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# BICYCLE-SAFE GRATE INLETS STUDY
## VOLUME NO. 5
## OCTOBER 1980

PREPARED FOR

FEDERAL HIGHWAY ADMINISTRATION

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Report No. FHWA/RD-80/081

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# BICYCLE-SAFE GRATE INLETS STUDY

## Vol. 5. Hydraulic Design of General Slotted Drain Inlets

October 1980

Final Report

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Prepared for
FEDERAL HIGHWAY ADMINISTRATION
Offices of Research & Development
Environmental Division
Washington, D.C. 20590

FHWA/RD-80/081 BICYCLE-SAFE GRATE INLETS STUDY, Vol. 5

# FOREWORD

This report describes the additional hydraulic tests conducted on slotted drain inlets. Tests were conducted to extend design equations to a wider range of field installations than those presented in the Volume 4 report. Test results and design procedures are presented for slot widths of 1.00 in. (25.4 mm), 1.75 in. (44.5 mm) and 2.5 in. (63.5 mm), with solid vertical transverse spacers at 6 in. (152.4 mm) spacing, installed at 0 and 15 in. (381 mm) from the curb face. They cover the total and partial flow interception conditions on continuous grades.

The research was conducted by the Water and Power Resources Services (formerly the Bureau of Reclamation) Engineering and Research Center for the Federal Highway Administration, Office of Research, Washington, D.C. under P.O. 5-3-0166.

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Director, Office of Research
Federal Highway Administration

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16. ABSTRACT

Additional tests were conducted on slotted drain inlets to extend design equations to a wider range of field installations. Total flow capture tests and partial flow interception tests were conducted for a range of slot widths, curb to slot distances, back slope, longitudinal slopes, and cross slopes.

Design procedures are presented for slots with solid vertical transverse bars at 6-in (152.4 mm) spacing in the form of graphs and equations.

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# NOTATION

B.S. - Reciprocal of Back slope (curb to slot)
C.D. - Curb distance (inches)
E - Hydraulic efficiency, Qi/Q (percent)
L - Total capture flow length
LA - Actual slot length
n - Manning's roughness coefficient
So - Longitudinal slope
Sx - Cross slope
Q - Gutter flow
Qc - Carryover flow
Qi - Flow intercepted by the slot
SW - Slot width (inches)
T - Width of spread (feet)
Z - Reciprocal of cross slope (Sx)

Standard slot design symbol

(SV) - (SW) - (SS) - (CD)

| Type of spacer | Slot width (inches) | Spacing of spacers (inches) | Distance from curb to slot (inches) |
|---|---|---|---|

(SV) = Solid vertical spacer with gutter flow on rough roadway surface (n = 0.0165)

A, B, C - Regression coefficients

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# CHAPTER 1

## INTRODUCTION

This volume presents results of hydraulic tests and analysis conducted to generalize the hydraulic design of slotted drain installation. A design procedure was developed and reported for the basic slot design in volume 4(1)*. A 1.75-in (44.55-mm) wide slot with solid vertical spacers at 6-in (152.4-mm) spacing installed 3.5 in (888.9 mm) from the curb face (SV-1.75-6-3.5) was used to develop a design method for total and partial flow capture. The testing and analysis described in this report cover a range of slot widths, curb distances, cross slopes, slot to curb back slopes, longitudinal slopes and discharges. Slotted drains with solid vertical spacers at 6-in (152-4 mm) spacing were used in all testing.

The design method reported in volume 4 remains valid for the conditions tested. However, this report covers a wider range of slot installations.

The test facility and experimental approach are essentially the same as those described in volume 4. Therefore, volume 4 should be referred to for details of the test facility, references, and additional information on slotted drains. Volume 5 is intended to supplement the information in volume 4.

### Scope

Table 1 lists the conditions tested. The tests at slot lengths of 8 and 24 ft (2.44 and 7.32 m) were conducted to determine efficiencies (Qi/Q) over a range of flows. At slot length = 48 ft (14.63 m) testing was limited to total flow capture lengths (L).

