February	2 hours 40 minutes
March	12 hours 15 minutes
April	2 hour 30 minutes
May	1 hours 40 minutes
June	12 hours
July	1 hours 30 minutes
August	12 hours 15 minutes
September	5 hours 30 minutes
October	9 hours 40 minutes
November	11 hours 20 minutes
December	4 hours 45 minutes
Total	**79 hours 15 minutes**

Source: Tagbilaran Airport

Table 12.8-7 Estimated Diesel Consumption by Generators in the Bohol Airport

Average Grid Power Consumption in Tagbilaran Airport (kWh/month) *1	Assumed Operation Time of Generator in Bohol Airport (hours/year)	Assumed Power Produced by Generator in Bohol Airport (kWh/year)	Unit of Diesel Consumption of Generator in Bohol Airport (kg/kWh) *2	Diesel Consumption by Generator in Bohol Airport (L/year) *3
39,900	79.25	8,823	0.2175	2,258

*1: Data from Tagbilaran Airport (summer season)
*2: Specification from this DD Study
*3: Specific gravity of diesel oil is 0.85 kg/L

12.9. Total Emission Reduction in the Bohol Airport

Based on the calculations above, the Bohol Airport is expected to reduce 939.13 tCO2 per year. The details are shown in the table below.

Table 12.8-8 Total Emission Reduction in the Bohol Airport

Scenario	CO2 Emission (tCO2/year)				
	Solar Power System	VRF Air-Conditio-ning System	Solar Water Heating System	Lighting System	Total
Baseline	310	1,875	6	0.97	2,191.97
Project	0	1,252	0	0.84	1,252.84
Reduction	310	623	6	0.13	**939.13**

CHAPTER 13

Environment & Social Consideration

TABLE OF CONTENTS

List of Attachments

Attachment 1:	Environmental Compliance Certificate dated April 16, 2013 issued by DENR-EMB Region VII
Attachment 2:	Memorandum of Agreement on the Creation of the Multi-Partite Monitoring Team, Environmental Monitoring Fund and the Environmental Guarantee Fund
Attachment 3:	Program of Work (List of Approved Budget)
Attachment 4:	Permits to Cut Coconut Trees dated May 22, 2013 issued by Philippine Coconut Authority

Chapter 13 Environmental and Social Consideration

13.1. Introduction

The Government of the Philippines (GOP) has been planning to construct a new Bohol Airport in Panglao Island that meets international standards since 1990s. In the past, feasibility studies had been conducted twice in 2000 and 2007, and detailed engineering was conducted once by a local consultant in 2009.

In accordance with the Philippines Environmental Impact Statement System (PEISS), an Environmental Impact Statement (EIS) was prepared based on the feasibility study in 2000 and submitted to Department of Environment and Natural Resources (DENR)-Environmental Management Bureau (EMB) Region VII for issuance of an Environmental Compliance Certificate (ECC). The initial ECC for the Project was issued by DENR-EMB Region VII in July 2003. The term of validity of the initial ECC was June 2008 which was extended by 5 years to June 2013 in July 2008.

The implementation of the Project requires special attentions to the possible environmental impacts as the project site is located at the Panglao Island which is formed of coral limestone and is surrounded by Marine Protection Areas. Accordingly, the Project is categorized as ‘A’ as per the JICA’s Guidelines on Environmental and Social Considerations, implying that the project is likely to have significant adverse impacts on the environment and society.

As the Project plan such as the air traffic forecast as well as the facility requirements and layout were changed and revised during the Basic and Detail Design, an overall review and revisions of the plans and documents related to the following environmental and social consideration issues have been carried out as described hereunder:

- ✓ Environmental Compliance Certificate (ECC);
- ✓ Environmental Management Plan (EMP);
- ✓ Environmental Monitoring Plan (EMoP);
- ✓ Solid Waste Management Plan (SWM);
- ✓ Social Development Plan (SDP);
- ✓ Information, Education and Communication Plan(IEC); and
- ✓ Biodiversity Conservation Plan.

13.2. Environmental Compliance Certificate

13.2.1. DENR Administrative Order (DAO) 2003-30

The validity of original ECC, issued in July 2003 had been once extended from June 2008 to June 2013, which needed further extension during the period of the Study. The Study Team assisted DOTC in the procedure of requesting DENR to issue an updated ECC. The Study Team also assisted DOTC in updating documents related to the Environmental and Social Considerations including those prepared during the Preparatory Survey, for example, Updated EIS, Terrestrial Biodiversity Assessment

Report, and Resettlement Action Plan.

GOP's Rules and Regulations on Environmental and Social Considerations

DENR Administrative Order (DAO) 2003-30 stipulates that the Philippine Environmental Impact Statement System (PEISS) which requires any project implementing agency to prepare an Environment Impact Statement (EIS) and to obtain an Environmental Compliance Certificate (ECC) prior to the project implementation. The Revised Procedural Manual for DAO 2003-30, issued in August 2007 by DENR-EMB, prescribes the details of rules and regulations, implementation manuals, and required documents.

Initial and Updated Environmental Compliance Certificates (ECC) of the Project

The initial ECC for the Project had been issued on 4 June, 2003 by DENR, after examining the EIS submitted by DOTC. Since the ECC was valid for 5 years, the updated ECC for the Project (but for the old plan) was issued on 3 June 2008. The conditions of the updated ECC were partially changed from those of the initial ECC, but the project scope in general satisfied the requirements of the Revised Procedural Manual for DAO 2003-30 (see Table 13.2-1).

Table 13.2-1 Conditions of ECC for the Project (Updated in June 2008)

Environmental Management and Monitoring Plan (EMMoP)
・ To ensure all commitments, appropriate mitigating/enhancement and monitoring requirements; ・ To establish 200,000 seedlings at the project site within 6 months after the project implementation; ・ To establish and deposit the Environmental Guarantee Fund (EGF); ・ To create Multi-partite Monitoring Team (MMT), and to establish an Environmental Monitoring Fund (EMF); ・ To undertake a continuing Information, Education and Communication (IEC) Program to explain to all stakeholders about the ECC conditions; ・ To submit an updated Project Environmental Risk Categorization prior to implementation or as soon as or after the final sitting and design of facilities have been decided which ever comes earlier.
General Conditions
・ To conform with the applicable provisions of RA 6969 (Toxic Substances and Hazardous and Nuclear Waste Control Act of 1990), RA 8749 (Philippine Clean Air Act of 1999), RA 9003 (Ecological Solid Waste Management Program Act of 2000), RA 9275 (Philippine Clean Water Act of 2004); ・ To monitor the actual project impact; ・ To submit semi-annually an ECC Compliance Report; ・ To install a billboard notifying the issuance of an ECC to the Project.

Source: JICA Study Team

13.2.2. Revised ECC（R07-0804-0133-25）Dated 16 April, 2013

During the Basic and Detail Design Study, the Study Team assisted DOTC to comply with the conditions stipulated in the ECC, and to complete the actions to be taken prior to the construction.

DOTC prepared and submitted the Amendment Plan of the Project to DENR-EMB Region VII on 12 April, 2013. DENR- EMB Region VII issued the revised ECC

(Attachment 1) on 16 April 2013. The Amendment Plan consisted of the following documents;

- Screening Form;
- Letter of Request;
- Project Description Report;
- Copy of Approved ECC to be Amended;
- Project Environmental Monitoring and Audit Prioritization Scheme (PEMAPS);
- Site Development Plan;
- Impact Management Plan;
- Environmental Management Plan; and
- Statement Accountability of Proponent.

(Note: "Site Development Plan", "Impact Management Plan", and "Environmental Management Plan" are from JICA Study Report, 2012.)

13.2.3. New Conditions of Revised ECC

The Revised ECC (Attachment-1) included two additional conditions as follows;

ADDITIONAL CONDITIONS (16 April 2013):

✓ The proponent shall ensure that all commitments, appropriate mitigating/enhancement measures and monitoring requirements especially those contained in the IMP and EMMoP in the IEER-EPRMP documents/Annex C, its modifications and additional information as approved by The EMB during the EIA Report review shall be instituted and strictly implemented throughout the project implementation; and

✓ A private nursery with at least Five Hundred Seventy Two Thousand and Five Hundred (572,500) [formerly: Two Hundred Thousand (200,000) seedlings shall be established in support of the Green Philippines Master Plan which will be utilized for tree planting activities. Planting of appropriate tree species shall be implemented within the project area as planned to serve as a buffer and compensation for the vegetation removal caused by the project implementation. The planted trees shall be maintained throughout the lifespan of the project. Approved Work and financial program for seeding production and tree planting activities shall be submitted within one (1) month upon receipt thereof.

The item 2) was an instruction made by DENR Provincial Office (PENRO) as a part of the Philippine Green Program Activities (see Sub-Chapter 13.8). PENRO is currently preparing the action plan. The implementation of the seedlings will be in 2014.

A brief history of EIS and ECC for the Project is shown in Table 13.2-2.

Table 13.2-2 Brief History of EIS and ECC

Year	Items	Note
2000	Original EIS was prepared.	Based on the first Feasibility Study result.
July, 2003	ECC was initially issued（the term of validity: June, 2008）.	DENR－EMB Region-VII
July, 2008	Extension of ECC validity（revised term of validity: June, 2013）	Required process for future project
September, 2012	JICA assisted the preparation of updated EIS, updated RAP, Biodiversity Assessment Study.	Review the study reports according to the Revised Procedural Manual for DAO 2003-30 and JICA's Guideline.
12 April, 2013	Amendment Plan (Project Description Report: PDR) was submitted to DENR-EMB Region VII.	To adjust the Project as Sustainable Environment Protection Project
16 April 2013	The Plan was approved and amended ECC was issued by DENR-EMB Region VII.	Additional conditions of strict compliance with IMP/EMP/EMoP, etc. and private nursery of 572,500 seedlings were stated.

Note: ECC requires the starting of the project within the term of ECC validity.

13.3. Environmental Management Plan

The Updated EIS, which was prepared during the Preparatory Survey, included the EMP (Environmental Management Plan) and the EMoP (Environmental Monitoring Plan) in accordance with the Revised Procedural Manual for DAO 2003-30 and the JICA's Guidelines. During the Basic and Detailed Design Study, the EMP and the EMoP have been finalized through coordination with DENR.

In particular, EMP has been formulated based on the Impact Management Plan. EMP will provide guidance for the activities of Multi-partite Monitoring Team and EMP consists of the following plans:

- Impact Management Plan;
- Social Development Plan (Outline of required activities for PAFs);
- Biodiversity Conservation Plan (Outline);
- Waste Management Plan (Outline);
- Information Education and Communication Plan (Outline); and
- Emergency Response Plan.

13.3.1. Impact Management Plan

To ensure that ecological balance and environmental safety is preserved, a sound environmental management and monitoring plan shall be established for the Project. Any adverse effect on the environment could be controlled if it is averted earlier and necessary mitigating measures are applied.

Although the proposed Project, in general, has its direct and indirect negative environmental impacts, these could be minimized through sound planning and introduction of proper construction and monitoring techniques during all phases of the project implementation by the concerned government instrumentalities and local government units as well as the contractors.

The benefits that are expected to accrue from the project implementation far outweigh the expected adverse effects on the environment. In order to ensure that proper designs and operational standards are adhered to and that the environment and public safety is not compromised, appropriate site practices and procedures outlined in this section should be strictly followed throughout the lifetime of the Project.

Resources would be wasted and significant environmental impacts mignt follow in the event of failure to enforce rigorously the specified standards of site and operational management. The Impact Management Plan (IMP) is designed to ensure that the mitigating measures recommended to prevent or control the negative impacts of the different aspects of the project on environment, life, and property are properly followed, while positive impacts are enhanced to gain maximum benefits from the project.

The Impact Management Plan shown in Table 13.3-1 is a matrix of the mitigation and enhancement plan following the DENR format of DAO 03-30.

Total management of the Environmental Management Plan shall be carried out by DENR-EMB Regional VII. The plan shall be implemented by Project Management Office of DENR and Local Project Management Team of the Provincial Government of Bohol (PGB).

Table 13.3-1 Impact Management Plan

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact Degree /	Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Guarantee/ Financial Arrangements
1. PRE-CONSTRUCTION PHASE						
Environmental Aspect # 1	A. The Land	B	Scraping of soil for embankment foundation	▪ Need suitable soil quality to replace excavated soil • Importation of soil of suitable quality from borrow area	DOTC Contractor	Terms of Reference (TOR) of the Contractor
		C	Due to refilling of excavated areas, soil erosion and siltation	• Newly laid soil will be well compacted. Loose soil to be covered to avoid its erosion. Disposal of unused portion	DOTC Contractor	TOR of the Contractor
		B	Due to cutting and removal of trees, deprive birds and other wildlife of habitat	• None. The wildlife will move to other places	DOTC Contractor	Government Regulations replacement permit to cut from DENR
		D	Sodding and re-planting of trees	• Sod all bare areas and plant trees as per government regulation	DOTC Contractor	TOR, Government Regulations
		C	Improvement of visual effects after clearing area and landscaping undertaken	▪ Collect and remove all demolition debris • Landscape the area	DOTC Contractor	TOR of the Contractor
Environmental	B. The Water	B	Due to demolition of	▪ Construction of	DOTC	TOR of the

Table 13.3-1 Impact Management Plan

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact Degree /	Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Guarantee/ Financial Arrangements
Aspect # 2			structures, soil erosion and siltation and closure of wells	protective measure ▪ Construction of siltation canal • Sealing of wells in the alignment	Contractor	Contractor
		C	Clearing the area	• Improvement of water infiltration to groundwater table	DOTC Contractor	TOR of the Contractor
		D	Sodding and landscaping	• Tree planting	DOTC Contractor	TOR of the Contractor
Environmental Aspect # 3	C. The Air	C	Dust (TSP) due to demolition of structures and removal of debris	• Place portable perimeter wall around the structure and sprinkling of water of unpaved grounds (roads, parking lots)	DOTC Contractor	TOR of the Contractor
		B	Gaseous (SO_2 and NO_2) due to demolition of structures and removal of debris	• Good repair of trucks especially the exhaust system and use low sulfur construction equipment	DOTC Contractor	TOR of the Contractor
		B	Nuisance noise due to demolition of structures and removal of debris	• Proper equipment maintenance and exhaust of vehicles must be in good condition especially the mufflers	DOTC Contractor	TOR of the Contractor
		B	Dust (TSP) due to demolition and trucking of debris and reusable materials	• During transport and hauling, truck haulers must be covered by tarpaulin and it requires extreme care and precautions	DOTC Contractor	TOR of the Contractor
Environmental Aspect # 4	D. The People	A	Disruption of existing community. Based on survey, there are 66 houses (55 families) that will be affected	• Identify/validate affected people/households thru census • Determine tenurial status of affected people/households • Fair and timely compensation or resettlement assistance (for resettlement, ensure that resettlement site is acceptable to the households to be resettled; with basic utilities such as electricity and water and services such as transportation and communication, etc.) • Provide sufficient time for relocation before start of an	Provincial Government of Bohol (PGB) DOTC NHA	Memorandum of Agreement (MOA)

Table 13.3-1 Impact Management Plan

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact Degree /	Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Guarantee/ Financial Arrangements
				earth-moving activities		
		A	Land affected	• Identify/validate affected land and assessment of values • Fair and timely compensation thru land acquisition from owners	PGB DOTC	Memorandum of Agreement (MOA)
		A	Structures and land improvements affected	• Identify affected structures thru tagging, identification of owners, and assessment of values • Study zoning policies and work for re-classification of affected land if necessary (e.g., obtain permits and clearances, coordinate with LGU's to pass necessary ordinances, etc.) • Fair and timely compensation to owners	PGB DOTC	Memorandum of Agreement (MOA)
		A	Agricultural crops affected	• Determine agricultural crops affected and assess fair market value • Allow harvest of last crop prior to any earth-moving activity. If not possible, provide fair compensation of affected crops (prior to earth-moving)	PGB DOTC	Memorandum of Agreement (MOA)
		B	Trees affected	• Determine affected trees and assess fair market values • Identify owners of affected trees • Explore possibility of transplanting. If not possible, provide fair and timely compensation of owners	PGB DOTC	Memorandum of Agreement (MOA)
		B	Acquisition of permits, clearances required by various government; formulation of MOAs needed	• Proper coordination should be made by the proponent to secure necessary permits at the earliest stage of the project	PGB DOTC	Government Rules/ Regulations

Table 13.3-1 Impact Management Plan

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact Degree /	Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Guarantee/ Financial Arrangements
2. CONSTRUCTION PHASE						
Environmental Aspect # 1	A. The Land	A	Project activities such as the construction of embankment	▪ Need suitable soil quality to replace excavated soil ▪ Importation of soil of suitable quality from borrow area	Contractor	TOR of the Contractor
		D	Soil scraping filling for the embankment	▪ Strengthen the foundation of the structures ▪ Use quality soil for embankment	Contractor	TOR of the Contractor
		A	Land subsidence/ Alteration of natural drainage pattern	▪ Setting up the necessary structural support foundations and adequate drainage channels/use of interceptor dikes, pipe slope drains, sediment trap	Contractor	TOR of the Contractor
		A	Soil contamination due to oil/fuel spill	▪ Close supervision during construction; provision of secondary containment and lining to fuel and oil storage areas	Contractor	TOR of the Contractor
		B	Loss of vegetation/fish and wildlife disturbance	▪ Selective removal of vegetation cover; re-greening of project site	Contractor	TOR of the Contractor
Environmental Aspect # 2	B. The Water	A	Poorly located/constructed system could cause erosion and weakening of the structure foundation	▪ All drainage system will be replaced, in most cases by a better system	Contractor	TOR of the Contractor
Environmental Aspect # 3	C. The Air	A	Generation of TSP/dust from soil excavation and emission from heavy equipment and trucks bringing construction materials	▪ Sprinkling of water of loose soil and exhaust of vehicles must be in good condition especially the mufflers	Contractor	TOR of the Contractor
		B	Gaseous (SO_2 and NO_2) emissions from construction equipment	▪ Proper maintenance and repair of equipment and use low sulfur construction equipment	Contractor	
		A	Noise emission from construction equipment	▪ Construction of temporary baffle wall especially near residential areas and exhaust of vehicles must be in good	Contractor	TOR of the Contractor

Table 13.3-1 Impact Management Plan

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact Degree /	Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Guarantee/ Financial Arrangements
				condition especially the mufflers ▪ Appropriate planning of construction schedule; regular maintenance of construction equipment		
Environmental Aspect # 4	D. The People	B	Health hazards from noise, dust, smoke, and other suspended particles in the air	• Periodic water sprinkling on the ground to minimize dust and suspended particles in the air • schedule use of heavy equipment emitting noise as much as possible during day time or when most people are at work or in school • ensure that the heavy equipment and machines used are well-conditioned to prevent emission of excessive noise and toxic fumes • coordinate with the barangay officials and local health units to issue health bulletins on health hazards brought about by construction activities and offer advice on prevention	PGB DOTC Contractor	TOR of the Contractor
		A	Heavy vehicular traffic jams	(Please see options for mitigation of bad vehicular traffic under Pre-Construction Phase where a traffic management plan is recommended)	PGB DOTC	
		B	Generation of spoils/waste materials	• ensure regular collection of spoils/waste materials such as soil excavated, wood, and waste metals to prevent obstruction of roads, sidewalks, and other open spaces • consider using pre-fabricated slabs and panels to avoid using roads, sidewalks, and other open spaces as work areas and to minimize spoils/wastes	PGB DOTC Contractor	TOR of the Contractor

Table 13.3-1 Impact Management Plan

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact Degree /	Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Guarantee/ Financial Arrangements
				generated in the construction sites • have an approved disposal site/s for spoils/waste materials generated		
		B	Safety concerns for motorists and pedestrians passing in the vicinity of the construction sites	• contractors to ensure safety of motorists and pedestrians passing in the vicinity of construction sites by posting warning signs of ongoing construction in strategic areas, blocking off danger areas, and as much as possible scheduling works in areas during periods when there is least number of motorists and pedestrians	PGB DOTC	TOR of the Contractor
		B	Safety and health concerns for construction workers and personnel at the construction site	• First-aid/health service to be available in the area, provision of early warning and alert system, provision of protective clothing and gears for workers, employ health and safety program	Contractor	TOR of the Contractor
		B	Housing concern for construction workers and personnel	• contractors to provide acceptable facilities for temporary housing of construction workers and personnel	Contractor	TOR of the Contractor
		B	Disorganized routing and operations of existing public utility vehicles (e.g. bus, jeepney, and tricycle)	• help organize or strengthen public utility vehicle operators and drivers associations to complement the planned rail transportation service as well as ensure efficient use of the planned road connector and other access roads by, among others, establishing new transportation lines and routes and rationalizing fares	PGB DOTC	TOR of the Contractor Access available resources from cooperating LGU's and other groups
		C	The construction activities will generate short-term employment.	• Qualified laborers shall be recruited to the extent practical and reasonable.	Contractor	TOR of the Contractor

Table 13.3-1 Impact Management Plan

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact Degree /	Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Guarantee/ Financial Arrangements
3. OPERATION PHASE						
Environmental Aspect # 1	A. The Land	B	Increased vehicular flow thereby increasing the incidence of traffic congestion due to the operation of the roadway	▪ Fielding of traffic enforcers near bus/jeep terminals and place traffic signage and precautions along the roadway	PGB DOTC	DOTC or PGB
		B	Water ponding in the alignment and soil erosion could weaken the embankment and foundation	▪ Cleaning of drainage system of obstructing material before the rainy season starts and during the rainy season	PGB DOTC	DOTC or PGB
		B	Erosion of loose soil and siltation in low areas	▪ Protection of loose soil from action of rain ▪ Sodding of bare areas	PGB DOTC Contractor	DOTC or PGB
Environmental Aspect # 2	B. The Water	B	Water ponding in the alignment and soil erosion could weaken structure embankment and foundation	▪ Cleaning of drainage system of obstructing material before the rainy season starts and during the rainy season	PGB DOTC Contractor	DOTC or PGB
		A	Wastewater generation of domestic influent will be generated Discharge of the untreated wastewater may cause nuisance or produce foul odor and groundwater contamination	▪ Establishment of wastewater treatment facility/multi-chambered septic tank; Treatment of wastewater to meet DENR Effluent Standards	PGB DOTC Contractor	Airport Operation Manual; Sanitation Code of the Philippines, ECC
Environmental Aspect # 3	C. The Air	B B B	Impact on air quality Impact on gaseous (SO_2 and NO_2) emission Noise Pollution	• None, except proper maintenance and repair of equipment • None, except proper maintenance and repair of equipment and use low sulfur vehicles • Provision of noise control structures, relocation of affected households	DOTC	Airport Operation Manual; ECC
Environmental Aspect # 4	D. The People	A	Disorganized routing and operations of existing public utility vehicles (e.g. bus,	• Help organize or strengthen public utility vehicle operators and drivers associations to complement the rail	PGB DOTC	TOR of the Contractor Access available resources

Table 13.3-1 Impact Management Plan

Project Phase/ Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact Degree /	Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Guarantee/ Financial Arrangements
			jeepney, and tricycle)	transportation service as well as ensure efficient use of the road connector and other access roads by, among others, establishing new transportation lines and routes and rationalizing fares		from cooperating LGU's and other groups
		A	Solid waste generation about 500-1,000 kg/day of solid wastes will be generated Uncollected, not properly disposed of solid wastes cause sanitation problems and aesthetics of the area	• Employ solid waste management plan • Regular solid wastes collection and disposal by solid waste collectors operating in the area	DOTC	Airport Operation Manual; ECC; RA 9003
		C	The operation will generate source of livelihood and employment for project affected and local residents.	• Qualified project affected persons and local residents will be considered for employment during operation.	DOTC	MOA between Proponent and stakeholders
		A	Airport accident	• Implement contingency response plan	PGB DOTC	Airport Operation Manual/ Contingency Plan of Bohol

Note: For Degree of Impact A – High Negative Impact B – Low Negative Impact C – High Positive Impact D – Low Positive Impact

Source: JICA Study Team

13.4. Environmental Monitoring Plan (EMoP)

13.4.1. General

EMoP has been prepared based on the revised version of the initial EMoP prepared during the Updated EIS (2012), and the estimated monitoring cost was included in the cost of Construction Work. Multi-partite Monitoring Team (MMT) will monitor and evaluate the field investigation results and laboratory examinations. The evaluation should be based on the national and regional environmental standards applicable.

