Field Performance of Prefabricated Underdrains

Report No. 4

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Project 67-2 JHR 71-39

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Introduction

In 1968 the Joint Highway Research Advisory Council sponsored a research program to develop a prefabricated underdrain system in the Civil Engineering Department at the University of Connecticut. The object of this research was to devise an underdrain system that would reduce or eliminate some of the problems in the design and construction of conventional underdrains using mineral aggregate filters. The development of the prefabricated underdrains has progressed well and 2350 lin ft of the system have been installed in the field to solve drainage problems.

Previous reports describe the materials and techniques of fabrication and the types of installation. This report summarizes data gathered from field installations of prefabricated underdrains. There are four installations as of this writing (June 1971). For each of these installations a brief description, a sketch showing the location of the drain and flow data are given. The flow data have been converted to the rate for 1000 lin ft of underdrain. The observed rates converted to flow for 1000 lin ft of pipe, vary from 25 gpm for the installation behind Brien McMahon Dormitory to 10.5 gpm for the Fellon Road installation. Bar graphs are provided for the Tennis Court installation showing the relation between precipitation and water flow in the drains.

Sketches of the two types of cloth and two of the three types of core are shown in the appendix. Also included in the appendix are the particle size analyses of the soils in which the drain has been tested.

Brien McMahon Installation

The first field test of the prefabricated underdrain was the installation of 20 lin ft in the east slope of a drumlin behind Brien McMahon Residence Hall at the University of Connecticut. The primary object of this installation was to demonstrate that prefabricated underdrains would function properly in a field site. The behavior of the slope, after the drains were installed, showed that the water flow was strongly influenced by the horizontal permeability and to improve the stability of the slope the underdrains must be placed to intercept the ground water at the elevation at which it reaches the surface of the slope.

The backfill against the drains is concrete sand with the native material bringing the slope to grade. This test showed that the prefabricated underdrains are effective in collecting and removing ground water.

Date of Installation: June 1968

Total Length of Drain: 20 lin ft

Type of Core: Expanded polystyrene with sawed grooves

Height of Core: 2 ft

Type of Cloth: Butterfly

Pipe: 4 inch hard plastic

Type of Soil: Glacial Till, USCS* designation sandy silt (SM)

Permeability of Disturbed Lab Samples: 1.5×10^{-6} ft/min

Equivalent Maximum Observed Flow Rate: 25 gpm per 1000 lin ft of drain

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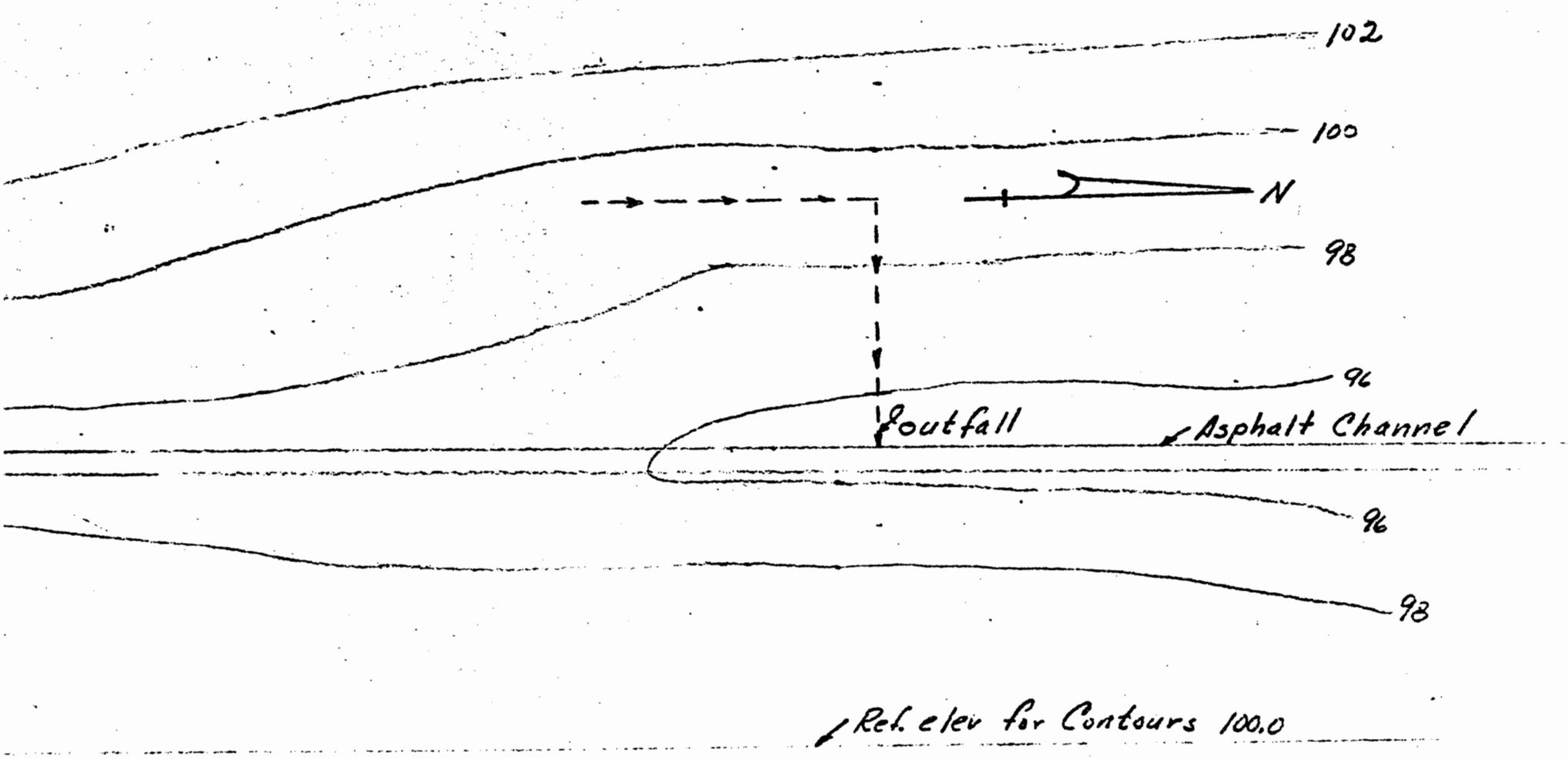
* Unified Soil Classification System

