

ME444 ENGINEERING PIPING SYSTEM DESIGN

**CHAPTER 7 : BUILDING
PLUMBING SYSTEM**

LAST SESSION

1. Fundamental of Pumps
2. Operating Point
3. Pump Selection
4. Pump Installation

CONTENTS

1. INTRODUCTION
2. ESTIMATION OF DEMAND
3. PIPING IN TOILET ROOM
4. BUILDING CW PIPING
5. EXERCISE

1. INTRODUCTION

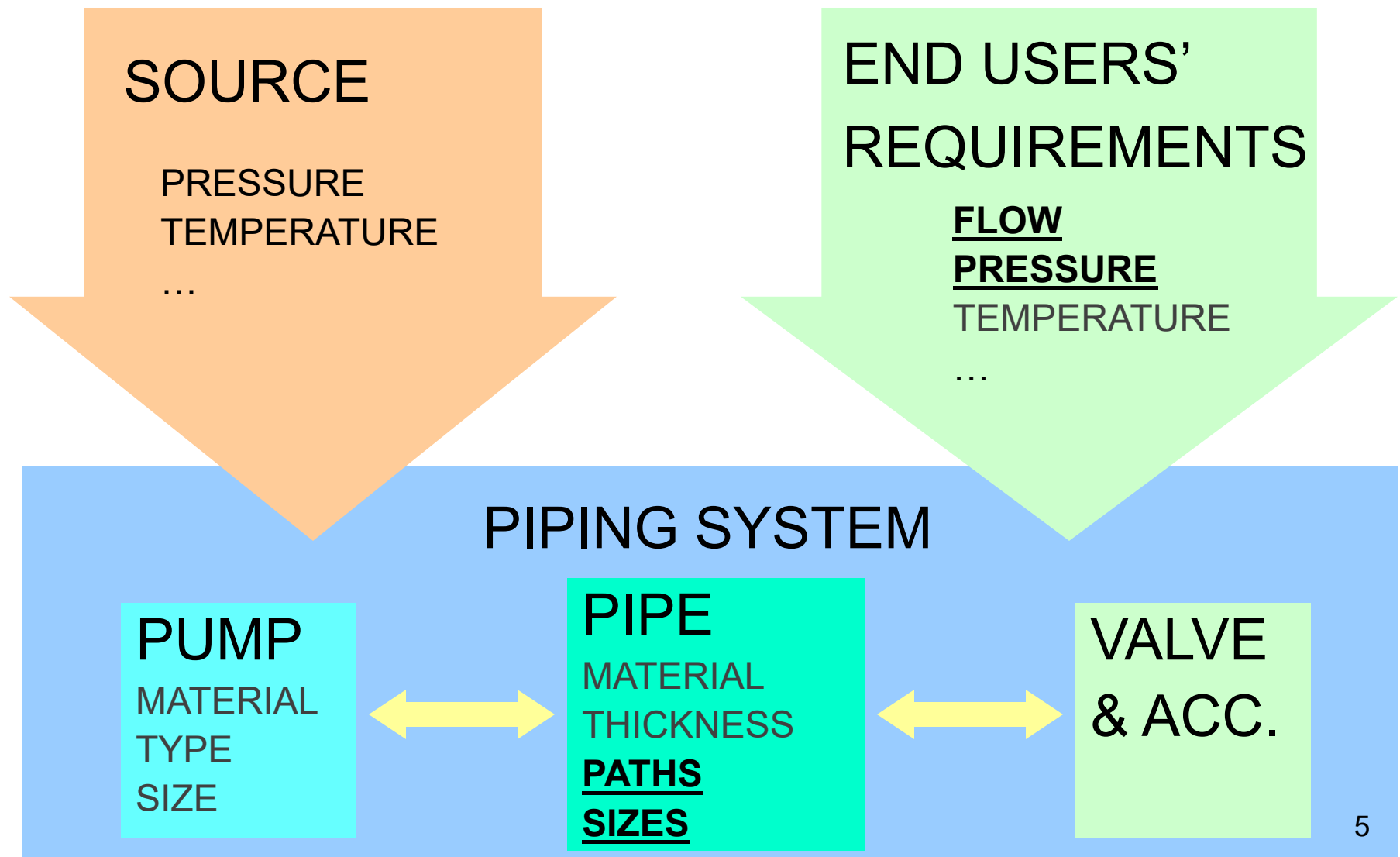
OBJECTIVE:

PROVIDE SUFFICIENT FLOWRATE @
SUFFICIENT PRESSURE

GENERAL INFORMATION

- GALVANIZED STEEL AND PVC PIPES ARE POPULAR.
- WATER AUTHORITY SUPPLY CW AT 2 BARS (ENOUGH FOR 3 STOREY BUILDINGS)

DESIGN FOCUS



PLUMBING FIXTURES



SH



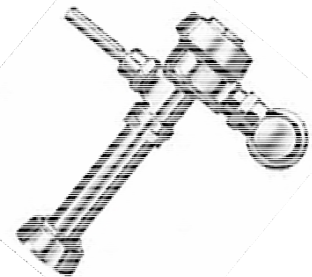
UR



BD



WC



HB



6

PLUMBING FIXTURES



LAV

LAVATORY



UR

URINAL



WC

WATER CLOSET
(FLUSH TANK)



WC

WATER CLOSET
(FLUSH VALVE)

PLUMBING FIXTURE (2)



BT

BATH TUB



SH

SHOWER



BD

BIDET

WATER REQUIREMENT

FIXTURES		FIXTURE UNIT (FU)	PIPE SIZE (DN)	FLOW RATE (lpm)	PRESSURE (bar)
Bath tub	BT	2	15	19	
Lavatory (private)	LAV	1	10	8	0.34
Lavatory (public)	LAV	2	10	8	0.55-0.85
Shower	SH	2	15	11	0.82
Urinal (flush valve)	UR	5	20	38-76	1
Water closet (flush tank)	WC	5	15	11-19	0.7-1.4
Water closet (flush valve)	WC	10	25	57-150	
Bathroom group (flush tank)	WC LAV SH/BT	6			
Bathroom group (flush valve)	WC LAV SH/BT	8			
Bidet		1	15	8	

WATER REQUIREMENT(2)

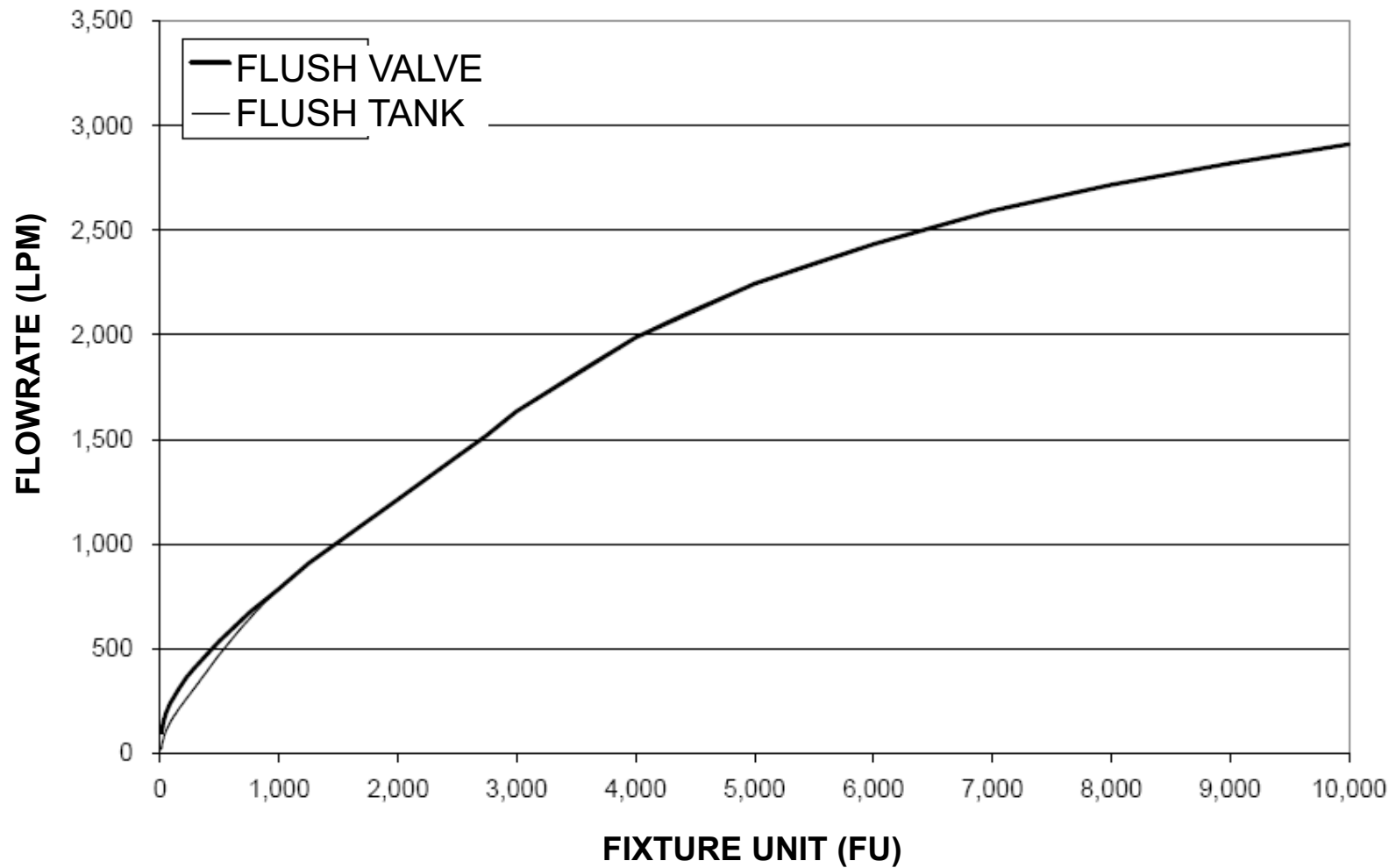
FIXTURES		FIXTURE UNIT	PIPE SIZE	FLOW RATE	PRESSURE
		(FU)	(DN)	(lpm)	(bar)
Drinking fountain		0.5	15	2	
Clinic sink		2	15	11	
Dishwasher (domestic)		1	15	11	
Dental sink		1	15	4	
Kitchen sink		2	15	11	
Washing machine		2	15	19	
Laundry tray		2	15	11	
Hose bib (private)	HB	3	15	11	
Hose bib (public)	HB	5	20	19	