An integral part of the environmental protection is periodic monitoring of the immediate environmental condition to determine any occurrence of undesirable changes as a result of the Project during construction and operation phases.

The monitoring program for the Project shall determine the extent of variations and changes in the levels of pollutants in the environment and other parameters and indicators considering the implementation or operation of the project. The monitoring program shall have the following objectives:

- ✓ Monitor implementation of mitigation measures;
- ✓ Monitor compliance with the air, noise, and water quality standards; and
- ✓ Monitor other parameters and indicators for socio-economics and health.

13.4.2. Self-Monitoring Plan

The monitoring program will be dynamically designed as it could be modified to take into several considerations such as the various stages of the project cycle, revision of standards, enactment of new rules and regulations and development of new methodologies and technologies for environmental monitoring. A summary matrix of the Environmental Monitoring Plan is shown in Table 13.4-1.

Table 13.4-1 Summary Matrix of the Environmental Monitoring Plan

Key Environmental Aspects per Project Phase	Potential Impacts per Environmental Sector	Parameter to be Monitored	Sampling and Measurement Plan			Lead Person	Annual Estimated Cost
			Method	Frequency	Location		
I. PRE-CONSTRUCTION PHASE/CONSTRUCTION PHASE							
Environmental Aspect # 2 (The Water)	The water (The influences from general construction work)	Copper	Dao 34	Monthly	Two (2) Seawater Sampling Stations	MMT/ Contractor	Php 1.2 M
		Total Coliform	DAO34	Monthly			
		Fecal Coliform	DAO34	Monthly			
		pH	DAO34	Monthly			
		Temperature	DAO34	Monthly			
		Color	DAO34	Monthly			
		Dissolved Oxygen	DAO34	Monthly			
		Biological Oxygen Demand	DAO34	Monthly			
		MBAS	DAO34	Monthly			
		Phenols	DAO34	Monthly			
		Total Suspended Solids	DAO34	Monthly			
		Oil and Grease	DAO34	Monthly			
		Iron	DAO34	Monthly	Two (2) Groundwater Sampling Stations		
		Total Coliforms	DAO34	Monthly			
		Escherichia Coli	DAO34	Monthly			
		Heterotrophic Plate Count	DAO34	Monthly			
		pH	DAO34	Monthly			

Table 13.4-1 Summary Matrix of the Environmental Monitoring Plan

Key Environmental Aspects per Project Phase	Potential Impacts per Environmental Sector	Parameter to be Monitored	Sampling and Measurement Plan			Lead Person	Annual Estimated Cost
			Method	Frequency	Location		
		Temperature	DAO34	Monthly			
		Color	DAO34	Monthly			
		Settleable Solids	DAO34	Monthly			
		Dissolved Oxygen	DAO34	Monthly			
		Biological Oxygen Demand	DAO34	Monthly			
		Chemical Oxygen Demand	DAO34	Monthly			
		Total Dissolved Solids	DAO34	Monthly			
		MBAS (Surfactants)	DAO34	Monthly			
		Phenols	DAO34	Monthly			
		Total Suspended Solids	DAO34	Monthly			
		Oil & Grease	DAO34	Monthly			
		Calcium	DAO34	Monthly			
		Magnesium	DAO34	Monthly			
		Chloride	DAO34	Monthly			
		Silica	DAO34	Monthly			
		Sulfite	DAO34	Monthly			
		Total Hardness	DAO34	Monthly			
Environmental Aspect # 3 (The Air)	The Air (TSP/Dust from Soil excavation/embankment and from heavy equipment/trucks)	SO_2, NO_2, Pb, TSP	- Proper maintenance of equipment, sprinkling of water on unpaved grounds and site - 1-hour ambient sampling (DAO14)	-visual inspection (weekly) - Monthly	- 5 stations (Tawal Elem. School, Danao Brgy. Hall, Panglao Mun. Hall, Access Road to Airport and Bolod Elem. School	MMT/Contractor	Php 1.044M
	Noise (Noise from construction work by heavy equipment/trucks)	Noise, dB(A)	- Proper maintenance of equipment -10-minute averaging time at seven	-monthly measurement -weekly hearing	- 5 stations (Tawal Elem. School, Danao Brgy. Hall, Panglao Mun. Hall, Access Road to Airport and Bolod Elem.	MMT /Contractor	Php 0.072M

Table 13.4-1 Summary Matrix of the Environmental Monitoring Plan

Key Environmental Aspects per Project Phase	Potential Impacts per Environmental Sector	Parameter to be Monitored	Sampling and Measurement Plan			Lead Person	Annual Estimated Cost
			Method	Frequency	Location		
			readings (DAO14)		School		
Environmental Aspect # 4 (The People)	Solid and liquid waste		Visual inspection	Monthly	On-site and around site	MMT/ Contractor	Php 0.108M
	Life Conditions		Interview	Monthly	Around site	MMT/ Contractor	Php 0.108M
I. OPERATION PHASE							
Environmental Aspect # 2 (The Water)	The water (The influences from general construction work)	Copper	Dao 34	Monthly	Two (2) Seawater Sampling Stations	MMT/ Contractor	Php 1.2 M
		Total Coliform	DAO34	Monthly			
		Fecal Coliform	DAO34	Monthly			
		pH	DAO34	Monthly			
		Temperature	DAO34	Monthly			
		Color	DAO34	Monthly			
		Dissolved Oxygen	DAO34	Monthly			
		Biological Oxygen Demand	DAO34	Monthly			
		MBAS	DAO34	Monthly			
		Phenols	DAO34	Monthly			
		Total Suspended Solids	DAO34	Monthly			
		Oil and Grease	DAO34	Monthly			
		Iron	DAO34	Monthly	Two (2) Groundwater Sampling Stations		
		Total Coliforms	DAO34	Monthly			
		Escherichia Coli	DAO34	Monthly			
		Heterotrophic Plate Count	DAO34	Monthly			
		pH	DAO34	Monthly			
		Temperature	DAO34	Monthly			
		Color	DAO34	Monthly			
		Settleable Solids	DAO34	Monthly			
		Dissolved Oxygen	DAO34	Monthly			
		Biological Oxygen Demand	DAO34	Monthly			
		Chemical Oxygen Demand	DAO34	Monthly			

Table 13.4-1 Summary Matrix of the Environmental Monitoring Plan

Key Environmental Aspects per Project Phase	Potential Impacts per Environmental Sector	Parameter to be Monitored	Sampling and Measurement Plan			Lead Person	Annual Estimated Cost
			Method	Frequency	Location		
		Total Dissolved Solids	DAO34	Monthly			
		MBAS (Surfactants)	DAO34	Monthly			
		Phenols	DAO34	Monthly			
		Total Suspended Solids	DAO34	Monthly			
		Oil & Grease	DAO34	Monthly			
		Calcium	DAO34	Monthly			
		Magnesium	DAO34	Monthly			
		Chloride	DAO34	Monthly			
		Silica	DAO34	Monthly			
		Sulfite	DAO34	Monthly			
		Total Hardness	DAO34	Monthly			
Environmental Aspect # 3 (The Air)	The Air (TSP/Dust from Soil excavation/embankment and from heavy equipment/trucks)	SO_2, NO_2, Pb, TSP	-Proper maintenance of equipment, sprinkling of water on unpaved grounds and site - 1-hour ambient sampling (DAO14)	-visual inspection (weekly) - Monthly	- 5 stations (Tawal Elem. School, Danao Brgy. Hall, Panglao Mun. Hall, Access Road to Airport and Bolod Elem. School	MMT/ Contractor	Php 1.044M
	Noise (Noise from construction work by heavy equipment/trucks)	Noise, dB(A)	- Proper maintenance of equipment -10-minute averaging time at seven readings (DAO14)	- monthly measurement - weekly hearing	- 5 stations (Tawal Elem. School, Danao Brgy. Hall, Panglao Mun. Hall, Access Road to Airport and Bolod Elem. School	MMT/ Contractor	Php 0.072M
Environmental Aspect # 4 (The People)	Waste collection-solid waste collection/ disposal	Solid waste at the airport	Provision of coded garbage bins (biodegradable, non-biodegradable and recyclables)	Daily as necessary as per refuse collection schedule	Airport/At project site	MMT/ Contractor	Php 0.108M
	Life Conditions	General	Interview	Monthly	Around Site	MMT/ Contractor	Php 0.108M

Source: JICA Study Team

Table 13.4-2 Monitoring Stations of Water

Sta. ID No.	GPS Readings		Description of Sampling Stations
	Longitude	Latitude	
GW-1	N 09^{O}35’05.7”	E123^{O}46’14.5”	It is located at Airport Site in Brgy. Tawala, Panglao, Bohol. Owned by deceased Mr. Leoncio Boncaron
GW-2	N 09^{O}33’30.6”	E123^{O}45’28.4”	It is located inside compound of former barangay captain Mr. Avito Arcay which is in front of the Brgy. Hall of Brgy. Danao crossing the municipal road in the municipality of Panglao, Bohol.
SW-1	N 09^{O}32’51.1”	E123^{O}46’22.2”	This is situated about 100 meters away from the seashore which is in front of the Alona Kew Beach in Brgy. Tawala, Panglao, Bohol.
SW-2	N 09^{O}34’05.0”	E123^{O}45’03.1”	This is located inside mangrove trees about 150 meters away from seashore in Brgy. Danao, municipality of Panglao, Bohol.

Source: JICA Study Team

Table 13.4-3 Monitoring Stations of Air & Noise

AS. ID No.	GPS Readings		Description of Sampling Stations
	Longitude	Latitude	
AS - 1	N 09O33’42.3”	E123O46’40.1”	It is located in front of Tawala Elementary School in Brgy Tawala, Panglao, Bohol. It is situated about 10 meters away from center of the municipal road and about 35 meters from the Classrooms.
AS - 2	N 09O33’32.9”	E123O45’27.0”	It is situated almost in front of the Brgy Hall of Brgy Danao in the municipality of Bohol. It is about 7 meters away from center of the municipal road.
AS - 3	N 09O34’50.4”	E123O45’08.4”	It is about 30 meters away in front of the municipal hall building of Panglao and about 25 meters from center of the municipal road.
AS - 4	N 09O34’19.9”	E123O46’28.9”	It is located along access road of the proposed new Bohol airport in Brgy Tawala in the municipality of Panglao.
AS - 5	N 09O34’10.4”	E123O47’14.5”	It is located in front of Bolod Elementary School in Brgy Bolod, Panglao. It is about 2 meters away from the perimeter fence of the school and 5 meters away from center of the municipal road.

Source: JICA Study Team

Source: JICA Study Team

Figure 13.4-1 Location of Monitoring Stations of Water, Air & Noise

13.4.3. Multi-sectoral Monitoring Framework

During the implementation of the proposed project, a Multi-Partite Monitoring Team (MMT) needs to be established to undertake monitoring the ECC conditions. The MMT shall be composed of the representative of the Proponent, LGUs, stakeholders, NGOs, and concerned PENRO/CENRO. Periodic meetings shall be conducted.

The Study Team confirmed that the Multipartite Monitoring Team (MMT) for the Project was created, and the Environmental Monitoring Fund (EMF) and the Environmental Guarantee Fund (EGF) were established in accordance with the ECC conditions. Establishment of the MMT and the EMF is under the jurisdiction of DENR Regional Office (Region VII located in Cebu City), while the EGF is managed by the DENR Headquarter.

EMF is to support the activities of MMT and will be replenished based on the actual expenses incurred in the monitoring activities. Items covered by this fund include air, noise quality analysis, effect of vibration, flooding, etc., honoraria for the members of the MMT, documentation, meeting expenses, transportation costs and other related expenses.

EGF is for the immediate clean-up or rehabilitation of areas affected by damages in the environment and the resulting deterioration of environmental quality as a direct consequence of a project's construction, operation or abandonment. It shall likewise be used to compensate parties and communities affected by the negative impacts of the project, and to fund community-based environment related projects including, but not limited to, information and education and emergency preparedness programs.

MOA was approved and signed by DENR, DOTC, and related agencies on 8 July 2013. MMT has become the official organization for monitoring of the Project. MMT kickoff meeting was held on 11 July 2013 at Tagbilaran City. The MMT is to be managed under the Operation Manual. There will be scheduled and unscheduled meetings, and shall be held basically at least once every three (3) months.

The actual monitoring work shall be conducted by the Contractor employed by DOTC for the construction works as a part of his contractual obligations and the monitoring results shall be reported to MMT periodically.

Table 13.4-4 Official Members of MMT

Office/Company	Permanent Representative	Alternate
Executive Committee		
DENR-EMB-Region VII (Chair)	OIC, Regional Director	OIC, EIAMD Chief
DENR 7	OIC, Regional Executive Director	RTD, FMB7
DOTC	Proponent	PCO
LGU-Bohol	Provincial Governor	Provincial Administrator
LGU-Panglao	Municipal Mayor	Municipal Administrator
LGU-Dauis	Municipal Mayor	Municipal Administrator
Technical Committee		
DENR-EMB Regional VII (Chair) EIA	OIC, EIAMD Chief	EMB7 MMT Coordinator
DOTC	PCO	Alternate PCO
DENR-PENRO	PENRO	Assistance PENRO
DOT	DOT	Assistance officer
CAAP	CAAP Officer	Assistance officer
LGU Bohol - PPDO	PPDO	Assistance PPDO
LGU Bohol - PEO	Provincial Engineer	Assistance Provincial Engineer
LGU Bohol - BEMO	BEMO	Assistance BEMO
LGU Panglao - MENRO	MENRO	Assistance MENRO
LGU Panglao - MPDO	MPDO	Assistance MPDO
LGU-Barangay Tawala	Barangay Chairman	Barangay 1st Councilor
LGU-Barangay Danao	Barangay Chairman	Barangay 1st Councilor
LGU-Barangay Bolod	Barangay Chairman	Barangay 1st Councilor
LGU-Barangay Lourdes	Barangay Chairman	Barangay 1st Councilor
NGO-PLOMPCO	PLOMPCM President	PLOMPCM Vice-President
Academe Holy Name University	President	Dean
Academe Bohol island State university	President	Dean
Secretariat		
DENR-EMB Region VII	EMB7 MMT Coordinator	
DOTC	PCO	Alternate PCO

Source: JICA Study Team

Table 13.4-5 Detailed Cost Estimation of Environmental Monitoring Plan

What	Items	Method	Unit Cost (Php)	Frequency	Cost Estimation
1. Preconstruction phase/Construction Phase					
Seawater Sampling Station (2 places)	Copper	Dao 34	770	Monthly	1 Place Monthly Cost = Php22,205/month 2 places Monthly Cost = Php44,410/month Annual Cost (12 times) = Php532,920/Year Total Cost (36 times) = Php1,598,760 (including sampling cost)
	Total Coliform	DAO34	590	Monthly	
	Fecal Coliform	DAO34	540	Monthly	
	pH	DAO34	180	Monthly	
	Temperature	DAO34	170	Monthly	
	Color	DAO34	270	Monthly	
	Dissolved Oxygen	DAO34	590	Monthly	
	Biological Oxygen Demand	DAO34	960	Monthly	
	MBAS	DAO34	1,060	Monthly	
	Phenols	DAO34	1,350	Monthly	
	Total Suspended Solids	DAO34	520	Monthly	
	Oil and Grease	DAO34	980	Monthly	
	Sampling Cost		14,225		
	Sub-Total Cost		22,205		
Groundwater Sampling Station (2 places)	Iron	DAO34	470	Monthly	1 Place Monthly Cost = Php27,795/month 2 places Monthly Cost = Php55,590/month Annual Cost (12 times) = Php667,080/Year Total Cost (36 times) = Php2,001,240 (including sampling cost)
	Total Coliforms	DAO34	590	Monthly	
	Escherichia Coli	DAO34	960	Monthly	
	Heterotrophic Plate Count	DAO34	430	Monthly	
	pH	DAO34	180	Monthly	
	Temperature	DAO34	170	Monthly	
	Color	DAO34	270	Monthly	
	Settleable Solids	DAO34	270	Monthly	
	Dissolved Oxygen	DAO34	590	Monthly	
	Biological Oxygen Demand	DAO34	960	Monthly	
	Chemical Oxygen Demand	DAO34	960	Monthly	
	Total Dissolved Solids	DAO34	590	Monthly	
	MBAS (Surfactants)	DAO34	1,060	Monthly	
	Phenols	DAO34	1,350	Monthly	
	Total Suspended Solids	DAO34	520	Monthly	
	Oil&Grease	DAO34	980	Monthly	
	Calcium	DAO34	530	Monthly	
	Magnesium	DAO34	530	Monthly	
	Chloride	DAO34	430	Monthly	
	Silica	DAO34	710	Monthly	
	Sulfite	DAO34	430	Monthly	
	Total Hardness	DAO34	590	Monthly	

Table 13.4-5 Detailed Cost Estimation of Environmental Monitoring Plan

What	Items	Method	Unit Cost (Php)	Frequency	Cost Estimation
	Sampling Cost		14,225		
	Sub-total Cost		27,795		
Air- 5 Stations (Tawal Elem. School, Danao Brgy. Hall, Panglao Mun. Hall, Access Road to Airport and Bolod Elem. School	SO_2, NO_2, Pb, TSP	DAO 14	15,000	Monthly	1 Place Monthly Cost = Php15,000/month 5 places Monthly Cost = Php75,000/month Annual Cost (12 times) = Php900,000/Year Total Cost (36 times) = Php2,700,000
	Dust	visual inspection	3,000	weekly	Monthly Cost = Php12,000/month Annual Cost (12 months) = Php144,000/Year Total Cost (36 months) = Php432,000
Noise- 5 stations (Tawal Elem. School, Danao Brgy. Hall, Panglao Mun. Hall, Access Road to Airport and Bolod Elem. School	Noise, dB(A)	DAO 14	3,000	Monthly	Monthly Cost = Php3,000/month Annual Cost (12 months) = Php36,000/Year Total Cost (36 months) = Php108,000
	Noise	hearing	3,000	weekly	Monthly Cost = Php3,000/month Annual Cost (12 months) = Php36,000/Year Total Cost (36 months) = Php108,000
Solid Waste	Waste	Visual inspection	9,000	Monthly	Monthly Cost = Php9,000/month Annual Cost (12 months) = Php108,000/Year Total Cost (36 months) = Php324,000
Life Conditions	General	Interview	9,000	Monthly	Monthly Cost = Php9,000/month Annual Cost (12 months) = Php108,000/Year Total Cost (36 months) = Php324,000
Total Cost					Monthly Cost = Php211,000/month Annual Cost (12 months) = Php2,532,000/Year Total Cost (36 months) = Php7,596,000
2. Operation Phase					
Seawater Sampling Station (2 places)	Copper	DAO 34	770	Monthly	1 Place Monthly Cost = Php22,205/month 2 places Monthly Cost = Php44,410/month Annual Cost (12 times) = Php532,920/Year
	Total Coliform	DAO34	590	Monthly	
	Fecal Coliform	DAO34	540	Monthly	

Table 13.4-5 Detailed Cost Estimation of Environmental Monitoring Plan

What	Items	Method	Unit Cost (Php)	Frequency	Cost Estimation
	pH	DAO34	180	Monthly	(including sampling cost)
	Temperature	DAO34	170	Monthly	
	Color	DAO34	270	Monthly	
	Dissolved Oxygen	DAO34	590	Monthly	
	Biological Oxygen Demand	DAO34	960	Monthly	
	MBAS	DAO34	1,060	Monthly	
	Phenols	DAO34	1,350	Monthly	
	Total Suspended Solids	DAO34	520	Monthly	
	Oil and Grease	DAO34	980	Monthly	
Groundwater Sampling Station (2 places)	Iron	DAO34	470	Monthly	1 Place Monthly Cost = Php27,795/month 2 places Monthly Cost = Php55,590/month Annual Cost (12 times) = Php667,080/Year (including sampling cost)
	Total Coliforms	DAO34	590	Monthly	
	Escherichia Coli	DAO34	960	Monthly	
	Heterotrophic Plate Count	DAO34	430	Monthly	
	pH	DAO34	180	Monthly	
	Temperature	DAO34	170	Monthly	
	Color	DAO34	270	Monthly	
	Settleable Solids	DAO34	270	Monthly	
	Dissolved Oxygen	DAO34	590	Monthly	
	Biological Oxygen Demand	DAO34	960	Monthly	
	Chemical Oxygen Demand	DAO34	960	Monthly	
	Total Dissolved Solids	DAO34	590	Monthly	
	MBAS (Surfactants)	DAO34	1,060	Monthly	
	Phenols	DAO34	1,350	Monthly	
	Total Suspended Solids	DAO34	520	Monthly	
	Oil & Grease	DAO34	980	Monthly	
	Calcium	DAO34	530	Monthly	
	Magnesium	DAO34	530	Monthly	
	Chloride	DAO34	430	Monthly	
	Silica	DAO34	710	Monthly	
	Sulfite	DAO34	430	Monthly	
	Total Hardness	DAO34	590	Monthly	
Air- 5 stations (Tawal Elem. School, Danao Brgy. Hall, Panglao Mun. Hall, Access Road to Airport and Bolod Elem. School	SO_2, NO_2, Pb, TSP	DAO 14	15,000	Monthly	1 Place Monthly Cost = Php15,000/month 5 places Monthly Cost = Php75,000/month Annual Cost (12 times) = Php900,000/Year
	Dust	visual inspection	3,000	weekly	Monthly Cost = Php12,000/month

Table 13.4-5 Detailed Cost Estimation of Environmental Monitoring Plan

What	Items	Method	Unit Cost (Php)	Frequency	Cost Estimation
					Annual Cost (12 months) = Php144,000/Year
Noise- 5 Stations (Tawal Elem. School, Danao Brgy. Hall, Panglao Mun. Hall, Access Road to Airport and Bolod Elem. School	Noise, dB(A)	DAO 14	3,000	Monthly	Monthly Cost = Php3,000/month Annual Cost (12 months) = Php36,000/Year
	Noise	hearing	3,000	weekly	Monthly Cost = Php3,000/month Annual Cost (12 months) = Php36,000/Year
Solid Waste	Waste	Visual inspection	9,000	Monthly	Monthly Cost = Php9,000/month Annual Cost (12 months) = Php108,000/Year
Life conditions	General	Interview	9,000	Monthly	Monthly Cost = Php9,000/month Annual Cost (12 months) = Php108,000/Year
Total Cost					Monthly Cost = Php211,000/month Annual Cost (12 months) = Php2,532,000/Year

Source: JICA Study Team

13.5. Solid Waste Management Plan

13.5.1. Introduction

Waste management is one of the major issues to mitigate the environmental impact from airport construction works and operations. If not given a priority attention it will greatly affect the health and sanitation, aesthetic, and social problems to the community in construction phase and it will give uncomfortable circumstance for airport passengers in operation phase. It is imperative to put some efficient systems and policies to closely monitor how to keep the airport and surroundings clean.

