CMGT 235 – Electrical and Mechanical Systems

Department of Construction Management ❁ California State University, Chico

Exam #2 [100 points]

You may work with one person or individually. Every student SHALL complete their own answer sheet. Include units in all answers.

Name: Solution
Name:

30 pts 1. Complete the following steps for the house plan provided. The owner has approved all options shown including the finished second floor. MDSSPA = 60 psi. The elevation of the highest Fixture above the source of water supply is 45 feet. Meter Pressure loss is 5 psi. The developed length of pipe to the Furthest Fixture is 200 feet. There is a total of six ½" hose bibbs: three on one supply segment and three on another supply segment.

A. Calculate the pressure loss due to static head.

Pressure Loss = 45 ft x 0.433 psi/ft = 19.485 psi

B. Calculate the Total Available Pressure under no flow conditions.

Available Pressure = 60 psi – 19.485 psi – 5 psi = 35.515 psi

C. Complete the WSFU table below. [2016 CPC - Table 610.3]. Color and count all plumbing fixtures shown on the plan using a yellow highlighter. Calculate the WSFUs for each fixture using one, two, or three decimals as applicable. Use one or two decimals for WSFU totals.

(Section 01)

Water Supply Fixture Units							
Fixture	# of Fix.	HOT WSFU		COLD WSFU		TOTAL WSFU	
		EACH	THIS JOB	EACH	THIS JOB	EACH	THIS JOB
WC FT	5	---	---	2.5	12.5	2.5	12.5
LAV	7	0.75	5.25	0.75	5.25	1.0	7.0
BT/SHW	3	3.0	9.0	3.0	9.0	4.0	12.0
BT	2	3.0	6.0	3.0	6.0	4.0	8.0
SHW	2	1.5	3.0	1.5	3.0	2.0	4.0
KS	3	1.125	3.375	1.125	3.375	1.5	4.5
BS	1	0.75	0.75	0.75	0.75	1.0	1.0
DW	2	1.5	3.0	---	---	1.5	3.0
CW	1	3.0	3.0	3.0	3.0	4.0	4.0
LT	1	1.125	1.125	1.125	1.125	1.5	1.5
HB	6	---	---	2.5	15.0	4.5x2	9.0
TOTALS			34.5		59.0		64.5

CPC 2016 Appendix A, Chart A 103.1(2)

D. Demand Load = 35 GPM

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(Section 02)

Water Supply Fixture Units							
Fixture	# of Fix.	HOT WSFU		COLD WSFU		TOTAL WSFU	
		EACH	THIS JOB	EACH	THIS JOB	EACH	THIS JOB
WC FT	6	---	---	2.5	15.0	2.5	15.0
LAV	8	0.75	6.0	0.75	6.0	1.0	8.0
BT/SHW	4	3.0	12.0	3.0	12.0	4.0	16.0
BT	2	3.0	6.0	3.0	6.0	4.0	8.0
SHW	2	1.5	3.0	1.5	3.0	2.0	4.0
KS	3	1.125	3.375	1.125	3.375	1.5	4.5
BS	1	0.75	0.75	0.75	0.75	1.0	1.0
DW	2	1.5	3.0	---	---	1.5	3.0
CW	1	3.0	3.0	3.0	3.0	4.0	4.0
LT	1	1.125	1.125	1.125	1.125	1.5	1.5
HB	6	---	---	2.5	9.0	4.5x2	9.0
TOTALS			38.25		59.25		74.0

CPC 2016 Appendix A, Chart A 103.1(2)

D. Demand Load = 35 GPM

E. Use the 2016 CPC Table 610.4 complete the table below for your results:

2016 CPC - Table 610.4

Pressure Range	**30 to 45 psi**
Maximum Allowable Length	**200 ft**
Distribution Piping	**Pipe Size (inches)**
Meter and Street Service	1"
Building Supply	2"
Cold Water Supply	1 ½"
Hot Water Supply	1 ½"