2. ESTIMATION OF DEMAND

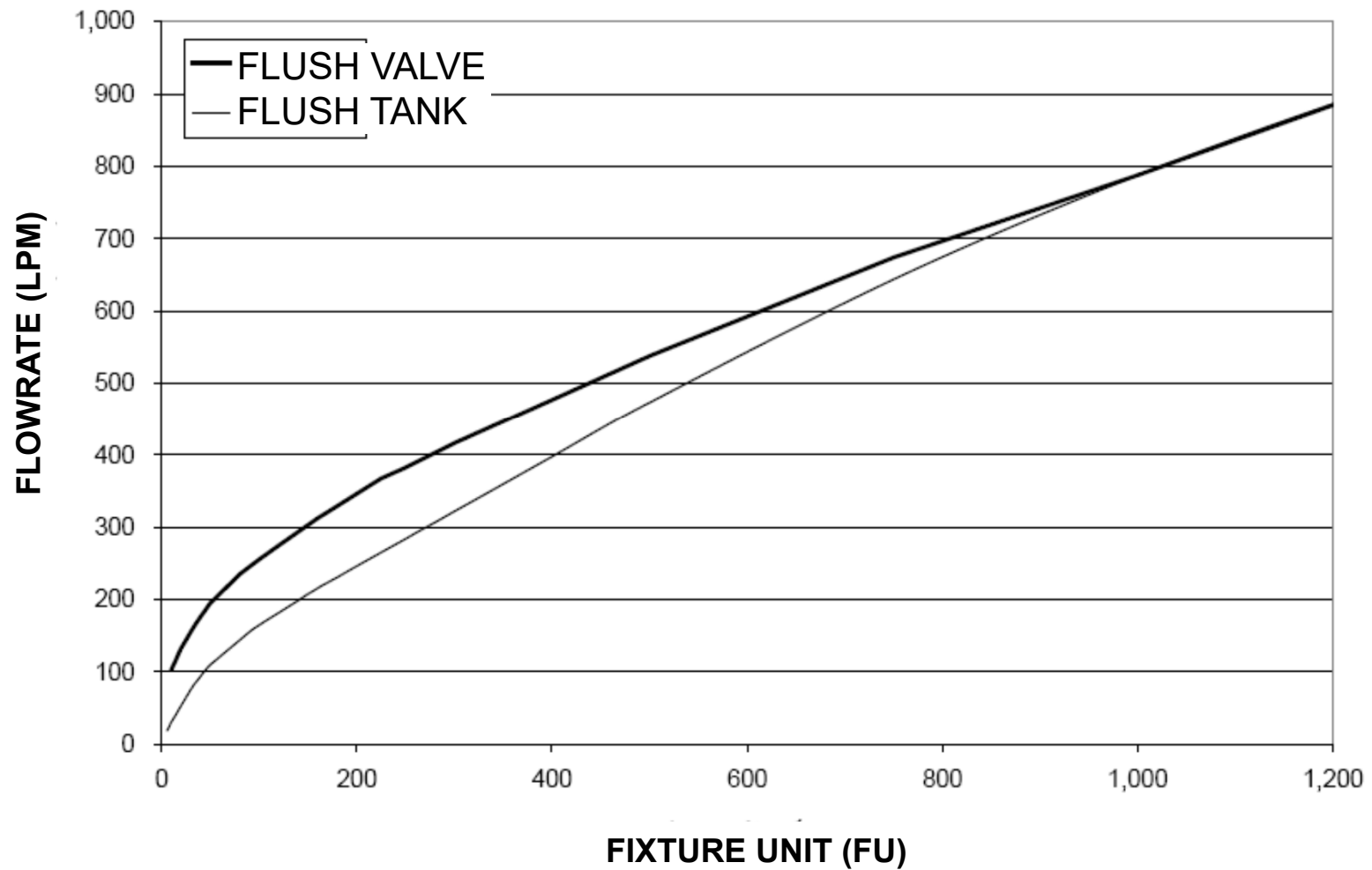
ALL FIXTURES IN THE BUILDING DON'T REQUIRE WATER AT THE SAME TIME.

STATISTICAL INFORMATION HAS BEEN COLLECT AND MODELLED BY HUNTER (1941) FOR OFFICE BUILDINGS.

HUNTER'S CURVE



HUNTER'S CURVE (ZOOM)

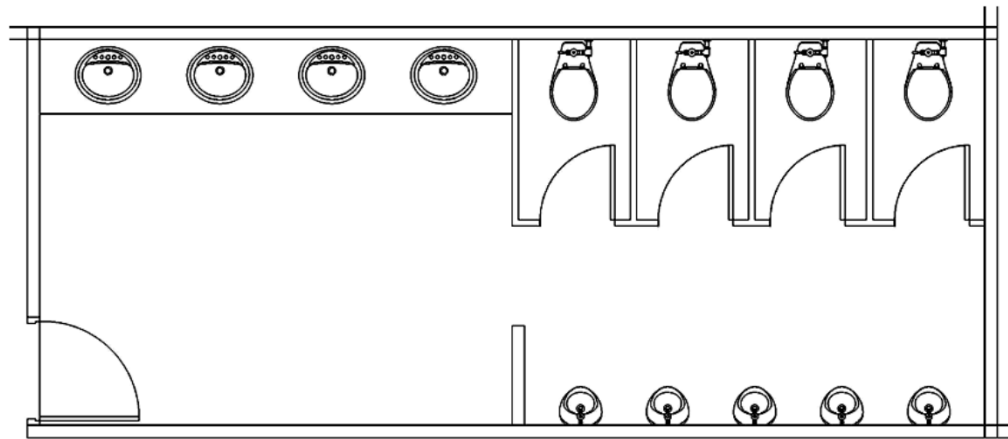


HUNTER'S CURVE (TABULATED, PARTIAL)

FIXTURE UNIT (FU)	DEMAND FLOWRATE (LPM)	
	ระบบที่ใช้ ถังชักโครก (FLUSH TANK)	ระบบที่ใช้ วาล์วชักโครก (FLUSH VALVE)
6	19	
8	25	
10	30	102
12	35	108
14	39	114
16	44	120
18	48	126
20	53	132
25	64	144
30	76	155
35	85	166

FIXTURE UNIT (FU)	DEMAND FLOWRATE (LPM)	
	ระบบที่ใช้ ถังชักโครก (FLUSH TANK)	ระบบที่ใช้ วาล์วชักโครก (FLUSH VALVE)
225	265	367
250	284	382
275	303	399
300	322	416
400	397	477
500	473	537
750	643	674
1,000	787	787
1,250	908	908
1,500	1,011	
1,750	1,113	

EXAMPLE 7.1: ESTIMATE DEMAND OF THE TOILET



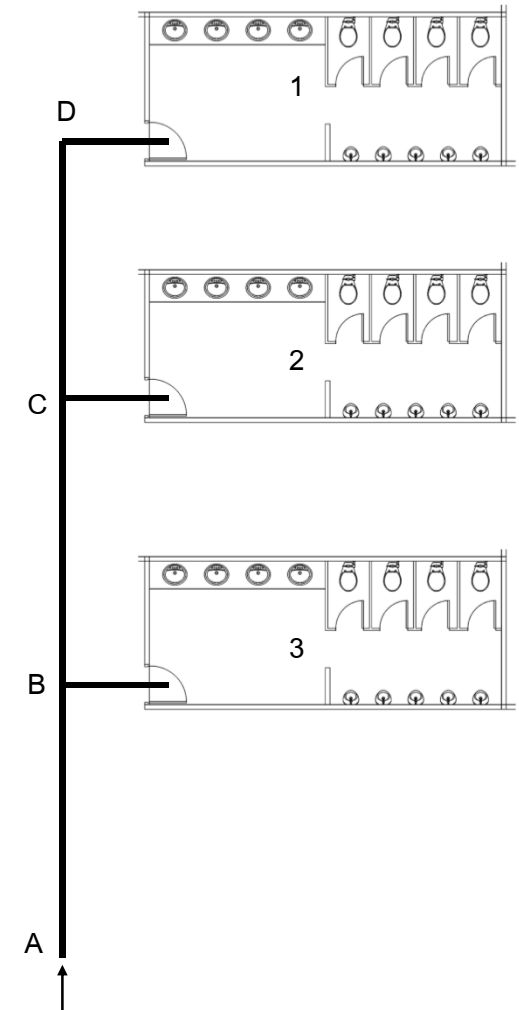
Fixture	FU	Quantity	Sum FU
WC			
UR			
LAV			
		Total FU	
		Flowrate	225.2

EXAMPLE 7.2: ESTIMATE DEMAND OF THE SYSTEM

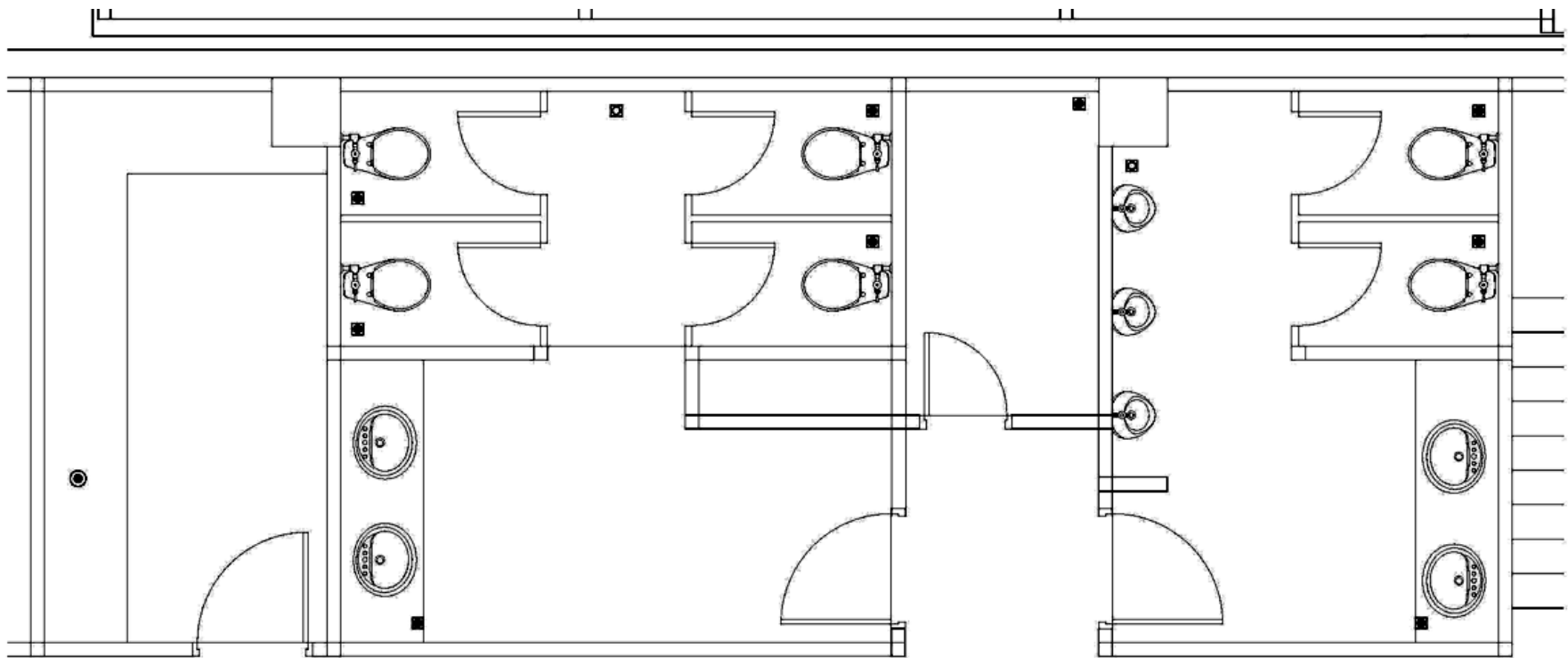
Toilet	FU	Section	Section FU	LPM	Pipe size
1		CD			
2		BC			
3		AB			

