【Outline of Work】

1 New Water Treatment Plant (600 liter/sec)
(Existing Water Treatment Plant (1,000 liter/sec)
2 Distribution Pipe (non)
3 Water Pipe Bridge (non)

Existing Facility

Site for New Water Treatment Plant (Ayung River)

Figure-5.4 Central Water Supply System and Current Condition of planned WTP

<Weir>

The intake construction is suggested in permanent weir type with dam body's height that is possible to lead gravitational flow to the storage tank. The using of pump machine is only implemented if the river topography and water treatment facilities position are impossible to be flowed gravitationally.

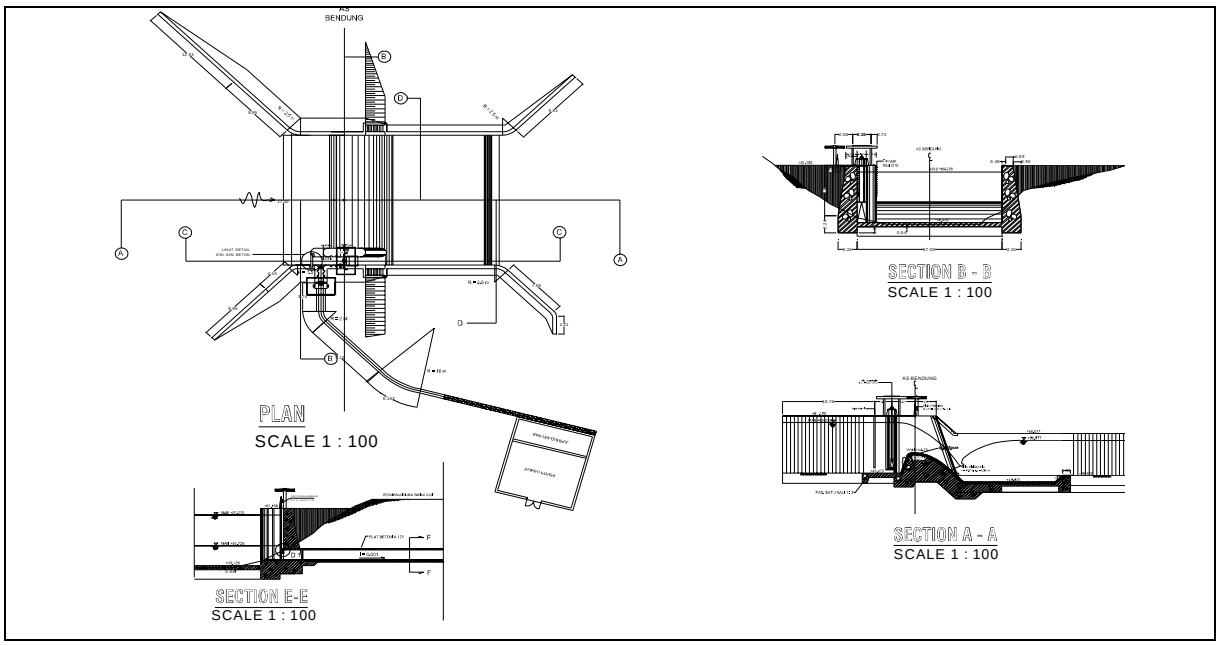


Figure-5.5 Weir of Central Water Supply System in Ayung River

<Water Treatment Plant (WTP)>

The structure of sedimentation tank and pump house position are designed to be built in the south/downstream of the Ayung WTP III's pump house. WTP facilities position for these three units were planned in the east of Ayung Installation III, north of the road, while the Sludge Drying Bed (SBD) was in the south of the road in a row with the WTP.

Nowadays, the land use condition which shall be used for the building of Water Treatment Plant is dry field and rice field owned by the surrounding peoples.