F. Allowing for 12 psi at the highest fixture under the maximum demand load of 35 gallons per minute:

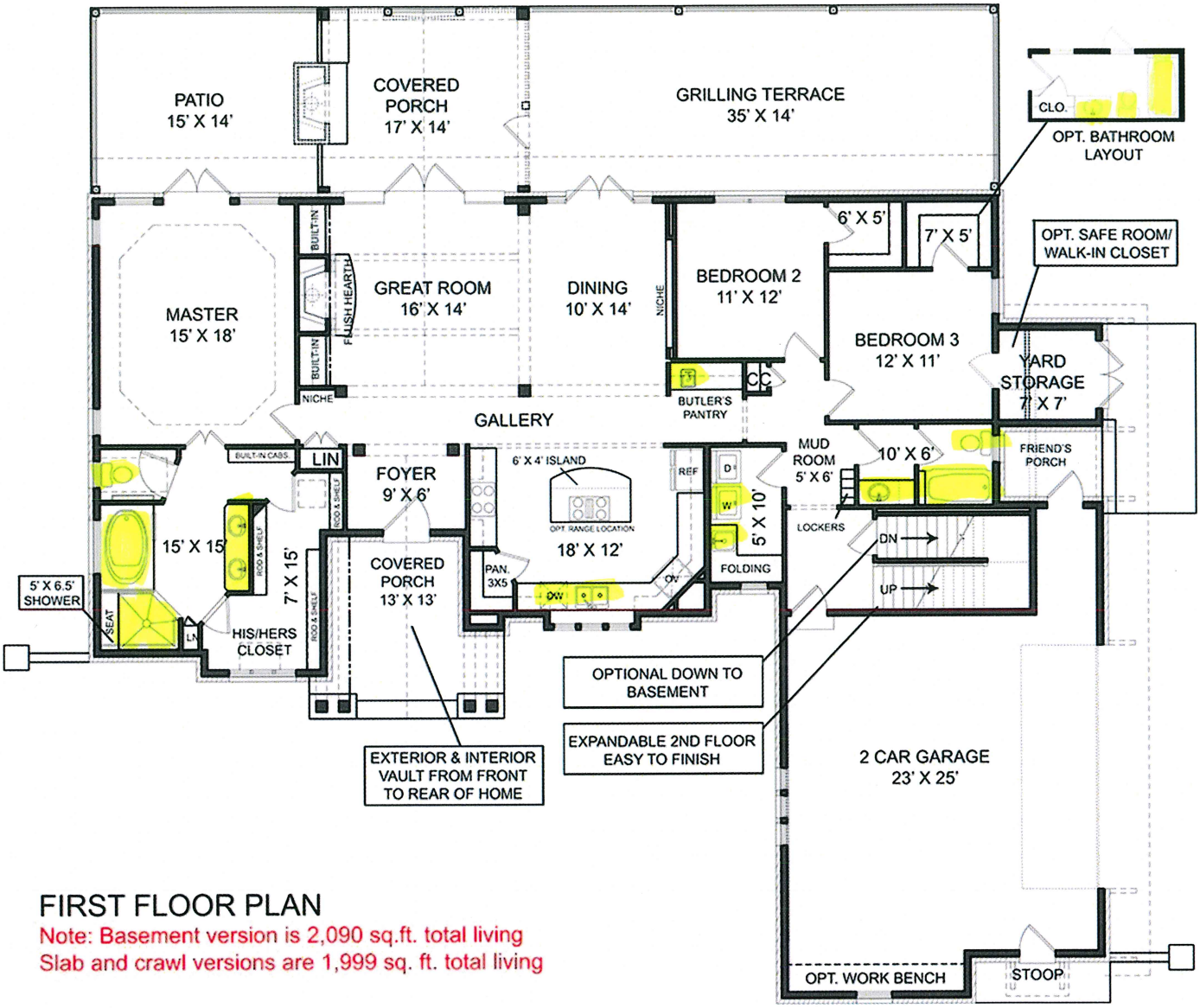
Calculate the pressure available for friction loss.

Pressure Available = 35.515 psi – 12 psi = 23.515 psi

Calculate the allowable friction loss per 100 feet of pipe.