Purpose

The solid waste management plan will guide the proponent of the project and LGU to implement measures and mechanisms.

National and Local Laws and Regulations

The solid waste management plan is formulated in accordance with Ecological Solid Waste Act of 2000 (RA9003), Implementing Rules and regulations of Republic Act 6969 (DAO1992-29), an Act to Control Toxic Substances and Hazardous and Nuclear Wastes, providing Penalties for Violations thereof, and for other purposes (RA6969), the Updated Bohol Environmental Code (BEC) of the province and Municipal Ordinance/s of the

Municipalities of Panglao and Dauis.

Policy

Waste segregation should be strictly enforced and implemented to reduce volume of the waste by the Contractor, airport operator, and the new airport users.

Implementation

Multi-partite Monitoring Team (MMT) will manage and monitor the Solid Waste Management (SWM) Program described in this Plan and actual conditions at construction and operation phase to keep natural and social environment of Panglao Island.

13.5.2. Construction Phase

(1) Roles and Responsibilities

a) Roles and Responsibilities of the Contractors

The roles and responsibilities of the Contractor are as follows:

- The Contractor is responsible for waste discharge in construction phase;
- The Contractor shall effort to reduce, reuse, and recycle of construction waste;
- The Contractor shall treat construction waste in accordance with relevant laws and regulations of the Philippines; and
- The Contractor may subcontract to other specialist companies the transportation, intermediate treatment and final disposal of the solid waste. The Contractor shall pay reasonable cost to the subcontractors to ensure suitable treatment.

b) The Role and Responsibility of the Proponent and Related Agencies/Authorities

The Proponent and other authorities and agencies concerned shall exercise their duty for a suitable management of the construction waste (i.e. reduce, reuse, and recycle).

- The Proponent shall encourage adoption of a design for reducing, reusing, and recycling the construction wastes;
- The engineers shall take into account of the design requirements for reducing, reusing, and recycling the construction wastes;
- Subcontractors shall cooperate with the Contractor to reduce, reuse, and recycle the construction waste; and
- Specialist subcontractors for waste management shall treat the wastes suitably in accordance with the subcontract.

c) The Responsibility for Municipal Waste from Field Office

The municipal waste from the field office shall be treated by the original contractor in accordance with indications of located municipality.

(2) Plan and Management

a) Establishment of Management Organization

The Contractor shall establish an organization for waste management and make clear the roles and responsibility of each position.

b) Plan and Management at the Construction Site

The Contractor shall formulate the waste management plan to reduce the waste disposal volume. The waste management plan shall include waste reduction and segregation methods. The waste management plan shall include the following:

- Waste treatment policy for the construction work;
- Communication procedure between the Contractor and specialist subcontractors for the solid waste management;
- The construction waste volume shall be estimated before the actual work;
- The construction methods and materials shall be considered;
- Generated construction waste shall be recycled as much as possible and practicable;
- Non-recyclable waste shall be reduced by intermediate treatment;
- Final disposal waste shall be considered about transportation and disposal method,
- Segregation system shall be introduced;
- The Contractor shall confirm the license and evaluate the capacity of the specialist subcontractors for waste treatment; and
- The management organization shall carry out the monitoring of waste management plan.

(3) Solid Waste Management Plan of New Airport Construction Work

a) Major Construction Work and Waste Sources

Major construction works and waste sources are shown in Table 13.5-1. The table shows that the waste from the construction work are few roots of trees/plants and household waste.

Table 13.5-1 Major Construction Works and Waste Sources

Waste Resource	Types and Sources of Waste	Waste Amount	Note
Preparatory work	Waste from tree trimming/Stumping	Few	The owner has brought own trees and plants to resettlement area. The remaining plants are very few.
Housing for Construction workers	Household waste	Note 1) Around 500kg/day	Household waste from workers daily activities
Earth work	Remaining soil	None	The soil amount of excavation and embankment is balanced. The rock also is used for embankment material after crashing.
Building work	Plate for framework	None	There are few frameworks at building

Waste Resource	Types and Sources of Waste	Waste Amount	Note
			work. The plate shall be brought out from the Island after finish of construction work.
	Hazardous waste (paints, thinners, batteries, spray and others)	None	Hazardous waste is brought out from the Island after finish of construction work. The contractor prepare temporally storage house.

Note 1) The household waste volume is calculated as around 500 workers. Unit is 1 kg/person/day.

Source: JICA Study Team

b) Waste Management Plan

Segregation

The Contractor shall prepare local rules during the construction work period. The Contractor shall prepare a temporary Material Recovery Facility (MRF) at the housing area for recyclable waste and a storage house for hazardous waste.

- Household waste shall be segregated by instruction of appointed waste management manager. The segregation is carried out by three types, biodegradable waste, recyclable waste and residual waste. Recyclable waste should be segregated according to method of recycle; bin, can, plastic and paper.
- Hazardous waste from household and construction waste should be once stored at special house and brought out from the Island.

Collection/Transportation/Final disposal

The Contractor may contract out the collection/transportation/final disposal of waste to licensed specialist subcontractor. If the specialist subcontractor needs to bring residual waste to public landfill site, the company shall get permission from Local Government Unit located in the final disposal facility.

(4) Information, Education and Communication

Information, Education and Communication (IEC) shall be done for all waste generators and workers to make sure that they observe what are mandated by the Law (RA9003) and local rules pertaining to the waste management. The Contractor shall develop education materials i.e. flyers and brochures for IEC Campaign and hold seminars and workshops.

The Contractor shall clearly identify where bins are located and how to use them; educate subcontractors and workers about the benefits of recycling; place informational signs on or near bins explaining why recycling is important; develop signs that show products that are made from recycled materials and also display large banners telling workers "Recycles".

(5) Monitoring

The Contractor shall submit monthly inspection report to Multi-partite Monitoring Team.

The Contractor's monitoring may include visual inspection as required at and around the site. The inspection activity includes not only inspection but also cleaning activities.

13.5.3. Operation Phase

Solid waste management plan in operation phase has been formulated based on "Developing and Implementing an Airport Recycling Program, April 2009, United States Environmental Protection Agency, EPA 530-K-08-002"

(1) Organization

a) Organization and Responsibilities

The airport management will organize solid waste management team including individuals from every sector of the airport: terminals, offices, hangars, vendors, airlines, and flight kitchens. The team plans and implements the recycling program in the initial phase, then maintains and monitors the program once it is in place. If there is a recycling program in Panglao Municipality, consider involving the local solid waste office. They are valuable team members with knowledge regarding local haulers and material markets. The team may include individuals from inside and outside the airport. If it is possible that the team include environmental professionals, local government staff, government officials, recycling staff from other airports, as well as their own staff from various departments, to discuss and develop the best options for implementing a recycling program at their airport. Once assembled, the team is responsible for:

- working with airport management;
- gathering information needed to design and implement the program;
- encouraging the participation of other staff;
- training and educating tenants and concessionaires; and
- monitoring the program.

b) Selecting a Team Leader or Recycling Coordinator

Appointing a recycling coordinator to oversee the program is beneficial. Too often recycling responsibility divided among several individuals causes a disjointed program with low recycling rates. A recycling coordinator is responsible for the entire program, including overseeing implementation and monitoring operations. The recycling coordinator should understand the current waste management program. While the recycling coordinator does not need to work full time on recycling, it should be a top priority.

Creating a recycling coordinator position, either through contracting with a recycling specialist or creating a staff position, will enable the new airport to organize, execute and evaluate the recycling program. Team members that may make a good recycling coordinator include the airport environmental specialist, an operations manager, or a construction and maintenance service manager. A recycling expert can help save time by researching basic needs for the program and possible markets for materials.

Table 13.5-2 Organization for Implementation of Recycling Program (Operation Phase)

Program Implementation Team		
- Team Leader	- Recycling coordinator - Airport environmental specialist - Operation manager - Maintenance service manager	- Terminal staffs - Offices staffs - Vendors - Airline staffs - Flight kitchen staffs
Airport Administrative Office	Appointed for new airport	Registered members
Program Assistance Team		
- Environmental professionals - Local government staff (Panglao Municipality) - Government officials (Provincial Government of Bohol, DENR, DOTC) - Recycling staff from other airports		

(2) Identify Types and Sources of Waste

a) Waste Assessment

Before developing a recycling plan, it is necessary to understand what waste is generated and collected at the new airport by performing a waste assessment. A waste assessment provides qualitative and quantitative data. It also provides a baseline to measure progress in the future.

A waste assessment will help the team answer the following questions:

- What particular areas in the airport generate waste?
- What kind of recyclable material is being generated?
- What type of waste is being generated in each area of the airport?
- How much waste is being generated by each area of the airport (airlines, airport offices, customers, concessions, etc.)?
- What are the waste-related costs for trash and recycling containers, hauling, disposal recycling and labor (in equipment cost and worker time)?

There are three primary approaches to conduct waste assessment:

- Records Examination;
- Facility Walk-Through; and
- Waste Sort.

b) Records Examination

A records examination provides information on the quantity of waste generated, as well as costs for labor, equipment and services. The team will try to compile all the waste data from the different haulers that provide services in the airport. The records that may be useful include:

- Purchasing, inventory, maintenance and operating logs;
- Supply and equipment invoices; and,
- Waste hauling and disposal records and contracts.

The team shall revise the original program after 6 months upon opening of the new airport based on the result of waste assessment.

c) Facility Walk-Through

A facility walk-through provides qualitative waste information through observation of the staff and customers. The primary benefit of a facility walk-through is the first-hand observation of waste handling practices. The types and amounts of waste generated at the facility can be observed at this time. Track the movement of wastes inside the airport. Assess existing space and equipment available for storage of waste, processing of recyclables, and other collection tasks. Also, interview the staff about their waste generation and disposal habits. The custodial staff is an excellent source of information in a facility walk-through.

d) Waste Sort

The most comprehensive and resource intensive waste assessment is a waste sort. A waste sort looks at the contents of waste receptacles throughout the airport to evaluate what and where are the materials being disposed. Any airport recycling program, from a new program to a well-established program, benefits from understanding how much waste is generated and recovered by their facility. Due to fluctuations in passenger travel and the corresponding fluctuation in waste generation, it is useful to normalize waste assessment data to the passenger level. For example, some airports compare the kilogram of waste generated per passenger to the kilogram of waste recovered per passenger. Airports often define “recovered” as material recycled instead of placed in trash cans. This allows program staff to establish more accurate program goals and measure impacts.

Table 13.5-3 Waste Assessment Approaches

Strengths	Limitations
Records Examination • Provides weights and volumes of waste generated • Tracks major potential waste from the point of origin • Identifies the expensive or valuable components of an organization’s waste • Documents financial benefits of reuse and recycling including total revenues and avoided disposal costs • Requires the least time and effort • Establishes baseline for metrics	• Lack of quantitative data for specific waste components • Does not provide qualitative data on how or why wastes are generated • Substantial effort necessary to collect and analyze data
Facility Walk-Through • Requires less time and effort than waste sorts • Allows first-hand examination of facility operations • Provides qualitative information about major waste components and waste-generating processes • Reveals waste reduction activities • Develops appreciation of logistics and obstacles tenants encounter in their efforts to recycle	• Limited identification of wastes generated • Multiple attempts may be necessary for comprehensive evaluation • Relies on estimates of waste generation
Waste Sort	

• Provides quantitative data on total waste generation and specific waste components • Allows problem solving and design of recycling program to be site specific	• Requires more time and effort than other approaches • Multiple attempts may be necessary for comprehensive evaluation • Does not provide qualitative data on how or why wastes are generated

Source: USEPA, Business Guide for Reducing Solid Waste, 1993.

e) Estimation of Generated Waste Amount at New Airport

There are few records of generated waste quantity at an airport. In this estimation reference was made to the record of Komatsu Airport in Japan. Komatsu Airport had around 1.6 million annual passengers and the capacity is almost same as the Panglao new airport. The new airport will have around 1.4 million annual passengers in 2020.

Generated waste amount at Komatsu airport was around 684 tons in 2011 as shown in Table 13.5-4. The generated waste unit was 406 g/day/passenger and daily generated waste volume was 1.78t. The waste volume from the passenger terminal building was 1.19 tons/day, hence it was 67% of total waste from the airport. Total recycle waste volume was 0.2 tons/day, equivalent to 11% of the total waste.

The estimation for the new airport is done based on the same unit throughput of Komatsu Airport. The calculation result is shown in Table 13.5-5. The table shows the total generated waste amount at the new airport is estimated as 1.6 t/day including 0.2t recycle waste (bin, can, paper, plastic).

Table 13.5-4 Actual Result of Generated Waste Amount at Komatsu Airport in Japan

Items (unit)	Actual Result (2011)
Annual passenger (number of person)	1.595,584
- Domestic passenger (number of person)	1,547,767
- International passenger (number of person)	48,817
Total waste amount (t/year)	648
- Waste from passenger terminal (t/year)	434
- Waste from office (t/year)	71
- Others (t/year)	143
Total waste amount (t/day)	1.78
Recycle waste (bin, can, paper, plastic) amount (t/year)	71
Recycle waste(bin, can, paper, plastic) amount (t/day)	0.2
Generated waste amount unit (g/person/day)	406
Recycle waste amount (g/person/day)	45

Source: Komatsu Airport Environment Management Plan, 2011, April

Table 13.5-5 Estimation of Generated Waste Amount at the New Airport

Items (unit)	Estimate (2020)
Annual passenger (number of person)	1.436,000
- Domestic passenger (number of person)	1,393,000
- International passenger (number of person)	43,000
Total waste amount (t/year)	583
- Waste from passenger terminal (t/year)	391
- Waste from office (t/year)	64
- Others (t/year)	128
Total waste amount (t/day)	1.6
Recycle waste amount (t/year)	65
Recycle waste amount (t/day)	0.2
Generated waste amount unit (g/person/day)	406
Recycle waste amount (g/person/day)	45

(3) Waste Collection Contracts

Recycling programs require someone to transport the waste from the airport (a hauler) and a market to accept the material (a recycler). One company may provide both services or separate contracts may be needed for these services.

There are two systems of waste hauling contracts: decentralized and centralized. An airport with individual contracts for each tenant is a decentralized system. An airport that handles all waste together is a centralized system. Many airports decide to use a centralized waste management system to simplify collection. A centralized system requires only one set of bins and central collection areas for all tenants. A centralized system may be useful if tenants do not individually generate sufficient recyclable material to support collection.

- What types of recyclable materials will the company accept and how must they be sorted/prepared (single-stream, commingled)?
- What contract terms will the buyer require?
- Who provides the transportation?
- What is the schedule of collection?
- What are the maximum allowable contaminant levels and what is the procedure for dealing with rejected loads?
- Where will the waste be weighed?
- Who will provide containers for the recyclables?
- Can “escape clauses” be included in the contract?
- What revenues should recycling generate?
- What tracking statistics (tonnage, costs, rebates, etc.) will they provide and in what

format?

- Would baling onsite improve revenue and collection issues?

The custodial or maintenance staff will likely be tasked with moving recyclables from public areas to a common staging area. Evaluate internal waste collection practices to determine if collection of recyclables will require additional staff. Determine if there are contract limitations with the staff that currently collects waste. For example, they may be limited in the areas of the terminal they can service.

(4) Develop a Plan

a) Recyclable Material

To develop a successful recycling plan, it is necessary to consider factors such as the number of passengers that pass through a new airport each day, the size of a new airport, and the characteristics of an airport traffic. Identify all factors that will influence the waste management plan and affect the scale and scope of the recycling program. Use the information from the waste assessment to identify critical needs.

Many airports initially target the “big five” recyclable materials – paper, plastic, glass, corrugated cardboard, and aluminum – then expand their program to recycle wooden pallets, food waste, electronics, used tires and other materials. Initially, target materials that would be easiest to collect and draft a plan to expand into other materials. Corrugated cardboard and aluminum are good initial materials with substantial environmental benefits and possible financial returns. Additionally, “back of the house” material collection only requires employee participation.

b) Select a Collection System

There are multiple types of sorting systems to consider for the program. The best system may employ a combination of sorting methods, including commingled recycling and multi-stream recycling. Each system has its own advantages and each airport should carefully consider its collection practices at all levels before making a decision. Local market conditions, the regulatory framework, and hauler collection standards must be taken into consideration during the system design phase.

- Separate stream (multi-stream) – requires airport patrons and employees to place recyclables in separate bins. The most common version of separate stream recycling is one bin for containers (plastics bottles, aluminum cans, and glass bottles) and another bin for paper.
- Single stream (commingled) – allows airport patrons and employees to place all recyclables in a single bin. The material is sorted later, usually at the materials recovery facility.
- Post-treatment separation – airport patrons and employees dispose of recyclables and trash together. All material is sorted later. This is a very labor intensive

process and lacks visibility within the airport. The public may not realize the airport recycles if you use post-treatment separation.

The new airport will adopt “Separate Stream”, and the airport prepares the collection bins for each recyclable materials.

c) Storage and Staging Areas

Staging areas are central locations where recyclables from throughout the airport are stored and haulers pick up material. A common problem among airports is finding sufficient area to stage materials. Staging areas require space for larger containers. As discussed in the previous step, the complex ownership and multiple tenants in airports may require airports to lease additional space from the airlines to establish staging areas.

The most common equipment found in staging areas is dumpsters, compactors and balers. Compactors and balers condense material, thus saving space. Depending on the quantity of plastic bottles and cardboard collected, a baler or compactor should be considered in order to maximize the weight and quantity in transportation.

Total generated waste amount at the new airport is estimated as 1.6 t/day including 0.2t recycle waste (bin, can, paper, plastic). In the case of specific gravity of the waste o.1t/m3, the waste volume is 16 m3/day. Material Recovery Facility (MRF) is planned in the airport area. The floor area of the MRF is shown in Table 13.5-6. The MRF is evaluated as 3 days – 1 week capacity.

Table 13.5-6 Floor Area Schedule of MRF

Item	Floor Area (m2)
1. Segregation Area	55.70
2. Residual Waste	5.70
3. Plastic	8.90
4. Paper	5.85
5. Metal/Glass	5.85
6. Others	5.85
7. Hazardous Waste	5.65
Total	93.50

Source: JICA Study Team

Table 13.5-7 Common Recyclable Materials Found at Airports

		WHERE											
		Public Terminals	Ticketing	Security Gates	Food Service Areas	Offices	Cargo Shipping	Maintenance Areas	Airport Grounds	Aircraft	Airfield Ramps	Construction Areas	Concessionaires, Retailers, Rental Car Facilities
WHAT	Corrugated Cardboard				✔	✔	✔	✔		✔			✔
	Mixed Paper	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔
	Newspaper	✔	✔	✔		✔				✔			
	Glass	✔	✔	✔	✔	✔	✔	✔		✔			
	Aluminum Cans	✔	✔	✔	✔	✔	✔	✔		✔			
	Plastic Bottles	✔	✔	✔	✔	✔	✔	✔		✔			
	Pallets						✔						
	Food Waste & Cooking Oil	✔			✔	✔							
	Organics/ Green Waste								✔				
	Electronics					✔							
	Used Tires							✔					
	Used Oil							✔					
	Scrap Metal						✔	✔				✔	
	Concrete											✔	
	Lumber											✔	
	Batteries					✔							
	Toner Cartridges					✔							✔
	Plastic (non-bottles, e.g. film)						✔	✔					✔

d) Bin Selection and Placement

Proper collection bins are vital to the success of the recycling program. They are also the major expense at the formation of the program. For these reasons, the decision of what bins to purchase, how they are labeled, and where they will be located is the most important decision you will make in this stage of the recycling plan.

The type of collection bins used at airports is as unique as the airports. Some airports choose all-in-one systems that include compartments for recyclables and trash. Other airports use modular systems. A new trend in bins is the inclusion of advertising.

The best bins are those with clear labeling and design features that limit contamination. Be sure that each visible side of the bin is labeled. Mark the bins with words and pictures, so they are understandable to international passengers. Often, labeling "bottles and cans" rather than "glass, plastic, and aluminum" gives a stronger message, reducing confusion and contamination. One airport redesigned their recycling bins to make them more noticeable to the public. With a simple relabeling of the same basic bin, public recycling at the airport increased by 40 percent.

Choice of the bag inside of the bins is important as well. Using different colored liners for the recycling bins allows the cleaning crew to easily keep track of what is recyclable and which central collection container it goes in. Other options include clear, see-through liners or half- clear/half-colored liners.

Placement of bins in high traffic areas and areas of material generation is important. Always place recycling containers next to trash cans to reduce contamination. It is important to check the waste bins often enough to keep them from overfilling and discouraging people from using the recycling bins for trash. Another way to prevent contamination is to buy bins with distinct openings (round for bottles and cans, slotted for paper) and different colored tops.

e) Set Goals

Establish goals for the program before the team begins collection. These goals may be based on targets set by the community. Many localities are working to be the most environmentally friendly in the country. They may require the airport to recycle a certain percentage of their waste to help with this goal. Use information obtained during your waste assessment to establish goals.

Photo. Collection Bins at the Airports

(From top to bottom: Kansas City International Airport, Baltimore-Washington International Thurgood Marshall Airport, Philadelphia International Airport, and Seattle-Tacoma International Airport.)