System flowrate → sum FU of all toilets

Common mistake → sum lpm of all toilets



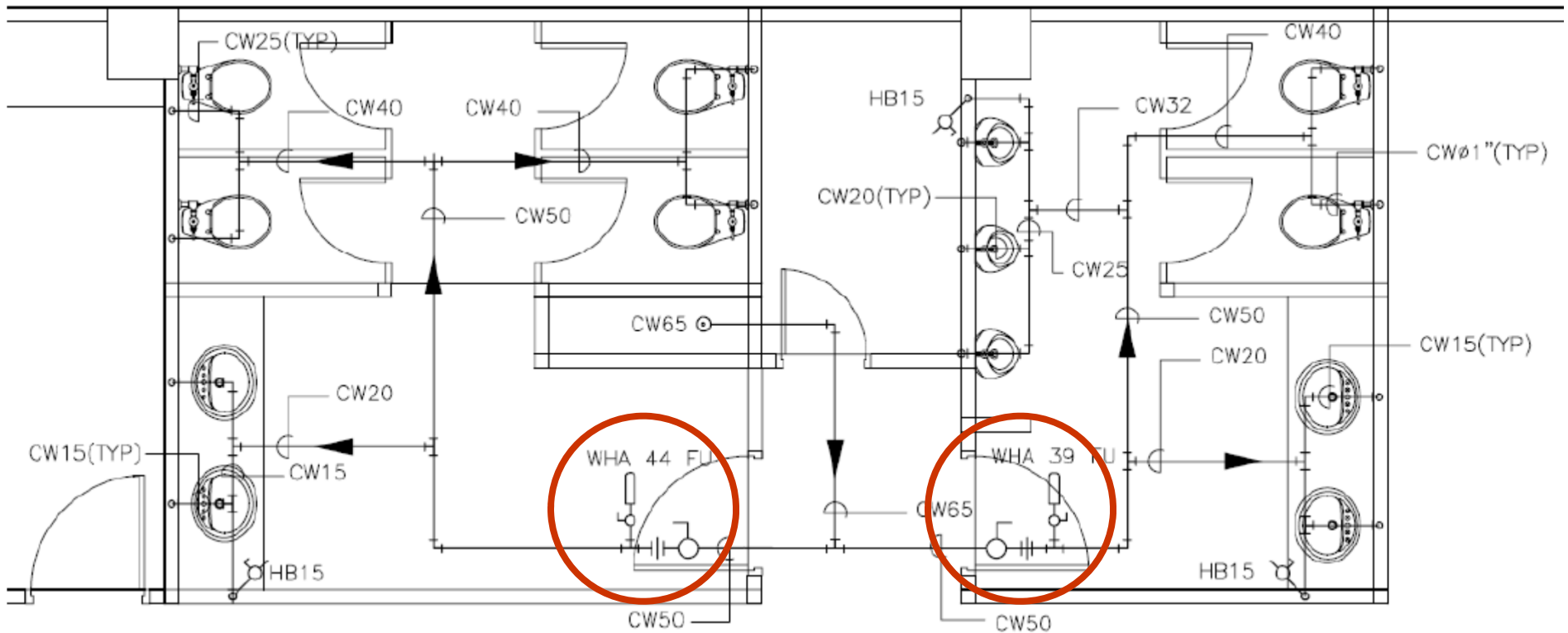
3. PIPING IN TOILET



ARCHITECTURAL DRAWING

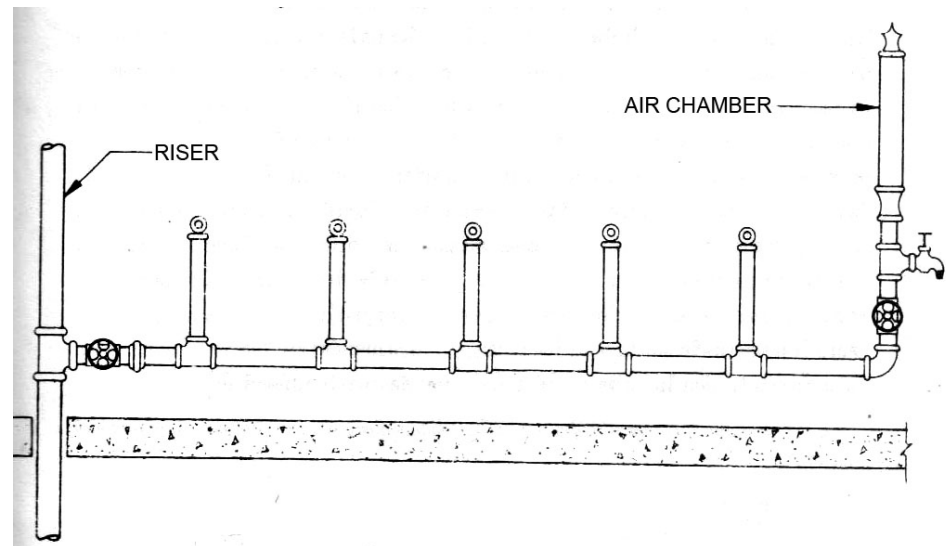
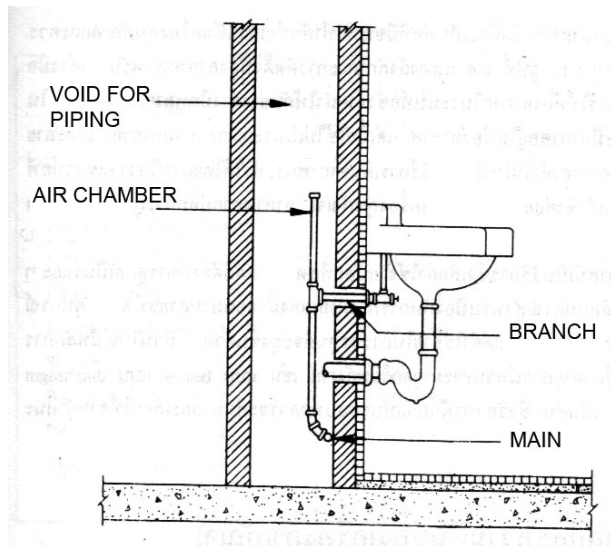
CW PIPING DRAWING