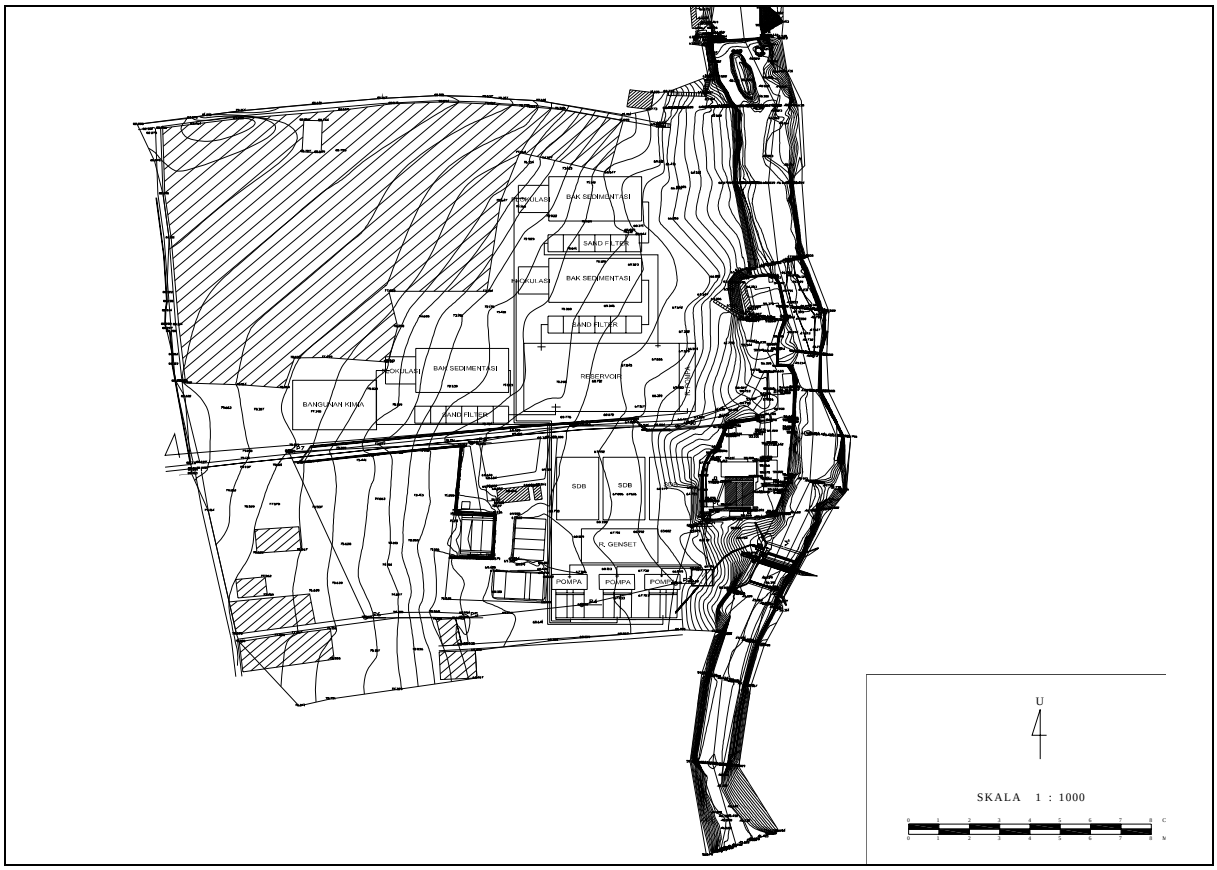


Figure-5.6 General Plan for Ayung Water Treatment in Ayung River

(3) Eastern Water Supply System

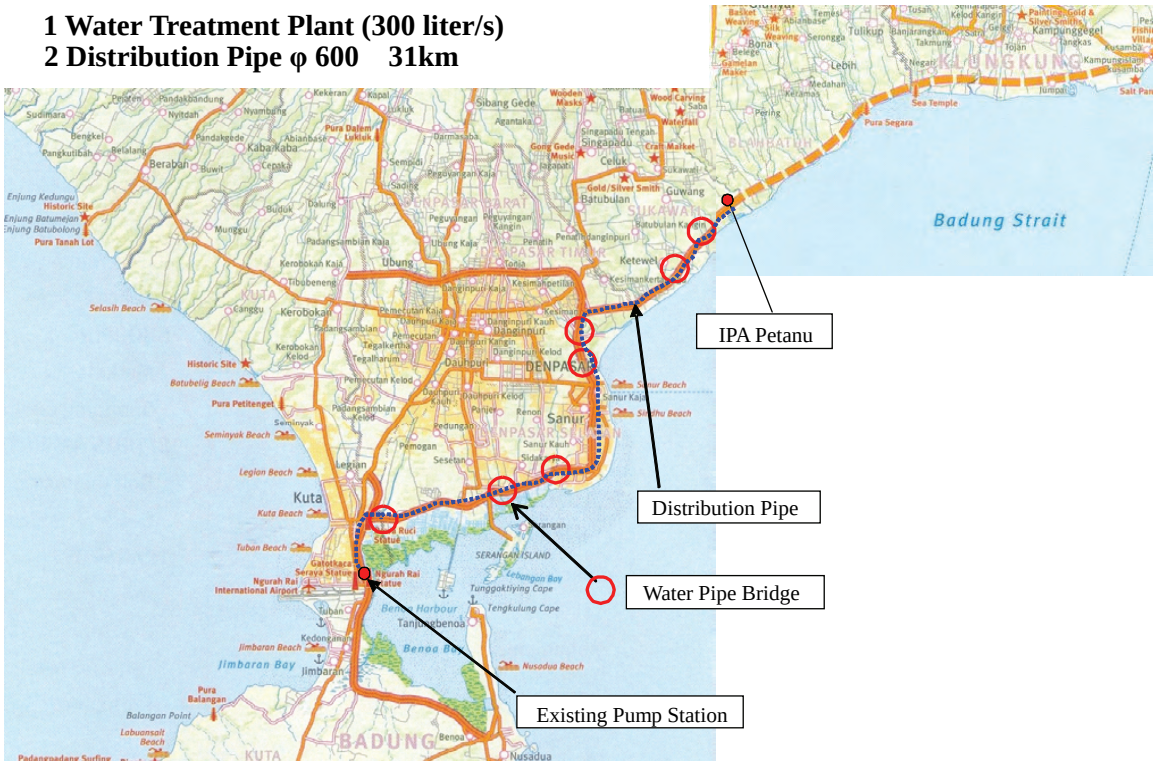
The raw water shall be taken at the downstream area of Petanu River, about 1,5 km from the coast line. The WTP location was selected at Glumpang sub-village, Sukawati Sub district, Gianyar Regency by taking into account hydraulic condition such as salinity intrusion as well as magnitude of effect against the existing springs located at upstream from planned weir along Petanu River. The production capacity for eastern system shall be planned to 300 l/sec (25,920 m^3/day).

<Eastern Water Supply System>

East System (River Petanu Water Treatment Plant)

【Outline of Work】

1 Water Treatment Plant (300 liter/s)
2 Distribution Pipe φ 600 31km



Distribution Pipe Rout
(Sanur Kusumba Bypass)

Site for New Water Treatment Plant
(Petanu

Figure-5.7 Eastern Water Supply System and Current Condition of planned WTP

<Weir>

For the intake type selection, permanent type weir was selected with dam body height that is possible to lead gravitational flow to the storage tank. The using of pump machine shall be only implemented in case of river topography condition and water treatment facilities position shall be impossible for flowing due to gravitation.

<Water Treatment Plant (WTP)>

Layout of WTP building is designed around 300 m in the north of Petanu Bridge, in the west side of the Petanu River. The location choosing was exerted to be far from the side of By Pass Prof. Ida Bagus Mantra and close to the riverside, so that land acquisition cost will be lower. Area planed for WTP buildings is now functioned as rice field owned by surrounding people. Land level is a little bit higher than river course for which gravitation flows is possible to be implemented.

<Transmission Pipe>

The transmission pipe shall be installed along the side of By Pass Prof. Dr. Ida Bagus Mantra runs between Sunur and Kesamba and By Pass Ngurah Rai runs between Kuta and Sunur, and it shall be connected with the reservoir at the IPA Estuary Dam location.

The pipe position shall be planned at the shoulder of the road, in the northern side for By Pass Prof .Dr. Ida Bagus Mantra and in the eastern side for By Pass Ngurah Rai.