Allowable Friction loss = 23.515 psi x 100 / 200 ft = 11.7575 psi

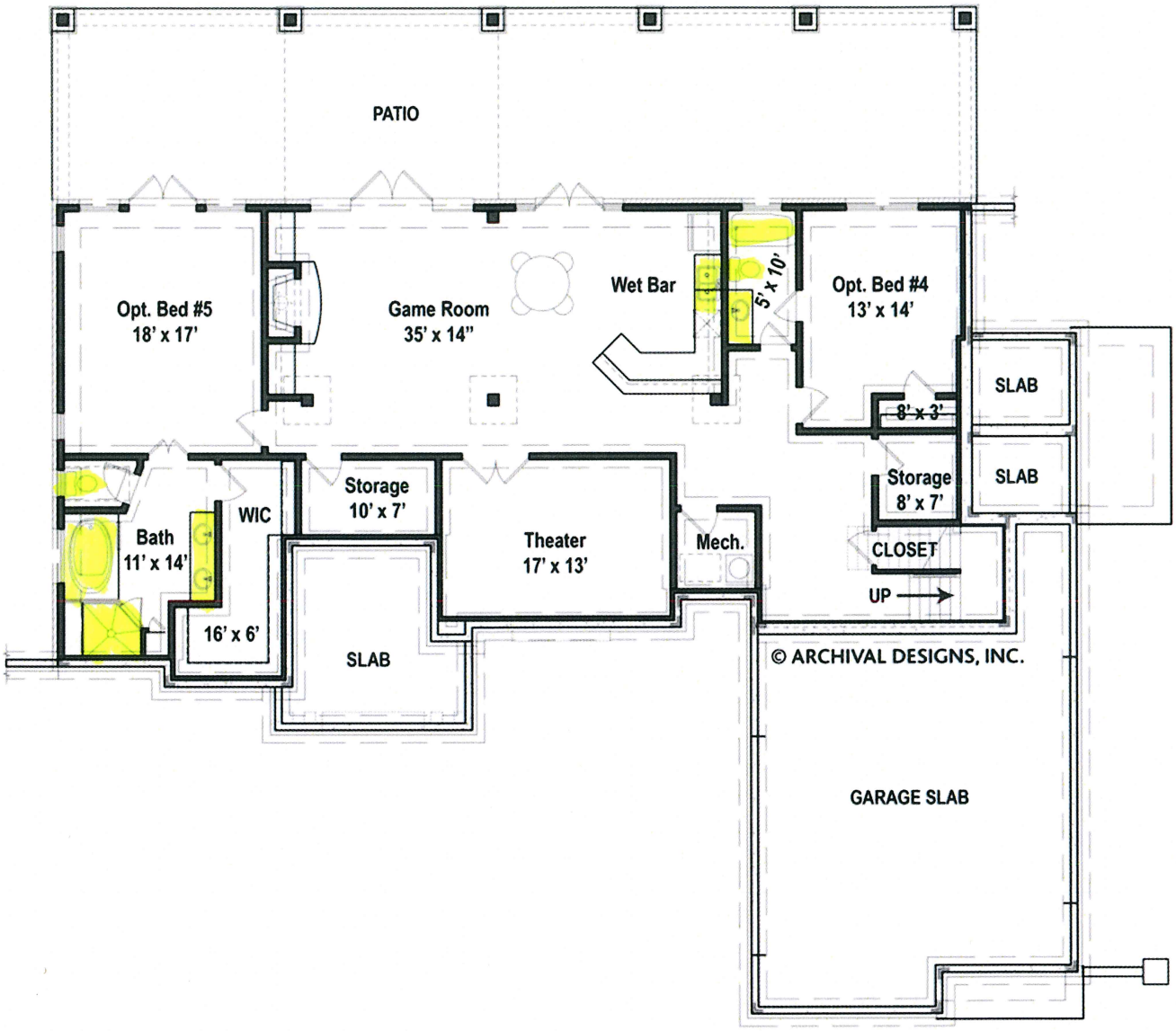
House Plans



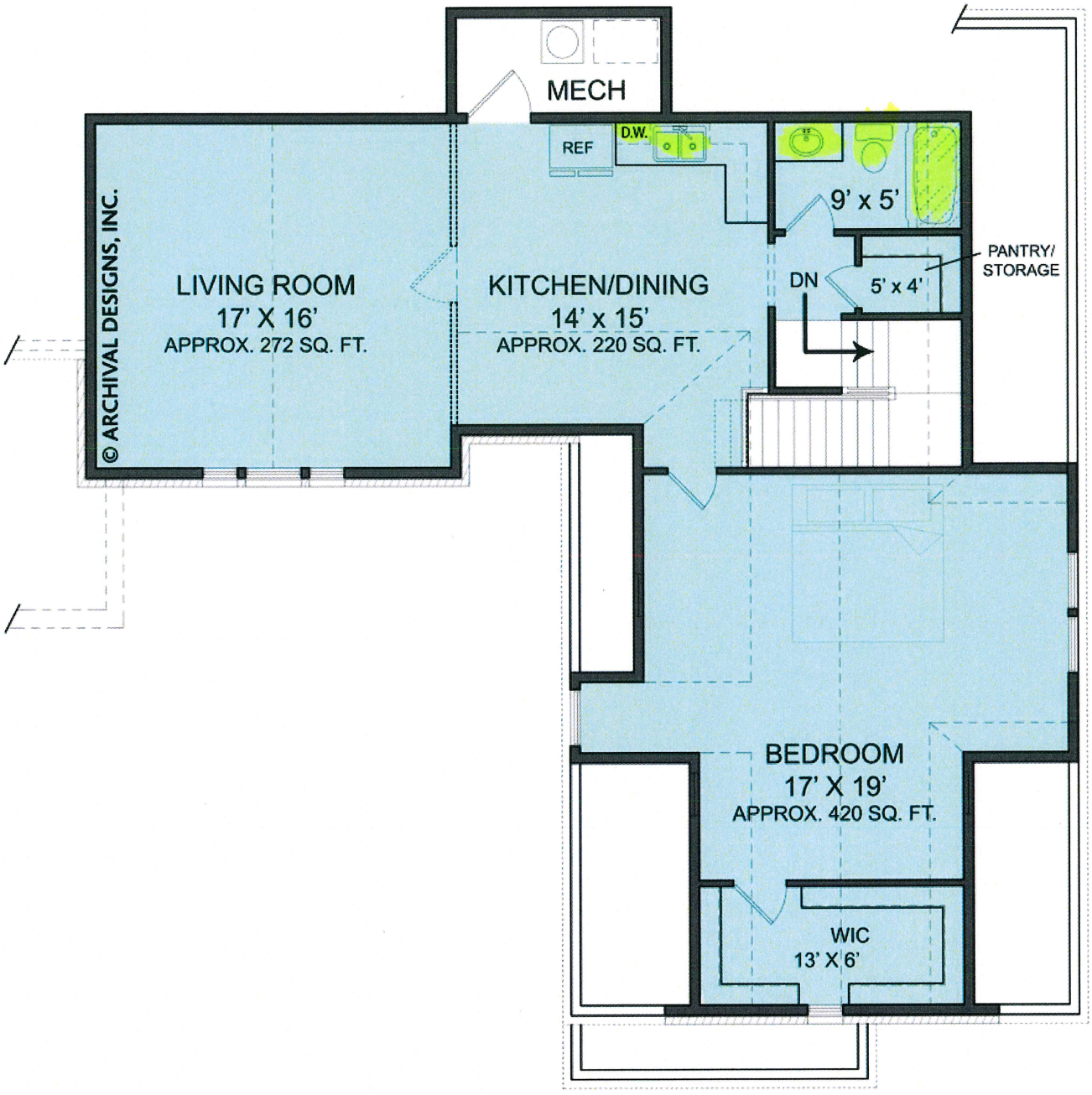
FIRST FLOOR PLAN

Note: Basement version is 2,090 sq.ft. total living
Slab and crawl versions are 1,999 sq. ft. total living