M/F TOILETS PLAN



CW pipes are usually installed above the ceiling

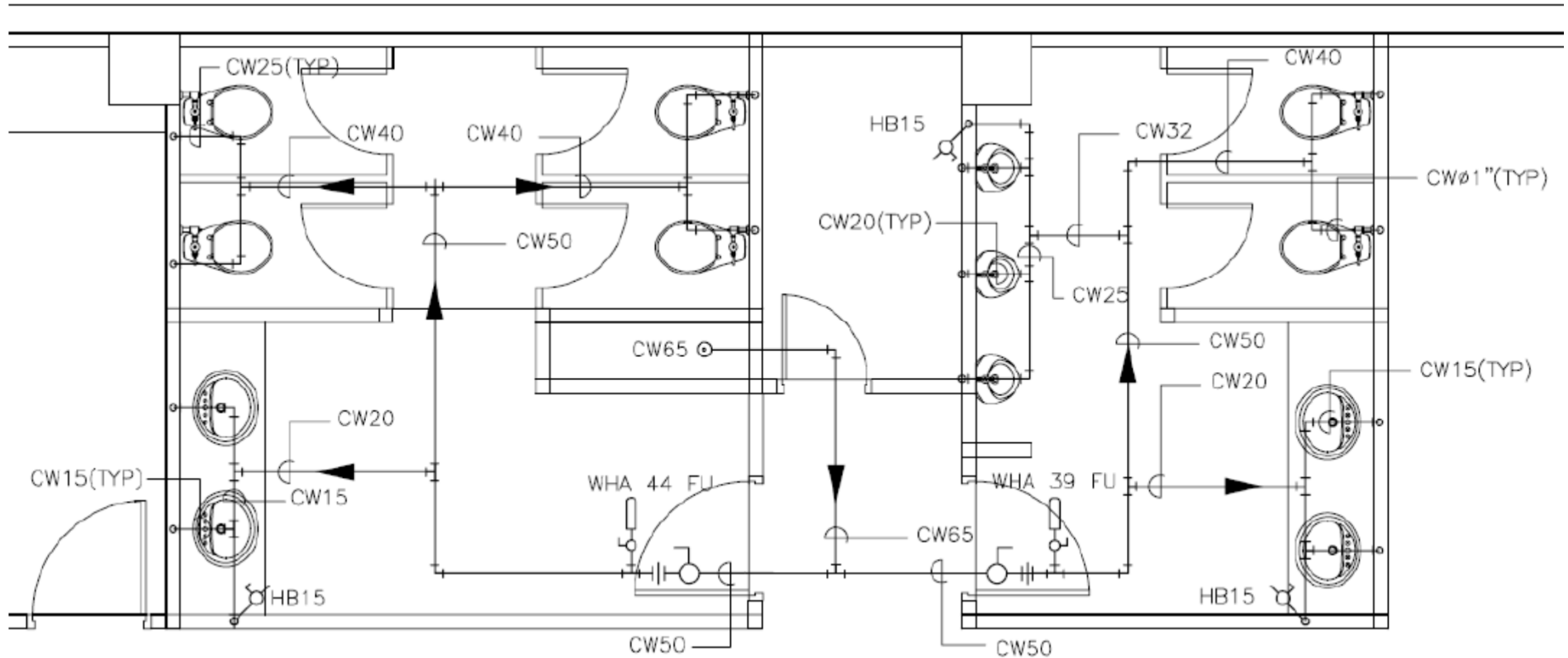
WATER HAMMER PREVENTION



WATER HAMMER ARRESTER



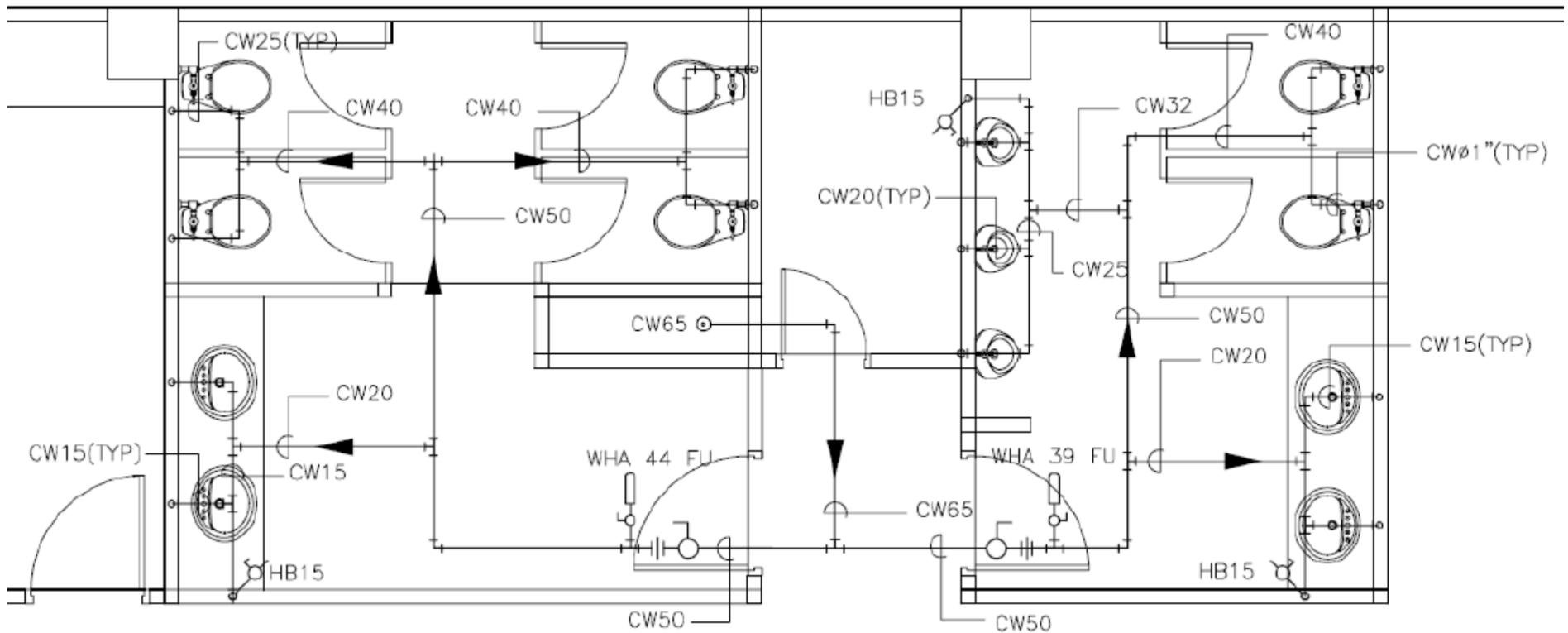
PIPE SECTIONS



3 SECTIONS OF PIPE IN TOILETS:

- CONNECTION TO FIXTURE
- HEADER BRANCH
- MAIN PIPE

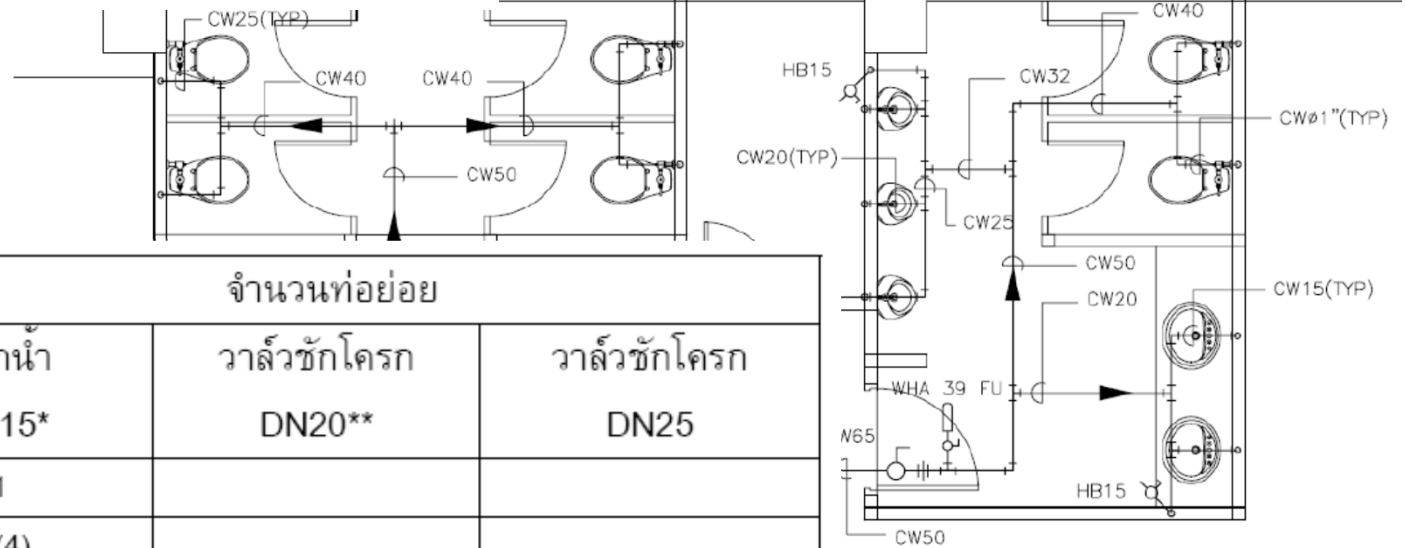
CONNECTION TO FIXTURE



- CONNECTION TO FIXTURE FOLLOW TABLE 7.1

HEADER BRANCH SIZING

■ HEADER BRANCH FOLLOW TABLE 7.3



ขนาดท่อรวม	จำนวนท่อย่อย		
	ก๊อกน้ำ DN15*	วาล์วชักโครก DN20**	วาล์วชักโครก DN25
15	1		
20	3 (4)		
25	6 (10)		
32	12 (20)	2	1
40	20 (30)	8	4
50	35 (50)	24	12
65	60 (90)	50	25
80	85 (125)	80	40
100	150 (225)	200	100

*ตัวเลขในวงเล็บหมายถึงกรณีใช้งานโดยเฉลี่ยไม่พร้อมกันทั้งหมด

** วาล์วชักโครก DN20 สองตัวเทียบเท่ากับวาล์วชักโครก DN25 หนึ่งตัว

MAIN PIPE SIZING

- CALCULATE **FU** IN EACH SECTION
- CONVERT **FU** INTO **LPM**
- FOLLOW RECOMMENDATION IN CHAPTER 5

4. BUILDING CW PIPING



SYSTEM TYPES

UPFEED SYSTEM

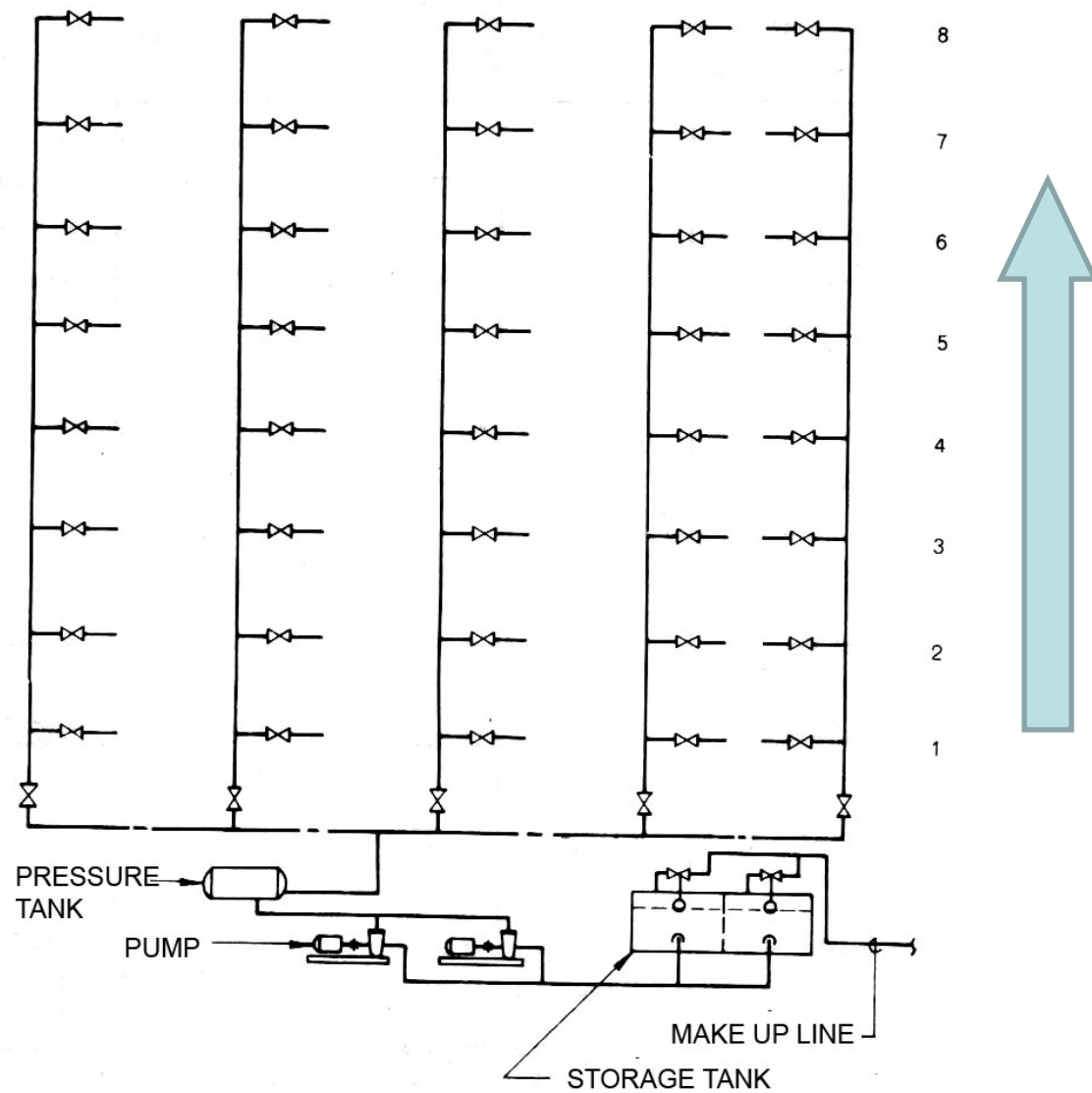
REQUIRE PRESSURE TANK (25-30 TIMES OF FLOWRATE)
FOR SMALL SYSTEM

- LESS THAN 10 STOREYS
- LESS THAN 10,000 SQ.M.