(5) Educate Staff and Customers

Airports must educate both employees and customers about a new recycling program.

Employee education begins as soon as the plan is developed. Customer education will begin after the team implemented the plan. For a successful, long-term recycling program continual education of these groups is necessary.

a) Educate Airport Staff

Before the plan is rolled out, meet with the participants. Talk to vendors, maintenance staff, airline staff and other employees face-to-face about their role in the program. After the program is in place, they follow-up regularly to ensure there are no new questions.

Airports frequently re-educate the entire airport staff regarding the benefits of recycling and how the program functions in the airport. Airport will prepare information about the recycling program in new employee training, emails, staff meetings, vendor meetings, and through regular face-to-face interactions with airport users. Airport will create a handbook, in Tagalog and English, explaining the recycling program. In the handbook, employees learn how the recycling program operates, why the airport chose a single-stream approach, the benefits of recycling and recycling facts.

b) Educate Customers

As with any good recycling program, airports must clearly identify where bins are located and how to use them. Educating customers about the benefits of recycling reinforces the practice. Place informational signs on or near bins explaining why recycling is important. Airport will develop signs that show products that are made from recycled materials and also display large banners telling customers “Recycles”. A terminal poster may encourage a visitor to walk a few extra feet to find the bin. External publicity should be considered through press releases to local news media to inform hometown customers and other interested parties of airport recycling.

The new airport will prepare the IEC posters for customers at near collection bins.

Photo. Display of PET Bottle and Collection Bin (Tel Aviv Airport)

(6) Monitor and Refine the Plan

During the life of the recycling program, periodically evaluate how well the plan is working and what adjustments are needed. Be prepared to make changes to bins, collection schedules, and educational material. Monitor the use of all bins to determine if they are being used properly. Visual inspections of the bins by members of the team and discussions with the custodial staff can help identify bins that are not used or that are overfilling before collection. The solution may be as simple as moving the location of the bins; however, if resources are available you may also decide to add additional bins to certain areas of the airport.

The amount of recyclables collected varies by quantity and material throughout the day. For example, airports find that more newspapers are disposed of in the morning. As a result, the newspaper bins fill at a faster rate in the morning and may require earlier collection by custodial staff than plastic bottles, which are generated more frequently in the afternoon. If the program succeeds in dramatically changing the composition and timing of the waste collected, the initial estimates for hauler contracts may also require adjustment.

Even the most successful programs will experience contamination problems in their recycling program. Regular visual inspections of dumpsters and trash cans can educate the recycling team about problem areas.

(7) Measure Performance

Establish a set of measures to monitor the team performance. Metrics that are measured consistently (annually/quarterly/monthly) using the same collection methodology allow the team to correct problems and report measurements to airport management and the public.

Quantifying the amount of waste you collect is a challenging project. However, without accurate measurements it is difficult to improve or expand your program. Use your initial waste assessment as a baseline and methodology for monitoring the program. Airports with recycling programs recommend that measurement metrics are normalized by the number of passengers. Normalizing the waste collection data adjusts for seasonal and long-term changes in airport traffic.

Expenses are often higher during the first year of a new program. The largest first year costs include purchasing collection bins and training staff. As the recycling program progresses the team should be able to see cost savings from reduced trash pick-ups and sale of recycled material.

Consider the following factors when collecting program data:

- Cost of waste disposal;
- Cost of recycling;
- Dumpster rental costs;
- Internal labor cost (including custodial staff, recycling coordinator);
- Location of bins;
- Weight of waste disposed; and
- Weight of materials recycled

(8) Promote Success

Publicize the program inside and outside the airport. As cities compete to be classified as the most environmentally friendly, promoting recycling in new airport enhances airport local image. An airport is often the first and last experience a traveler has with a particular area. Promoting an environmental message like recycling will send a positive message to the passengers coming through the airport. Many consumers have come to expect recycling bins in public areas. A successful program reflects positively on the airport's environmental stewardship, and it encourages employees and customers to continue to contribute to the program's growth.

Demonstrate the success of the program to the public by quantifying the positive impact the program is having on the environment. Waste reduction programs reduce greenhouse gas (GHG) emissions and saves energy by using fewer resources. Mining or harvesting virgin material is reduced in producing new products from recovered materials. United States Environmental Protection Agency's Waste Reduction Model (WARM) (http://www.epa.gov/WARM) is a tool for airports and other businesses to estimate the greenhouse gas and energy savings from recycling, composting and source reduction.

Table 13.5-8 Sample Greenhouse Gas Benefits of Recycling Using EPA's WARM model

Material Recycled	Metric Tons of Carbon Dioxide Equivalent	Equivalency
Glass (10 tons)	3	Emissions from the consumption of 341 gallons of gasoline
Corrugated Cardboard (10 tons)	34	Emissions from the consumption of 3,859 gallons of gasoline
Mixed Plastics (10 tons)	16	Emissions from the consumption of 1,816 gallons of gasoline

(9) Expand the Program

After successfully running the recycling program for a year or season the team may decide to expand the program to collect additional materials or include new areas of the airport. Periodic review of the program can help focus efforts to improve and expand the program.

Most programs start with paper, aluminum, plastic, glass and corrugated cardboard. While working to maximize the materials already collected, consider new materials such as organic waste. A program targeting organic waste, such as food scraps and yard waste for composting, may involve new partners outside of the airport.

Program expansion may include involving additional partners. Integrate vendors, airlines and flight kitchens into the program if the team is not able to do so initially.

Airports' recycling programs also expand to new areas of the airport as their programs grow. Parking areas are often not included in initial plans. Recycling in parking areas may require collection bins that are more durable than those inside of the airport in order to withstand weather and collisions with vehicles.

(10) Special Considerations for Airports

a) Airport Security

The first priority for airports is to ensure that all program elements are consistent with security requirements. Including a recycling element in waste management plan may require additional personnel in secure areas of the airport and on the airfield. Bins may need to be additionally secured and inspected. Bombproof receptacles may be required outside secure areas.

b) Facility Space Constraints

Airports have unique space considerations. Gates areas, tenant space, and concessionaires often do not have large amounts of additional space for bins, and staging areas are limited. The airfield generally has space constraints as well, leaving little area for additional bins. On the airfield, airports need to be aware of concerns recycling bins may raise such as foreign object debris (FOD), animal attractants, and storm water contamination. However, a successful recycling program will reduce the amount of trash generated and the number of containers to store trash. This space can be used for recyclable materials.

c) Time

When airlines become involved with the recycling program, time is a primary concern. Airline staff or cleaning service providers have limited time to clean an aircraft before it is scheduled for another departure. A program with easily accessible collection receptacles (dumpsters, compactors, etc.) and clear instructions make it easier for airlines to actively participate in recycling.

d) Working with Tenants

Establishing and maintaining consistent recycling practices and educating airport tenants (food/beverage, concessions, airlines and others) are key components of an airport's recycling program. Educational material that is readily available for easy distribution to all new employees allows tenants to stay involved.

13.5.4. Solid Waste Management Plan at Panglao Island

(1) Dauis and Panglao Municipality

The solid waste management Plan will guide the LGU to implement measures and mechanisms in accordance with Republic Act 9003, the updated Bohol Environment Code (BEC) of the province and municipal ordinance of the Municipality of Panglao and Dauis. The Solid Waste Management Plan has been formulated by the SWM-TWG of the Project.

a) Segregation Methods

Waste segregation should be strictly followed and implemented by the residents or LGUs. Solid waste should be segregated into following four (4) types:

i) Biodegradable waste that can be decomposed by natural decomposition or with the aid of an organic enzyme;

ii) Recyclables/reusable refer to any waste material retrieved from the waste stream and free from contamination that can be converted into suitable beneficial use or for other purposes, including, but not limited to, newspaper, ferrous scrap, metal non-ferrous scrap metal, corrugated cardboard, aluminum, glass, office paper, and plastics;

iii) Residual shall refer to the leftover, remaining, unused or unconsumed at the end of the process and waste that cannot be recycled, reuse and non-biodegradable. These waste are to be disposed in the landfill;

iv) Special waste shall refer to household hazardous waste such as paints, thinners, household batteries, lead-acid batteries, spray canisters and like. These include waste from residential and commercial sources that comprise of bulky waste, consumer electronics, white goods, yard waste are usually handled separately from other residential and commercial waste.

LGUs shall prepare separate receptacles or containers for segregated wastes at collection points. The containers shall be properly covered, secured or protected to prevent spillage or scattering of the waste and to ensure its containment. For bulky waste, it will suffice that the same be collected and placed in a separate container in designated areas. It must be properly labeled and color-coded as shown below:

- Biodegradable – Green
- Recyclable/reusable – Blue
- Residual – Yellow
- Special waste - Red

b) Collection

Collection of waste will be done by barangay or municipality. It can be done through proper scheduling of collection using the garbage collection vehicle with a separator or separate different types of waste. Only residual waste will be brought to the final disposal site. Biodegradable waste is to be composed either by barangay or at source, recyclable waste will be recycled by the barangay or it can be sold to junk shops.

LGUs are required to establish Material Recovery Facility (MRF) for the recyclable waste. It is a must that all kinds of recyclable waste shall be properly segregated before storing to the facility. It is also a requirement that LGUs will have a Residual Containment Area (RCA) which serves as a temporary storage for the residual waste before it will be brought to the sanitary landfill.

c) Final Disposal

A sanitary landfill is now being constructed in the municipality of Alburquerque and it is a part of the long-term project by the Provincial Government of Bohol and expected to be operational by 2015.

d) IEC Campaign

Information, education and communication campaign will be done to all waste generators to make sure that they will follow what is mandated by the law (RA9003) pertaining to the management of waste. IEC Campaign can be done through barangay/purok assemblies and LGU shall develop flyers, brochures stating things to done by the waste generators.

(2) Resettlement Area

a) Location of Resettlement Area

Affected families will be relocated to Barangay Tawara located near the new airport site. The waste generated from the resettlement area shall be managed by Panglao municipality according to the policy and regulation mentioned in 13.5.1.

b) Action Plan and Financial Plan

The action/financial plans of Solid Waste Management for resettlement area are shown in Table 13.5-9. The plans will start after completion of the relocation.

Table 13.5-9 Action/Financial Plans of Solid Waste Management for Resettlement Area

Program/description	Cost (PhP)	Responsible Agency
Formulation of work/financial plan will be formulated and approved by SWM-TWG and MMT.	2,000	BEMO
Orientation: all residents in resettlement area will be oriented on the mandatory requirements of RA9003.	50,000	BEMO/TWG
Colored garbage bins will be purchased and the bins will be labeled based on the type of waste.	100,000	DOTC/PGSO
Establishment of MRF, which will be managed by Panglao Landowners Multipurpose Cooperative (PLOMPCO).	500,000	DOTC/PGSO/BEMO
Training on waste recovery: PLOMPCO will be trained on recycling by trainers/resource persons.	200,000	DOT/BEMO
Establishment of Residual Containment Area (RCA): RCA is a temporary storage area for residual waste, the area will be managed by the barangay.	100,000	DOT/PGSO/BEMO
Establishment of Composting Facility: Composting facility will be constructed for biodegradable waste. The facility is managed by PLOMPCO.	150,000	DOT/PGSO/BEMO
Observation Tour: PLOMPCO and selected barangay officials will visit successful area to observe the SWM.	500,000	DOTC/BEMO
Monitoring and Evaluation: All activities will be monitored regularly by SWM-TWG.	300,000	SWM-TWG
Regular meeting: regular monthly meeting with SWM-TWG, barangay officials and residents of resettlement area.	500,000	SWM-TWG
Sub-total	1,952,000	
Contingency fund	48,000	
Total Budget	2,000,000	

13.6. Social Development Plan

13.6.1. Introduction

The Social Development Plan (SDP) incorporates proposed interventions of the Project Proponent in favor of the various stakeholders of the Project. As part of its social responsibility, the Proponent aims to empower the stakeholders, especially the affected residents as partners of development. As an active player in the society, the Proponent seeks to alleviate the low standard of living of residents through programs that will harness their productive potentials to the fullest and reinforce their self-reliance and dignity as equal members of the society.

It should be noted that this Sub-Chapter does not deal with the issues related to the Relocation of Affected People (RAP). These issues are discussed in Sub-Chapter 14.

13.6.2. Programs during Airport Construction and Operations Phases

(1) Construction Phase

a) Environmental Monitoring and Management and Mitigation

As discussed in Sub-Chapters 13.4 and 13.5, the Environmental Monitoring and Management during the construction stage shall be efficiently implemented. In case any environmental deficiency is found, proper action will be taken in accordance with the EMP/EMoP.

b) Traffic Safety and Management

The Construction Contract requires the Contractor to prepare traffic management and safety plans and submit them to the Engineer for approval. The Construction Contract also requires several safety measures especially in early stage of the construction until three Barangay roads running across the Site can be closed.

c) Generation of Spoils/Waste Materials

The Construction Contract requires that the Contractor shall submit Solid Waste Management Plan to the Engineer for approval, prepare the monitoring reports and submit to MMT.

d) Safety and Health for Construction Workers and Personnel

The Construction Contract requires that the Contractor shall take reasonable precautions to maintain the health and safety of the Contractor’s Personnel.

e) Housing Concern for Construction Workers and Personnel

The Construction Contract requires that the Contractor shall provide and maintain all necessary accommodation and welfare facilities for the Contractor’s Personnel.

f) Disorganized Routing and Operations of Public Utility Vehicles

MMT will discuss with PGB about the existing public transportation system, and propose the modification if required.

g) Employment Opportunity

The construction activities will generate short-term employment opportunities. The Contractor is encouraged to the extent practicable and reasonable to employ staff and labor with appropriate qualifications and experiences from sources within the Country. PGBas prepared the local employment matching mechanism for the Project Affected People (see Sub-Chapter 14).

(2) Operation phase

- With regard to the disorganized routing and operations of existing public utility vehicles (e.g. bus, jeepney, and tricycle), MMT and PGB will consider reorganization of the road network and transportation system.
- Solid waste of about 500-1,000 kg/day will be generated. DOTC has prepared Solid Waste Management Plan already.
- Priority for employment to be given to qualified residents. DOTC will propose the airport operator to employ local qualified residents.
- Aircraft Accident

Civil Aviation Authority of the Philippines (CAAP) will coordinate relevant organization and authorities for formulate the contingency plan based on applicable international standard.

13.6.3. Medium-term and Long-term Social Development Plan

(1) JICA Technical Assistance Project

The objective of the Project is to control the environmental load around Panglao Island caused by the increase in the number of tourists after the construction of the new airport. The Technical Assistance Project will assist improve effluent quality discharged from on-site Sewage Treatment Facilities (STFs).

At present due to social/financial constraints, it is difficult to introduce sewerage system in Panglao Island. However, proper management of effluent quality discharged from STPs is to contribute to the improvement of coastal water and ground water quality.

Expected outputs of the JICA Technical Assistance Project are as follows:

- Effective and realistic regulations for the construction and the management of the on-site STFs are proposed;
- Effective and realistic management systems to control STFs in Panglao Island are established; and
- Possible design of the septic tanks with improved capacity is proposed.

(2) Eco-tourism Development Plan for Panglao Island

PGB formulated “Eco-Tourism Development Plan for Panglao Island” in 2010. It is a master plan for the sustainable tourism development of the island. Development principles are 5Gs (Green urbanism, Green sustainable development, Green architecture, Green technology, Green Energy). The major issues of the plan are development of the infrastructure. There are few recommendations for social investment field.

The report recommends only "Livable Communities" for social investment field as follows, but those are only principles:

- Design on human scale: Compact, pedestrian-friendly communities allow residents to walk to shops, services, culture resources, and jobs and can reduce traffic congestion and benefit for health.
- Provide choice: people want variety in housing, shopping, recreation, transportation, and employment. Variety creates lively neighborhoods and accommodates resident in different stage of their lives.
- Encourage mixed-use development: Integrating different land use and varied building types creates vibrant, pedestrian-friendly diverse communities.
- Preserve urban center: Restring, revitalizing and infilling urban centers take advantage of existing streets, services, and buildings and avoid the need for few infrastructure. This helps curb sprawl and promote stability for city neighborhoods,
- Vary transportation options: Giving people the option of walking, biking and using public transit. This reduces traffic congestion, protects the environment, and encourages physical activities,
- Build vibrant public spaces: Citizens need welcoming, well-defined public places to stimulate face to face interaction, collectively celebrate, encourage civic participation, admire public art, and gather for public events,
- Create a neighborhood identity: A "sense of place" gives neighborhoods a unique character, enhances the walking environment, and creates pride in the community,
- Protect environmental resources: A well-designed balance of nature and development preserves natural systems, protects waterways from pollution, reduces air pollution, and protects property values,
- Conserve landscape: Open space, farms, and wildlife habitat are essential for environmental, recreational, and cultural reasons,
- Design matters: Design excellence is the foundation of successful and healthy communities.

PGB shall develop Social Development Plan under actual social/financial conditions; the plan shall be reviewed and revised during 3-5 years. The Social Development Plan and urban development plan work together to run association effectively.

In Panglao Island, water supply and distribution will become a social problem of great urgency in near future including water resource development.

13.7. Information, Education and Communication (IEC) Plan

13.7.1. Present Situation

(1) Disclosure of Project Information

Environmental Impact Statement (EIS) Report and Environmental Compliance Certificate (ECC) shall be disclosed at least 120 days before signing a Loan Agreement in accordance with the JICA Guideline. Accordingly, the EIS Report, Updated EIS Report, ECC, and Resettlement Action Plan (RAP) for the Project were disclosed on JICA website. DOTC disclosed the hard copy of the EIS Report, the ECC from DENR-EMB, Updated EIS Report, and Biodiversity Assessment Report at the public places, DENR regional office-region VII, DENR-Provincial office (PENRO), Provincial Government of Bohol (PGB), Municipality of Panglao and Dauis and Project Field office, from July 2013 to end of construction phase. These documents are available at all times for perusal by Project stakeholders such as local residents during the Project duration and photocopying is permitted. DOTC also prepared summary brochures of the project in English and Tagalog languages.

In accordance with ECC, Multi-partite Monitoring Team (MMT) will disclose the results of monitoring to the public through the MMT and the IEC program.

(2) Sharing Information between Local Project Management Team (LPMT) and DOTC

Implementation of Resettlement Action Plan is a very important program for the Project. Therefore, LMPT and DOTC shall share the information of current conditions. They had many meetings at Bohol Government office where the Activity Report on Social Consideration on the following issues (August, 2013 DOTC) was described in details:

- Results of Resettlement Data Validation and Option;
- Validated Project Affected Family (PAF) data on Resettlement;
- Livelihood Restoration Program; and
- Employment Strategy and Matching.

(3) Activities of Effective Development Communication Unit (EDCOM)

EDCOM, one of the Bohol Provincial Government organizations, formulated the Information, Education and Communication Plan and requested the budget for implementation. DOTC has approved the budget of 1,090,000 PhP, for implementation.

(4) IEC Program prepared by EDCOM

The implementation of any government infrastructure project, such as the New Bohol Airport Development Project, requires a means to solicit feedback from the public and receive their concerns and also a means to relay the necessity and significance of the Project to the people.

These needs are by no means petty or inconsequential, since opposition to the Project could lead to costly delay or, in extreme cases, even its stoppage.

Comprehensive Information, Education and Communication (IEC) campaign for the Project answers these needs by immediately responding to public misconceptions about the Project whenever they arise. The IEC campaign must further generate popular support for the Project at all stages of its implementation by pursuing massive information dissemination that does not stop at the level of municipal and barangay officials but reaches the level of community members in their respective household.

(5) Purpose

The proposed Information, Education and Communication (IEC) Plan for the Project is aimed towards supporting an informed public that is knowledgeable about the Project and continually updated on its developments; encouraging and maintaining the public acceptance of New Bohol Airport Project; and generating public support for the New Bohol Airport Project.

(6) Objectives

The activities outlined in this proposed IEC Plan will be undertaken to accomplish the following objectives:

- To inform the public of important details about the Project, relevant and significant developments in its implementation, and on the important and publicly relevant issues on the need for the New Bohol Airport;
- To answer legitimate public concerns regarding the Project and its implementation and to search for where such concerns may be heard;
- To respond to and manage publicity which may tend to have a negative effect on the public acceptance of the Project;
- To generate unanimous public support for the implementation of the Project; and
- To provide communication support services in the implementation of the Project.

(7) Organization and Support System (EDCOM Communication Support)

In the information of its mandate as the communications center of the Provincial Government, the Effective Development Communications Office, under the Office of the Governor, has already been carrying out support communications functions in the generation and releasing of publicity materials regarding the Project.

These support functions, as outlined below, will be considered an integral part of the strategies and activities under the IEC Plan.

Among the functions that the office has already been performing that may enhance the Communication Plan are shown in Table 13.7-1.