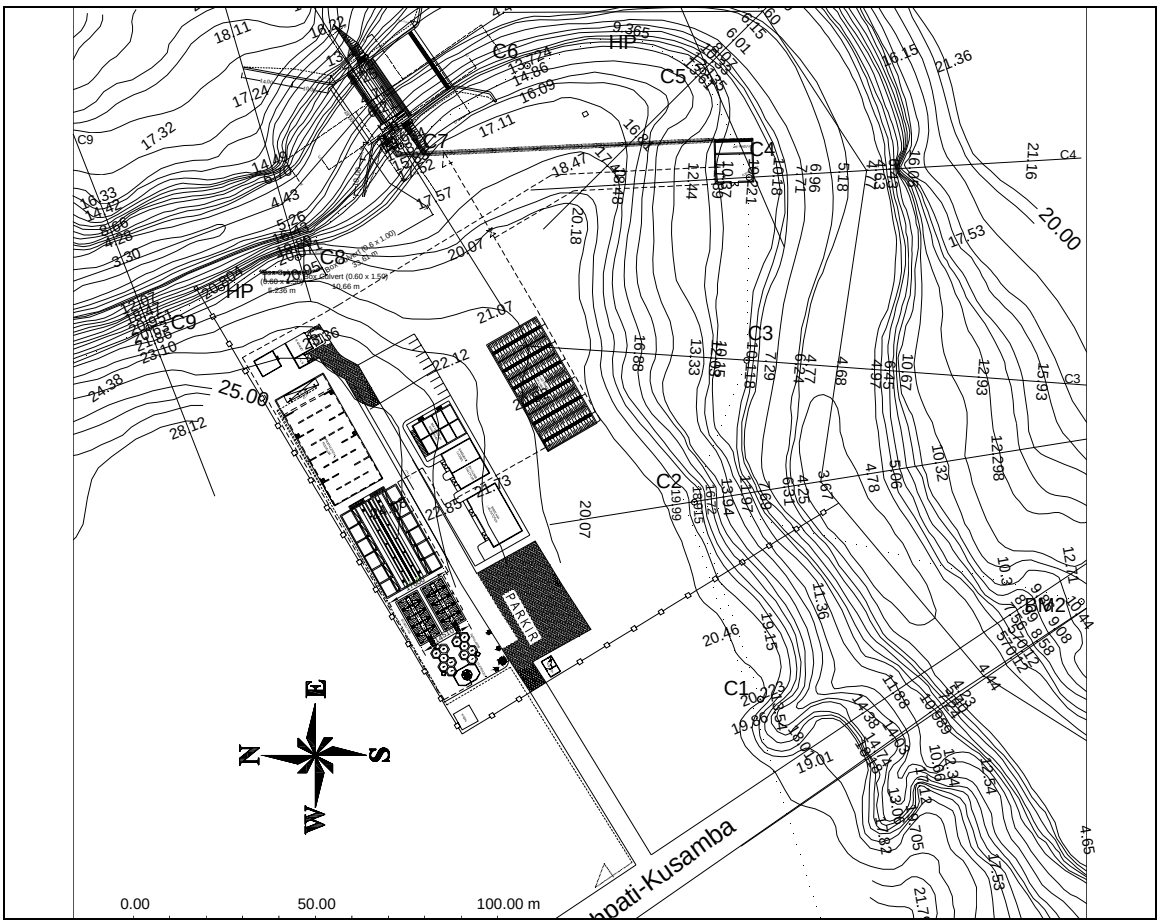


Figure-5.8 General Plan for Petanu Water Treatment in Petanu River

5.2.3 Work Quantities

Works quantities for three systems are shown in Table-5.2– Table-5.4

Table-5.2 Work Quantities for Western Water Supply System

Works Description	Works Item		Unit	Quantity	Remarks
Common Temporary Work			Ls	1.0	

Works Description	Works Item		Unit	Quantity	Remarks
Intake & Conduit					Height×Wide×Length
	Intake Weir& Pump Pit	Temporary Work	Ls	1.0	7.3m×19m×28m
		Earths Works (Excavation)	m^3	2400.0	
		Earths Works (Backfill)	m^3	1300.0	
		Earths Works (Bank)	m^3	3400.0	
		Concrete Works	m^3	500.0	
		Masonry Works	m^3	1800.0	
		Intake (Pump Pit)	m^2	110.0	10m×11m×4.0m
	Waterline Pipe φ600		m	200.0	
		Other (Mechanical Equipment)	Ls	1.0	
Treatment Plant Facilities					
	Treatment Plant (Civil Works) Other Building Work	Temporary Work	Ls	1.0	
		Earths Works (Excavation)	m^3	4579	
		Earths Works (Bank・Backfill)	m^3	1585	
		Concrete Works	m^3	1870	
		Wall Structure Works: Receiving well : 35m^2	m^2	35.0	5m×7m
		Wall Structure Works: Flocculation Tank	m^2	110.0	9m×6m×2sites
		Wall Structure Works: Chemical Reservoir	m^2	200.0	14m×7m×2sites
		Wall Structure Works: Sand Filter	m^2	445.0	25.5m×17.5m
		Wall Structure Works: Clear Water Reservoir	m^2	495.0	33m×15m
		Wall Structure Works: Sludge Drying Bed	m^2	495.0	33m×15m
		Wall Structure Works: Other (Mechanical Equipment)	Ls	1.0	
		Wall Structure Works: Pipes Setting	Ls	1.0	
		Office & Laboratory	m^2	165.0	15m×11m×7.6m
		Chemical Room	m^2	235.0	20m×9m×3.9m
					11m×5m×7.6m
		Mechanical & Electric Room	m^2	120.0	11m×11m×5.3m
		Workshop	m^2	50.0	8m×6m
		Guard House	m^2	15.0	3m×4.5m
Transmission Facility					
	Waterline Pipeφ600 Water Pipe Bridge		m	8800.0	
		L=10m	Site	1.0	
		L=15m	Site	1.0	
		L=20m	Site	3.0	
Electrical & Mechanical Cost (E & M)			Ls	1.0	