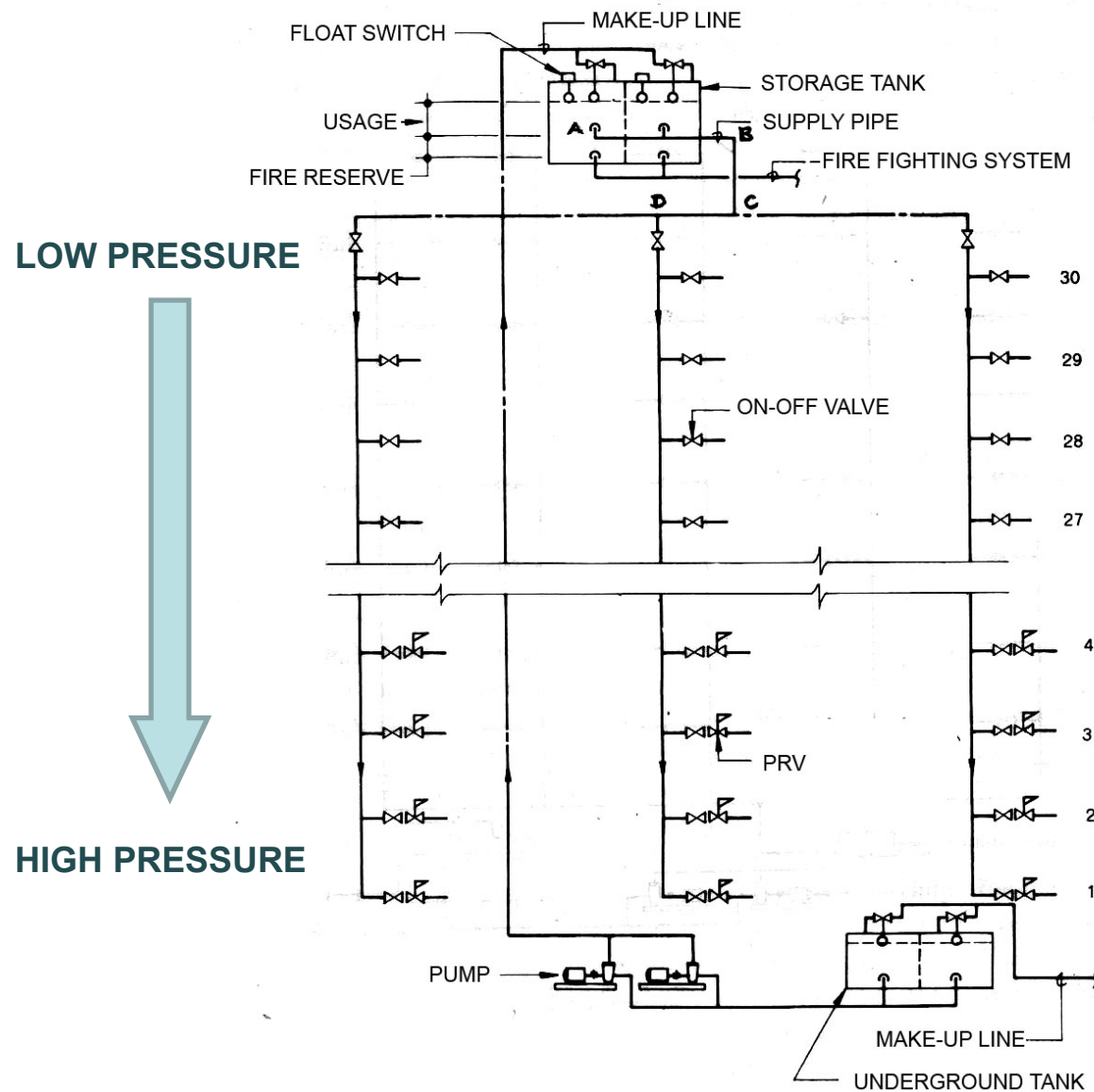
DOWN FEED

- MAY NEED PRESSURE REDUCING VALVE
- REQUIRE STORAGE TANK ON ROOF

UPFEED SYSTEM



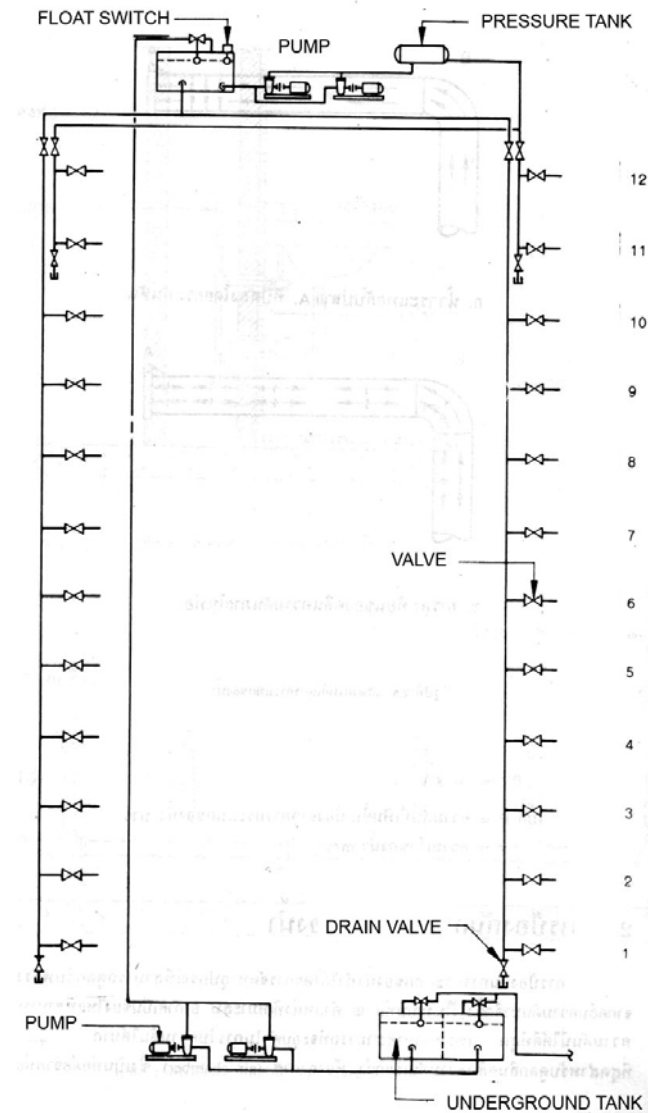
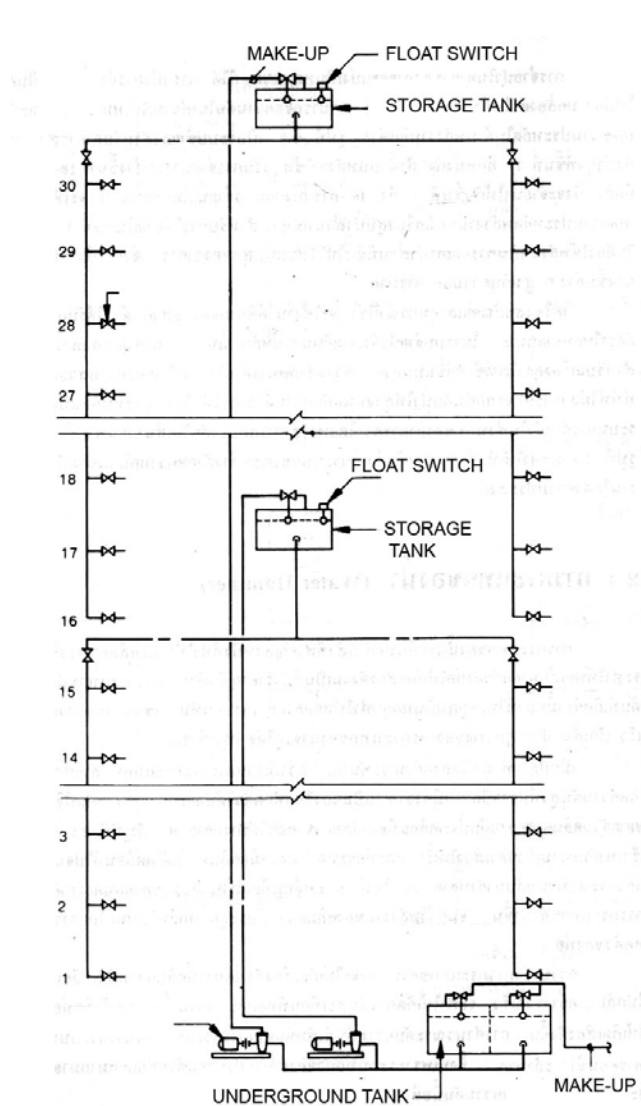
DOWNFEED SYSTEM



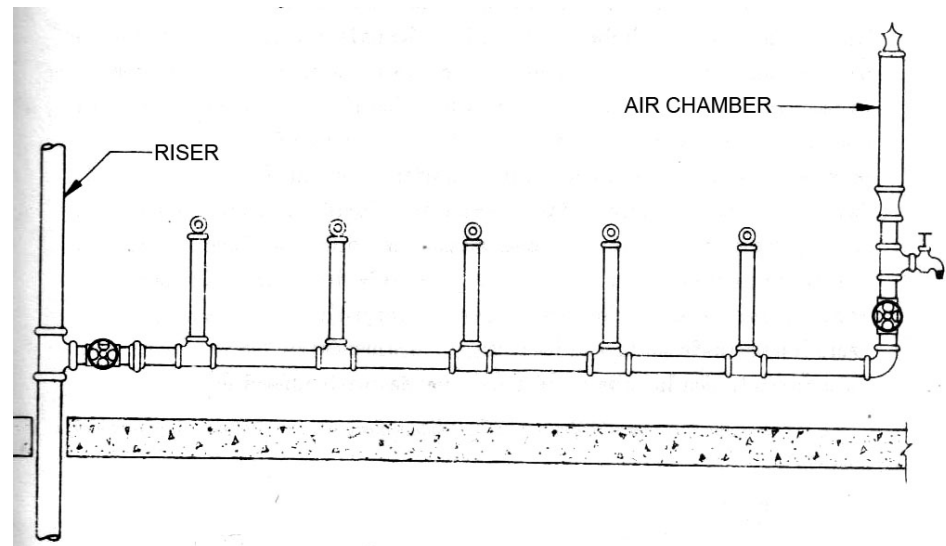
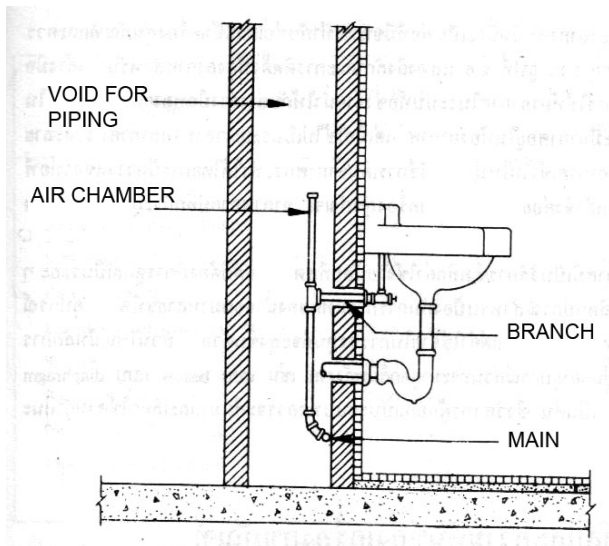
DOWNFEED SYSTEM PROBLEMS