In order to cover a range of slope conditions, longitudinal slopes (So) of 0.005, 0.02, and 0.09 were tested at cross slopes (1/Z) of 1/16, 1/32, and 1/64. Back slopes (1/B.S. of 1/16 and 1/24 were tested at a curb distance of 15 in (381 mm) for all installatons. In addition to the 15-in (381-mm) curb distance, all installations were tested with the curb adjacent to the slot (C.D. = 0). The data for a 1-in (25.4-mm) wide slot was used to scale larger curb distances according to the Froude scaling law. A series of 4 or 5 discharges were tested for each condition listed in table 1.

### Hydraulic Tests

The test procedure was to install a length of slot at a particular curb distance, and record several parameters over a range of slope and flow conditions. The test conditions were limited by the maximum gutter flow, 5.3 $ft^3/s$ (0.15 $m^3/s$) or the length of slot installed.

Total flow interception measurements included:

1. Gutter flow (Q)
2. Total flow interception length (L)
3. Width of spread measured just upstream of the slot (T)
4. Depth of flow measured 1-ft (0.305-m) upstream of the slot (Y)

Typical total flow capture tests are shown in figure 1.

Partial flow interception tests included:

1. Gutter flow (Q)
2. Carryover flow (Qc) - Flow not intercepted by the slot.
3. Width of spread upstream and downstream from the slot (T)
4. Depth of flow measured 1-ft (0.305-m) upstream from the slot (Y)

Partial flow interception tests were not possible at some slope conditions for a 24-ft (7.32 m) slot length, since the total flow capture length was less than 24 ft (7.32 m) at the system flow capacity. Figure 2 shows typical partial flow capture tests.

Each test was photographed to complete the documentation.

### References

(1) Pugh, C. A., "Bicycle-safe Grate Inlets Study, Volume 4, Hydraulic Characteristics of Slotted Drain Inlets," Federal Highway Administration, Report No. FHWA-RD-79-106, June 1979

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* Numbers in parenthesis refer to references at the end of the chapter.

Table 1. - Test Conditions

| Slot length (ft) | Slot width (in) | Curb distance (in) | Curb back slope | Cross slope (Z) | Long. slope (So %) |
|---|---|---|---|---|---|
| 8+ | 1.00 | 0 | 0 | 16,32,64 | 1/2,2,9 |
| 8 | 1.00 | 15 | 16 | 16,32,64 | 1/2,2,9 |
| 8 | 1.00 | 15 | 24 | 16,32,64 | 1/2,2,9 |
| 8 | 1.75 | 0 | 0 | 16,32,64 | 1/2,2,9 |
| 8 | 1.75 | 15 | 16 | 16,32,64 | 1/2,2,9 |
| 8 | 1.75 | 15 | 24 | 16,32,64 | 1/2,2,9 |
| 8 | 2.50 | 0 | 0 | 16,32,64 | 1/2,2,9 |
| 8 | 2.50 | 15 | 16 | 16,32,64 | 1/2,2,9 |
| 8 | 2.50 | 15 | 24 | 16,32,64 | 1/2,2,9 |
| 24+ | 1.00 | 0 | 0 | 16,32,64 | 1/2,2,9 |
| 24 | 1.00 | 15 | 16 | 16,32,64 | 1/2,2,9 |
| 24 | 1.00 | 15 | 24 | 16,32,64 | 1/2,2,9 |
| 24 | 1.75 | 0 | 0 | 16,32,64 | 1/2,2,9 |
| 24 | 1.75 | 15 | 16 | 16,32,64 | 1/2,2,9 |
| 24 | 1.75 | 15 | 24 | 16,32,64 | 1/2,2,9 |
| 24 | 2.50 | 0 | 0 | 16,32,64 | 1/2,2,9 |
| 24 | 2.50 | 15 | 16 | 16,32,64 | 1/2,2,9 |
| 24 | 2.50 | 15 | 24 | 16,32,64 | 1/2,2,9 |
| 48* | 1.00 | 0 | 0 | 16,32,64 | 1/2,2,9 |
| 48 | 1.00 | 15 | 16 | 16,32,64 | 1/2,2,9 |
| 48 | 1.00 | 15 | 24 | 16,32,64 | 1/2,2,9 |
| 48 | 1.75 | 15 | 16 | 16,32,64 | 1/2,2,9 |
| 48 | 1,75 | 15 | 24 | 16,32,64 | 1/2,2,9 |
| 48 | 2.50 | 0 | 0 | 16,32,64 | 1/2,2,9 |
| 48 | 2.50 | 15 | 16 | 16,32,64 | 1/2,2,9 |
| 48 | 2.50 | 15 | 24 | 16,32,64 | 1/2,2,9 |

+ - Tests to determine slot efficiency (E = Qi/Q).
* - Tests to determine total capture length (L).

