CHAPTER 13

DESIGN OF WATER SUPPLY AND DRAINAGE SYSTEMS

13.1 WATER SUPPLY SYSTEMS:

13.1.1 Overview:

- Water supply system inside

The water supply system including all piping, equipment used for processing, distribution and transport of water to the water equipment. The main pipe and fittings are connected together through the co connectors, valves etc .... The pressure regulation system (average expansion, pressure switches) systems adjust the flow of water (water level sensor, electrical float valve, float valve engine ...) and controls electric pump.

- Water

It is supplied of local aquatic.

- Water method

Using a combination water tank and booster pump.

Water from the local hydro meter after the last injection water tank capacity on the ground floor technical room. From ground level water tank pump is connected to the system pumps water activities. Compared to the pressure variant from the roof water tank variants used turbochargers have many advantages:

+ Pressure and water flow in the output of the device guarantees

+ Reduce the load to the building structure by not building roof water tanks

+ Reduce the height of the building design, as the construction of water tank, the roof height to a device pool bottom water to the 9th floor at least 5m to be enough pressure to use.

- Water tank

Water tank is placed in the pump room. Feedwater pump is mounted in the pump room.

- Pipes lines

Using PP-R pipe systems for water (PN10 for cold water and PN20 for hot water), cold water pipe symbol blue stripes. The pipe size was noted directly on the design drawings.

❖ The sanitary system inside

Classification of wastewater:

Wastewater from the hand sink, bathtub and floor drain is collected on a main pipeline D168 mm diameter exit the manholes tangled dirty water out of the city's sewer system.

Distribution and urinal waste water is collected from the pipelines D168mm diameter leading into the holder's own septic tanks located underground. After treatment given drainage of the area along with domestic wastewater.

❖ The system of rain water

Standing rainwater pipes are not used in conjunction with sewage pipes and ventilation.

Plumbing rain on the roof will come in engineering from the roof box directly into the exhaust system of rainwater drainage ditch on the campus of the project.

Pump system: (Look spreadsheet flow and pumping capacity).

❖ Water tank

Water tank with plumbing waiting include: water pipe in, water pipe out, pipe blowdown, overflow drain, vent pipe, glass pipe waiting level visits..

Overflow pipe diameter, in principle larger than 2 inlet pipe size, overflow drain is connected to the stormwater drainage system outside the home.

Septick tank: At the rear of the building and distribution of domestic wastewater from toilets is focused on the septic tank. After a period of sedimentation, water will flow through the filter holder to handle. Eventually the water will be poured into the man hole of the local station

Related design standards:

- TCVN 4513 – 1998: “Internal water supply - Design standards”.
- TCXD 3989 – 1985: “Internal water supply system and construction - Rules and construction acceptance”.
- TCXDVN 33 – 2006: “Water supply pipeline network and construction - Design standards”.
- TCXDVN 33 – 2006: “Water supply - Pipe network and works - Design standards ".

13.1.2 Calculation of water supply system flow:

- Water supply standard:
  - Water users in large industrial zones:

    q_1 = 400 L/per/day, population 250 person Q_{sh1}=100 (m^3/day)
  - Public service water (water the) 10%Q_{sh1}: Q_{cc} =10 (m^3/day)
  - Factory water: Q_{sh2}= 58 (m^3/day)
  - Backup water: 15%.q_{Sh} => q_{dp} =15 (m^3/ngày)
- Water flow:

  Q_{sh1} = (q_1 * number of person) = 47 (m^3/day) (8.1)
- Water flow of production area:

  Q_{sh2} = ∑(q_2 * number of equipment) = 58 (m^3/day) (8.2)
- Total water flow:

  ∑Q_{tt} = 100+10+58+15= 183(m^3/day)

NO	Equip.	Amount	Water used in time (l)	Time used in 1 hour (h)	Water flow Qsd (l/h)	Total Qsd (l/h)	Pipe dim (dm)	Select pipeline actual (mm)
CENTRAL PLANT-1F								
1	Toilet	12	10	8	960	1664	0.485	50
2	Lavabo	7	10	8	560			
3	Urinals	6	2	12	144			
CENTRAL PLANT-2F								
4	Toilet	10	10	8	800	1424	0.449	50
5	Lavabo	6	10	8	480			
6	Urinals	6	2	12	144			
LIBRARY-1F								
7	Toilet	12	10	8	960	1664	0.485	50
8	Lavabo	7	10	8	560			
9	Urinals	6	2	12	144			
LIBRARY-2F								
10	Toilet	8	10	8	640	1192	0.411	50
11	Lavabo	6	10	8	480			
12	Urinals	3	2	12	72			
LIBRARY-3F								
13	Toilet	8	10	8	640	1192	0.411	50
14	Lavabo	6	10	8	480			
15	Urinals	3	2	12	72			
LIBRARY-4F								
16	Toilet	8	10	8	640	1192	0.411	50