Table-5.3 Work Quantities for Central Water Supply System

Works Description	Works Item		Unit	Quantity	Remarks
Common Temporary Work			Ls	1.0	
Intake & Conduit					Height×Wide×Length
	Intake Weir & Pump Pit	Temporary Work	Ls	1.0	11.5×60×30m
		Earths Works(Excavation)	m^3	10,800	
		Earths Works(Backfill)	m^3	5,850	
		Earths Works(Bank)	m^3	15,300	
		Concrete Works	m^3	2,250	
		Masonry Works	m^3	8,100	
		Intake(Pump Pit)	m^2	495	10m×11m×4.0m
	Waterline Pipe φ600		m	250.0	
		Other (Mechanical Equipment)	Ls	1.0	
Treatment Plant Facilities					
	Treatment Plant (Civil Works)	Temporary Work	Ls	1.0	
		Earths Works (Excavation)	m^3	4579	
		Earths Works (Bank・Backfill)	m^3	1585	
		Concrete Works	m^3	1870	
		Wall Structure Works: Receiving well : 35m^2	m^2	35.0	5m×7m
		Wall Structure Works: Flocculation Tank	m^2	110.0	9m×6m×2sites
		Wall Structure Works: Chemical Reservoir	m^2	200.0	14m×7m×2sites
		Wall Structure Works: Sand Filter	m^2	445.0	25.5m×17.5m
		Wall Structure Works: Clear Water Reservoir	m^2	495.0	33m×15m
		Wall Structure Works: Sludge Drying Bed	m^2	495.0	33m×15m
		Wall Structure Works: Other (Mechanical Equipment)	Ls	1.0	
		Wall Structure Works: Pipes Setting	Ls	1.0	
	Other Building Work	Office & Laboratory	m^2	165.0	15m×11m×7.6m
		Chemical Room	m^2	235.0	20m×9m×3.9m
					11m×5m×7.6m
		Mechanical & Electric Room	m^2	120.0	11m×11m×5.3m
		Workshop	m^2	50.0	8m×6m
		Guard House	m^2	15.0	3m×4.5m
Electrical & Mechanical Cost (E & M)			Ls	1.0	

Table-5.4 Work Quantities for Eastern Water Supply System

Works Description	Works Item		Unit	Quantity	Remarks
Common Temporary Work			Ls	1.0	
Intake & Conduit					Height×Wide×Length
	Intake Weir& Pump Pit	Temporary Work	Ls	1.0	7.8×20×30m
		Earths Works (Excavation)	m^3	3300.0	
		Earths Works (Backfill)	m^3	2000.0	
		Earths Works (Bank)	m^3	5200.0	
		Concrete Works	m^3	650.0	
		Masonry Works	m^3	2700.0	
		Intake (Pump Pit)	m^2	110.0	10m×11m×4.0m
	Waterline Pipe φ600		m	200.0	
		Other (Mechanical Equipment)	Ls	1.0	
Treatment Plant Facilities					
	Treatment Plant (Civil Works)	Temporary Work	Ls	1.0	
		Earths Works (Excavation)	m^3	4579	
		Earths Works (Bank・Backfill)	m^3	1585	
		Concrete Works	m^3	1870	
		Wall Structure Works: Receiving well : 35m^2	m^2	35.0	5m×7m
		Wall Structure Works: Flocculation Tank	m^2	110.0	9m×6m×2sites
		Wall Structure Works: Chemical Reservoir	m^2	200.0	14m×7m×2sites
		Wall Structure Works: Sand Filter	m^2	445.0	25.5m×17.5m
		Wall Structure Works: Clear Water Reservoir	m^2	495.0	33m×15m
		Wall Structure Works: Sludge Drying Bed	m^2	495.0	33m×15m
		Wall Structure Works: Other (Mechanical Equipment)	Ls	1.0	
		Pipes Setting	Ls	1.0	
	Other Building Work	Office & Laboratory	m^2	165.0	15m×11m×7.6m
		Chemical Room	m^2	235.0	20m×9m×3.9m
					11m×5m×7.6m
		Mechanical & Electric Room	m^2	120.0	11m×11m×5.3m
		Workshop	m^2	50.0	8m×6m
		Guard House	m^2	15.0	3m×4.5m
Transmission Facility					
	Waterline Pipeφ600		m	31,000.0	
	Water Pipe Bridge	L=10m,50m,95m,100m	Site	1	
		L=20m	Site	3	
		L=25m	Site	5	
		L=35m	Site	2	
Electrical & Mechanical Cost (E&M)			Ls	1.0	