Brien McMahon Installation (Continued)

Previous Reports Describing Installation:

Healy, K.A. and R.P. Long, "Preliminary Report, Prefabricated Underdrains", Report No. JHR 69-23, Department of Civil Engineering, University of Connecticut, Storrs, Connecticut, January 1969 (Report No. 1).



Scale 1"=10'

Brien McMahon
Dorm

FIG 1 Brien McMahon Inst.

Tennis Court Slope Installation

This slope is located on the west side of a drumlin, south of Memorial Stadium and Stadium Road, beside tennis courts on the University of Connecticut Campus. This installation of 710 lin ft was the first attempt to solve a slope stability problem by collecting the ground water with prefabricated underdrains before it seeps to the surface of the slope. The installation of the upper and lower line of drains was made during June 1969 with the drains in location A and B on Figure 2 being installed during June 1970. The slope has weathered two winters intact.

Graphs are included for this installation showing the relation between precipitation and water flow out of the drains. (Fig. 3) When viewing these graphs, keep in mind that the precipitation shown for the winter months was bound up in snow and ice until spring.

Date of Installation: June 1969 (Main System); June 1970 (Locations A & B)

Total Length of Drain: 710 lin ft

Type of Core: Expanded aluminum (Main System); polyvinyl tubing (Locations A & B)

Height of Core: Expanded aluminum (4 ft); polyvinyl tubing (2-1/2 ft)

Type of Cloth: Butterfly Cloth (Main System); Nylon Chiffon (Locations A & B)

Pipe: 4 inch hard plastic

Type of Soil: Glacial Till, USCS* designation, sandy silt (SM)

Equivalent Maximum Observed Flow Rate: 16 gpm per 1000 lin ft of drain

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* Unified Soil Classification System

Tennis Court Slope Installation (Continued)

Previous Reports Describing Installation:

Healy, K.A. and R.P. Long, "Interim Report on Prefabricated Subterranean Drains", Project 67-2, JHRC PR 70-28, Department of Civil Engineering, University of Connecticut, Storrs, Connecticut, March 1970 (Report No. 2).