17	Lavabo	6	10	8	480			
18	Urinals	3	2	12	72			
Qsd					8328	8328	2.652	300

Table 13.2 Flow of water used for equipment:

Diameter of feeding pipe into sanitary equipment according to installation size is D20mm.

13.1.3 Calculation chosse water tank:

Storage tanks underground water:

$Q_{tw1} = (Q_{sd1}$ x $t_1)/1000$ (m^3)

t_1: Factor using time 1h ~ 2h largest

Q_{tw1} = (8328x 2) /1000 = **16,65** (m^3)

The total water demand: ΣQtt = 50 m^3

The total actual capacity of the underground water tank:

$Q_{sd} = Q_{tt}$ / 70% = 50/ 0.7 = 72 (m^3)

We chose the underground water tanks: 72 (m^3)

13.1.4 CALCULATE AND CHOOSE WATER PUMP

Pump flow rates (l/min):

$Q_{PW} = K_1$ x Q_{sd}/ 60 (l/min)

K_1 : Factor of water use during the biggest (=1.0)

Q_{sd} : 8328 (l/h)

Q_{PW} = 1 x 8328/60 = 138,8 (l/min)

Calculated pressure pump column (mH_20) H = H1 + H2 + H3 + H4

Inside:

H_1 : Pipe friction losses (~75 m_{H20}).

For materials PPR pipe tube 1m average loss ≈ 300Pa.

H_2 : Local friction loss $H_2 = 0.5\ H_1$.

H_3 : Actual height, measured from the top of the pump to suck the cock of the highest position. (75 m_{H20}).

H_4 : Free minimum pressure required

(the pressure to get out the equipment, loss worksheet...30-70pa).

choose 70Pa ($1mH_2O$=9,81Pa)

H_4 = 70/9,81 = 7.1 m_{H20}

Pressure required for water use inside is:

H = 75 x 0.03 + 0.5 x (75 x 0.03) + 75 + 7.1 = 85.475 mH_20.

Choose a safety factor 1,1

=> H' =1.1 × H = 1.1 × 85.475=9402 mH20

With Q = 138,8 l/min and H = 94.02 mH20

Choose to pump EVM 10 11N5/4.0 with flow Q = 150l/mi , Pressure column H = 94,02mH_2O