- NORMAL VALVES ARE RATED AT 10 BARS
- LOW PRESSURE NEAR TANK
- HIGHER PRESSURE AT LOWER FLOOR
- DO NOT EXCEED 5 BARS AT THE FIXTURES
- PRV'S ARE EXPENSIVE
- INSTALL PRV IN RISER EVERY 8 FLOORS CAN SAVE COST
- **MULTI-TANK SYSTEM** SHOULD BE CONSIDERED FOR HIGH RISED BUILDINGS
- USE **MIXED SYSTEM** TO SOLVE LOW PRESSURE PROBLEM AT TOP FLOORS

MULTI TANK AND MIXED SYSTEMS



WATER HAMMER PREVENTION



WATER HAMMER ARRESTER

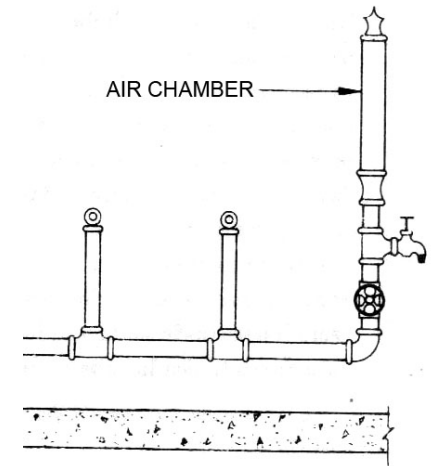


WATER HAMMER PREVENTION

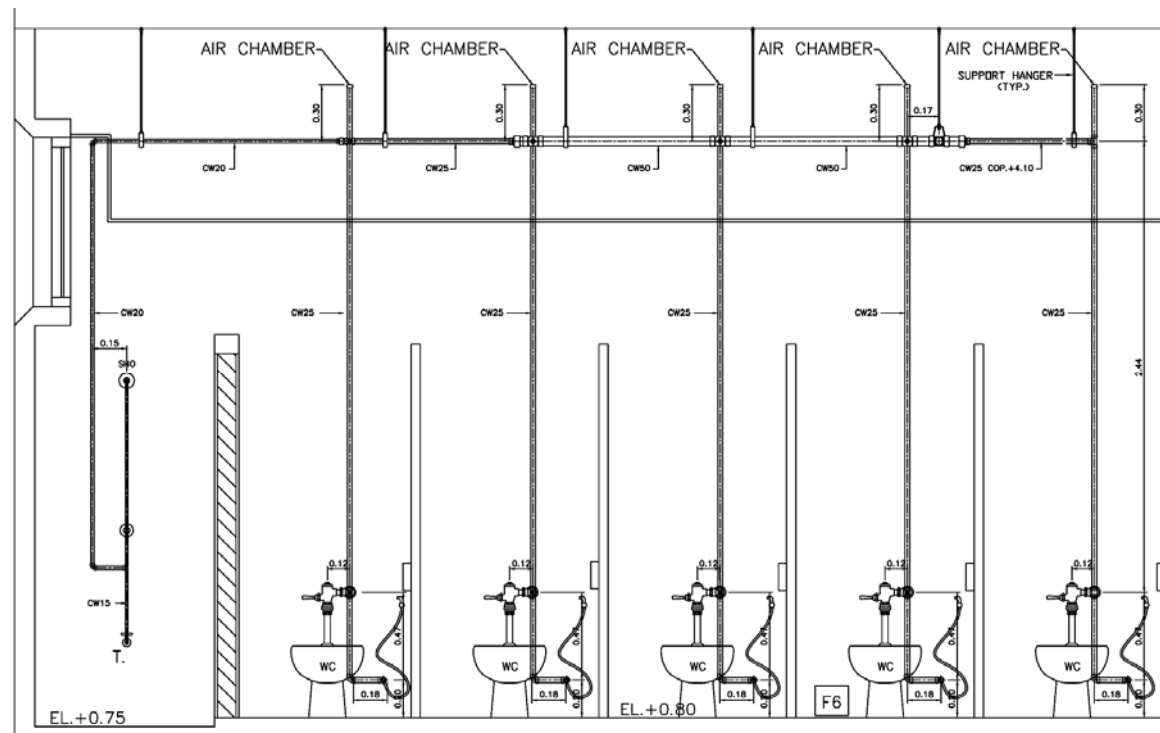
มาตรฐานท่อระบบสุขาภิบาล มยพ.3101-51

AIR CHAMBER

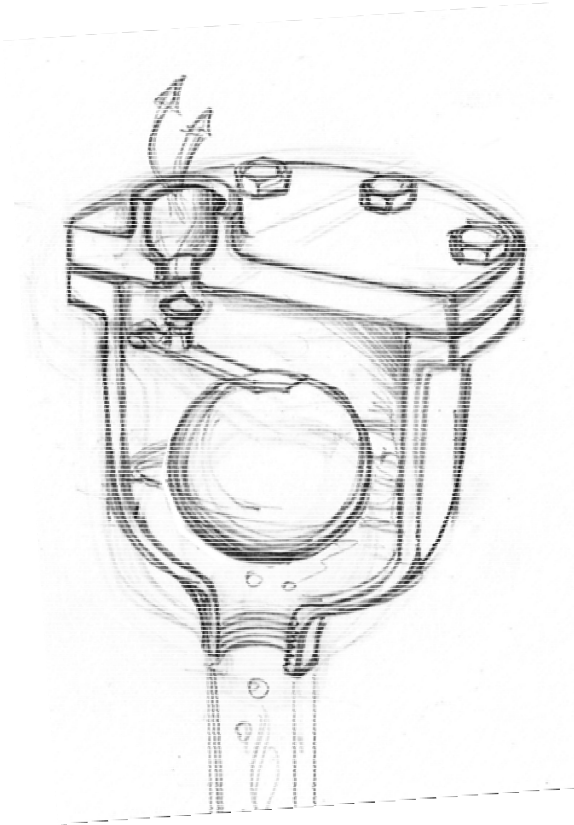
- (1) Must be installed at the end of the branch pipe.
- (2) Must be at least one size above the pipe size.
- (3) Must be at least 20 mm diameter and 450 mm tall.
- (4) The end of the air chamber must be capped and sealed to prevent air leak.
- (5) Bottom of the air chamber must have a shut off valve and a drain valve



WATER HAMMER PREVENTION



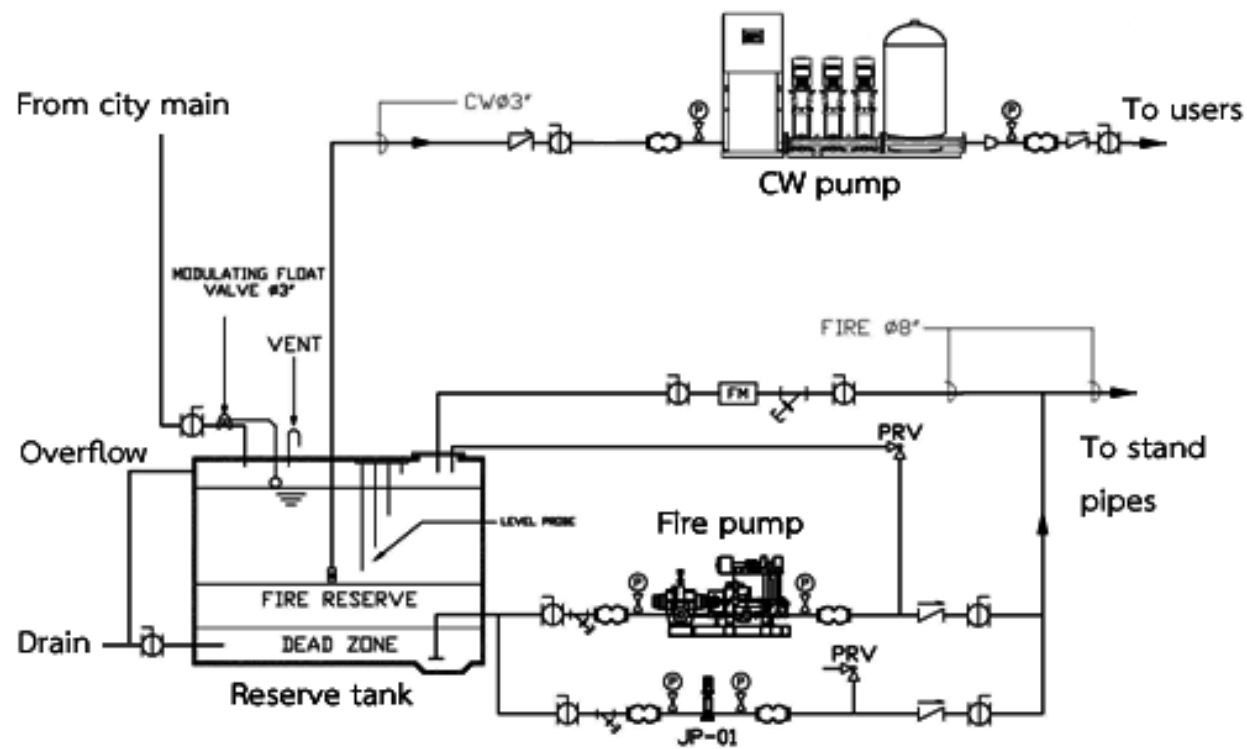
AIR RELEASE VALVE



Air release valves shall be install at the highest point of the piping system or any points that air can be trapped. Class PN10 (10 bars) is required.