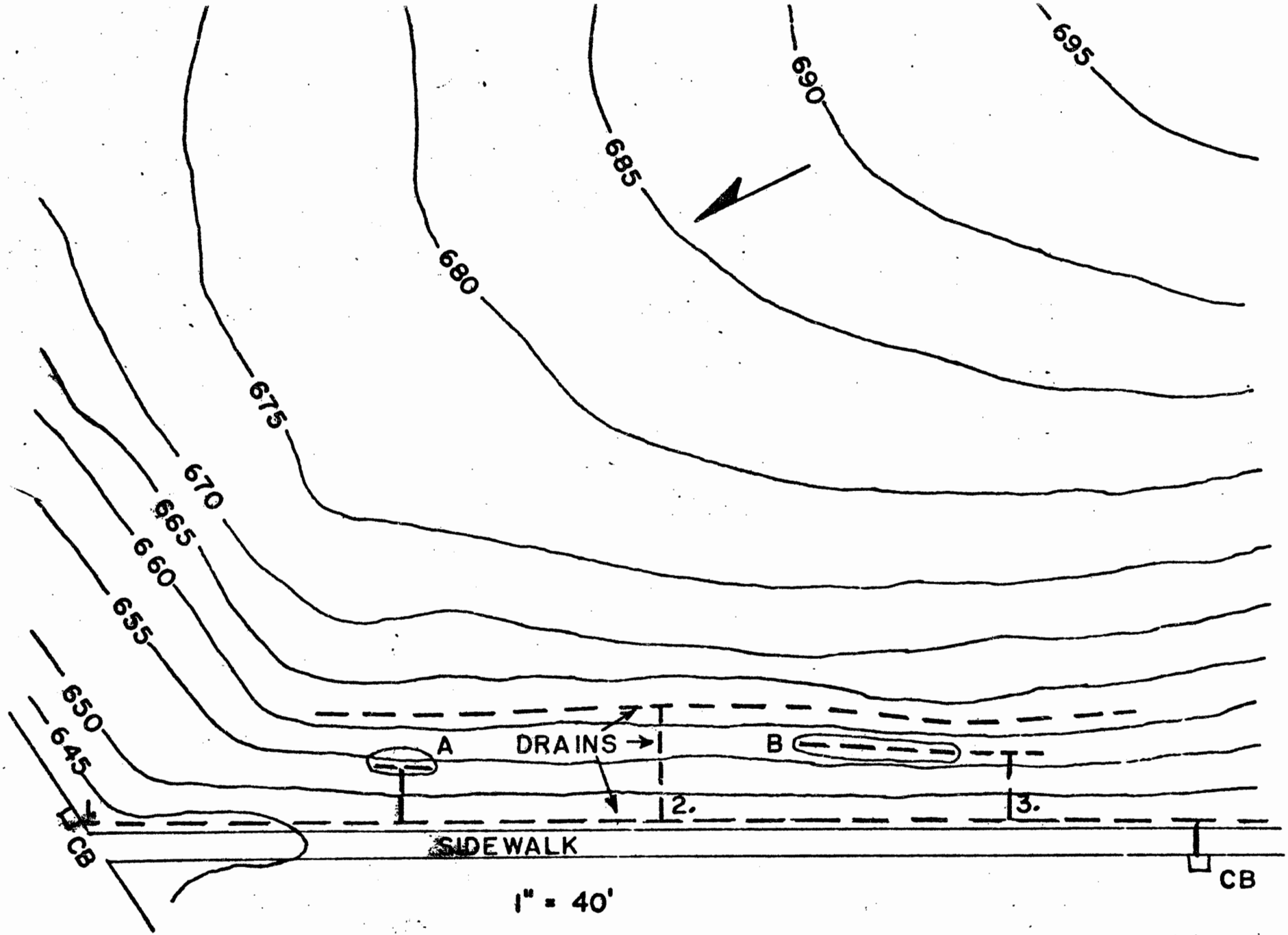


FIG. 2 Tennis Court Slope Installation

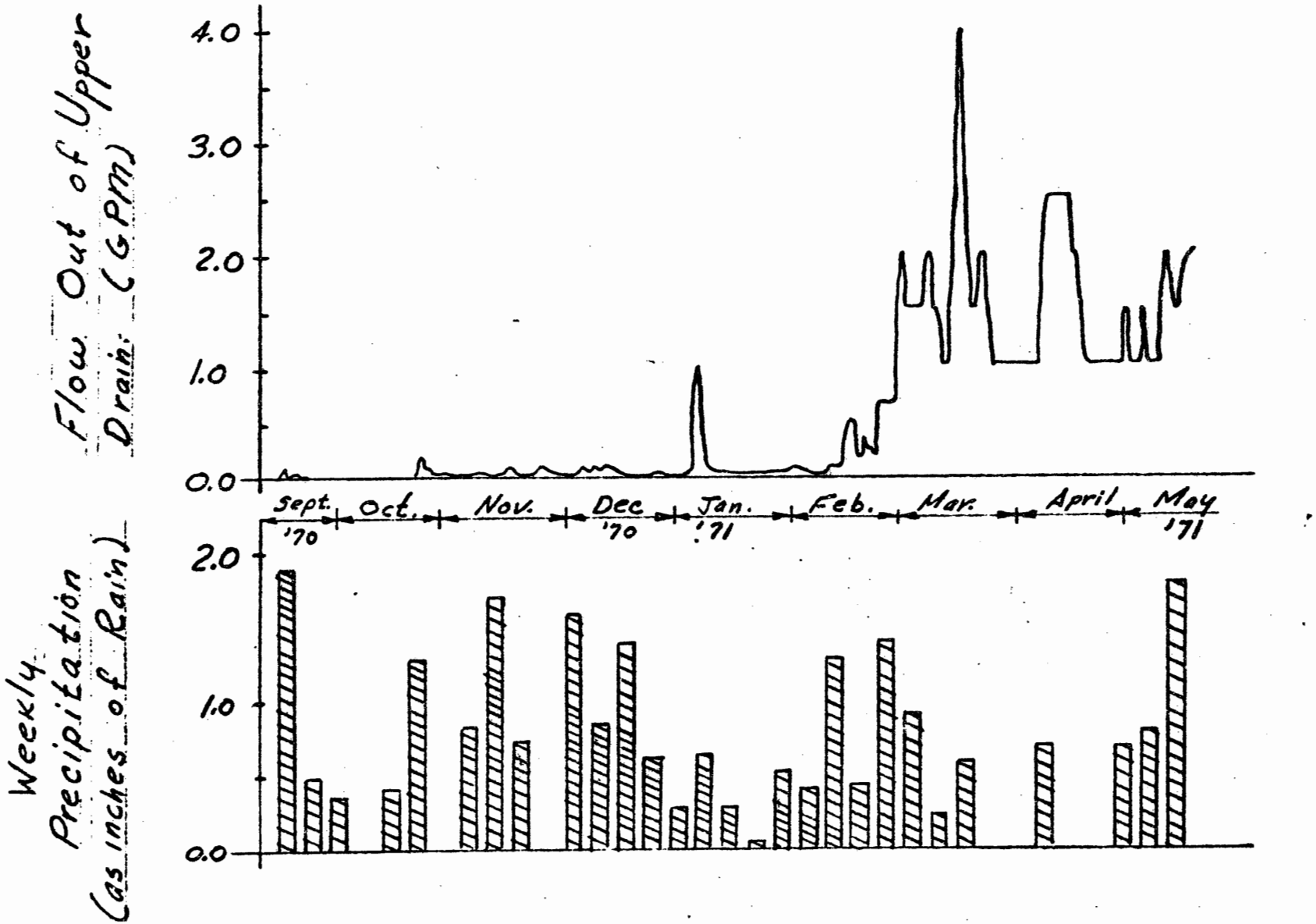


FIG. 3 Rain and Flow Data for Tennis Court Slope Inst.

Route 44-A Installation

This installation was made by a maintenance crew from the Bureau of Highways with the assistance of University personnel on the north side of Route 44-A about 1.8 miles west of the intersection with Route 32. The drain height varies from 3 to 5 ft. The purpose of the drain was to prevent frost heave under the pavement by controlling the ground water. This installation has experienced one winter during which the pavement showed no signs of heave.

Date of Installation: August 1970

Total Length of Drains: 440 ft

Type of Core: Polyvinyl tubing

Height of Core: All sections were originally 5 ft; where cover was insufficient the polyvinyl core was bent over.

Type of Cloth: Nylon Chiffon

Pipe: 4 inch hard plastic

Type of Soil: Varied from fracture rock to sandy silt

Permeability of Disturbed Lab Sample: 2×10^{-3} ft/min

Equivalent Maximum Observed Flow Rate: 17 gpm per 1000 lin ft of drain

Previous Reports Describing Installation:

Long, R.P. and K.F. Briggs III, "Preliminary Report, Installation of Prefabricated Underdrain Along Route 44-A", Report No. JHR 70-31, Department of Civil Engineering, University of Connecticut, Storrs, Connecticut, September 1971 (Report No. 3).