EVM 3-5-10-18

Pump type EVM 3-5-10-18	Motor kW	Motor HP	Motor Size	Maximum working pressure (MPa)	Q = Capacity l/min 0	20	40	60	75	100	130	150	200	250	300	350	400
					m^3/h 0	1.2	24	3.6	4.5	6.0	7.8	9	12	15	18	21	24
					H = Total manometric head in meters												
B/M 3 2N5/0.37	037	0.5	71	1,6	18,6	16,7	14,0	10,3	6,6	-	-	-	-	-	-	-	-
B/M 3 3N5/0.37	037	0.5	71	1,6	27,9	25,1	20,9	15,5	9,9	-	-	-	-	-	-	-	-
B/M 3 4N5/0.55	055	0.75	71	1,6	37,2	33,4	27,9	20,6	13,2	-	-	-	-	-	-	-	-
B/M 3 5N5/0.55	055	0.75	71	1,6	46,5	42,0	34,9	25,8	16,5	-	-	-	-	-	-	-	-
B/M 3 6N5/0.75	075	1	80	1,6	56,0	50,0	42,0	30,9	19,8	-	-	-	-	-	-	-	-
B/M 3 7N5/0.75	075	1	80	1,6	65,0	58,5	49,0	36,1	23,1	-	-	-	-	-	-	-	-
B/M 3 9N5/1.1	1,1	1.5	80	1,6	84,0	75,0	63,0	46,5	29,7	-	-	-	-	-	-	-	-
B/M 3 11N5/1.1	1,1	1.5	80	1,6	102,0	92,0	77,0	56,5	36,3	-	-	-	-	-	-	-	-
B/M 3 13N5/1.5	1,5	2	90S	1,6	121,0	109,0	90,5	67,0	43,0	-	-	-	-	-	-	-	-
B/M 3 15N5/1.5	1,5	2	90S	1,6	140,0	125,0	105,0	77,5	49,5	-	-	-	-	-	-	-	-
B/M 3 18F5/2.2	2,2	3	90L	2,5	167,0	151,0	126,0	92,5	59,5	-	-	-	-	-	-	-	-
B/M 3 22F5/2.2	2,2	3	90L	2,5	205,0	184,0	154,0	113,0	72,5	-	-	-	-	-	-	-	-
B/M 3 26F5/3.0	3	4	100	2,5	242,0	217,0	182,0	134,0	86,0	-	-	-	-	-	-	-	-
B/M 5 2N5/0.37	037	0.5	71	1,6	20,2	-	18,4	16,9	15,4	12,2	6,9	-	-	-	-	-	-
B/M 5 3N5/0.55	055	0.75	71	1,6	30,2	-	27,6	25,3	23,1	18,4	10,3	-	-	-	-	-	-
B/M 5 4N5/0.75	075	1	80	1,6	40,5	-	36,8	33,8	30,8	24,5	13,8	-	-	-	-	-	-
B/M 5 5N5/1.1	1,1	1.5	80	1,6	50,5	-	46,0	42,0	38,6	30,6	17,2	-	-	-	-	-	-
B/M 5 6N5/1.1	1,1	1.5	80	1,6	60,5	-	55,0	50,5	46,5	36,7	20,6	-	-	-	-	-	-
B/M 5 7N5/1.5	1,5	2	90S	1,6	70,5	-	64,5	59,0	54,0	43,0	24,1	-	-	-	-	-	-
B/M 5 8N5/1.	1,5	2	90S	1,6	80,5	-	73,5	67,5	61,5	49,0	27,5	-	-	-	-	-	-
B/M 5 10N5/2.2	2,2	3	90L	1,6	102,0	-	93,5	86,0	79,0	63,0	36,6	-	-	-	-	-	-
B/M 5 11N5/2.2	2,2	3	90L	1,6	113,0	-	103,0	94,5	86,5	69,5	40,5	-	-	-	-	-	-
B/M 5 12N5/2.2	2,2	3	90L	1,6	123,0	-	112,0	103,0	94,5	75,5	44,0	-	-	-	-	-	-
B/M 5 14N5/3.0	3	4	100	1,6	143,0	-	131,0	120,0	1100	88,0	51,0	-	-	-	-	-	-
B/M 5 16N5/3.0	3	4	100	1,6	164,0	-	150,0	138,0	126,0	101,0	58,5	-	-	-	-	-	-
B/M 5 18F5/4.0	4	5.5	112	2,5	184,0	-	168,0	155,0	142,0	113,0	66,0	-	-	-	-	-	-
B/M 5 19F5/4.0	4	5.5	112	2,5	194,0	-	178,0	163,0	150,0	120,0	69,5	-	-	-	-	-	-
B/M 5 22F5/4.0	4	5,5	112	2,5	225,0	-	206,0	189,0	173,0	139,0	80,5	-	-	-	-	-	-
B/M 5 24F5/5.5	5,5	7,5	132S	2,5	246,0	-	224,0	206,0	189,0	151,0	88,0	-	-	-	-	-	-
B/M 10 2N5/0.75	075	1	80	1,6	22,0	-	-	-	21,0	20,4	18,9	17,6	13,2	7,8	-	-	-
B/M 10 3N5/1.1	1,1	1,5	80	1,6	33,0	-	-	-	31,6	30,5	28,4	26,4	19,8	11,7	-	-	-
B/M 10 4N5/1.5	1,5	2	90S	1,6	44,0	-	-	-	42,0	40,5	37,8	35,2	26,4	15,6	-	-	-
B/M 10 5N5/2.2	2,2	3	90L	1,6	55,0	-	-	-	52,5	51,0	47,5	44,0	33,0	19,5	-	-	-
B/M 10 6N5/2.2	2,2	3	90L	1,6	66,0	-	-	-	63,0	61,0	57,0	53,0	39,5	23,4	-	-	-
B/M 10 8N5/3.0	3	4	100	1,6	88,0	-	-	-	84,0	81,5	75,5	70,5	52,5	31,2	-	-	-
B/M 10 10N5/4.0	4	5,5	112	1,6	110,0	-	-	-	105,0	102,0	94,5	88,0	66,0	39,0	-	-	-
B/M 10 11N5/4.0	4	5,5	112	1,6	121,0	-	-	-	116,0	112,0	1040	97,0	72,5	43,0	-	-	-
B/M 10 12N5/5.5	5,5	7,5	132S	1,6	134,0	-	-	-	130,0	126,0	1180	111,0	86,5	55,0	-	-	-
B/M 10 14N5/5.5	5,5	7,5	132S	1,6	157,0	-	-	-	151,0	147,0	1380	130,0	101,0	64,5	-	-	-
B/M 10 15F5/5.5	5,5	7,5	132S	2,5	168,0	-	-	-	162,0	158,0	1480	139,0	108,0	69,0	-	-	-
B/M 10 16F5/7.5	7,5	10	132S	2,5	179,0	-	-	-	173,0	168,0	1580	148,0	115,0	73,5	-	-	-
B/M 10 18F5/7.5	7,5	10	132S	2,5	202,0	-	-	-	194,0	189,0	1770	167,0	129,0	83,0	-	-	-
B/M 10 20F5/7.5	7,5	10	132S	2,5	224,0	-	-	-	216,0	210,0	1970	185,0	144,0	92,0	-	-	-