Basement

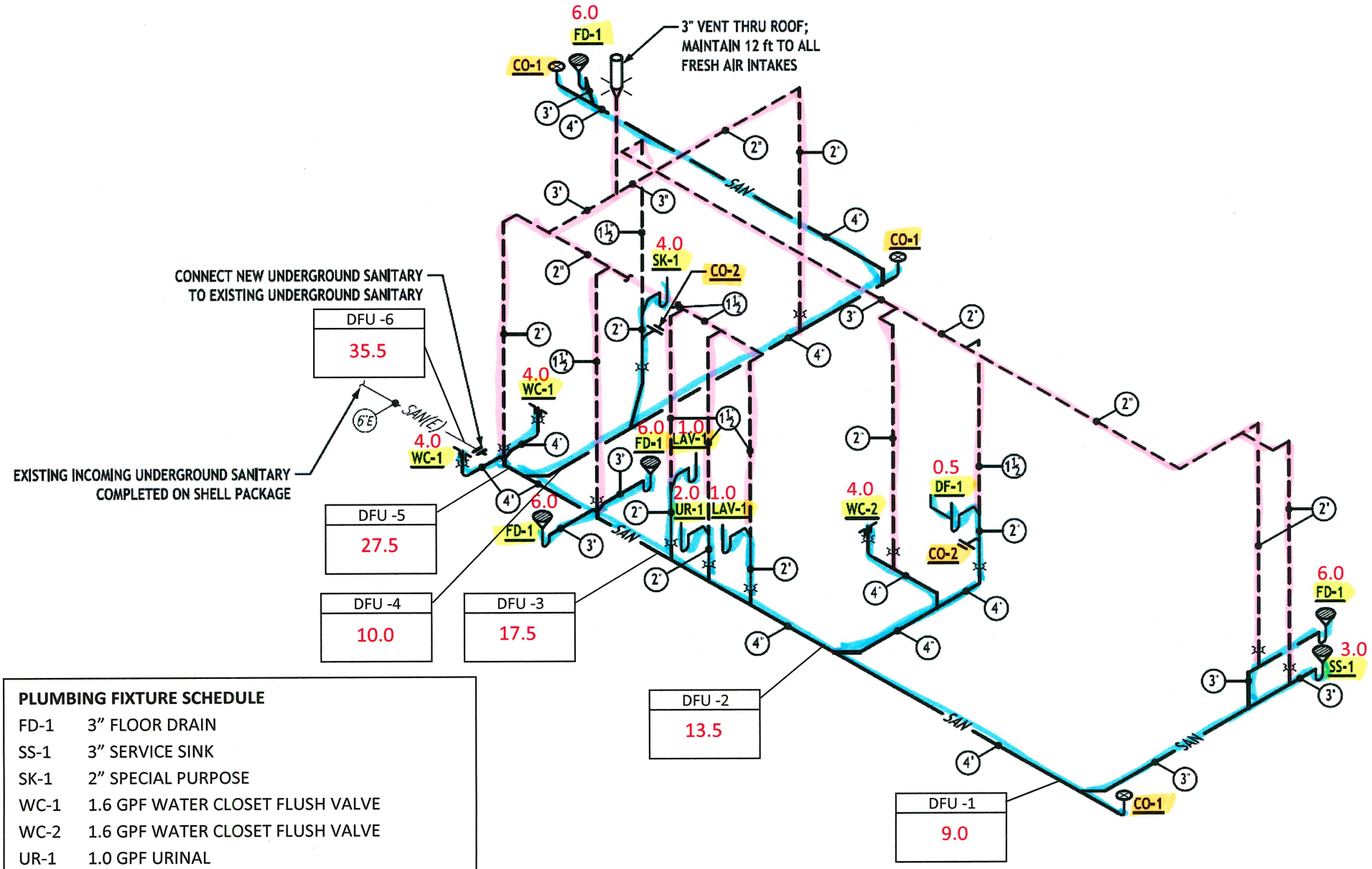

PATIO
Opt. Bed #5
18' x 17'
Game Room
35' x 14"
Wet Bar
5' x 10'
Opt. Bed #4
13' x 14'
SLAB
8' x 3'
Storage
8' x 7'
SLAB
Storage
10' x 7'
WIC
Bath
11' x 14'
Theater
17' x 13'
Mech.
CLOSET
UP
16' x 6'
SLAB
© ARCHIVAL DESIGNS, INC.
GARAGE SLAB