PIPE SIZE	AIR RELEASE VALVE SIZE	TYPE OF JOINT
100	25 single-float	THREADED
200	50 double-float	FLANGED
300	80 double-float	FLANGED
600	100 double-float	FLANGED

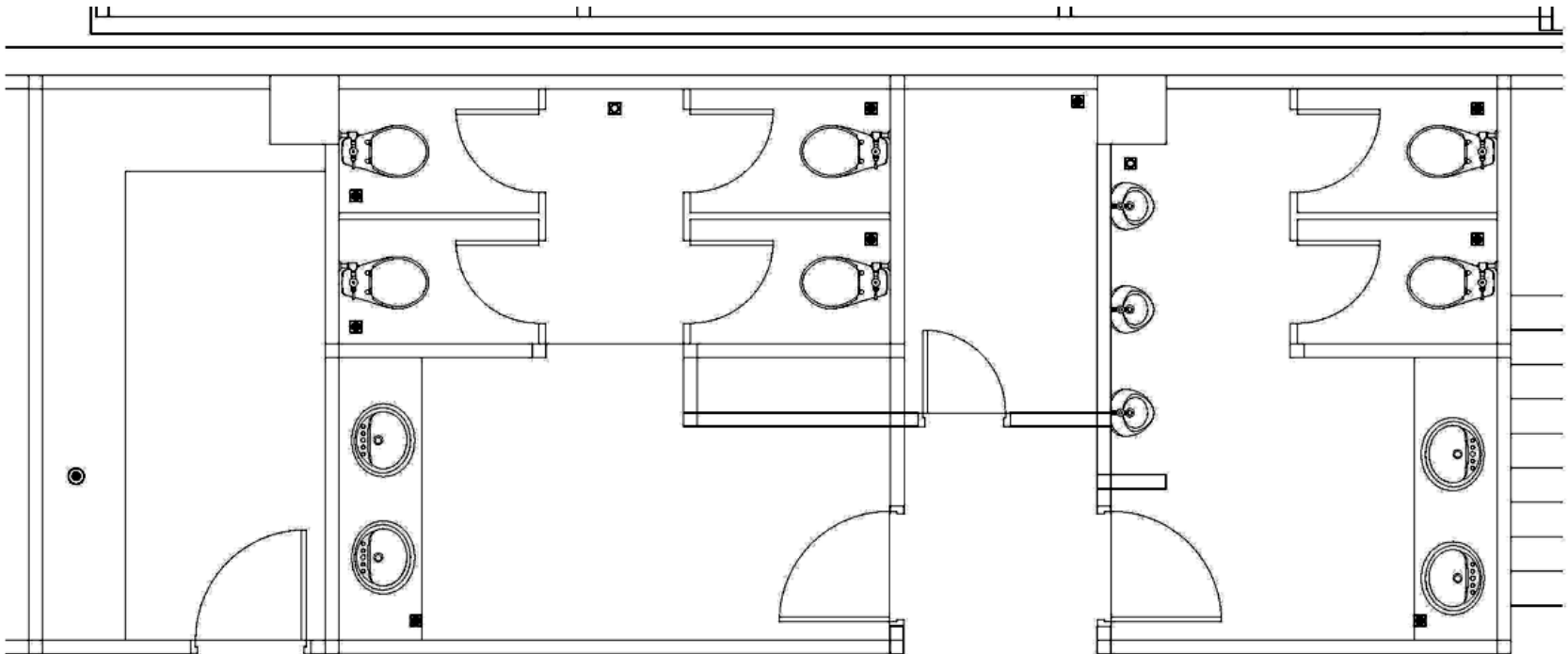
WATER STORAGE TANK



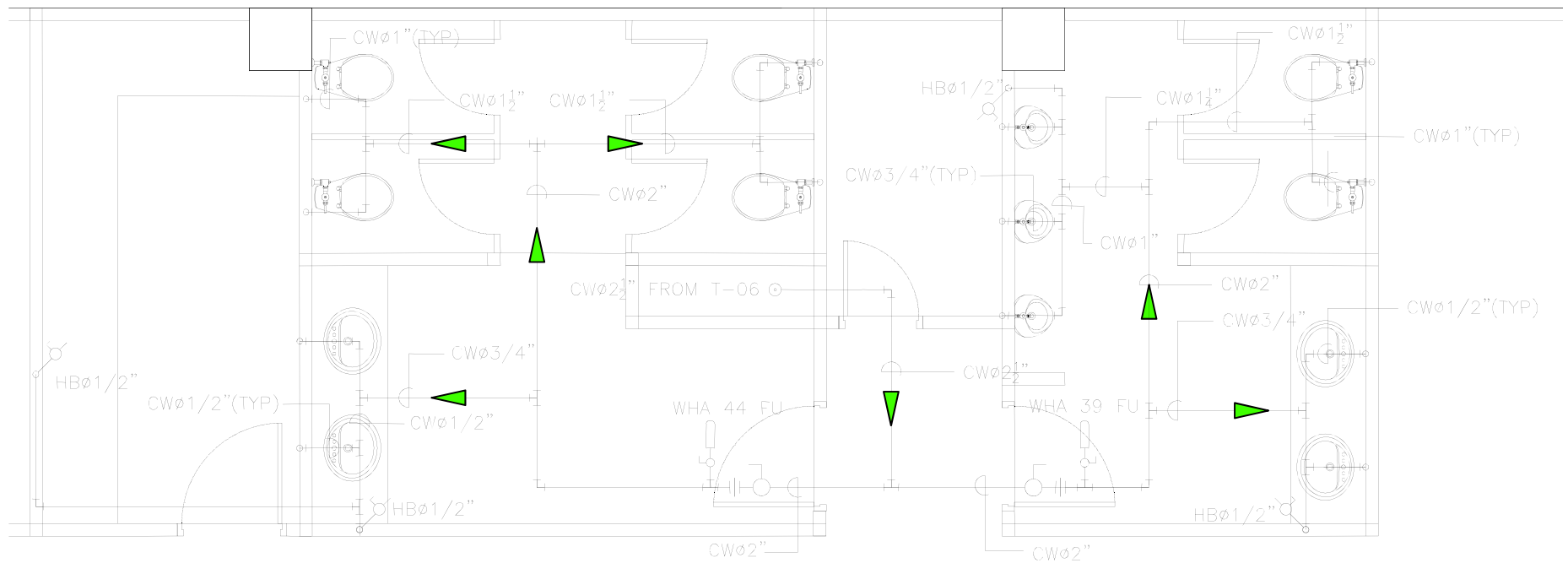
WATER STORAGE TANK

TYPE	Water usage	Notes
RESIDENTIAL BUILDINGS	100 – 300 litre/person/day	Recommend 200 litre/person/day
OFFICE BUILDINGS	40 – 75 litre/person/day	
HOSPITAL	600 – 1200 litre/bed/day	Cover all other usage.
SCHOOL	50 – 80 litre/person/day	
HOTEL	200 – 400 litre/room/day	Some case studies found 700 litre/person/day. Not include swimming pool
CLEANING	20 – 40 litre/1 kg of clothes	