5.2.4 Construction Plan

Construction method for main facilities is shown in Table-5.5.

Table-5.5 Construction Method of Main Facility

Facility	Construction Method or Construction Sequence	Remark
1) Intake Weir	・Because it becomes work inside the river, it is done in dry season (in May, - October). ・Execution is done with method of the half-river deadline.	Intake weir of the central system should be constructed in the final scale (1.8m^3/s).
2) Water Treatment Plant	・It is planned by a grade-like execution along water-demand. ・Western system does for 1 year and eastern system does for 2-3 years next. ・As for the central system of big capacity (1800 liters/sec), it is divided in the facility of the water ability of 600 liter/sec, and constructed.	
3) Water Pipe	・Adjustment with the road administrator is necessary before the execution. ・The construction of water pipe is presumed at the 60m/ day. ・The execution of the western system is done for six months (8,800m/60m/25day/month). ・The execution of the eastern system is done for six months (3,100m/60m/25day/month).	

Construction Schedule for southern Bali area water supply system is shown in Table-5.6. It takes four years for both western system and eastern system. After completion of these systems, central system shall be started at the fifth year.

Table-5.6 Construction Schedule for Southern Bali Area Water Supply System

System Name and River Name	Works Description	1 year		2 year		3 year		4 year		5 year		6-8 year		9 year		10-12 year		13 year	
		dry	wet	dry	wet	dry	wet	dry	wet	dry	wet	dry	wet	dry	wet	dry	wet	dry	wet
West System	Intake weir	*																	
Penet River	Treatment Plant	*	*																
Water Supply Capacity 300 liter/s	Waterline Pipe	*	*																
Intake weir	Water Pipe Bridge	*	*																
East System	Intake weir			*															
Petanu River	Treatment Plant			*	*														
Water Supply Capacity 300 liter/s	Waterline Pipe			*	*	*	*	*	*										
Intake weir	Water Pipe Bridge			*	*	*	*	*	*										
Central System	Intake weir									*				*				*	
Ayung River	Treatment Plant									*	*			*	*			*	*

Dry Season May-October, Wet Season November-April

5.3 Ayung Multipurpose Dam

5.3.1 General

Dam site for Ayung multipurpose dam with catchments area of 218km^2, reservoir volume of 1,000 thousand m^3 and dam height of 66m is located at the downstream of meeting points of Ayung River and Siap River, belong to Buangga village Petang District in Badung Regency in right side and Payangan village Payangan District Gianyar Regency in the left bank.