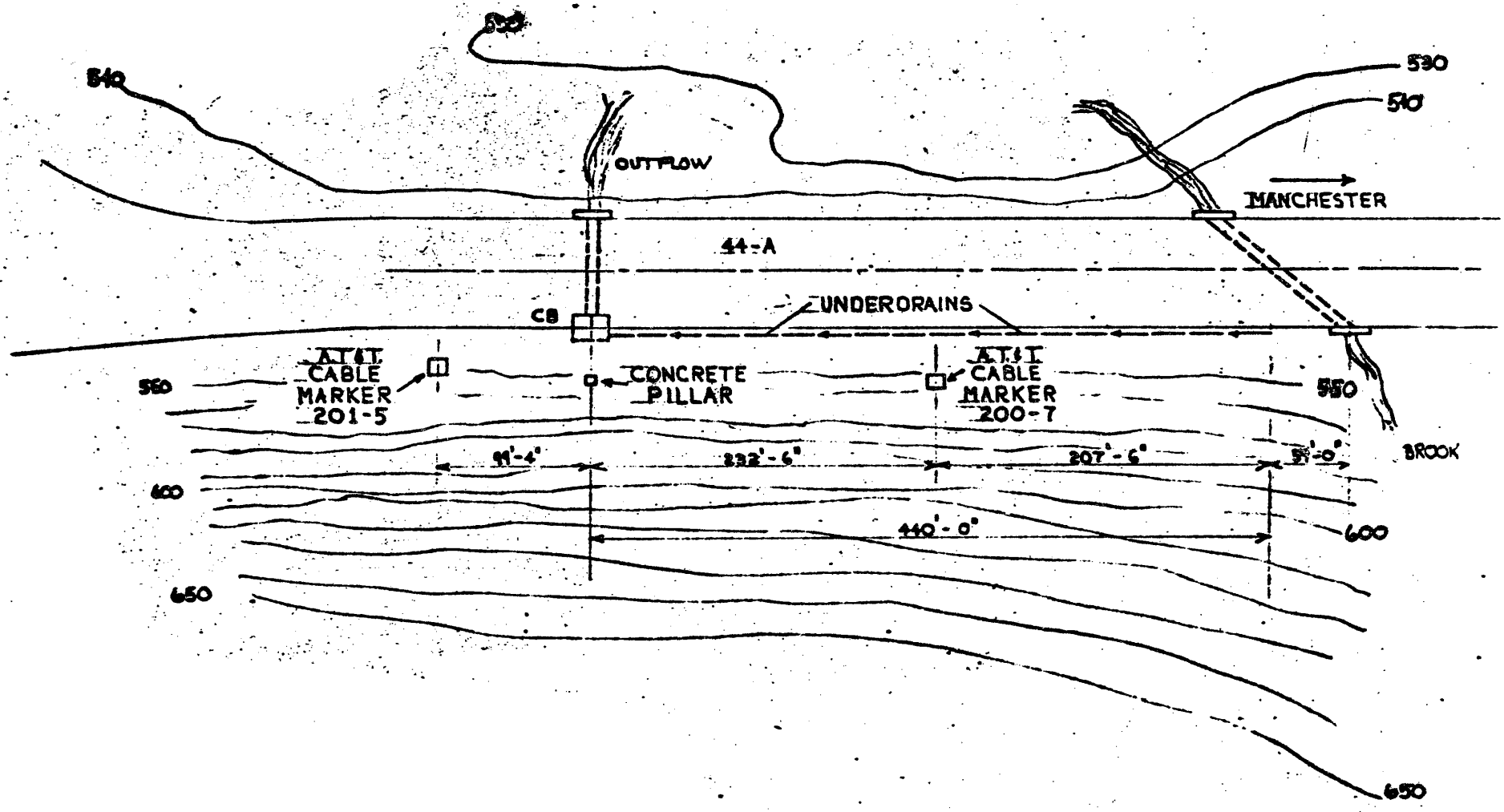


Fig. 4 · Route 44-A Installation

Fellon Road Installation

This installation was made at the owner's expense in an area intended for home construction. The collected data is included as further substantiation of the good field performance of the prefabricated underdrains.

Date of Installation: October 1970

Length of Underdrains: 1200 ft

Type of Core: Polyvinyl tubing

Height of Core: 5 ft

Type of Cloth: Nylon Chiffon

Pipe: 4 inch hard plastic

Type of Soil: USCS, silty sand (MS)

Permeability of Disturbed Lab Samples: 1.1×10^{-3} ft/min

Equivalent Maximum Observed Flow Rate: 10.5 gpm per 1000 lin ft of drain

Previous Reports Describing Installation: None.