## CHAPTER 2

## TOTAL FLOW INTERCEPTION TESTS

### Introduction

Total flow interception tests were conducted to verify the design method developed in volume 4 and to extend the ranges of physical conditions which the design method covers.

In volume 4, a method is developed covering a standard curb and gutter installation. A 1.75-in (44.4 mm) wide slot with solid vertical spacers at 6-in (152.4-mm) spacing located 3.50 in (88.9 mm) from the curb face (SV-1.75-6-3.5) was used. The tests and analysis described in this report cover slot widths from 1.00 to 2.50 in (25.4 to 63.5 mm); curb distances from 0 to 38 in (0 to 965 mm); cross slopes from 1/Z = 1/64 to 1/16; longitudinal slopes from So = 0.005 to 0.09; and curb to slot back slopes from 1/B.S. = 1/24 to 1/16. The relationship between roadway roughness and slot length was developed in the previous tests. The previous tests also indicated that the transverse bar spacing and design has essentially no effect on the total flow capture length over the majority of possible field installations; therefore, a standard spacer type and spacing was used for further tests.

### Test Results

Back slope. - All tests with a 15-in (381-mm) curb distance were conducted with back slopes (1/B.S.) of 1/24 and 1/16. Figures 3 through 11 compare total flow capture lengths for back slopes of 16 and 24 while holding the other variables constant.

These graphs show that the differences in capture length are small. Where differences occur one back slope is not consistently better than the other; therefore, the differences are attributed to experimental inaccuracies in determining the total flow capture length (L). In the range from B.S. = 16 to 24 no correction is needed to determine L.

Slot width. - Slot widths of 1.00, 1.75, and 2.50 in (25.4, 44.45, and 63.5 mm) were tested for curb distances of 0 and 15 in (0 and 351 mm) over a range of slopes. Figures 12 through 34 compare total flow capture lengths for the three slot widths while holding the other variables constant. As it was found in volume 4, little difference was found in capture length at low flows and flat cross slopes where weir flow controls. The point where submerged or orifice flow starts to control L is dependent on the slot width. A method to determine L for different slot widths is discussed in the design method section.

Curb distance. - Tests were conducted at curb distances of 0 and 15 in (0 and 381 mm) for slot widths of 1.00, 1.75, and 2.50 in (25.4, 44.4, and 63.5 mm). Results for a 1.00-in (25.4-mm) slot width at a 15-in (381-mm) curb distance (SV-1.00-6-15) were scaled up to SV-1.75-10.5-26 and SV-2.50-15-38 using the Froude law. Figures 35 through 43 are comparisons showing the effect of curb distance. These plots indicate the L decreases slightly up to C.D. = 15, then increases again as the curb distance increases (see figure 35). A method to determine L as related to curb distance is discussed in weir flow section below.

### Analysis

Weir flow. - The following equation was developed in volume 4 for L when weir flow is the controlling factor.

$$L = 0.706\, Q^{0.442} S_o^{A}\, Z^{0.849}/n^{0.385} \qquad (2\text{-}1)$$

where:

$$A = 0.207 + 0.007\, Z + 2.613\, S_o - 0.049\, S_o Z - 19.084\, S_o^2 - 0.0001\, Z^2 \qquad (2\text{-}2)$$

When equation 2-1 was compared to data collected for this report the agreement was good at all conditions except Z = 64. The minimum cross slope used to develop equations 2-1 and 2-2 was Z = 48. When a cross slope of Z = 64 was used a significant error resulted in the computed L. Therefore, a new regression analysis was done using all data available, to determine equations for L and A. The effect of curb distance was also included in the determination of the exponent A. The analysis resulted in the following equation for L in the weir flow zone.

$$L = 1.257\, Q^{0.404} S_o^{A}\, Z^{0.841}/n^{0.235} \qquad (2\text{-}3)$$

where:

$$A = 0.2048 + Z/394.8 + 3.996\, S_o - S_o Z/19.24 - 31.42\, S_o^2 - Z^2/46956 + CD/349.3 - (CD)^2/10944 \qquad (2\text{-}4)$$

Where CD = curb distance (inches)

For a quick approximation of L, the average value of A is 0.285. Table 2 lists values of A for various slopes and curb distances.