Second Floor



25 pts 2. Complete the following using the Sanitary Isometric drawing shown on page 7:

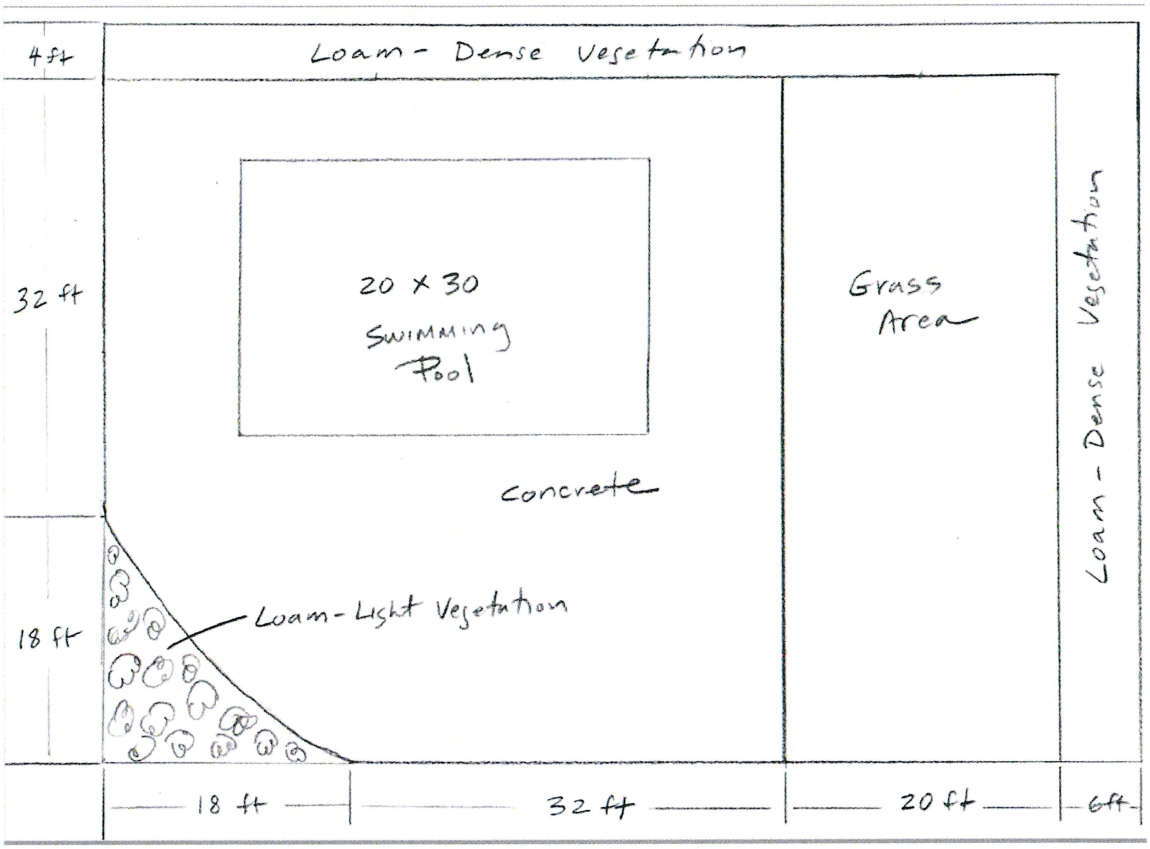
- ☐ Highlight the plumbing fixture names using a yellow highlighter (i.e., FD-1, SS-1, etc.) and the Clean Out names using an orange highlighter.
- ☐ Highlight the Sanitary Drainage piping using a blue highlighter.
- ☐ Highlight the Vent piping using a pink highlighter.
- ☐ Using the CPC 2016 and a pencil write the DFU (use one decimal) for each plumbing fixture above its name.
- ☐ Complete the DFU totals (DFU-1 through DFU-6) using the boxes shown on the drawing.