Table 13.7-1 Communication Plan being Performed by EDCOM

Programs/Activities	Expected output	Time frame/ Measurement	Implementing Partner	Remarks/Details
A. Information dissemination through print/ broadcast media & others				
News Releases				
Print	News releases on the PMO published regularly or as needed in local papers	Regularly or as needed for the duration of the project	Departments/ attached offices of the province/ NGAs and NGOs	Bohol Chronicle/ Sunday Post/ Bohol Standard/ Bohol Times/ Bohol Balita
Broadcast	New releases or bulletins of PMO developments provided to and aired in local radio stations	As needed, for the duration of the project	Bohol Tri-Media	DYRD/DYTR/ HOT-FM, DYZD(Ubay)/Radyo Natin, Radyo Jagna, DYJP(Jagna)
Photo Release	Photo release on major PMO developments printed in local papers	As needed, for the duration of the project	Bohol Tri media	
PADAYAN BOLANON radio program				
Radio program	New updated on the PMO implementation/ discussions and Interaction on PMO developments by program anchors and guests	As needed, for the duration of the project	DYRD & DYTR	
KITA UG ANG GOBERNADOR radio program and interaction media	Major PMO developments as the need arises	The duration of the project	Live-stream-internet/ HOT Fm, DYZD(Ubay)/ Radyo Jagna, DYDL Carmen	
Text dispatch on major NBADP news developments	Text messages on major PMO developments dispatched to selected media practitioners	As needed, for the duration of the project		For on the spot coverage and info dissemination
CHATTO (Communication g HEAT-Bohol Activities & programs Thru Tri-media Outreach)	Incorporation of NBADP IEC material in PGB AVPs during film showing	As needed, for the duration of the project		Video/film showing to LGUs/ barangays during Fiesta/ Foundation Day/ Heat Caravan activities/ and other venues/events as required
Publication and Distribution of IEC materials				
Inclusion of NBADP articles in mainline EDCOM IEC materials such as the “Padayon Bolanon” newsletter and Gob. Edgar Infokomiks	Publication of NBADP-related news in regular IEC materials	As needed, for the duration of the project		

Table 13.7-1 Communication Plan being Performed by EDCOM

Programs/Activities	Expected output	Time frame/ Measurement	Implementing Partner	Remarks/Details
Documentation and Monitoring				
Video and photo coverage	Multimedia coverage of NBADP-related events and developments	As needed, for the duration of the project		

(8) Action Program

The EDCOM proposed IEC Action Program for the Project is as follows:

Planning Period: 3years

Major Activities:

- Creation of Audio Visual Presentation
- Preparation of English and Visayan Brochures
- Web-page Creation
- Media and Publicity Monitoring

Table 13.7-2 First Year Activities

Activity/Intervention	Components	Responsible Entity	Remarks/Details
Creation of Media Clearinghouse Group for NBADP-Related Information	- Destination of an official clearinghouse group for all NBADP-related publicity	PGB – G.O./PMO	Destination of a body tasked with media interaction for public information and the generation and releasing of NBADP-related news materials to all available media
Audio Visual Presentation (Production in –charge EDCOM)	- Audio-visual recording and documentation - AVP production and pre-prod materials - Logistics - Distribution - Contingencies	PMO	100 DVD copies of audio-visual presentation featuring detailed project information and updates on the NBADP, produced and distributed to LGAs, LGUs, and private sector stakeholders for public viewing or broadcast (Production in –charge EDCOM)
English and Visayan Brochures (Production in –charge EDCOM)	- Pre-production materials - production costs - Logistics - Distribution - Contingencies	PMO	2,000 copies of English brochures explaining import points about the NBADP for distribution in hotels, restaurants, spa and wellness centers and other tourism establishment; 10,000 copies of Visayan brochures explaining important points about the NBADP for distribution in municipal and barangay halls and during local assemblies and for a.
Billboard tarpaulins (Production in –charge EDCOM)	- Pre-production materials - Production costs - Logistics - Distribution and Mounting - Contingency	PMO	60 Billboard Tarpaulins featuring pertinent information about the NBADP mounted for display at strategic points province wide
NBADP (Production in –charge EDCOM/BICTU)	-Webpage creation - Upgrading - Contingency	EDCOM	A moderated NBADP web page linked to social networking sites, featuring pertinent information and updates on the NBADP and to evaluate and screen comments and feedback on the NBADP
Media and Publicity Monitoring (Production in –charge EDCOM)	- regular media monitoring - Feedback to NBADP implementers and stakeholders	EDCOM	Monitoring of radio programs, newspapers, and other media (including social media networks) for NBADP-related news or commentaries

Table 13.7-3 Second Year Activities

Activity/Intervention	Components	Responsible Entity	Remarks/Details
Updating of Audio Visual Presentation (Production in –charge EDCOM)	- Audio-visual recording and documentation - AVP production and pre-prod materials - Logistics - Distribution - Contingencies	PMO	100 DVD copies of audio-visual presentation featuring detailed project information and updates on the NBADP, produced and distributed to LGAs, LGUs, and private sector stakeholders for public viewing or broadcast
Updating English and Visayan Brochures (Production in –charge EDCOM)	- Pre-production materials - production costs - Logistics - Distribution - Contingencies	PMO	1,500 copies of updated English brochures. 7,000 copies of Visayan brochures.
Billboard tarpaulins (Production in –charge EDCOM)	- Pre-production materials - Production costs - Logistics - Distribution and Mounting - Contingency	PMO	40 Billboard Tarpaulins featuring updated project information.
Year II (Production in –charge EDCOM)	Media Site visit Meals and Transportation Press kits and logistics Contingencies	PMO	NBADP site visit for Bohol media practitioners
NBADP (Production in –charge EDCOM/BICTU)	-Webpage updating - Contingencies	EDCOM	Updating of moderated NBADP web page
Media and Publicity Monitoring (Production in –charge EDCOM)	- regular media monitoring - Feedback to NBADP implementers and stakeholders	EDCOM	Continued monitoring of radio programs, newspapers, and other media (including social media networks) for NBADP-related news or commentaries

Table 13.7-4 Third Year Activities

Activity/Intervention	Components	Responsible Entity	Remarks/Details
Updating of Audio Visual Presentation (Production in –charge EDCOM)	- Audio-visual recording and documentation - AVP production and - Logistics - Distribution - Contingencies	PMO	100 DVD copies of audio-visual presentation
Updating English and Visayan Brochures (Production in –charge	- Pre-production materials - production costs - Logistics	PMO	1,500 copies of updated English brochures. 7,000 copies of Visayan brochures.

EDCOM)	- Distribution - Contingencies		
Billboard tarpaulins (Production in –charge EDCOM)	- Pre-production materials - Production costs - Logistics - Distribution and Mounting - Contingency	PMO	40 Billboard Tarpaulins featuring updated project information.
Year III Media site visit (Production in –charge EDCOM)	Media Site visit Meals and Transportation Press kits and logistics Contingencies	PMO	NBADP site visit for Bohol media practitioners
NBADP web page (Production in –charge EDCOM/BICTU)	-Webpage updating - Contingencies	EDCOM	Updating of moderated NBADP web page
Media and Publicity Monitoring (Production in –charge EDCOM)	- regular media monitoring - Feedback to NBADP implementers and stakeholders	EDCOM	Continued monitoring of radio programs, newspapers, and other media (including social media networks) for NBADP-related news or commentaries

(9) Approved Budget by DOTC

DOTC approved the budget for IEC shown in Table 13.7-5.

Table 13.7-5 IEC Budget

Items	Budget (PhP)
Audio Visual Presentation	200,000
English and Visayan Brochures	400,000
Billboard Tarpaulins	390,000
Year II and III Media Site Visit	100,000
Total	1,090,000

13.8. Biodiversity Conservation Plan

13.8.1. Introduction

As discussed in Sub-Chapter 13.2, the Environmental Compliance Certificate for the Project was amended as of April 16, 2013. The amended ECC stipulated following additional conditions:

ADDITIONAL CONDITIONS (16th April 2013):

A private nursery with at least Five Hundred Seventy Two Thousand and Five Hundred (572,500) [formerly: Two Hundred Thousand (200,000)] seedlings shall be established to support the Green Philippines Master Plan which will be utilized for tree planting activities. Planting of appropriate tree species shall be implemented within the project area as planned to serve as a buffer and compensate the removal of vegetation caused by the project implementation. The planted trees shall be maintained throughout the lifespan of the project. Approved Work and financial program for seeding production and tree planting activities shall be submitted within one (1) month upon receipt thereof.

Green Philippines Master Plan: National Greening Program

President Benigno S. Aquino III issued Executive Order No. 26 ordering and declaring the implementation of a National Greening Program as a government priority. The program shall plant 1.5 billion trees covering about 1.5 million hectares by 2016.

DOTC is considering and planning two alternatives to satisfy the ECC condition for seedlings as follows;

- ✓ DENR (PENRO) will plant all number of the seedlings based in a request of DOTC on National Green program; or
- ✓ DENR (PENRO) and Local Project Management Office – Technical Working Group will share the required number of seedlings.

DOTC submitted a letter as of 10 July 2013, requesting PENRO to help DOTC in the inclusion of the 572,500 seedlings in PENRO's Greening Program activities. DOTC will decide the direction after receiving an official answer from PENRO.

13.8.2. Environmental Conditions in Panglao Island

Bohol is the 10th largest island and blessed with an array of natural and cultural resources, has come a long way in becoming the top tourist destination in the Philippines. Attractions include white beaches, reefs, wetlands, caves as well as historical and religious landmarks (Ecotourism & Biodiversity Framework Plan, 2006-2015).

Panglao Island, composed of the municipalities of Panglao and Dauis, is one of the country's prime coastal tourism destinations. It is known for its beautiful beaches, sailing and whale/dolphin watching (Panglao Island Assessment Report, 2006). Both Panglao and Dauis belonged to fourth class municipalities (Wikipedia, retrieved in November 2012).

Panglao Island, like the rest of mainland Bohol, was once a forest over limestone. At present, the whole area is classified as agricultural zone with few patches of forests and plantations. There are about 167 plant species, 26 avifaunae, 4 bats and 6 anurans identified in four barangays (Bolod, Danao, Loudes and Tawala) of Panglao alone (Biodiversity Assessment Report, 2012)

In the Bohol Marine Triangle (BMT) alone, which comprises the large island of Panglao and smaller island of Balicasag and Pamilacan, five major ecosystems are present. These are the fringing mangroves (222.39 hectares), sea grass beds (467.56 ha), sargassum beds dominant species of which are Hormophysa cuneiformis, Sargassum, spp. And Turbinaria ornate (242.32 hectares), coral reefs (264.84 hectares), and open water or deep sea (Ecotourism & Biodiversity Framework Plan, 2006-2015).

Bohol's unique coastal biodiversity like in Panglao Island, however, is under threat due to population growth, tourism, persistent and excessive utilization and sale of different species coupled with conversion of forests into agricultural and urban areas, monoculture with exotic species, forming on steep hills and coral destruction and over-fishing (Ecotourism & Biodiversity framework Plan, 2006-2015)

(Source: Biodiversity Conservation Plan prepared by LPMO-TWG)

13.8.3. Arranging Scenery Plan at the Site by Seedlings

(1) Site Clearing and Grubbing

DOTC announced "Preparatory Work for New Bohol (Panglao) Airport Development Project" on March 15, 2013. Major scope of works is as follows:

- Clearing and grubbing (Area=216.26 ha); and
- Construction of barbed wire and frangible fence (Length=10,638 m).

The preparatory work includes cutting trees. Cutting of coconut trees in the Philippines is generally prohibited, and allowed only under certain conditions, after payment of mandatory fees and planting of replenishment seedlings, in which case a permit-to-cut (PTC) is issued by the authorized government agency (Pabuayon, et al., 2009)

(2) Enabling Laws and Policy Guidelines for Clearing and Grubbing

The government's objective is to maintain a suitable coconut resource base in order to ensure an adequate supply of raw materials and products for the coconut industry. This is supported by four enabling laws as described hereunder.

The first is Republic Act (RA) 8048 or the Coconut Presentation Act of 1995 and its implementing rules and regulations as defined in PCA Administrative Order 02 Series of 2005.

The policy provides for the regulation of the cutting of coconut trees as well as growth of the national industry by embarking on a sustainable and efficient replanting program.

The second is Executive Order (EO) 213 of 2000 constituting the National Enforcement Task Force or NETFORCE on Coconut tree Conservation whose main function is to formulate and execute action plans to control the rampant cutting of coconut trees. It supports RA 8084 by ensuring an execute action plans to control the rampant cutting of coconut trees. It supports RA 8084 by ensuring an effective and timely coordination among the concerned agencies, local government units (LGUs) and private sector implementing its provisions.

The third is Executive Order (EO) 015 series of 2007 of the Office of Quezon Provincial Governor which reconstituted the Quezon Coconut Industry Development Council. It is a provincial ordinance specifying the creation of a task Force that would monitor the illegal cutting of coconut trees pursuant to RA 8084.

The fourth is Memorandum Circular (MC) 02 series of 2008 or Moratorium on the issuances of permit to cut coconut trees. It is a national directive from PCA stating that “all issuances of permit to cut coconut trees and corresponding transport/transshipment clearances are suspended nationwide except on a limited exception and under certain circumstances. It was issued to arrest the ever-increasing and unabated incidence of illegal cutting trees.

Under RA 8084, the cutting of coconut trees is prohibited except under certain requisites where cutting is allowed based on a permit issued by PCA.

Among others, these requisites include:

a) Existence of a valid ground for tree cutting, which could be any of the followings;

- the tree is 60 years old or more;
- the tree is no longer economically productive;
- the tree is severely disease-infected and/or pest infested;
- the tree is damaged by typhoon or lightning;
- the coconut land shall be covered into other agricultural-related activities; and
- the tree would cause hazard to life and property;

b) Planting of the required equivalent number of coconut seedlings.

However, RA 8048 is silent on whether cutting may be disallowed if the removal of coconut trees are in a given area, whether partial or clear cutting could potentially bring about environmental problems. Such problems are likely to occur when trees are cut in large scale in sloping and marginalized areas without guarantee of replanting, reforestation, or soil conservation measures.

(3) Permission of Clearing and Grubbing

In accordance with RA 8048 and its implementing rules and regulations, DOTC obtained permits of the Philippine Coconut Authority as of May 22, 2013 to cut in total 372 naturally-grown coconut trees within the proposed project site as listed in Table 13.8-1. The Permits to Cut Coconut Trees issued by the Authority are as per Attachment 4..

Table 13.8-1 Number of Coconut Trees to be Cut in the Project Site

Barangay Name	Danao	Bolod	Lourdes	Tawala	Total
Number of coco trees	136	19	153	64	372

DOTC also submitted a request letter to DENR for clearing and grubbing as a part of the preparatory work in accordance with DAO No.18. DENR is under process for issuance of permit.

(4) Arranging Scenery Plan at the Site by Seedling

The landscape area of the new airport construction work is 134,570 m2 (RW and TW is 65,455 m2, access road is 6,216m2, and others are 62,899 m2). The total seedlings are 243,947 which include Shrubs (see Table 13.8-2).

Table 13.8-2 Detailed Number of Seedlings under the Project

Items		Access road	Airport				Total
			Div.1	Div.2	Div.3	Div.4	
Tree	Pcs.	202	1,498	140	27	0	1,864
Shrubs & Ground Cover	Pcs.	158,865	73,910	0	9,308	0	242,083
	m2	0	5,728	713	0	108,386	114,826

13.8.4. National Green Program

(1) Policy and Legal Basis

Environmental laws of national and international interests which may serve as the legal basis in the creation of this biodiversity plan include, among others, the following:

National

- Republic Act 7586 or the NIPAS Act for Protected Areas;
- PD705- revised Forestry Code of the Philippines of 1975;
- Philippine Agenda 21 of 1990;
- PD 1152-Philippine Environment Code of 1977;
- PD 1586- Environmental Impact Assessment System 1978;
- 1987 Philippine Constitution;
- DENR Memorandum Circular No. 98-17 Guidelines for Ecological Destination Development and Management in the Philippines (p.74);
- Republic Act 7160 – Local Government Code of 1991 (pp 30-32);
- Executive order 247 – The Bio-prospecting of Biological and Genetic Resources of 1996;
- Republic Act 8749 – Clean air Act of 1999;
- Republic Act 9072 – Cave and Cave Resources Management & Protection Act of

2001;

- Republic Act 9147 – Wildlife Resources Conservation and Protection Act of 2001; and
- Republic Act 9275 – Philippine Clean Water Act of 2004.

International

- Global Agenda 21;
- United Nations Commission on Suitable Development. (UNCSD), Berlin Declaration on Biological Diversity and Sustainable Tourism, March 1997; and
- Commission on International Treaties and Agreements.

Source: National Ecotourism Strategy: Sustainable Coastal Tourism Handbook

At the provincial level, the Bohol Environmental Code of 1998 (BEC of 1998) and Ecotourism and Biodiversity Conservation Framework also provide basis for the contextualization of the biodiversity plan. Both provide sectoral focus on environmental protection and sustainable development.

The revision of the BEC of 1998 included the creation of separate section, the biodiversity and ecotourism in order to put emphasis on biodiversity conservation and ecotourism development in the province. In line with these, the Ecotourism and Biodiversity Framework gives a practical and positive contribution to alleviating poverty by helping local communities draw the maximum benefit from the region's tourism potential, while protecting the environmental and cultural heritage of region concerned.

All activities in this biodiversity conservation plan centered from the strategies of the Bohol Biodiversity Conservation Framework, among others, include;

- Development of specific management and conservation;
- Presentation island ecosystems and endangered species through proper site management, rehabilitation of original habitats by reintroducing native species and replacement of introduced species;
- Conservation (and protection) of wildlife species through rehabilitation of their habitats to promote ecological balance and enhance biological diversity;
- Involvement of LGUs and local communities in habitat rehabilitation and biodiversity management;
- Enhancement of conservation and protection of biodiversity resources through trainings and comprehensive IEC programs;
- Institutionalization of innovative but appropriate monitoring and evaluation systems for biodiversity conservation and
- Establishment of wildlife corridors to connect forest fragments or similar ecosystem, and Harmonization of municipal and barangay legislations to support

biodiversity conservation.

(2) Lead Agency

The national Green Program is carrying out the agencies as follows;

- Department of Environment and Natural Resources (DENR): primary agency responsible for the conservation, management, development and proper use of country's environmental natural resources.
- Department of Agriculture (DA): lead agency to boost farmers' income and reduce poverty in rural sector, and
- Department of Agrarian Reform (DAR): agrarian reform and sustainable rural development program.

(3) Target Area and Seedlings

The national target of number of seedlings from CY 2011 to CY 2016 is shown in Table 13.8-3.

Table 13.8-3 National Target of Seedlings

Year	Area (ha)	Number of Seedlings
2011	100,000	100 Million
2012	200,000	200 Million
2013	300,000	300 Million
2014	300,000	300 Million
2015	300,000	300 Million
2016	300,000	300 Million
Total	1,500,000	1.5 Billion

In Provincial of Bohol, target area and accomplishment is shown in Table 13.8-4 and seedlings target and accomplishment is shown in Table 13.8-5.

Table 13.8-4 Area Target and Accomplishment (Province of Bohol)

Year	Target area (ha)	Accomplishment (ha)	Ratio (%)
2011	1,563	1,615	103
2012	1,667	1,710	102
2013	5,020	967 (on going)	19 (on going)
Total	8,250	4,292	52 (on going)

Table 13.8-5 Seedlings Target and Accomplishment (Province of Bohol)

Year	Target Seedlings	Accomplishment	Ratio (%)
2011	596,295	8,47,109	142
		540,000	(mangrove)
2012	834,500	1,013,931	121

	222,221	275,000	124 (mangrove)
2013	2,062,238	1,673,431	81 (on going)
	1,326,000	1,500,000	113 (mangrove)
Total	3,493,033	3,534,511	101 (on-going)
	1,548,000	2,315,000	150 (mangrove)

(4) Bohol Green Program for New Airport

PENRO will contribute for DOTC to comply with ECC conditions for the New Airport Construction Work, if DOTC makes available proper budget and nursery area. PENRO has a capacity to carry out 572,500 seedlings in 2014. DOTC and PENRO start the discussion about the seedlings program. DOTC will also find out a nursery area near the construction site. The program will become clear by the end of September 2013 and be submitted to DENR-EMB Region VII.

13.8.5. Panglao Green Program Prepared by LPMO-TWG

The original program was developed by LPMO-TWG, and implementation budget was approved as the Environment Management Fund by DOTC. The original program was formulated under former ECC condition, the number of seedling is 200,000.

LPMO-TWG shall discuss with PENRO and review the original program to satisfy the revised ECC conditions. However, the original program including the opinions of BISU shall be respected. PENRO will propose the remaining number of seedlings (372,500) as Bohol Green Program. The original program is described as following section.

(1) Site Selection and Gathering of Baseline Information:

The information of a biodiversity conservation plan requires the conduct of floral and faunal rapid assessment in pre-determined sites of interest. This rapid appraisal will take only a week or two, primarily to list down species of plants and wildlife, determine their status and the present conditions of their habitats. All of this information will serve as the basis to design a well-formed conservation plan.

In this case, since the suggested conservation sites must be far from the proposed Bohol New Airport, areas to be subjected to conservation sites must be public domain in need of immediate rehabilitation. Several pre-identified land-uses within Dauis and Panglao include:

- areas considered as aesthetic potential tourist spots;
- habitat of endangered or threatened species of indigenous wildlife;
- areas of unique interest;
- historical, cultural and archaeological sites; and
- severely eroded areas.

Biodiversity conservation usually entails big investments thus only public domain will be subject of rehabilitation activities especially for native timber trees. Because of this, upland areas with a slope of more than 18%, identified barangay green parks and pocket forests, and degraded mangroves will be the priority of selection.

Identification of areas for rehabilitation activity will be done by the Technical Working Group (TWG) in coordination with the municipal and barangay LGUs.

In case identified public lands for rehabilitation within Panglao Island will not be sufficient enough to cater space for the 200,000 seedlings private lots will also be considered. Coconut and other fruit-bearing plant species will be raised for these lots.

(2) Survey and Mapping

Maps needed for the plan include the readily available administrative, topographic, land-use, land cover, soil fertility, slope, erosion, and LGU development maps. From these maps, the TWG will have to agree on its base map. The base map will serve as the standard working map for the preparation of new thematic maps.

The TWG will acquire base maps from the municipal local government units of Dauis and Panglao. Thematic maps, on the other hand, will be secured from the provincial Planning and Development Office (PPDO).

The required thematic maps may not all be available or may not be updated particularly those on vegetative cover, erosion and location of upland settlements. These data gaps should be noted during the data collection stage as they can be the subject of key informant interviews, rapid site assessment and even community mapping.

The actual delineation of the areas of interest will be done with the participation of key informants and selected barangay officials. Global Positioning System (GPS) devices will be used to facilitate recording of locations of boundaries and survey stations.

Areas for reforestation, enrichment and or enhancement planting will be demarcated in maps, together with those to-be-identified habitats of endangered wildlife. GPS maps, then, will be the major outputs of this activity.

(3) Selection of Plants for Reforestation, Enrichment and Enhancement Planting

In addition to the two endangered species (molave [Vitex parviflora Juss.] and bolong-eta [diospyros pilosathera]) listed in the Biodiversity Assessment Report of the Bohol New Airport proposed site, other common native species will be noted as reforestation species. The result of the rapid site (floral) assessment will provide a long list of plant species for selection.

Apart from these, indigenous, premium and endangered tree species recorded to be present in Panglao Island like Tindalo (Afzelia Rhomboidea) will also be considered in order to prevent the species from extinction in the island.

Priority is pegged to species with recorded regenerations (wildlings) in the field, and is noted to have high survival performances both in the nursery and reforestation sites.

Species-site-technology matching will be applied in identified reforestation areas to assure success. This means that only those species native in the reforestation site will be raised using appropriate silvicultural operations.

For areas within private lands, fruit tree species that are proven to adopt on the island including coconuts will be raised or purchased. These will be provided to selected community residents to be planted in their backyard. There is bigger assurance that they will not cut the planted trees because they will be after the fruits and not lumber.

Once reforestation areas within Panglao Island are insufficient to accommodate the commitment considering that Panglao Island has limited areas devoted for greening, additional planting sites will be identified in other areas outside Panglao Island to compensate the targeted number of seedlings to be planted.

(4) IEC Advocacy and Production of Information Materials

It is necessary to conduct public awareness on biodiversity conservation and enhancement to the directly or indirectly affected communities. IEC advocacy will be prioritized in four (4) barangays, namely: Bolod, Danao, Tawala and Lourdes, Panglao including two (2) MLGUs of Panglao and Dauis.