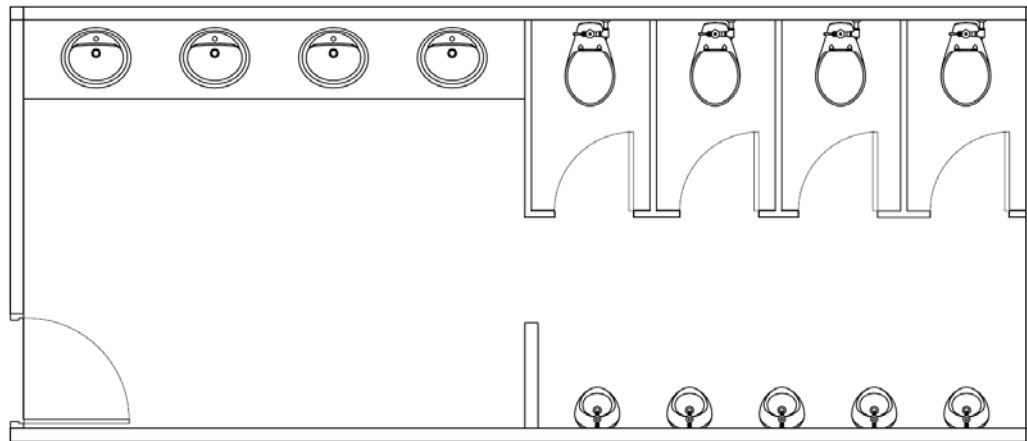
5. DESIGN EXERCISE



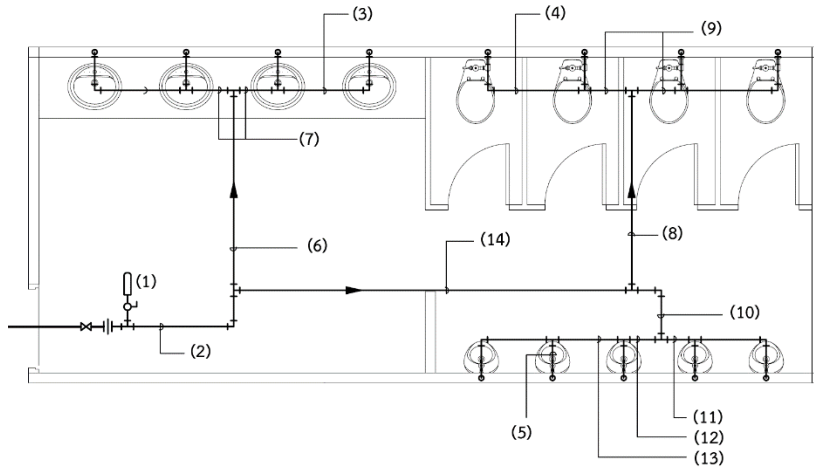
EXAMPLE



EXAMPLE 7.3

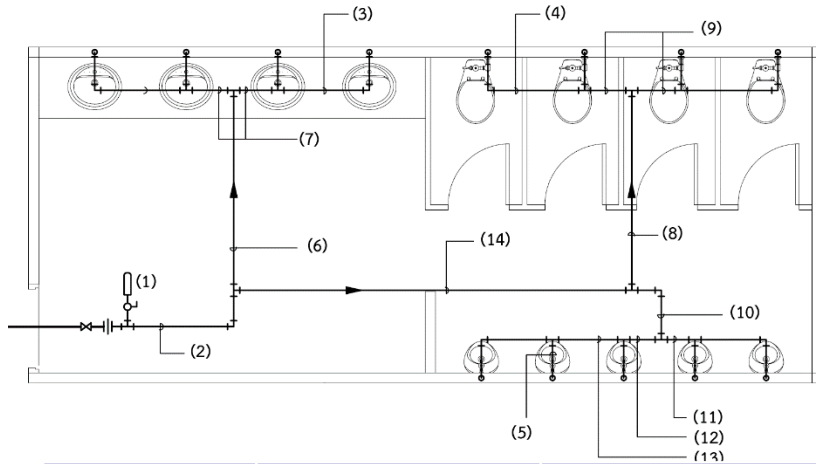


EXAMPLE 7.3



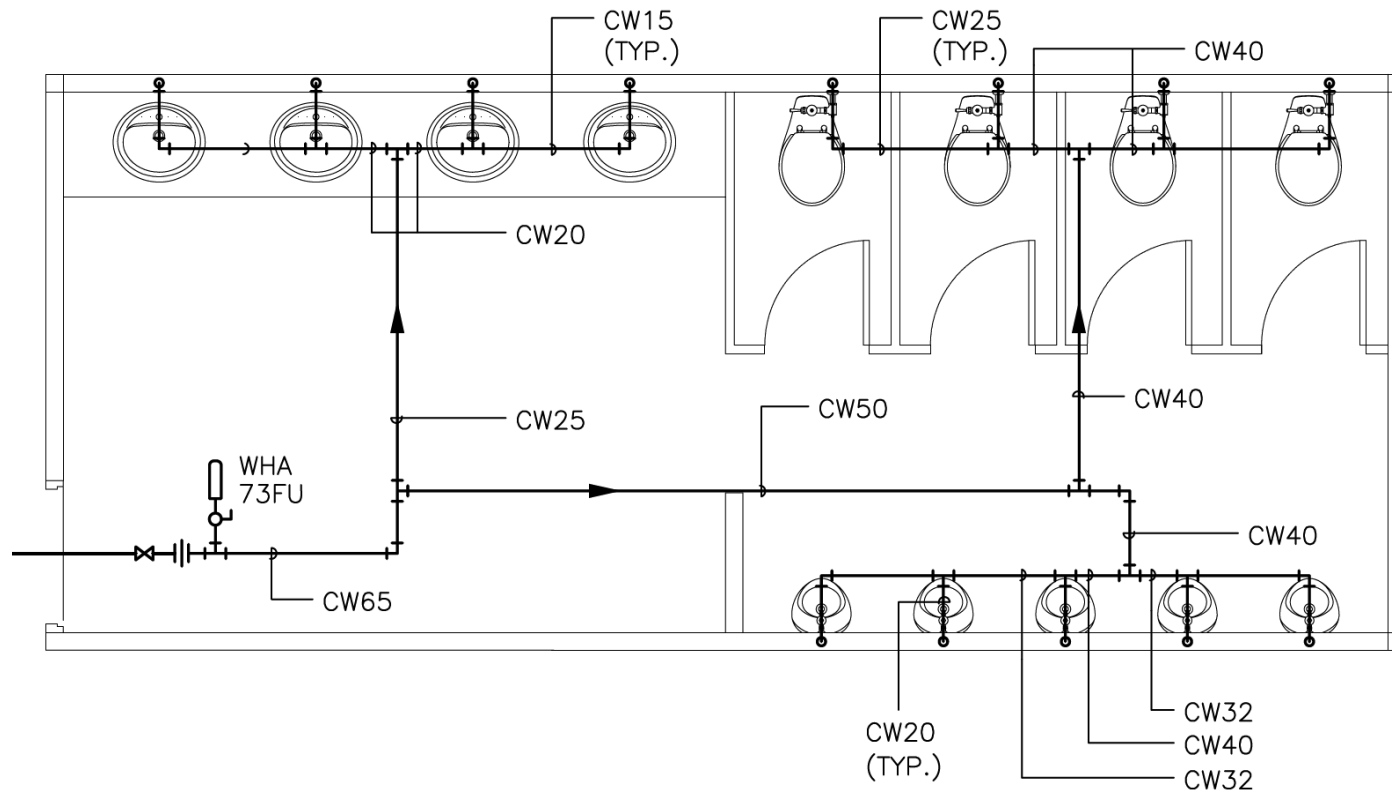
TYPE	TABLE	SECTION	DESCRIPTION	SIZE
WHA	7.1	(1)	From example 7.1: 73 FU	73FU
MAIN PIPE	5.6	(2)	From Hunter's curve: 73 FU = 225.2 lpm. At pressure drop rate of 4m/100m	DN65
CONNECTION TO FIXTURE	7.1	(3)	LAV	DN15
		(4)	WC (flush valve)	DN25
		(5)	UR (flush valve)	DN20

EXAMPLE 7.3

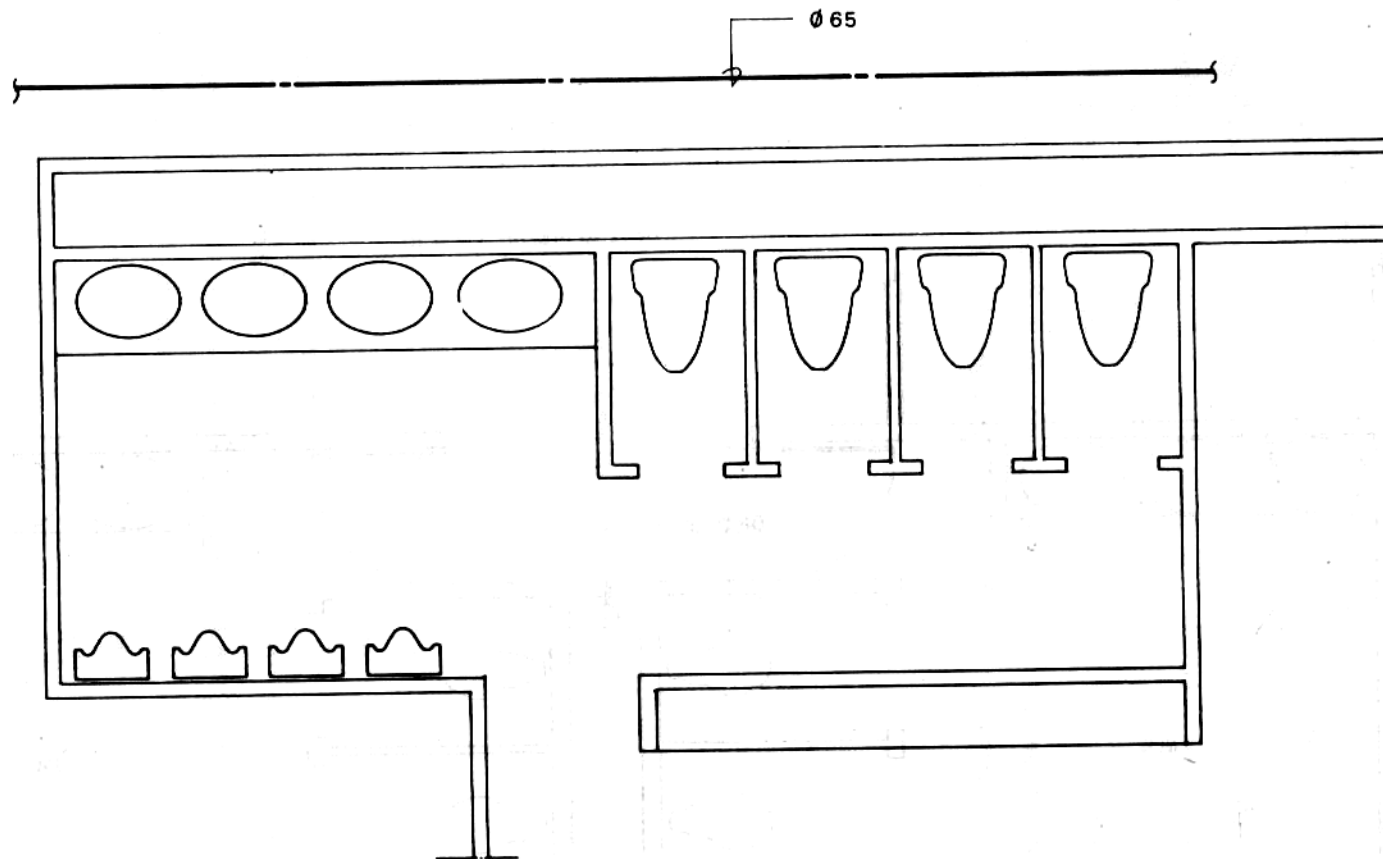


TYPE	TABLE	SECTION	DESCRIPTION	SIZE
HEADER	7.3	(6)	Header for DN15 x 4 (not more than 6)	DN25
		(7)	Header for DN15 x 4 (not more than 3)	DN20
		(8)	Header for DN25 x 4 (not more than 4)	DN40
		(9)	Header for DN25 x 2 (not more than 4)	DN40
		(10)	Header for DN20 x 5 (not more than 8)	DN40
		(11)	Header for DN20 x 2 (not more than 2)	DN32
		(12)	Header for DN20 x 3 (not more than 8)	DN40
		(13)	Header for DN20 x 2 (not more than 2)	DN32
		(14)	Header for DN25 x 4 + DN20 x 5 (Equivalent to DN25 x 2.5) = DN25 x 6.5 not more than 12)	DN50 40

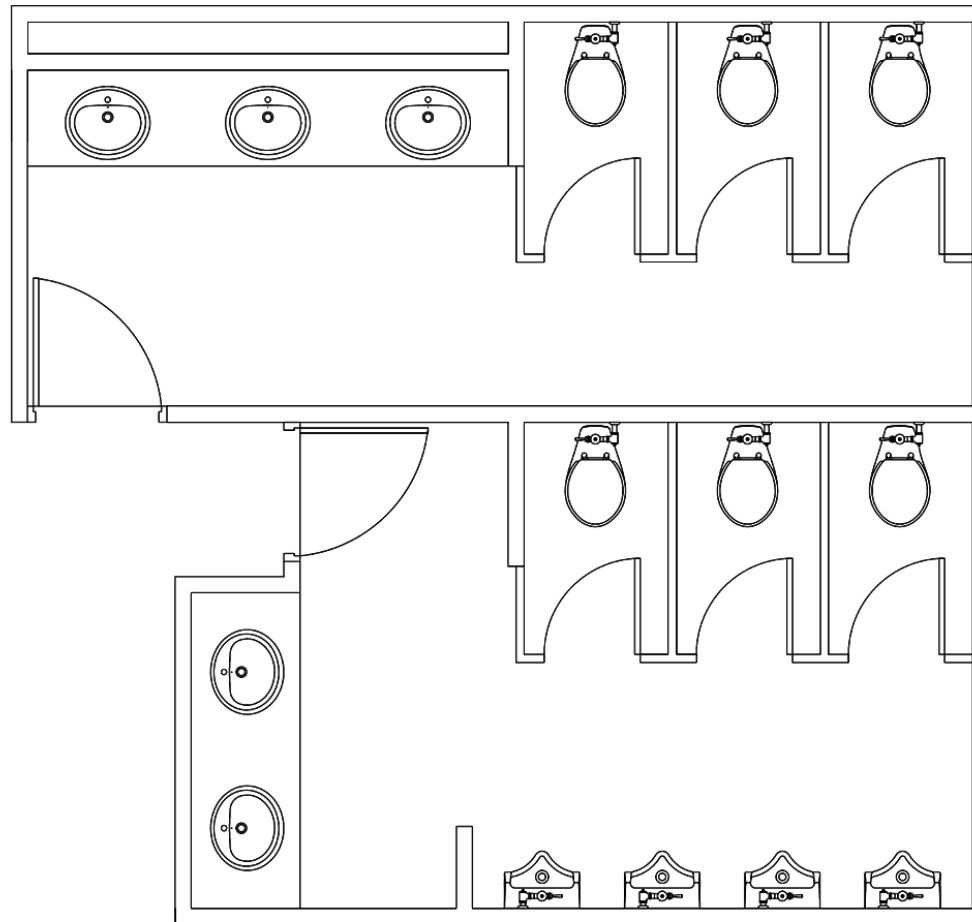
EXAMPLE 7.3



EXERCISE



HOMEWORK



NEXT SESSION: WASTE AND DRAIN