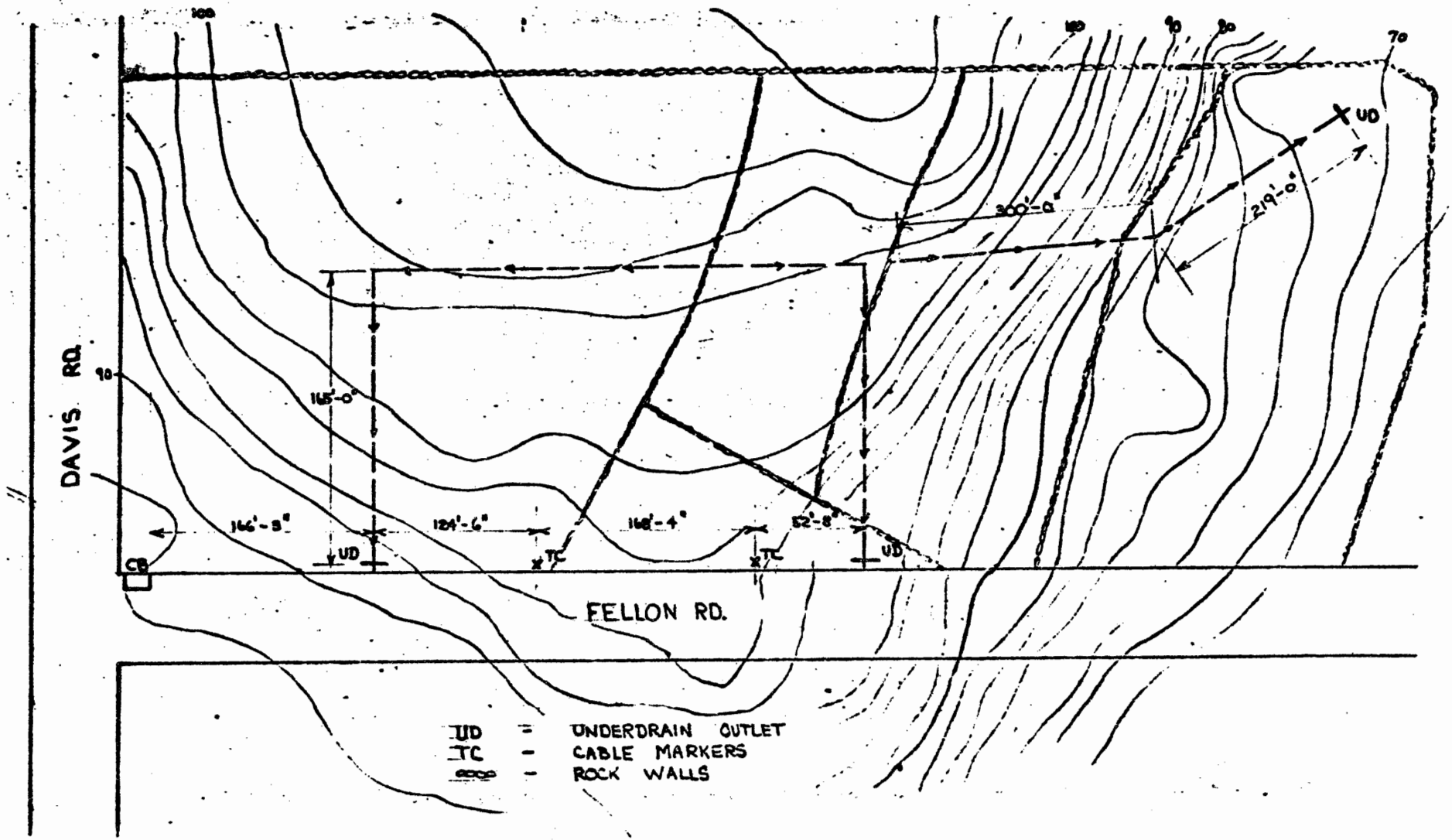
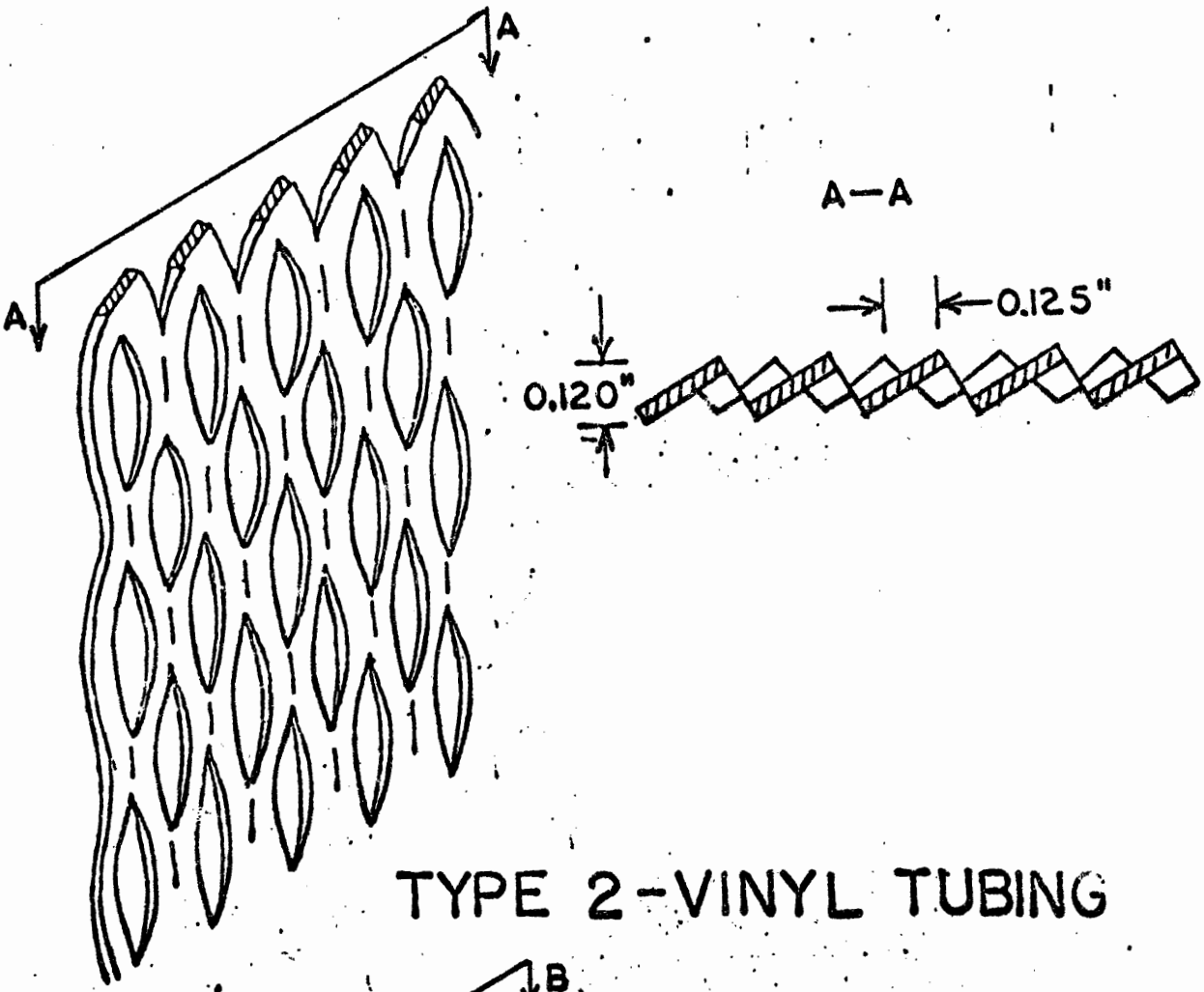