IEC materials like brochures, tarpaulins and leaflets will be produced and distributed to the communities to increase their awareness on biodiversity conservation and management. This activity will be done prior to seedling dispersal to community individuals who want to avail the free coconut and fruit tree seedlings to be planted in their respective private land. Seedling beneficiaries will be recorded and monitored in order to make sure that the seedlings were planted and also for future reference in giving out the incentives for taking care of the plants. This mechanism will help them be motivated in taking care of the plants. Cash incentives will be given to seedling beneficiaries once the plants are growing well and it can be withdrawn in 2016.

(5) Establishment of Temporary/Subsidiary Plant Nursery

Though majority of the seedlings will be raised at Bohol Biodiversity Complex (BBC), subsidiary nurseries will also be constructed on or near the site where outplanting is to be carried out.

The size of these nurseries will depend on the target number of seedling to be raised by interested People’s Organizations (POs) and the corresponding mortalities in all stages of seedling production and maintenance. Few small nurseries may be constructed depending on the number of reforestation sites and the distance of each site from another.

(6) Seedling Production and Outplanting

The TWG will design a scheme in which community residents or POs will be a part of the seedling production and outplanting activities. About 20% of seedling production will be given to POs. They will be involved in the collection either of seeds or wildlings in identified regeneration sources, in the production of seedlings/wildlings in the nursery, and also field out planting.

Eighty% of the total number of seedlings, on the other hand, will be raised in and procured from BBC nursery at Bilar.

The seeding production of mangrove and beach tree species can be done by POs that were tapped by the PADAYAN-BMT in their Mangrove and Seagrass Rehabilitation and Enhancement project in the PADAYAN area (i.e. Panglao, Dauis and Baclayon). The identified mangrove and beach species found in Panglao or known to exist in the island before shall be used for the rehabilitation of shoreline and mangrove areas. Propagules and seed producing mangrove species shall be raised in the nursery to ensure high survival in the mud flats.

For seedlings to be planted along the avenues, highways, municipal parks and plaza shall be rebadged in bigger bags to ensure high percentage of survival, and height requirement will be at least 1 meter high. Only seedling which have undergone, at least 1-2 months of hardening will be used in reforestation, enrichment and enhancement activities.

(7) Training and Capacity Building

A series of training (e.g. seed and seedling collection; nursery establishment and enhancement; quality planting material production; seeding care and maintenance; pest prevention and control; plantation establishment; etc.) will be conducted to capacitate selected community residents or POs. Trainings will be led by BISU and BEMO in accordance either DENR or the provincial and municipal LGUs. Each training will be conducted along with the schedules of Biodiversity Conservation activities.

(8) Location of Planting Area

The location of the planting area will be prioritized within Panglao Island (the towns of Dauis and Panglao) in order to mitigate the negative impacts of the Project.

The existing municipal regulations or ordinances and land-use plans of the two LGUs shall be the basis of the site selection. Possible areas will be the designated municipal parks and plaza, barangay pocket forest, along the highways or barangay roads, landslide prone areas or above 18% slope, beaches, and mangrove areas. The proposed planting areas will be determined by the TWG together with the municipal LGUs of Panaglao and Dauis.

(9) Planting and Maintenance Work

Planting activity should be done during rainy season which normally happens from June to October to ensure high survival in the field. The planting activity will be contracted to POs responsible for seedling production. Another option is to tap the DepED elementary and high school students to do the tree planting activities as part of their commitment to the National Greening Program (NGP) of the present administration. Concerned LGU personnel will also be tapped to help in the planting activities.

In order to ensure that the planted seedlings will survive in the field, the contracted POs will also be delegated to maintain the planted trees. Cash incentives will be provided to those people who will seriously participate in the maintenance activities. This will be based on the survival rate of planted seedlings. Two to five pesos (P2-5) per planted trees (healthy surviving trees) will be given to the group.

It is necessary to have a contract agreement between the proponent and the contracting POs regarding the seedling production, land preparation, planting, care and maintenance work in order to ensure that their responsibility and deliverables will be followed.

(10) Cost Arrangement

The cost of production and planting of the 200,000 seedlings will be shouldered by the Department of Transportation and Communications (DOTC). This will be a part of the Environmental Guarantee Fund of the project.

The seedlings will be priced according to species and size of polyethylene bags used. For the indigenous timber and mangrove species with 4x6 size plastic bags, the price will be P12/seedling. For fruit trees in 4x6 bags the price is P15/seedling. For bigger bags (6x8), the price will be P40/seedling. Coconut seedling will be purchased at the Philippine Coconut Authority (PCA) in Uvay and the price is P30/seedling inclusive of transportation cost.

In order to minimize the costs of seedling procurement, a bartering arrangement is also proposed, hardened seedling for re-forestation in exchange to top soil from the airport project. Since the BBC nursery is in need of potting soil and airport project is also looking at where to dump the top soil that will be scrapped during the start of the operation. This might be a good option that seedlings can be accessed from the nursery and in return the proponent will bring potting soil to the nursery.

The actual planting all will be done by the contracted POs. There is separate costing for the land preparation (e.g. cleaning, strip spot brushing, lay-outing, staking and hole digging and planting depending on the seedling planted.

The TWG will determine the detailed budgetary requirement for seedling production and planting after the flora and funnel rapid assessment has been done.

Biodiversity Monitoring and Evaluation: A system of biodiversity monitoring and evaluation will be employed during the whole duration of the program/project. A biannual monitoring and evaluation system will be conducted by the TWG in participation with the selected community residents/PD members. In support to this activity, a research will be designed to provide science-based interpretations and statistical inferences from the results of monitoring.

(11) Work Plan and Approved Budget

Work Plan and Approved Budget are summarized in Table 13.8-6. DOTC and LPMO-TWG will review the implementation schedule.

Table 13.8-6 Work Plan and Approved Budget

Programs/ Projects/ Activities	Description	Expected Output	Implementation Schedule	Approved Budget	Agency Responsible
Creation of the Technical Working Group under MMT	Meeting with the TWG members together other agencies & stakeholders	TWG Created (composed of BEMO, BISU, DENR, 2MLGUs)			TWG
Preparation of Biodiversity Conservation Plan (draft)	Drafting of Biodiversity Conservation Plan (BCP) by the TWG members	Draft Biodiversity Conservation Plan			TWG
Preliminary Activities					
Secondary Fata Collection	Collection of available data from the LGU concerned & other agencies relevant for the BC plan	Available secondary data from two MLGUs (e.g. municipal resolution & ordinances related to the environment)			TWG, MLGUs & BLGUs
Procurement of Supplies, Materials and Instruments	Logistic support	Supplies and materials procured/sourced- out		70,000	DOTC & PGB
Acquisition of Base and Thematic maps	Acquisition of maps from OODO and concerned LGUs as basis for the identification of the site	Available base maps and Thematic maps for the two MLGUs			BEMO & PPDO
Hiring of A Project Coordinator /TEV				200,000	DOTC
Actual Data Collection Activities					
Site Selection	Actual site identification	Proposed planting sites identified		100,000	TWG, MLGUs & PGB
GIS Survey and Mapping	Generation of GIS maps (Computer generated maps) of identified sites	Available GIS Map of the Sites			PPDO
Baseline Information gathering					
Floral rapid Appraisal	Assessment of plants that will be affected	Available floral assessment report			BISU & BEMO
Finalization of Biodiversity Conservation plan (serious of meetings)	Finalizing the BC Plan	Comprehensive BC Plan		30,000	TWG
Selection of Plants for	Selection will be based on the result	Available list of the total number			BISU & BEMO

Table 13.8-6 Work Plan and Approved Budget

Programs/ Projects/ Activities	**Description**	**Expected Output**	**Implementation Schedule**	**Approved Budget**	**Agency Responsible**
reforestation, Enrichment and Enhancement planting	of Floral rapid appraisal	of species and numbers of per individual			
Training and Capacity Building	Series of training on seed & wilding collection, temporary nursery establishment & mgt, production of quality seedlings, seedling care & maintenance, plantation estab. & mgt.	2-3 sets of trainings in different skills/technologies		100,000	DOTC, BISU & BEMO
IEC Advocacy (e.g. biodiversity conservation awareness) and Production of Information Materials (e.g. tarpaulins, brochures & etc)	Conduct IEC advocacy (re: Biodiversity conservation awareness) to directly affected barangays before the distribution of seedlings to the local communities (individual)	6 IEC Advocacy sessions to the 4 barangays directly affected & 2 MLGUs & IEC materials reproduced & distributed to the communities		150,000	BEMO, DENR
Seedling Procurement (e.g. native timber, fruit trees and coconut seedlings)	At least 55% can be procured in existing nurseries (e.g. 10,ooo coconut, 20,000 fruit trees and 70,000 native timber/mangrove pieces) and the rest will be raised in the nursery.	110,000 assorted seedlings procured in existing nurseries in the province		2,260,000	DOTC, PGB
Establishment of Temporary Plant Nursery	Temporary nurseries shall be established on or near the proposed planting sites 8e.g. for beach & mangrove species; timber and fruit trees)	2-3 temporary nurseries established		1,560,000	BISU, BEMO & DENR
Nursery Seedling Production	At least 455 of required seedlings will be raised at the temporary nurseries (e.g. 70,000 assorted mangrove & native seedlings; 20,000 fruit trees)	90,000 assorted mangrove, native and fruit tree seedlings produced at the nursery.			

Table 13.8-6 Work Plan and Approved Budget

Programs/ Projects/ Activities	**Description**	**Expected Output**	**Implementation Schedule**	**Approved Budget**	**Agency Responsible**
Seedling Recovery and Hardenning	At least 4-7 months before the seedlings raised are ready for out planting	Seedlings are ready for out planting at the onset of the rainy season			
Land Operation (e.g. brushing, lay-outing, staking, &hole digging)	Strip or spot brushing, staking & hole digging will be done before planting	Proposed sites ready for planting		360,000	MLGUs
Seedling Out-planting	Out planting will be done at the on set of the rainy season	200,000 seedlings planted		420,000	MLGUs
Care and Maintenance of Planted Seedlings (Cleaning/ring weeding, fertilizer application if necessary)- Provision of Incentive to Survived Seedlings	Year 1 (twice a month cleaning/ring weeding); year 2 (every quarter); year 3-4 (bi annual cleaning)	Well maintenance planted seedlings		550,000	MLGUs
Replanting (20% mortality)	Replanting will done by the concerned agency or POs after the M&E.	Dead seedling are immediately replaced		100,000	MLGUs
Biodiversity Monitoring and Evaluation	Bi-annual monitoring of planted trees including the faunal species (esp. the birds & other wildlife)	Bi-annual M&E report			DOTC, TWG, MLGUs
Total				5,900,000	

Source: JICA Study Team

13.9. Recommendation from JICA Advisory Committee

13.9.1. Soaking Yard

Normally, the airport storm drainage system is designed based on the rainfall intensity of its return period of 5 years (by FAA) or 10 years (by JCAB). However, the area of soaking yard should cope with extraordinary weather condition recently encountered worldwide, the capacity of the soaking yard is so designed that any storm water would not overflow from the airport property for long future.

The Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA) analyzed based on their 29-year record, that daily maximum rainfall could be 143 mm for the return period 10 year, 197 mm for that of 50 years, and 219 mm for that of 100 years. Reservoir capacity of detention pond (soaking yard) for the return period of 100 years should not be less than 220,000 tons of water (i.e. 50% x 0.219 m x 2,000,000 m^2). In addition, a maximum 420 tons in total of water used for the building complex will be discharged via sewage treatment plant to the same soaking yard, which culminate a total of 220,420 ton of water. Meanwhile, dimension of the soaking yard is planned to be 20 ha in area and 2.5 m in depth, where 500,000 tons of reservoir capacity is available. The detailed calculation is described in design documents.

13.9.2. Seedlings

The original program was developed by LPMO-TWG, and implementation budget was approved as the Environment Management Fund by DOTC. The original program was formulated under former ECC condition, the number of seedling is 200,000. The seedlings are from the original vegetation of Panglao Island in recommendation of Bohol Island State University.

LPMO-TWG shall discuss with PENRO and review the original program to satisfy the revised ECC conditions. However, the original program including the opinions of BISU shall be respected. PENRO will propose the remaining number of seedlings (372,500) as Bohol Green Program.

13.9.3. Recycling Waste Water System

The new airport will daily create 300 to 400 tons of effluent after flushing toilet, washing hand and plates, cleaning and cooking. To conserve the precious water, the vast volume of treated water is proposed to be recycled to daily irrigate the landscaping area.

The treated wastewater from the new Bohol Airport STP will be in conformance to Category II Protected Waters (Class SB) so that it will not contaminate the quality of underground water. The appropriate standards set in the DENR DAO 35 were adopted as the treatment objective criteria for the proposed STP.

The most appropriate treatment systems must be able to produce an effluent that meets the required discharge standards, and must be cost-efficient with minimal operational and maintenance requirements. In consideration of the aforementioned factors, Oxidation Ditch

Process (OD) shall be chosen. The detailed calculation is described in design documents.

13.9.4. Hot Water Supply System

Both Solar water-heater and electrical water heaters shall be installed at each place as required. Hot water shall be used for kitchen, showers and lavatories' vanity basins. The detailed calculation is described in design documents.

13.10. Required Activities and Future Schedule

Preparation works for environmental legal procedure and establishment of environmental management organization have been completed in this work. The Project has been evaluated in compliance with the Philippines Environmental lows and JICA Guide line.

Table 13.10-1 shows future actions required to implement the Project. MMT shall promote every events in positively. DOTC shall assist to MMT and LPMO to implement the monitoring activities.

Table 13.10-1 Required Actions and Future Schedule

Items	Note
Pre-Construction Phase (by March, 2014)	
Promotion of MMT activities	
-Next MMT Executive Meeting	-Tentative schedule is set on 11 September
-Opening Bank Account for MMT	-By end of September -MMT is able to execute the budget for some programs.
-Review and revise draft MOO	-Discussion and approval on 11 September
-Approval of EMoP	-Discussion and approval on 11 September
ECC	
- Preparation of Seedlings Plan requested by ECC of the Airport Project.	-PENRO shall submit the action plan to DOTC including the budget.
- Preparation of Seedlings Plan requested by ECC of the Resettlement Project.	-PENRO shall submit the action plan to DOTC including the budget.
Construction Phase	
-MMT shall prepare and submit monitoring report to DENR, DOTC and JICA periodicity.	-MMT shall disclose the monitoring results.
-MMT shall inspect and report Seedlings Work.	-MMT shall disclose the monitoring results.
-MMT and the Contractor Monitoring Team (CMT) shall keep closed linkage.	-CMT shall join MMT meetings as observer.
After Construction	
-Management agency of new airport shall prepare and submit monitoring report to DENR, DOTC and JICA periodicity.	- Management agency of new airport shall disclose the monitoring results.

CHAPTER 14

REVIEW AND IMPLEMENTATION OF RESETTLEMENT ACTION PLAN (RAP)

TABLE OF CONTENTS

Chapter 14 Review and Implementation of Resettlement Action Plan (RAP)

14.1. Introduction

14.1.1. Scope of Work

The original Resettlement Action Plan (RAP) for this project was prepared from April to July 2012 under the Preparatory Survey assisted by JICA. According to the RAP, land acquisition and resettlement of the project was supposed be completed in March 2013. However, prior to commencement of this Detailed Design (D/D) Study assisted by JICA, it was already known that the progress of activities in the original RAP was minimal. Accordingly, 'Review and Implementation of RAP' became one of the components of the D/D Study. To assist Department of Transportation and Communications (DOTC) and Bohol Provincial Government (BPG) to expedite the RAP activities, following tasks were conducted during the D/D Study:

a) Identifying current status and issues on land acquisition and resettlement
b) Assisting in implementation and monitoring of land acquisition and resettlement
c) Assisting in preparation of a livelihood restoration program
d) Assisting in establishment of Grievance Redress Mechanism (GRM)
e) Assisting in updating the RAP

14.1.2. Implementing Structure of JICA Study Team

The above-mentioned tasks were conducted from March to August 2013. The JICA Study Team consisted of a Japanese consultant and members of a sub-contracted company based in Tagbilaran, Bohol (Figure 14.1-1). The work principle of the JICA Study Team was 'to assist and facilitate BPG in implementation of RAP activities, but not to directly implement them.' Accordingly, the JICA Study Team aimed to strengthen the institutional capacity of BPG and to enhance the linkages among BPG, DOTC and related agencies.

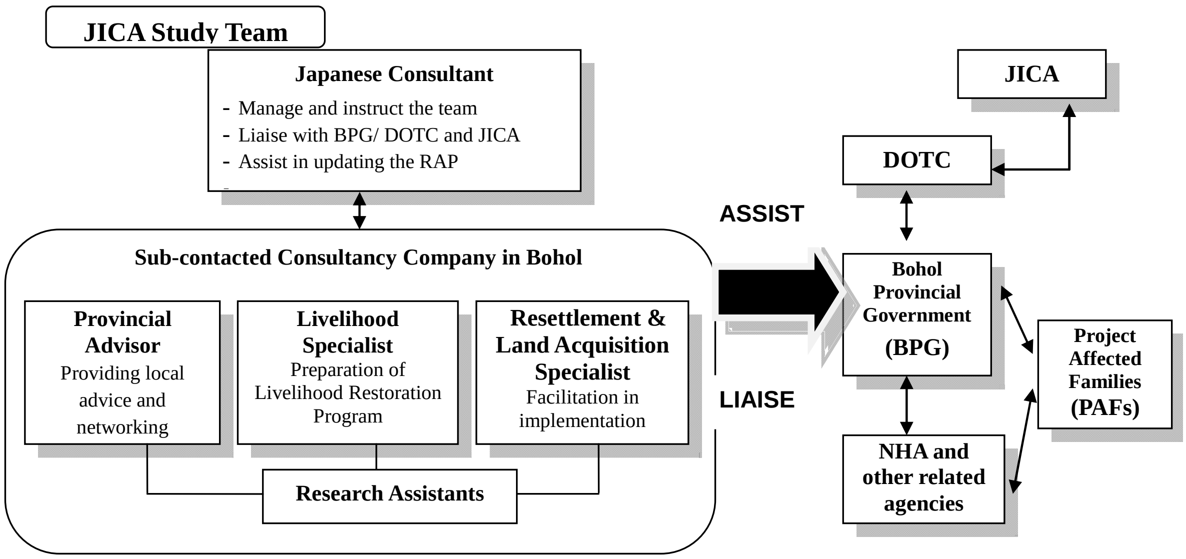


Figure 14.1-1 Implementing Structure of 'Review and Implementation of RAP' under D/D Study

14.2. Status of Land Acquisition and Resettlement

14.2.1. Scale and Progress of Land Acquisition

Land acquisition of the Right-of-Way (ROW) for the airport project in Panglao Island commenced in as early as 1990s. Bohol Provincial Government (BPG) had been entrusted by DOTC, Department of Tourism (DOT) and the Civil Aviation Authority of the Philippines (CAAP) to conduct the acquisition of the ROW for the project by virtue of a Memorandum of Agreement (MOA) dated 23rd January 1994. However, the new project had not been materialized for two decades. During the non-materialization of the project, another FS was conducted in 2007, which realigned the project site bearing North 30 degrees East. As a result, 32.6 ha out of the acquired 62.4 ha-land became outside of the ROW.

As shown in Table 14.2-1, as of end June 2013, the total area of the ROW is 223 ha, which equivalents to 407 lots. Out of the total 407 lots in the ROW, 358 lots, 88.0 %, are already acquired. Out of the remaining 49 lots, 40 are still for acquisition (under negotiation), and 9 are for expropriation.

Table 14.2-1 Status of Land Acquisitions as of End June 2013

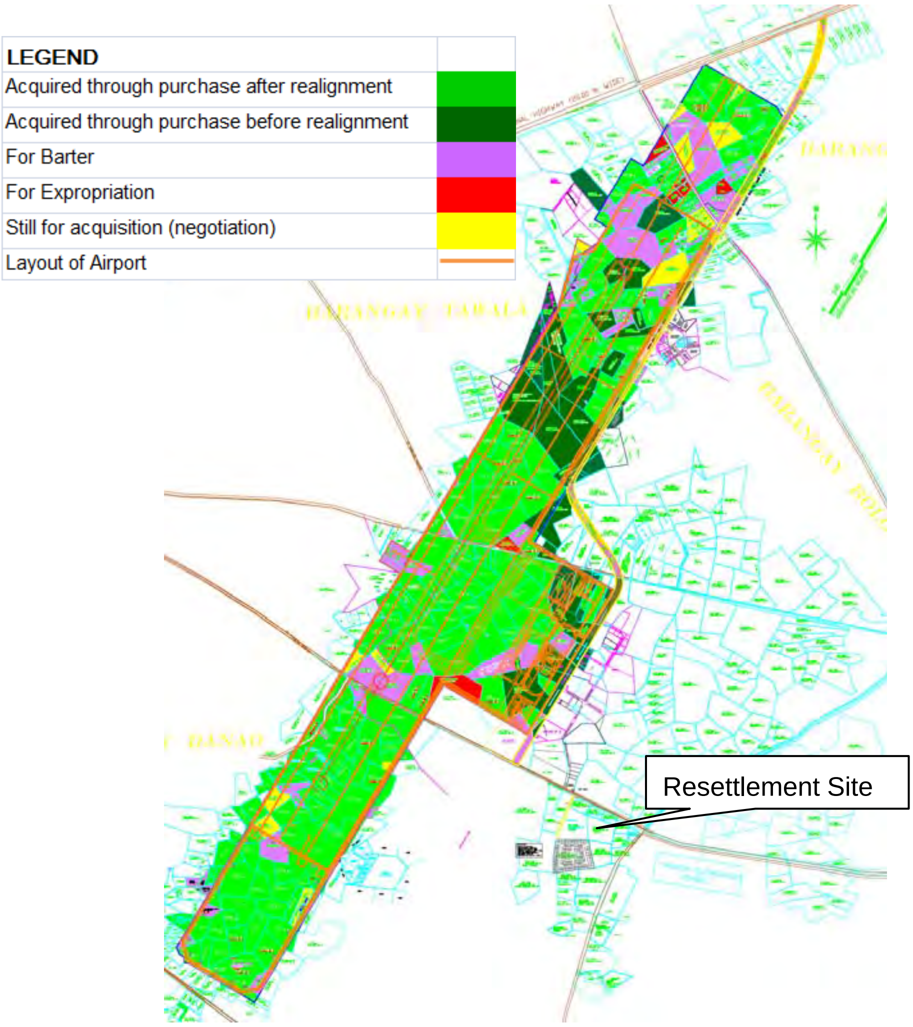
	Lots	Area (sq.m)	Lot-wise ratio (%)	Area-wise ratio (%)
Acquired through Purchase after Realignment	222	1,436,365	54.5%	64.4%
Acquired through Purchase Before Realignment	32	298,639	7.9%	13.4%
For Barter	99	321,978	24.3%	14.4%
Government Owned (Road)	5	18,635	1.2%	0.8%
Sub-total: Acquired	358	2,075,617	88.0%	93.1%
Still for Acquisition (Negotiation)	40	111,383	9.8%	5.0%
For Expropriation	9	42,849	2.2%	1.9%
Sub-total: Not Yet Acquired	49	154,232	12.0%	6.9%
Total	407	2,229,849	100.0%	100.0%

Source: BPG

For the 40 lots still for acquisition, ‘Entry Permits’ obtained from the landowners are necessary to enter the lands, which is under process by BPG. For the 9 lots for expropriation, the cases are under study by the Office of Solicitor General before filing with the Court. Only after the permission by the Court (issuance of ‘Writ of Possession’), the implementing agencies can enter the land and, if necessary, demolish houses. Out of the 9 lots for expropriation, 4 lots are owned by one landowner, and two houses remain in these 4 lots. According to DOTC officials who experienced expropriation cases in other projects, expropriation of the 9 lots including two houses is most likely to complete within 2013.