# Table 2 - Exponents (A) in Equation 2-4

VALUES OF A
CURB DISTANCE= 0 inches ( 0 mm)

| | Z | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| So | 16 | 20 | 24 | 28 | 32 | 36 | 40 | 44 | 48 | 52 | 56 | 60 | 64 |
| 0.0050 | 0.255 | 0.261 | 0.266 | 0.271 | 0.275 | 0.278 | 0.281 | 0.283 | 0.284 | 0.285 | 0.284 | 0.284 | 0.282 |
| 0.0100 | 0.268 | 0.273 | 0.278 | 0.281 | 0.284 | 0.286 | 0.288 | 0.289 | 0.289 | 0.289 | 0.288 | 0.286 | 0.283 |
| 0.0150 | 0.280 | 0.284 | 0.287 | 0.290 | 0.292 | 0.293 | 0.294 | 0.294 | 0.293 | 0.291 | 0.289 | 0.286 | 0.283 |
| 0.0200 | 0.291 | 0.294 | 0.296 | 0.297 | 0.298 | 0.298 | 0.298 | 0.297 | 0.295 | 0.292 | 0.289 | 0.285 | 0.281 |
| 0.0250 | 0.299 | 0.301 | 0.302 | 0.303 | 0.303 | 0.302 | 0.300 | 0.298 | 0.295 | 0.292 | 0.287 | 0.282 | 0.277 |
| 0.0300 | 0.307 | 0.307 | 0.308 | 0.307 | 0.306 | 0.304 | 0.301 | 0.298 | 0.294 | 0.289 | 0.284 | 0.278 | 0.271 |
| 0.0350 | 0.312 | 0.312 | 0.311 | 0.309 | 0.307 | 0.304 | 0.301 | 0.296 | 0.291 | 0.286 | 0.279 | 0.272 | 0.265 |
| 0.0400 | 0.316 | 0.315 | 0.313 | 0.310 | 0.307 | 0.303 | 0.298 | 0.293 | 0.287 | 0.280 | 0.273 | 0.265 | 0.256 |
| 0.0450 | 0.319 | 0.316 | 0.313 | 0.310 | 0.305 | 0.300 | 0.295 | 0.288 | 0.281 | 0.273 | 0.265 | 0.256 | 0.246 |
| 0.0500 | 0.320 | 0.316 | 0.312 | 0.308 | 0.302 | 0.296 | 0.289 | 0.282 | 0.274 | 0.265 | 0.256 | 0.245 | 0.235 |
| 0.0550 | 0.319 | 0.315 | 0.309 | 0.304 | 0.297 | 0.290 | 0.282 | 0.274 | 0.265 | 0.255 | 0.245 | 0.233 | 0.221 |
| 0.0600 | 0.317 | 0.311 | 0.305 | 0.298 | 0.291 | 0.283 | 0.274 | 0.264 | 0.254 | 0.243 | 0.232 | 0.220 | 0.207 |
| 0.0650 | 0.313 | 0.306 | 0.299 | 0.291 | 0.283 | 0.274 | 0.264 | 0.253 | 0.242 | 0.230 | 0.218 | 0.204 | 0.190 |
| 0.0700 | 0.307 | 0.300 | 0.292 | 0.283 | 0.273 | 0.263 | 0.252 | 0.241 | 0.228 | 0.215 | 0.202 | 0.188 | 0.173 |
| 0.0750 | 0.300 | 0.292 | 0.283 | 0.273 | 0.262 | 0.251 | 0.239 | 0.226 | 0.213 | 0.199 | 0.185 | 0.169 | 0.153 |
| 0.0800 | 0.292 | 0.282 | 0.272 | 0.261 | 0.250 | 0.237 | 0.224 | 0.211 | 0.196 | 0.181 | 0.166 | 0.149 | 0.132 |
| 0.0850 | 0.282 | 0.271 | 0.260 | 0.248 | 0.235 | 0.222 | 0.208 | 0.193 | 0.178 | 0.162 | 0.145 | 0.128 | 0.110 |
| 0.0900 | 0.270 | 0.259 | 0.246 | 0.233 | 0.219 | 0.205 | 0.190 | 0.174 | 0.158 | 0.141 | 0.123 | 0.105 | 0.085 |