FIG. 5 Fellon Road Installation

Appendix

TYPE 1-EXPANDED ALUMINUM



TYPE 2-VINYL TUBING

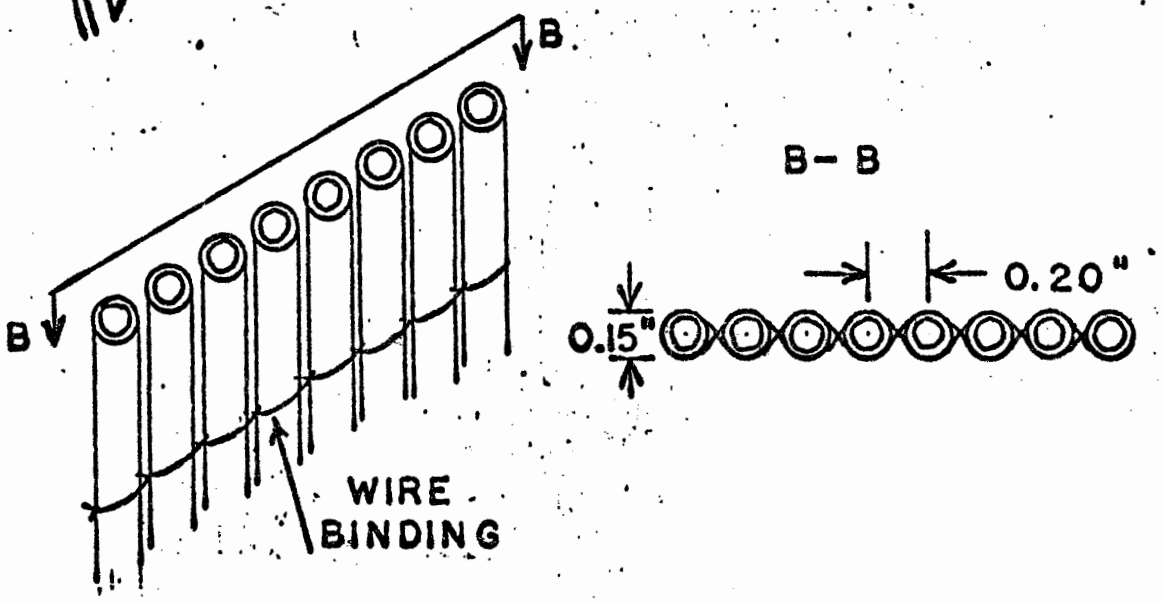
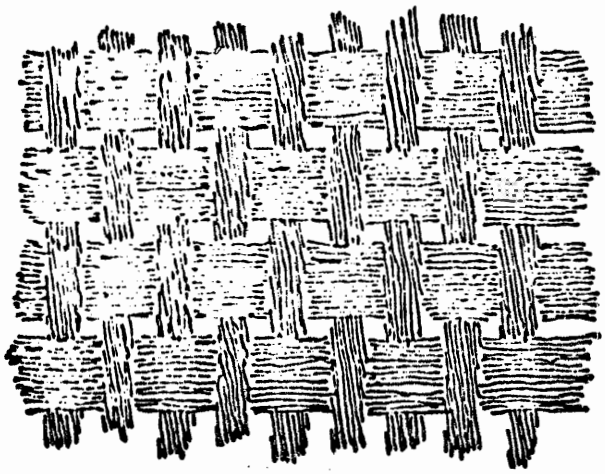


FIG. 6

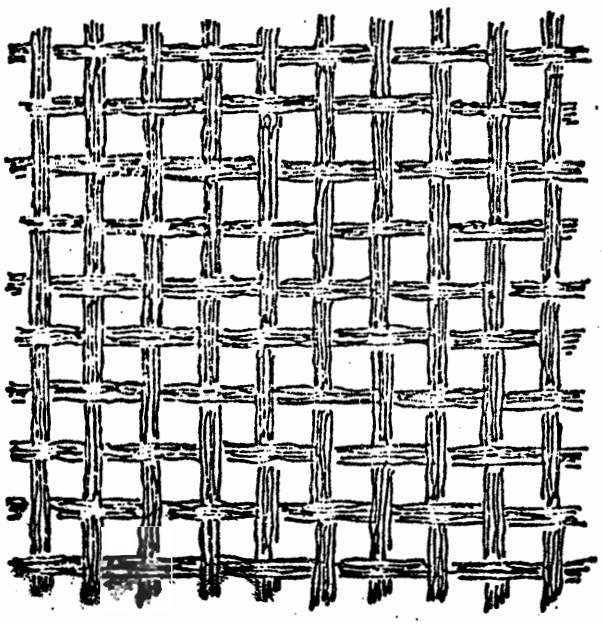
POLYESTER "BUTTERFLY" CLOTH



15% OPEN AREA

0.075 MM OPENINGS

NYLON "CHIFFON"