13.2 SANITARY SYSTEM

Consists of three separate type: Hard Waste, waste water, waste kitchen

Calculate the size of waste water pipes:

Table 12.2: *Factor of waste water unit*

Equip.	Unit load factor	Diameter pipe fitting equipment
Toilet	4	75
Lavabo	1	40
Urinals	4	50

Table 12.3: *Calculate pipe size*

DIAMETER	Unit load factor
40	3
50	6
65	12
75	20
100	160
125	360
150	620

From " Factor of sewage unit " I get the unit load coefficient for each wastewater equipment and diameter tubing directly to the device.

Look up table " Spreadsheet size pipe ", from generation units have been diameter sewage pipe

CHOOSE**:** Pipes confluence of two or more toilet pipe size is D140.

All sewage pipes have a minimum slope of 1/100 = 1%

- **Calculate septic tank**: Here we use type 3 septic pit stop.

W= Wn+Wc

Wn: the volume of wastewater into septic tanks in a day.

Wn = (4 x 4) x 5 = 80 m^3

Wc: *T*he volume of condensate tanks.

$$Wc = \frac{a \times T(100 - W1)b \times c \times N}{(100 - W2)100}$$, m^3

a: the amount of residue on average a person discharged in one day and night *(a = 0,5 l/ person day, night).*

T: the time between taking the residue. *T=180 days*

W_1, W_2: moisture residue in fresh hot and when the fermentation. *W1=95%, W2=90%*

b: factor of decrease volume of residue when fermented. *b = 0.7* (decrease *30%)*

c: factor retained part residue when smoking, to retain the microorganisms. *c=1.2 (keep 15%).*

N: the number of people that septic service *(N= 30 people).*

$$Wc = \frac{0{,}5x180x(100-95\%)0{,}7x1{,}15x30}{(100-90\%)x100} = 21.7$$

⇨ W = 80 + 21.7 = 101.7 = 102 m^3.

13.3 RAIN WATER SYSTEM

The total rain water:
Rainwater pipe diameter is calculated on the basis of floor area roof

We have formula : $Q = K\frac{Fq_5}{10.000}$

With
q_5: Rainfall intensity (l / s / ha) for the local computer time 5 minutes and wet periods in excess intensity calculated by 1 year (p=1)

F: water collection area (m^2)

K: coefficients obtained is 2

With: q_5 = 496 l/s.ha (TCVN 4474:1987)

Save rainfall calculated for a funnel rainwater harvesting, or for a stand pipe rainwater collected shall not exceed the values recorded in Table 9 (TCVN 4474:1987)

With the roof area: 1300 m^2

We have: Q_m = 128.96 l/s

Choose DN100 pipe stand. With water flow calculation for 1 pipe stand D100 is 20 l / s (table 9 TCVN 4474:1987).

Number of TNM minimum vertical pipe:

$$n = \frac{128.96}{20} = 6.5 \sim 7 \text{ pipe DN100 .}$$

We choose 7 Pipes DN100 stand pipes (inside wall).