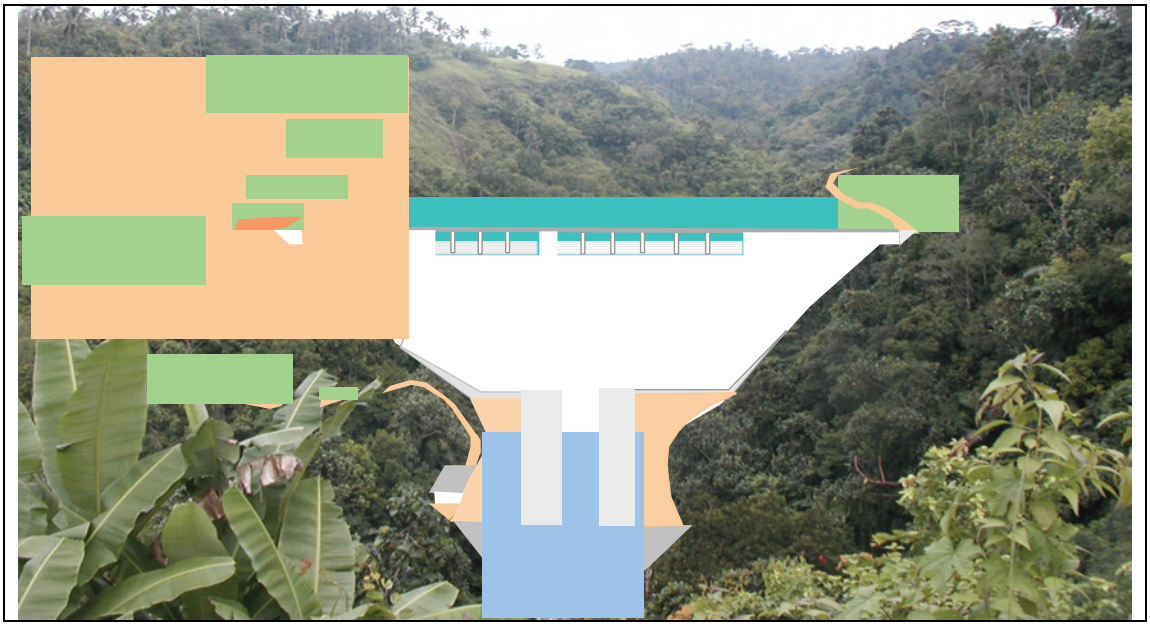


Figure-5.9 Ayung Dam Site from Downstream

The construction purpose of Ayung dam is shown as follows:

Development of Water Supply for Municipal Water

Depend primarily on use of stored water by Ayung Dam, municipal water of 1,800 l/sec (155,500m^3/day) shall be developed and taken at the water treatment plant IPA AYUNG. Due to development of water resource, the prospective shortage of water supply for drinking in Southern Bali Area such as Denpasar City, Badung Regency and Gianyar Regency shall be eliminated.

Maintenance and Improvement of River Environment

By outflow discharge stored by Ayung dam, river environment so as to maintain existing habitat for fauna and flora as well as natural landscape shall be conserved or improved.

In the river flowing to Denpasar City, water quality shall be improved due to the water conveyance of purification water developed by dam reservoir.

Hydro-power Generation

By using the differential head of water stored by Ayung dam, electric power of 8,000 Kw shall be generated.

5.3.2 Criteria for Dam Design

Criteria for dam design are as shown in Table-5.7.

Table-5.7 Criteria for Dam Design

Item	Specifications
Location	Ayung River Buangga village Petang District in Badung Regency in right side, Payangan village Payangan District Gianyar Regency in left side
Design standard	Design Standard authorized by International Commission on Large Dams (ICOLD)
Material values of Dam Foundation	Design shear stresses are as follows. - CH class $\tau = 160tf/m^2 + \tan 45°$ - CM class $\tau = 80tf/m^2 + \tan 40°$ - CL class $\tau = 40tf/m^2 + \tan 30°$
Design Discharge for Spillway	- Catchment Area : 218.4 km^2 - Design Discharge : 1,270 m^3/s (Return Period: 1,000 years) - Specific Discharge : 5.81 $m^3/s/km^2$
Design Sediment Amount	1,000,000m^3 (Storage capacity for sedimentation of Dam) 3,600,000m^3 (controlled sediment volume by 2 Check Dams to be constructed in upstream)
Storage Capacity	- Gross storage capacity : 10,000,000 m^3 - Water use capacity : 9,000,000 m^3 - Storage capacity for sedimentation : 1,000,000 m^3

5.3.3 Design for Ayung Dam

Design criteria applied for design of Ayung Dam are as follows.

(1) Design Discharge

Based on the Indonesian Standard for Dams, Design flood for spillway shall be adopted return period from 500 years to 1,000 years. For Ayung Dam, 1,000 years of return period shall be adopted and 1,270m^3/s shall be applied as design discharge.