Figure 14.2-1 shows the above-mentioned land acquisition status and the final airport layout. Due to the change in the layout in this Detailed Design (D/D) Study, some of the already acquired lands became outside of the airport layout. However, these lands will be kept owned by DOTC, since these lands are needed for construction and future expansion.

On the other hand, some lands still for acquisition were omitted from the ROW, assuming that they are not necessary in the future. These lands are the site initially planned for the south-side approach light and the soaking yard.



Source: BPG and JICA Study Team

Figure 14.2-1 Progress of Land Acquisition and Airport Layout (June 2013)

14.2.2. Status of Resettlement and Preparation of Resettlement Site

(1) Number of House-Affected Families

When a census was conducted for families living in the ROW in February 2008, there were 64 house-affected families who needed to resettle outside of the ROW. The cut-off date for compensation was decided as 20th February 2008. These 64 families were compensated for their lands and structures during 2008 and 2009. For these families, two options of resettlement mode were prepared, namely: 1) self-relocation (i.e., moving to a place where they find by themselves) and 2) relocation to a resettlement site prepared by BPG. Out of 64 families, 32 self-relocated after receiving compensation, while the other 32 remained in the site under the condition that they will vacate the area once the airport project pushes through.

In April 2012, under the Preparatory Survey assisted by JICA, a census of the families still living in the ROW was conducted. Along with the census, the remaining houses in the ROW were tagged, in order to avoid influx of unqualified people. The census revealed that the number of families increased from 32 to 43, meaning that 11 houses had been built after the cut-off date, and not entitled to compensation.

As of June 2013, the number of families who need to resettle increased from 43 to 45 by 2 families on the access road. The acquisition of their lands/ houses had already commenced before, but acquisition procedure was finalized since alignment of the access road was determined during this D/D Study. (The change of alignment of the access road will be mentioned in paragraph (1) under subsection 14.3.3) As of 6th August 2013, out of the two families, one is already compensated, and the other agrees with the determined compensation amount. Figure 14.2-2 shows the distribution of the 45 families still need

Source: JICA Study Team

Figure 14.2-2 Distribution of 45 Families Need to Resettle (June 2013)

(2) Preparation of Resettlement Site

a) Resettlement Site Plan by NHA

In April 2012, after several years had passed since compensation payment, the Preparatory Survey revealed that the most of the 43 families still living in the project site did not keep aside the money for constructing a new house.

As shown in Figure 14.2-1, a resettlement site with the total area of 20,414 m^2 was prepared 600 m away from the proposed terminal area, which was initially subdivided into 54 plots with 250 m^2 each. During JICA's appraisal mission in August 2012, involvement of the National Housing Authority (NHA) was discussed so that the above families could avail low-cost houses with minimal repayment amount. Consequently, DOTC, BPG and NHA discussed, and it was decided to develop the entire resettlement site under 'Socialized Housing Scheme' to meet the housing needs of homeless and marginal income families. Accordingly, the resettlement site was planned to be subdivided into 178 plots with 60-70 m^2, based on the standard size of the NHA's Socialized Housing.

As of May 2013, the tripartite MOA among DOTC, NHA and BPG was yet to be finalized, but each agency had committed the budget for development of the resettlement site and housing units. For the site development, 5 million Php by DOTC and 7 million Php by BPG were committed. In addition, 21.36 million Php (half of the amount was loan to BPG) was to be financed by NHA for construction of 178 houses.

b) Resettlement Site Plan by BPG

On 5th June 2013, the Governor of BPG made a resolution of withdrawing the proposal for fund assistance from the NHA for the Socialized Housing Scheme (Province of Bohol, Resolution No.1, Series of 2013). This was the decision made after discussions with DOTC. The followings are the main reasons for this decision:

- The tripartite MOA among DOTC, NHA and BPG have not yet been signed after a long time, which will delay the resettlement activities, and then the commencement of the construction of the airport.
- It was fond out that technical requirement of the NHA like the identification of all the 178 socialized housing project beneficiaries could not be made immediately available.
- Downsizing of 250 sq. m to 60-70 m^2 of a plot-size was not easily accepted by the Project Affected Families (PAFs) who had already purchased the plot.

Figure 14.2-3 shows the resettlement site plan prepared by BPG, which has 71 plots aside from communal spaces. Out of the 71 plots, there are 43 plots with the size of 250 m^2 and 28 plots with the size of 100 m^2 .The PAFs who built a house after the cut-off date (20th February 2008) are only entitled to 100 sq.m.-plot.

Source: BPG

Figure 14.2-3 Resettlement Site Plan by BPG (71 Plots)

A plot in the resettlement site needs to be purchased at the rate of 60Php/ m^2, which is the same rate as the land acquisition. The house in the resettlement site is uniform with the floor size of $21m^2$ and the cost of 180,200 Php (including 6% fixed term interest). NHA's standard for the cost of the Socialized Housing is around 200,000 Php. Accordingly the housing/ land cost under the BPG's scheme is still within the so-called low-cost housing. The amortization period ranges from 10 to 30 years, from the amount of 500.56 Php/ month to 1,501.67 Php/month.

In principle, the said 45 PAFs who need to resettle are entitled to a plot cum house in the resettlement site, but those who already have their own lands and houses outside the ROW will be exempt from the eligibility In addition, a PAFs who had purchased/ bartered a plot in 2009 is entitled to a 250 sq.m.-plot in the resettlement site without additional costs[1]. However, if these PAFs are only-land affected, they are not entitled to a house on the availed plot.

DOTC and BPG examined the necessary funding for the resettlement site development and housing, and total amount of 15 million Php was committed by both agencies: 8 million Php by DOTC and 7 million Php by BPG. Out of the 15 million Php, about 6 million Php were initially planned to be spent for the resettlement site development. The reasons for down-scaling the budget for resettlement site development from NHA Socialized Housing Scheme (12 million Php) to the current scheme (6 million Php) were: 1) decrease in number of plots from 178 to 71, and 2) changing the inner roads from asphalt to gravel roads.

On the other hand, around 9 million Php was secured for building houses, and within the available funds, 58 houses were planned to be constructed. However, during the regular meeting of the LPMT on 20th August 2013, it was decided to build only the necessary number of houses for resettlement of PAFs, and to use remaining budget for the resettlement site development.

On 22nd June 2013, a consultation meeting was conducted with the affected families regarding the resettlement package, which was followed by individual visits to ask about their resettlement options. The results of individual visits were further verified by BPG, and as of 27th August 2013, a plot cum house are planned to be allocated for 41 PAFs. In addition, 14 plots without houses will be allocated for PAFs who had previously purchased their plots but without needs or entitlement for a house. The remaining 16 plots are planned to be used for communal spaces.

14.2.3. Schedule and Progress of RAP Activities

Table 14.2-2 shows the monthly schedule and progress of RAP activities as of end August. According to this schedule, the completion of resettlement will be in May 2014. However, the issue of transferring the ownership of the resettlement site from DOTC to BPG has been a factor to impede the progress. The following are the activities prior to

[1] However, if the PAF is only land-affected and had bartered (not purchased) with a plot in the resettlement site, such plot will be bartered with other land.

and after the commencement of the resettlement site development.

(1) Prior to the Commencement of the Resettlement Site Development

Only after 1) issuance of the Environmental Compliance Certificate (ECC), followed by 2) obtaining the development permit, the resettlement site development can be commenced. For applying the ECC and the development permit, BPG has been requesting for DOTC to sign the Deed of Donation which transfers the ownership of the resettlement site from DOTC to BPG.

However, the Deed has been examined in DOTC since its submission by BPG on 12th July 2013. On the BPG's side, the Deed was signed by the Governor upon the approval of Sangguniang Panlalawigan (Provincial Assembly). As of 28th August 2013, DOTC Legal Office is referring to HLURB (Housing and Land Use Regulatory Board) on appropriateness of the Deed of Donation.

On the other hand, BPG considers that Deed of Donation is legally and practically required for BPG to own the resettlement site, since BPG is the one to apply for installation of basic infrastructure by related agencies, and eventually to collect housing amortization from the PAFs in the resettlement site.

In order to avoid delay due to not solving this issue, the ECC application was submitted to the Department of Environment and Natural Resources (DENR) on 31st July 2013 by DOTC as the signatory. The ECC was issued on 23rd August by DENR. Next step is obtaining the development permit from Municipality of Panglao, which takes only one week according to BPG. It is under examination that the DOTC could authorize BPG to apply for the development permit, in case the signing of Deed of Donation takes more time. It is very urgent to decide the application procedure and the signatory for the development permit.

BPG completed the D/D of the resettlement site development and hosing in middle of July. However, due to absence of the development permit, bidding for construction by BPG, which will take about 1.5 months, is not yet commenced. Thus, the obtaining the development permit is the most urgent matter as of end August 2013.

(2) After the Commencement of the Resettlement Site Development

BPG is currently preparing the bidding documents for the resettlement site development and housing construction. According to the bidding documents, it requires 175 days (about 6 months) to complete the construction. The JICA Study Team considers that such duration is reasonable, considering the scale and scope of the work.

For keeping to the schedule of completing the resettlement of PAFs in May 2014, it is a must to commence the resettlement site development at the beginning of November 2013.

Table 14.2-2 Schedule and Progress of RAP Activities（End of August 2013）

Item	SN	Activities	Responsible Agency/ Unit	Not yet Started	On-going	Completed	Plan/ Actual
Airport Construction	1	Preparatory Construction Work (Fencing, Clearing and Grubbing)	DOTC	■			Plan Actual
	2	Main Construction under ODA Loan	DOTC/ JICA	■			Plan Actual
Urgent Work Prior to Preparatory Construction Work	3	Information Dissemination to Local Residents on New Airport and Fencing Boundary	Community Relations & IEC Unit			■	Plan Actual
	4	Consultation with 43 Families still Living in the Site on the Preparatory Construction Work	Community Relations & IEC Unit			■	Plan Actual
	5	Establishing the Grievance Redress Mechanism during construction and informing the Public	Grievance Redress/Community			■	Plan Actual
	6	Final notification to land owners still under negotiation and obtaining entry permit	Land Acquisition Unit		■		Plan Actual
	7	Following up the cases under expropriation	Land Acquisition Unit		■		Plan Actual
	8	Establishing the Employment Matching Mechanism for construction	Livelihood Unit			■	Plan Actual
Resettlement of PAFs	9	Deed of Donation of the resettlement site from DOTC to PGBh	DOTC, Land Acquisition Unit		■		Plan Actual
	10	Tranfering the Title of the Resetttlemetn Site from Private Owner to DOTC, then PGBh	Land Acquisition Unit		■		Plan Actual
	11	Detailed Engineering Design of Site and Core Houses	Resettlement Unit			■	Plan Actual
	12	Determining the entitlement package and eligible PAFs	PGBh		■		Plan Actual
	13	Public consultation with PAFs (Entitlement Card, Brochure)	Community Relations & IEC/Resettlement Unit			■	Plan Actual
	14	Field Validation of PAFs (occupancy, resettling option, livelihood assistance needs, vulnerability)	Community Relations & IEC/ Livelihood Unit			■	Plan Actual
	15	ECC (application till approval)	Resettlement Unit			■	Plan Actual
	16	Development permit from Panglao Municipality (application till approval)	Resettlement Unit	■			Plan Actual
	17	Bidding for site development and housing construction (1.5month)	Resettlement Unit	■			Plan Actual
	18	Site Development & Housing Construction (175 days=5.8 months)	Resettlement Unit	■			Plan Actual
	19	Obtaining License to Sell from HLURB (not needed prior to construction)	Resettlement Unit	■			Plan Actual
	20	Clearing of structures and transfer of PAFs (not to only resettlement site)	Resettlement Unit	■			Plan Actual
	21	Providing Contract to Sell to PAFs	Resettlement Unit	■			Plan Actual
Land Acquisition	22	Land Acquisition of remaining lots (purchase, barter, expropriation)	Land Acquisition Unit		■		Plan Actual
	23	Documentation of deeds etc	Land Acquisition Unit		■		Plan Actual
	24	Registration and titling	Land Acquisition Unit		■		Plan Actual
Livelihood Assistance	25	Implementation of Employment Matching during construction	Livelihood Unit	■			Plan Actual
	26	Plan the livelihood restoration program for PAFs including financial planning	Livelihood Unit			■	Plan Actual
	27	Implement the livelihood restoration program for PAFs (training, access to employment)	Livelihood Unit	■			Plan Actual
Grievance Redress	28	Registering and attending the complaints at Barangay/ Municipal and provincial Level	Grievance Redress Unit	■			Plan Actual
Monitoring	29	Monitor the progress based on schedule and performance indicators	All Units and Secretariat		■		Plan Actual

Source: BPG

14.3. Activities Assisted by the JICA Study Team

In this Section 14.3, activities under 'Review and Implementation of RAP' Component of the D/D Study is reported. Since the outputs of the activities are described in the Updated RAP, the assistance conducted by the JICA Study Team is focused hereafter.

14.3.1. Re-organization of Local Project Management Team (LPMT)

At the commencement of the D/D Study, the current issues were identified through discussions with various officers at BPG. The JICA Study Team found out that the most important issue is to strengthen the Local Project Management Team (LPMT) in BPG. Information related to the project and resettlement was not adequately shared among the related officers. Moreover, organizational charts and implementation guidelines which had been previously prepared are not necessarily in accordance with the current operation, due to non-materialisation of the project for a long time.

Accordingly, re-establishment of the LPMT was discussed with BPG and related agencies. On 10th April 2013, a one-day workshop titled 'Work Planning Workshop for Implementing Resettlement Activities' was held in Tagbilaran City. 30 officials from BPG, 5 officials from DOTC/CAAP, and one official from NHA participated. In the workshop, after the explanation of the project and the JICA's guidelines, the participants actively discussed the functional organizational structure.

The workshop results were reflected in the Executive Order No. 15, series of 2013, which was issued by the Governor on 6th June 2013. The E.O. No. 15 approves the new organizational chart, and prescribes the Units with responsibilities as shown in Table 14.3-1. One Project Manager, three (3) Deputy Project Managers and Unite Heads were assigned to lead the activities of the LPMT, in liaison with other agencies, namely DOTC, Municipality of Panglao and Barangays.

Table 14.3-1 Responsibilities of Each Unit in the Re-Established LPMT

Name of Unit	Outline of Responsibilities
Secretariat	Coordination with Units and other agencies, organizing events/ meetings, budget planning, overall project monitoring
Land Acquisition Unit	Tasks related to land acquisition including titling
Resettlement Unit	Tasks related to construction of the resettlement site and houses, and transferring PAFs
Estate Management Unit	Management of the resettlement site, including collection of housing amortization
Livelihood Unit	Tasks related to livelihood assistance and employment matching
Community Relations and IEC Unit	Consultation with PAFs and information dissemination
Grievance Redress Unit	Settlement of issues and concerns of PAFs and local residents

14.3.2. Information Dissemination on the Project

Another issue faced by the JICA Study Team was that the general public still could not believe the materialization of the project after waiting for more than 20 years. Moreover, the benefits of the new airport were not well understood even among the local government units. This is partly due to the downscaling of the airport from what was designed in the D/D in 2009, i.e., decreasing the length of the runway from 2,500 m to 2,000 m, and changing the scale of the passenger terminal building from two storeys to one storey. Consequently, questions were raised such as what would be the difference between the new airport and the existing Tagbilaran Airport.

In order to gain better understating from the local residents including PAFs, the JICA Study Team, in cooperation with DOTC and BPG, prepared a brochure of the New Bohol Airport in both English and Visayan languages. The brochure emphasizes the safety and expandability of the new airport. 1,000 copies of the brochure were printed for English and Visayan versions respectively, and distributed among stakeholders including PAFs. It was also published in local newspapers on 19th May 2013.

14.3.3. Reflecting Social Considerations in Detailed Design and Construction Process of the New Airport

JICA's Guidelines for Environmental and Social Considerations stipulate 'Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. When, after such an examination, avoidance is proved unfeasible, effective measures to minimize impact and to compensate for losses must be agreed upon with the people who will be affected.' In this subsection, the attempts to minimize the negative impact on local residents are discussed, through reflecting social considerations in detailed design and construction process of the new airport.

(1) Airport Layout and Land Acquisition

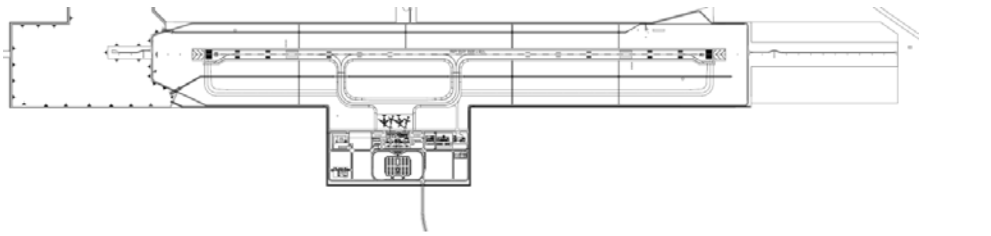
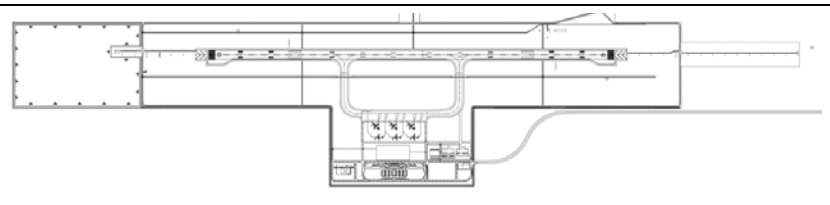
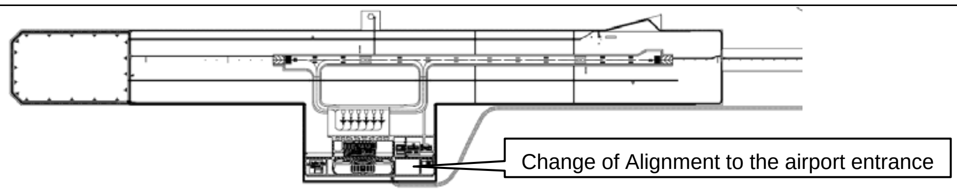
In this D/D Study, additional land acquisition and resettlement were avoided, by adjusting the final alignment of the airport and access road within the existing perimeter of land acquisition. The major adjustment was to decrease the width of airfield from 417.5 m for Code F to 400 m for Code E. (Code A - F indicates the size of the aircrafts and F is the largest one.)

After 2007 FS, land acquisition for the 400-m wide airfield and the 30-m wide access road had been processed by BPG. The alignment of the access road was then adjacent to the airfield and planned to be connected from the Central Highway. However, the 2009 D/D proposed the 417.5-m wide airfield for Code F aircraft and the access road connected from the south circumferential road, instead of the Central Highway. As a result, the width of airfield was within the perimeter of land being acquired, but it was difficult to even commence the negotiation of owners of lands affected by the access road due to existence of many houses.

Accordingly, during the JICA Preparatory Survey in 2012, the alignment of the access road was proposed back to the area adjacent to the 417.5-m wide airfield and to connect from the central highway. Consequently, it became necessary to acquire land with the width of 447.5 m (417.5 m + 30 m) , which requires to newly acquire the land of some 20-m wide x 2-km long.

During the D/D Study in 2013, the above additional land acquisition was discussed with BPG officials. Their opinion was that it would be extremely difficult to negotiate with newly affected landowners, considering that the land price had risen recently, while the land acquisition rate was set as 60 Php/m^2. If pursuing the new land acquisition, an extensive delay in the commencement of the airport construction was easily predicted. It was finally decided by DOTC to go back to the airfield for Code E and maintain the width of land acquisition as 430 m, considering that there is very little possibility for the airport to accommodate such world largest aircraft (Code F) in the foreseeable future.

Moreover, alignment of the access road to the airport entrance was realigned, so as to avoid the resettlement of 3 houses. These transitions are shown in Figure 14.3-1.

2009 D/D	 Airfield width was increased from 400 m for Code E to 417.5 m for Code F. Access road was planned to be perpendicular from the south circumferential road.
2012 Preparatory Survey	 Airfield width was maintained as 417.5 m. Access road was planned to be laid adjacently. Hence, 447.5 m was required for the width of ROW.
April 2013 D/D Study	 Airfield width was back to 400 m. 30-m wide access road was back to the original position.