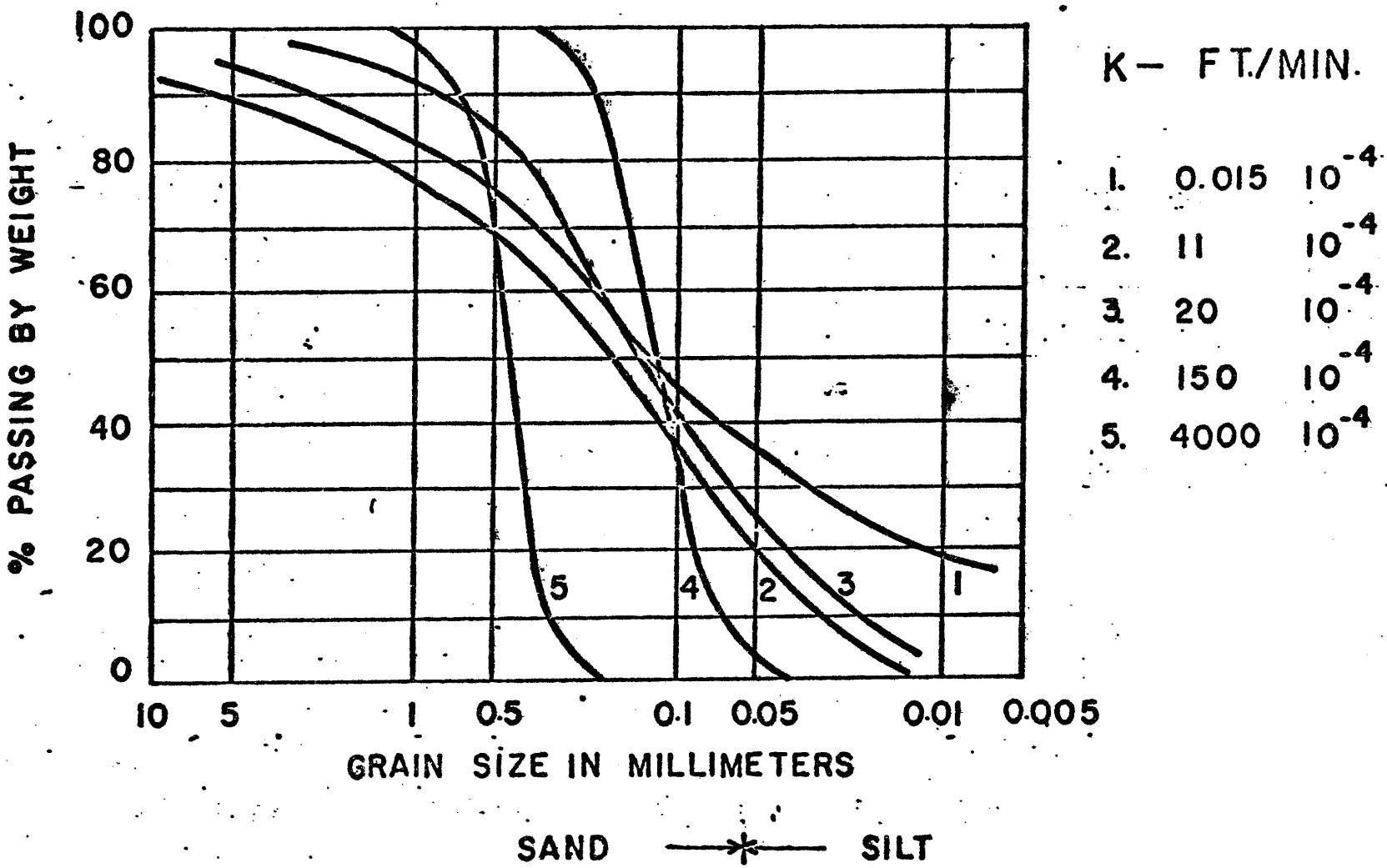


45% OPEN AREA

0.150 MM OPENINGS

FIG. 7

Fig. 8


100
80
60
40
20
0
% PASSING BY WEIGHT
10
5
1
0.5
0.1
0.05
0.01
0.005
GRAIN SIZE IN MILLIMETERS
SAND
SILT
5
4
2
3
1
K — FT./MIN.
1. 0.015 10⁻⁴
2. 11 10⁻⁴
3. 20 10⁻⁴
4. 150 10⁻⁴
5. 4000 10⁻⁴