(2) Result of Stability Analysis

Among the stability analysis, the condition of normal water level showed the most critical situation. Based on the stability analysis, basic dimension of Ayung dam which minimizes dam volume is shown as follows:

- Downstream Slope 1 : 0.80
- Height of Fillet 10 m
- Upstream Slope of Fillet 1 : 0.4

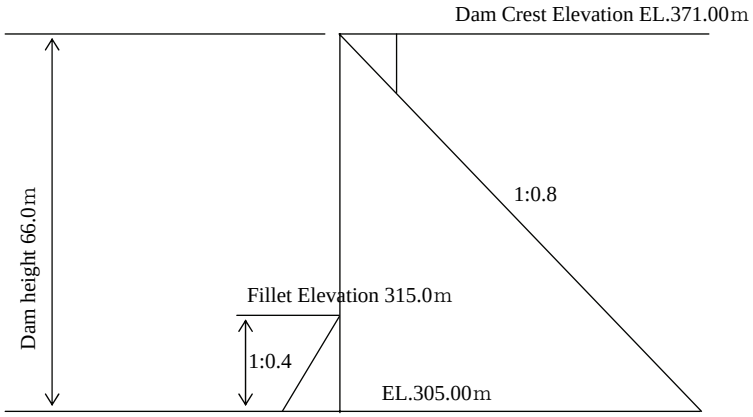


Figure-5.10 Basic Dimension of Ayung Dam

(3) Spillway

Since Ayung Dam does not have flood control function, spillway with capacity of 1,270m^3/sec discharge has to be installed in more than normal water level 366m in elevation. Taking into consideration with dam operation and maintenance, type of spillway for Ayung Dam shall be designed as toe guide wall type with no gates. Relations between overflow depth and width of overflow section to discharge 1,270m^3/sec are calculated.

Considering the river width and spillway width, overflow depth of spillway shall be adopted as 3.0m. Dam top elevation shall be 371m in elevation by adding normal water level 366m in elevation, overflow depth 3.0m, bridge clearance of 1.5m and bridge beam height of 0.5m.

(4) Artificial Concrete Plug

It is wasteful for adopting this dam shape; artificial concrete plug method was adopted. From the economical point of view for the decreasing of dam concrete volume, the height of 35m above riverbed basement with showing narrow width, artificial concrete plug method was adopted.

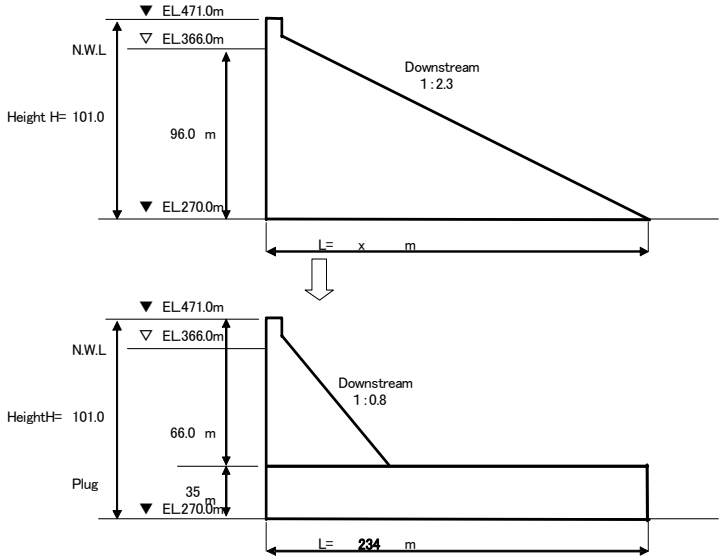


Figure-5.11 Comparison with Dam Shape without Plug and With Plug

(5) Specifications and Drawings

Specifications for dam and Reservoir of Ayung Dam are shown in Table-5.8.

Table-5.8 Specifications of Ayung Dam and Reservoir

Classification	Items	Specifications
1. Reservoir		
	1) Location (River)	Ayung River
	2) Catchments Area	219.4 km^2
	3) Lake Area	0.57 km^2 (EL370m)
	4) Normal Water Level (NWL)	EL 366 m
	5) Low water Level (LWL)	EL 325 m
	6) Effective Volume	9,000,000 m^3
	7) Sediment Volume	1,000,000 m^3
	8) Total Reservoir Volume	10,000,000 m^3
2. Dam		
	1) Dam Type	Concrete Gravity Dam
	2) Dam Top	EL 371 m
	3) Top Length	239 m
	4) Dam Basement	EL 305 m
	5) Dam Height	66 m
	6) Artificial Basement (Plug)	EL 270 m～305m (Plug Treatment)
	7) Total Dam Volume (Inclu. Plug)	290,000 m^3
3. Spillway		
	1) Type	Toe guide wall type with no gates
	2) Design Discharge	1,270 m^3/s (1/1,000)
	3) Depth	3.0 m
	4) Width	113 m (Net width)