DRAINAGE WORKSHOP
PROBLEMS 1, 2, 3
Solutions

Problem #1

A pattern drainage system is being designed for a 55 acre field for subsurface drainage flow only. The field is composed of mineral soil with a silty loam texture at the surface and a silty clay loam texture near the drain tile. The owner plans to grow spinach, radishes, and other truck crops that are easily damaged by excess surface water.

Given:	Area Drained	=	55 acres
	Soils	=	Mineral, silt loam to silty clay loam
	Crops	=	Truck crops easily damaged by excess surface water

a) Determine the drainage coefficient to be used in the design.

Page 2, MO 606 Standard. DC = ½" to ¾", I chose DC = ½"

Whether you use ½" or ¾" depends on the texture of the soil in the rooting zone. If the soils are tight clays or silty clays and ponding has been a problem, it would be advisable to use ¾" for the DC and/or install surface inlets.

b) Calculate the required capacity in cubic feet per second (cfs).

For DC = ½":
0.042 x 0.5 in/day x 55 acres = 1.16 cfs

For DC = ¾":
0.042 x 0.75 in/day x 55 acres = 1.73 cfs

c) Using the required capacity and a grade of S = 0.50%, calculate the size of corrugated plastic tubing that is needed. Assume normal installation conditions.

Using the Slide Rule:

For DC = ½"
Required CPT = 10", actual Q = 1.19 cfs
OK 1.19 > 1.155

For DC = ¾"
Use 12" CPT, Capacity = 1.92
1.92 > 1.734 cfs OK

d) What is the approximate velocity when the tubing is flowing full? Is this in the safe range?

For 10" CPT:
From Slide Rule: V = 2.2 fps.

From pages 2 & 3, MO 606 Standard, the minimum velocity for sedimentation areas is 1.4 ft/s and the maximum velocity for silty clay loam soils is
6 ft/s. The velocity 2.2 ft/s falls within this range.

For 12" CPT:
From the Slide Rule: V = 2.45 fps.

From pages 2 & 3, MO 606 Standard, the minimum velocity for sedimentation areas is 1.4 ft/s and the maximum velocity for silty clay loam is 6 ft/s. The velocity 2.2 ft/s falls within this range.

Problem #2

Design a drainage system for an 85 acre field with mineral soils, general field crops, subsurface flow only. Field has flat topography with surface ponding.

Given:	Field	=	85 acres
	Soils	=	Mineral, silty clay loam
	Crops	=	Field crops (soybeans and corn)
	Drainage	=	Subsurface pattern only with flat topography

Page 2, MO 606 Standard. DC = 3/8" to 1/2"; Use ½"

a) Determine the required main capacity.
Capacity Required:
For DC = ½":
0.042 x 0.5 in/day x 85= 1.78 cfs

b) What is the size of corrugated plastic tile needed for the main if it will be installed on a 0.20% grade. Assume normal installation conditions.

From the Slide Rule:

With DC = ½", 85 Ac, 0.2% grade: Use 15" CPT, Actual capacity = 1.9 cfs

OK 1.9 > 1.78

c) Using the same required capacity, what is the minimum grade necessary to reduce the tile size to the next diameter?

Required Q = 1.78 cfs

From the Slide Rule:

Minimum Grade = 0.45% for 12" CPT to have a capacity of 1.78 cfs

Problem #3

A grassed waterway is to be built, but a 12" corrugated plastic tile main exists in the center of the watercourse and needs to be replaced and moved to the edge of the waterway. The old and new tile mains have the same grade of 0.50%.

a) What is the capacity of the existing 12" main (cfs)?

12" CPT @ 0.50%, Q = 1.95 cfs, divide by 2, Q = 0.97 cfs

b) If the main is to be replaced with two new tiles of equal size, one on each side of the waterway, what size of corrugated plastic tubing is needed?

12" CPT @ 0.50%, Q = 1.95 cfs, divide by 2, Q = 0.97 cfs

Try 8" CPT @ 0.50%, Q = 0.74 cfs (Slide Rule)
Not big enough

Try 10" CPT @ 0.50%, Q = 1.19 cfs (Slide Rule)
U***se – Need 2 – 10" CPT***

c) The owner has a large stockpile of 6" corrugated plastic tile on the farm and wants to use it. How many 6" tile lines would be needed to replace the 12" main?

6" CPT @ 0.50%, Q = 0.34 cfs (Slide Rule)

No. # of lines = 1.95 cfs / 0.34 cfs = 5.7 or ***Need 6 - 6" tiles to replace one 12" tile.***