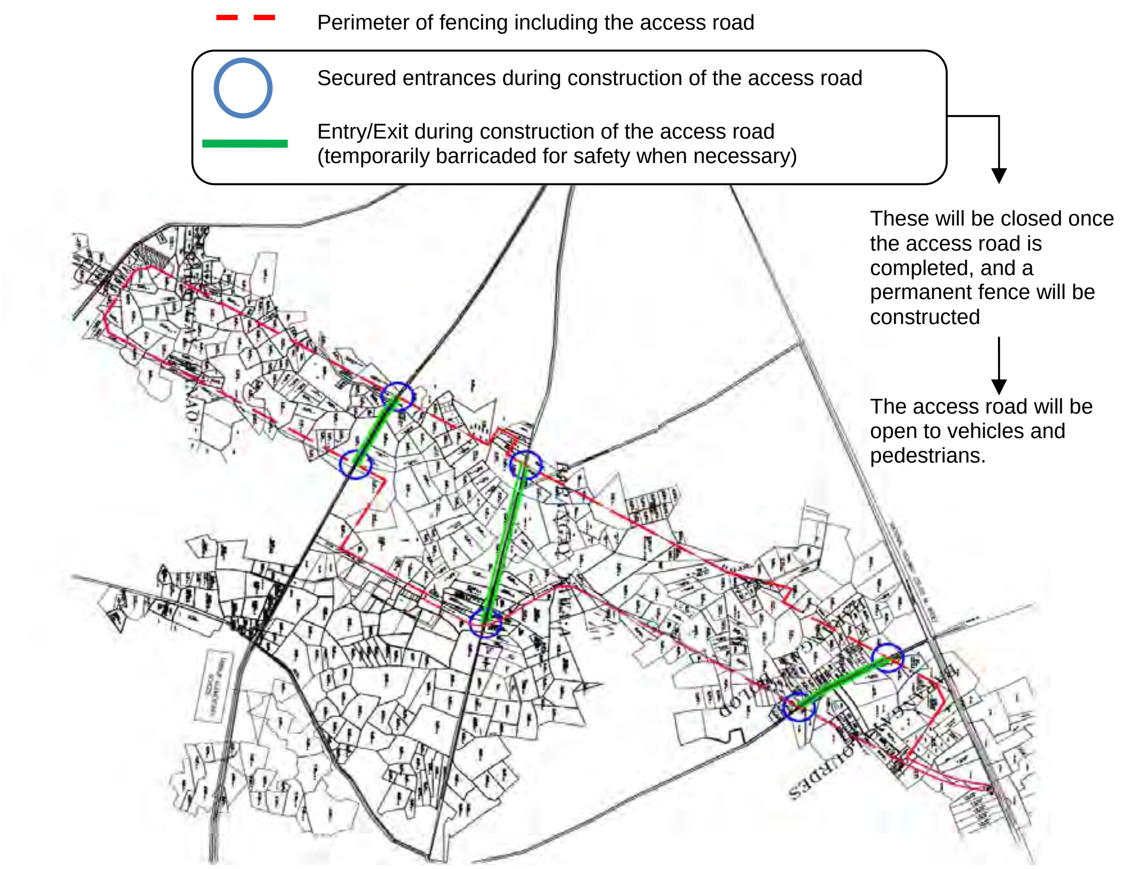
Source: JICA Study Team

Figure 14.3-1 Transition of Width of Airfield and Alignment of Access Road

(2) Securing Passage during Construction

As shown in Figure 14.3-2, there are three barangay roads crossing across the project site. These barangay roads connect houses in and around the project site to the Central Highway. In the preparatory construction work by DOTC, which was initially scheduled to commence in May 2013, the perimeter of the project site was planned to be temporarily fenced with barbed-wire boundary. Such fencing, however, was found to obstruct the access of residents to the Central Highway, especially for those who live inside and south side of the project site.

The JICA Study Team examined the way to solve this problem. As a result, barangay roads are to be kept passable until the completion of the access road to the airport, which is at longest one year after the commencement of the main construction work. During this period, entry and exist of three barangay roads are kept accessible with provision of 6 openings, where the fence is replaced by mobile barricades. These openings would be closed upon completion of the airport access road that would give more convenient access to those who live at the south of the new airport. This plan of keeping passage during construction was explained in the said project brochure and at the public consultation meeting on 30th May 2013.



Source: Project Brochure

Figure 14.3-2 Explanation on Passage of Barangay Roads during Construction

14.3.4. Formulation of Entitlement Package on Resettlement

As mentioned in Section 14.2, the resolution was made on 5th June 2013 to withdraw the proposal for fund assistance from the NHA for the Socialized Housing Scheme. Since then, various activities were conducted to formulate the assistance package for resettlement. The JICA Study Team especially assisted in the formulation for the draft Entitlement Package which was finalized by the LPMT at BPG after extensive discussions.

During this process, one difficulty was to determine who will be eligible for what entitlement. The resettlement site was initially divided into 54 plots with 250 m^2, and all of them were allocated to PAFs. Accordingly, it was necessary to establish a new rule to provide the plots in order to accommodate the house-affected families who still need to resettle. It was found that 24 out of 54 plots were bartered with land-only affected families without any legal documents. These 24 plots were decided to barter with lands outside of the resettlement site, and it had been actually done for most of such cases.

In principle, a plot cum house in the newly planned resettlement site will be allocated for 45 families: 1) 43 families still reside in the house which was tagged in April 2012; and 2) 2 families on the access road whose relocation was finalized in June 2013. However, if any of these 45 families have their own houses on their own lands outside the project site, they are exempt from the entitlement.

Aside from moving to the resettlement site, another option is to resettle to a house (already/ newly constructed or reassembled) on the land opted by a PAF. For these PAFs, the same assistance for the PAFs moving to the resettlement site will be provided, namely: paying the transfer fee of 15,000 Php, demolishing houses and transportation (providing vehicles for materials and other things that they can use in their new houses within the Panglao Island). With regard to the transfer fee, the LPMT decided to provide the same amount to PAFs who have already resettled, in order to keep equality among house-affected families. Such payment was incorporated in the revised budget.

The above-mentioned Entitlement Package was explained to the entitled PAFs in the public consultation meeting on 22nd June 2013 by distributing a brochure in Visayan language. This was followed by the individual survey, and PAFs' resettlement options were identified. The JICA Study Team prepared a questionnaire, trained enumerators (LPMT staff) and analysed the collected data. In the survey, it was questioned if a PAF does not opt for the resettlement site, where they will relocate. It was found that they would move to either their own land or their parents' land, which assured the security of tenure of these PAFs.

The details of the Entitlement Package and resettlement options of PAFs are described in the Updated RAP.

14.3.5. Preparation of Livelihood Restoration Program

In the D/D Study, preparation of a livelihood restoration program for PAFs was the important task of the JICA Study Team. Considering that around 60% of the PAFs who still need to resettle are under poverty line (1,869 Php per person/month), it would be crucial to assist these PAFs in increasing their income to enable the payment of housing amortization in the resettlement site. In addition, it was required to prepare a comprehensive livelihood restoration program, since livelihood assistance is to be provided for not only house-affected families but also the all PAPs including those who have already resettled and land-only affected families.

The Livelihood Unit established in the LPMT in BPG played a pivotal role in preparing the Livelihood Restoration Program. For this purpose, the JICA Study Team assisted the Livelihood Unit especially in situational analysis of PAFs including their vulnerability and skills/needs assessment. For the house-affected families, the house-to-house visit was conducted by Livelihood Unit and the JICA Study Team. For the land-only affected families, it was difficult to conduct a survey, since many are not in Panglao Island or even in Bohol Province. Accordingly, the JICA Study Team conducted needs analysis through discussions with the representatives of the land-affected families, namely: Panglao Landowners Multi-Purpose Cooperative (PLOMPCO), the cooperative established by the affected landowners and composes of around 100 members.

For the project, two means of livelihood restoration are planned, namely: 1) livelihood assistance, and 2) employment matching especially during the construction of the airport. The vulnerable PAFs who are under the poverty line are prioritized for the beneficiaries of the assistance.

(1) Livelihood Assistance

In the project context, the livelihood means the individual or community-based income generation activities. The Livelihood Assistance Plan consists of 1) Training, 2) Seed capital including the fund for business start kits, and 3) a long-term microcredit. Types of livelihood assistance include: enhancing the skills of what PAFs have been doing such as urban gardening and poultry farming; and getting new skills which are increasingly demanded in the resorts such as cooking, massage and reflexology. It is noticeable that the plan is based on the market demand in Panglao Island. Not only the new services but also agricultural products are required, due to increase demand for fresh vegetables and eggs etc.

The outline of work and financial plan for livelihood assistance is shown in Table 14.3-2. The total budget amounts to 3,195,000 Php. Through implementation, the budget for each component and activity would be reviewed and fine-tuned.

Table 14.3-2 Outline of Work and Financial Plan for Livelihood Assistance

	Description	Main activities	Indicative Budget (Php)
1	Basic Skills Trainings and Capacity Building (for individual and community-based livelihood)	Urban gardening, poultry farming, massage, reflexology, food safety etc	435,000
2	Entrepreneurship Capacity Building	Business planning, book keeping	360,000
3	Vocational training and Capacity Building for Employment	Commercial cooking, and masonry, carpentry, plumbing etc for supporting employment matching for the airport construction and other opportunities	200,000
4	Facility Support	Building Community Livelihood Centre in the resettlement site	600,000
5	Provision of Seed Capital and Micro Finance	Start-up capital, and seed money for micro finance	1,600,000

Note: '3 Vocational training' is related to Employment Matching mentioned in next paragraph (2).

Source: JICA Study Team

(2) Employment Matching

Under the D/D Study, the JICA Study Team assisted the LPMT in establishing the Local Employment Matching Mechanism for promoting the employment of PAFs and local residents during the construction of the new airport.

In the bidding documents for the project, the Environmental Management Plan out of the General Requirements stipulates the following measures for enhancing the local employment for the project (Table 14.3-3).

Table 14.3-3 Descriptions on Local Employment in Bidding Documents

Impact	Options for Enhancement
(Construction Phase) The construction activities will generate short-term employment among local residents including project affected persons	The contractor is encouraged to employ qualified project affected persons and local residents, to the extent practicable and reasonable, during construction. The Local Project Management Team (LPMT) of the Bohol Provincial Government already has a system to assist the contractor in this regard.
(Operation Phase) The operation will generate employment among project affected persons and local residents.	Qualified project affected persons and local residents will be considered for employment during operation.

Source: Specifications, General Requirements- Attachment E (Environmental Management Plan)

The under lined 'System' mentioned in the above table means the Local Employment Matching Mechanism. In the mechanism, the Bohol Employment and Placement Office (BEPO), an existing office in BPG, will play the pivotal role. BEPO will list up the candidates for interviews for the contractor, and the contactor could select employees among the interviewees. The candidates are selected based on their experience, skills and interests. However, the mechanism does not prevent the contactor(s) to employ workers through their own methods, since the contractor has the freedom to employ most suitable workers and such workers should be quality-based.

Currently, 26 PAFs are initially listed up as qualified candidates for the preparatory construction work by DOTC. In addition, selection of the candidates is on-going among land-only affected persons through PLOMPCO. If the application of the matching mechanism goes well with the preparatory construction work, it could be easily applied to the main work under the ODA loan.

With regard to the operation phase of the project, such Matching Mechanism may not be directly applied since the operation of the new airport will be entrusted to a concessionaire. However, if this employment matching system functions well for the construction of the new airport, it could be applied to other employment opportunities, especially in the resorts of Panglao Island.

14.3.6. Update of Resettlement Action Plan (RAP)

Based on the above-mentioned activities, the Updated RAP was prepared with assistance of the JICA Study Team. Aside from what have been mentioned, the following assistance was provided to BPG and DOTC by the JICA Study Team (Table 14.3-4).

Table 14.3-4 Other Assistance Conducted for Updating RAP

Item of Updated RAP	Assistance Conducted
Schedule	- Updating the implementation schedule based on the current progress (Table 14.2 -2) - Assisting the LPMT Secretariat in updating the progress and reporting to DOTC every month
Monitoring	- Preparing the <u>Performance Monitoring Sheet</u>, and enabling the LPMT to update and report the important indicators to DOTC every month (Table 14.3-5)
Grievance Redress Mechanism	- Establishing the grievance redress mechanism through discussing the provincial, municipal and barangay officials. - Introducing the Complaint/Registry Forms and the Grievance Registry to monitor the grievance registered and attended.

The Performance Monitoring Sheet as of end July 2013 is shown in Table 14.3-5.

Table 14.3-5 Performance Monitoring Sheet of Resettlement Action Plan（End of July 2013）

		Lots	Area (sq.m)	Lot-wise ratio (%)	Area-wise ratio (%)	Entry permit (lots)	Remarks
Land Acquisition	Already Acquired	361	2,091,663	88.70%	93.80%		Expropriation: - Handled by the Solicitor General - Required documents, on preparation and process
	Acquired through purchase	256	1,751,367	62.90%	78.54%		
	For barter	100	321,661	24.57%	14.43%		
	Government owned (road)	5	18,635	1.23%	0.84%		
	Still for Acquisition (Negotiation)	38	104,279	9.34%	4.68%	7	
	For expropriation	8	33,907	1.97%	1.52%		
	Total	407	2,229,849	100.00%	100.00%		
Resettlement of PAFs	PAFs still residing in the ROW	45	Attached is the spot map of PAFs still residing in the ROW				
	PAFs moved to the relocation site	0					
	PAFs self-relocated	32	Validation / Individual house visit of the PAFs was conducted last July 25-26				
Resettlement Site	Availability of water supply	Yes	Not yet				Construction of Resettlement Site not yet started
	Access to clinic	Yes	No				
	Access to school	Yes	No				
Livelihood Assistance	No. of PAFs employed for airport construction	0					Preparatory Activities for Livelihood Restoration is on-going.
	No. of Livelihood Activities Planned	0					
	No. of Livelihood Activities conducted	0					
	No. of beneficiaries of Livelihood Activities Conducted	0					
Grievance Redress	Establishment of Grievance Redress Committee (Province)	Yes	Not Yet				Initial Grievance Redress Mechanism (GRM) was presented to Barangay Captains for adoption. Review and finalization of GRM is going-on.
	Coordination with Brgy BOLOD	Yes	Not Yet				
	Coordination with Brgy DANAO	Yes	Not Yet				
	Coordination with Brgy TAWALA	Yes	Not Yet				
	Coordination with Brgy LOURDES	Yes	Not Yet				
	No. of complaints received	0					
	No. of complaints solved	0					
Consultation		Total No.	Date	Theme			
	Public Meetings Conducted	3	02-03-2013	Socialized housing for House-affected PAFs			No Public meeting was conducted for July 2013
			30-05-2013	Preparatory construction in PAFs and neighbors			
			22-06-2013	Resettlement options for PAFs still residing in ROW			
	Individual consultation/validation conducted	3	11,13-06-2013	Livelihood needs and skills validation for PAFs still residing in the ROW			Finalization of survey results is going-on
			27,28-06-2013	Resettlement options survey for PAFs still residing in ROW			
			25, 26-07-2013	Validation survey for PAFs who already left the ROW			
Information Dissemination		Total No.	Month	Contents			
	Brochures prepared	2	May -2013	Outline of the new airport and perimeter of fencing			1000 English Version 1000 Visayan Version; 50% of w/c were distributed to LGU Panglao Tourism and G.O.
			June -2013	Resettlement options and other entitlement for PAFs			

Source: BPG

14.4. Remaining Issues and Procedures

In this section, the remaining issues and procedures with regard to the land acquisition and resettlement. Although some of the main issues are already described in Section 14.2, they will be reiterated in following subsections.

14.4.1. Land Acquisition

(1) Expropriation and Its Timeline

As of end June 2013, there are 9 lots for expropriation, after a long time of not reaching the agreement on land acquisition either through purchase or barter. Out of the 9 lots for expropriation, 4 lots are owned by one landowner, and two houses remain in these 4 lots. These cases are under study by the Office of Solicitor General before filing with the Court. According to the land acquisition act (Republic Act 8974), after 1) filing the case by the Office of Solicitor General, and 2) Depositing the zonal value for land (and current market value for a house), the Court can issue the ‘Writ of Possession’, i.e., the permission for the implementing agencies to enter the land and, if necessary, demolish houses. According to DOTC officials who experienced expropriation cases in other projects, expropriation of the 9 lots including two houses is most likely to complete within 2013. However, the compensation is paid to the landowners, only after ‘final’ compensation amount is determined by the court, which will take a longer time.

In parallel with the above expropriation procedure, BPG continues negotiation with the landowners. As of 23rd August 2013, one (1) landowner under expropriation agreed to land acquisition. With regard to the four (4) lots resided, BPG have had several discussions with the landowner in order to avoid forced eviction.

(2) Obtaining ‘Entry Permit’ from Landowners under Negotiation

As of end June 2013, 40 lots are still for acquisition (some under procedure, and others still under negotiation), but if ‘Entry Permits’ are obtained from the landowners, contractors can enter these lands. BPG staff visit the landowners and obtain the Entry Permits, and as of end July 2013, 7 are already obtained. According to BPG officials, however, due to delay in commencement of the preparatory construction work by DOTC which was initially scheduled in May 2013, some landowners are getting suspicious of materialization of the project. Accordingly, it would be very important to commence the preparatory construction soon, in order to promote the procedure of land acquisition.

Out of the 40 lots still for acquisition, some of the landowners cannot be located. BPG is trying to contact these landowners through publishing their names on local newspapers and posting at barangay halls.

(3) Issues of Exchange/ Barter

On 28th November 2012, the amended MOA was signed between DOTC and BPG on Exchange/Barter, which enabled the land acquisition through barter to proceed. One remaining issue, however, is that the previously acquired lands are registered in the names of DOT and CAAP with singly or jointly with DOTC. For the formal signing of Deeds of Exchange/ Barter of lots with affected landowners, DOTC needs to secure the necessary authorization from DOT and CAAP. On 5th June 2013, the Governor of BPG issued an official letter to the DOTC Secretary, requesting for necessary procedure to solve this issue, and the actions by DOTC is awaited.

Nonetheless, according to BPG, the above issue does not hinder the contractors to enter the lands for barter, since the landowners already agreed on the land acquisition through barter.

14.4.2. Resettlement Site Preparation and Relocation

(1) Transferring the Ownership of Resettlement Site from DOTC to BPG

As mentioned in Section 14.2, it is important to decide whether to transfer the ownership of the resettlement site from DOTC to BPG through Deed of Donation. The Deed has been examined in DOTC since its submission by BPG on 12th July 2013. On the BPG's side, the Deed was signed by the Governor upon the approval of Sangguniang Panlalawigan (Provincial Assembly). As of 28th August 2013, DOTC Legal Office is referring to HLURB (Housing and Land Use Regulatory Board) on appropriateness of the Deed.

On the other hand, BPG considers that Deed of Donation is legally and practically required for BPG to own the resettlement site, since BPG is the one to apply for installation of basic infrastructure by related agencies, and eventually to collect housing amortization from the PAFs in the resettlement site.

The issue of ownership of the resettlement site needs to be solved as soon as possible between BPG and DOTC, and necessary action should be taken.

(2) Urgency of Obtaining Development Permit

Now that the ECC for the resettlement site was issued on 23rd August by DENR, next step is obtaining the development permit, which is the pre-requisite for commencing the resettlement site development. It is under examination that DOTC could authorize BPG to apply for the development permit from Municipality of Panglao, in case the signing of Deed of Donation takes more time. It is very urgent to decide the application procedure and the signatory for the development permit. According to BPG, the development permit can be obtained from Municipality of Panglao within one week after application, based on their previous experiences.

BPG completed the D/D of the resettlement site development and hosing in middle of July. However, due to absence of the development permit, bidding for construction by BPG, which will take about 1.5 months, is not yet commenced. Thus, the obtaining the development permit is the most urgent matter as of end August 2013.

(3) Allocation of Plots/ Houses to PAFs

As of 27th August 2013, a plot cum house are planned to be allocated for 41 PAFs. These PAFs will sign the Entitlement Card (a document to declare availing and paying for the plot/house in the resettlement site). Then the plots in the resettlement site will be allocated for these PAFs through raffles.

For the PAFs moving to the resettlement site, one plot in the resettlement site will be provided. However, the plot cannot be sold by a PAF until they complete paying the monthly amortization. The Contract to sell with such conditions will be issued from BPG to PAFs right after the relocation. For issuing the Contact to sell, BPG needs to submit an application to the Housing and Land Use Regulatory Board (HLURB) for Registration and Licence to Sell. However, such procedure is not the pre-requisite of the commencement of resettlement site development.

(4) Transfer of PAFs and Demolition of Houses

Notice to Vacate will be issued to PAFs so that they are ready to vacate their houses in the ROW. After relocation of PAFs, it is necessary to demolish the houses in the ROW immediately, to enable the hand-over of the project site to the Contractor. Also the demolition of original houses is required to avoid the return of PAFs to the project site and again living in the ROW.

(5) Water Supply to Resettlement Site

The water pipeline from the airport to the resettlement and elevated water tanks in the resettlement site will be constructed by DOTC. Since the construction of the said water pipeline can commence only after the start of the main construction under ODA loan, the transitional water supply to the resettlement site will be sourced from the existing water supply facility of Municipality of Panglao. Since the water supply is very scarce in Panglao Island, it is very important that the water supply works from the airport to the resettlement site will be completed at the earliest possible time.

14.4.3. Management of Resettlement Site

After the relocation of PAFs, the long-term tasks remain with BPG related to operation and management of the resettlement site. The Estate Management Unit of the LPMT is responsible for these tasks. The Unit head is the Provincial Treasurer who is responsible for collecting taxes from residents in Bohol Province.

(1) Collection of Housing Amortization

One of the most important tasks is to collect the housing amortization. Considering that the PAFs who still need to resettle are mostly poor (60% of the families are under the poverty line), it might be difficult for a PAF to repay the loan even at the lowest cost of 500.56 Php for 30 years. It is necessary to ensure the collection of housing amortization through assisting low-income PAFs with appropriate livelihood assistance and/ or employment promotion.

(2) Issuing Deed and Declaration of Commitments

In the resettlement site, certain regulations, namely 'Deed and Declaration of Commitments', need to be followed by residents. For example, if a PAF build or expand their house by themselves on the allocated plot, they have to follow certain regulations set by BPG. This was the decision by BPG to avoid the resettlement site from becoming like a shanty, since it is located near the airport.

Aside from housing construction, livelihood-related activities such as livestock raising could be regulated to maintain the sanitary environment in the resettlement site.

14.4.4. Enhancement of Grievance Redress Mechanism

Grievance Redress Mechanism (GRM) was established through Executive Order No. 15, series of 2013, at Provincial (Grievance Redress Committee), and at Barangay levels. The JICA Study Team assisted the LPMT to explain the mechanism at four (4) affected barangays and distribute Complaint/ Registry Forms, and Grievance Registry to monitor the registration and attendance of grievances. As the end of July 2013, however, such mechanism was not yet functioning at barangay levels. On the other hand, some PAFs visited and consulted with the Secretariat of the LPMT located in the building of BPG in Tagbilaran City.

On 6th August 2013, the related officials of barangay, municipal and provincial levels gathered and discussed functional GRM. As a result, either of these levels became the entry point of registering grievances and concerns of PAFs. (The details of the mechanism are written in the Updated RAP.)

Since the re-established GRM is still to be operated, practicability of the mechanism needs to be verified through implementation.

14.4.5. Strengthening Monitoring System

At the time of commencement of the D/D Study, the schedule of land acquisition and resettlement based on the current status did not exist, and the basic indicators such as status of land acquisition was not updated regularly. Through assistance of the JICA Study Team, the LPMT Secretariat is now updating the progress as per the schedule (Table 14.2-2) and the indicators in the Performance Monitoring Sheet (Table 14.3-5). They are reported from LPMT Secretariat to DOTC monthly.

Beyond the above achievement, it is recommended for DOTC and BPG to make use of the above monitoring tools for smooth project implementation. Especially, if there is a delay in the progress, the reason for such delay needs to be identified, so that necessary actions would be taken by both parties in a timely manner.