PLUMBING FIXTURE SCHEDULE

FD-1	3" FLOOR DRAIN
SS-1	3" SERVICE SINK
SK-1	2" SPECIAL PURPOSE
WC-1	1.6 GPF WATER CLOSET FLUSH VALVE
WC-2	1.6 GPF WATER CLOSET FLUSH VALVE
UR-1	1.0 GPF URINAL
LAV-1	LAVATORY
DF-1	DRINKING FOUNTAIN
CO-1	3" FLOOR CLEAN OUT
CO-2	2" WALL CLEAN OUT

25 pts 3. Complete the following table and calculate the runoff, Q (gpm) for each area and the total runoff and the total volume (gal) for a one-hour storm for the landscape plan shown. Refer to "How to calculate Drainage" to obtain the coefficient of runoff for each area. **SHOW AREA CALCULATIONS IN SPACE PROVIDED BELOW**



Drainage Area	C	I (in./hr)	Area (ft^2)	Q = c x I x A / 96.23 (gpm) (2 decimals)
Concrete	1.00	3.6	1738 ft^2	65.02
Grass Area	0.35	3.6	1000 ft^2	13.09
Loam – Dense Vegetation	0.35	3.6	604 ft^2	7.91
Loam – Light Vegetation	0.45	3.6	162 ft^2	2.73
			Total GPM	88.75
			Total Volume for a 60 min storm (gallons)	5325

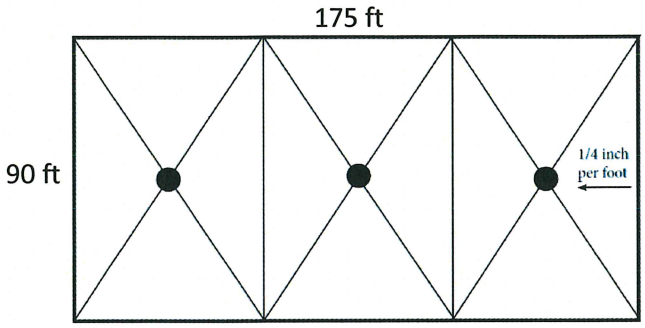
Concrete Area = 50 ft x 50 ft - ½ x 18 ft x 18 ft - 20 ft x 30 ft = 2500 ft^2 - 600 ft^2 -162 ft^2 = 1738 ft^2

Grass Area = 20 ft x 50 ft = 1000 ft^2

Loam - Dense Area = 6 ft x 50 ft + 4 ft x 76 ft = 604 ft^2

Loam - Light Area = ½ x 18 ft x 18 ft = 162 ft^2

20 pts 4. A commercial building is in an area that has a 2.6 in/hr rainfall rate. The roof drainage system is shown below.



Using the CPC 2016 Chapter 11 Storm Drainage, Tables 1101.8 and 1101.12 determine the following (show all calculations):

A. Required Drain Size

Roof Area = 90 ft x 175 ft = 15,750 ft^2

Each Drain = 15,750 ft^2 / 3 = 5,250 ft^2

3" Drain 8800 / 2.6 = 3385 ft^2 (too small)

4" Drain 18 400/2.6 = 7077 ft^2

Use 4" Drains

B. Horizontal rainwater pipe size

4" 10 600 / 2.6 = 4077 ft^2 (too small)

5" 18 880 / 2.6 = 7231 ft^2

Use 5" Horizontal pipe

C. Vertical Leader pipe size

4" Leader 18 400/2.6 = 7077 ft^2

Use 5" Leader pipe, cannot reduce pipe in direction of flow

D. If the owner decided to capture and store the rainwater in three cisterns and the highest month's rainfall rate is 5.0 in/hr, what volume cisterns in gallons would be required? Round answer up to the nearest 1000^{th}.

V = A x I x C x 7.5 = 15,750 ft^2 x 5.0 in/hr x 1 ft / 12 in x 0.9 x 7.5 gal/ft^3 = 44,296.875 gal = 45,000 gal

Three Cisterns

Volume for Each Cistern = 45,000 / 3 = 15,000 gal