VALUES OF A
CURB DISTANCE= 5 inches ( 127 mm)

| | Z | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| So | 16 | 20 | 24 | 28 | 32 | 36 | 40 | 44 | 48 | 52 | 56 | 60 | 64 |
| 0.0050 | 0.267 | 0.273 | 0.278 | 0.283 | 0.287 | 0.290 | 0.293 | 0.295 | 0.296 | 0.297 | 0.297 | 0.296 | 0.294 |
| 0.0100 | 0.280 | 0.285 | 0.290 | 0.293 | 0.296 | 0.299 | 0.300 | 0.301 | 0.301 | 0.301 | 0.300 | 0.298 | 0.295 |
| 0.0150 | 0.292 | 0.296 | 0.300 | 0.302 | 0.304 | 0.305 | 0.306 | 0.306 | 0.305 | 0.303 | 0.301 | 0.298 | 0.295 |
| 0.0200 | 0.303 | 0.306 | 0.308 | 0.309 | 0.310 | 0.310 | 0.310 | 0.309 | 0.307 | 0.304 | 0.301 | 0.297 | 0.293 |
| 0.0250 | 0.311 | 0.313 | 0.314 | 0.315 | 0.315 | 0.314 | 0.312 | 0.310 | 0.307 | 0.304 | 0.299 | 0.294 | 0.289 |
| 0.0300 | 0.319 | 0.319 | 0.320 | 0.319 | 0.318 | 0.316 | 0.313 | 0.310 | 0.306 | 0.301 | 0.296 | 0.290 | 0.284 |
| 0.0350 | 0.324 | 0.324 | 0.323 | 0.321 | 0.319 | 0.316 | 0.313 | 0.308 | 0.303 | 0.298 | 0.291 | 0.284 | 0.277 |
| 0.0400 | 0.328 | 0.327 | 0.325 | 0.322 | 0.319 | 0.315 | 0.310 | 0.305 | 0.299 | 0.292 | 0.285 | 0.277 | 0.268 |
| 0.0450 | 0.331 | 0.328 | 0.325 | 0.322 | 0.317 | 0.312 | 0.307 | 0.300 | 0.293 | 0.286 | 0.277 | 0.268 | 0.258 |
| 0.0500 | 0.332 | 0.328 | 0.324 | 0.320 | 0.314 | 0.308 | 0.301 | 0.294 | 0.286 | 0.277 | 0.268 | 0.257 | 0.247 |
| 0.0550 | 0.331 | 0.327 | 0.321 | 0.316 | 0.309 | 0.302 | 0.294 | 0.286 | 0.277 | 0.267 | 0.257 | 0.245 | 0.233 |
| 0.0600 | 0.329 | 0.323 | 0.317 | 0.310 | 0.303 | 0.295 | 0.286 | 0.276 | 0.266 | 0.255 | 0.244 | 0.232 | 0.219 |
| 0.0650 | 0.325 | 0.318 | 0.311 | 0.303 | 0.295 | 0.286 | 0.276 | 0.265 | 0.254 | 0.242 | 0.230 | 0.216 | 0.202 |
| 0.0700 | 0.319 | 0.312 | 0.304 | 0.295 | 0.285 | 0.275 | 0.264 | 0.253 | 0.240 | 0.228 | 0.214 | 0.200 | 0.185 |
| 0.0750 | 0.312 | 0.304 | 0.295 | 0.285 | 0.274 | 0.263 | 0.251 | 0.238 | 0.225 | 0.211 | 0.197 | 0.181 | 0.165 |
| 0.0800 | 0.304 | 0.294 | 0.284 | 0.273 | 0.262 | 0.249 | 0.236 | 0.223 | 0.208 | 0.193 | 0.178 | 0.161 | 0.144 |
| 0.0850 | 0.294 | 0.283 | 0.272 | 0.260 | 0.247 | 0.234 | 0.220 | 0.205 | 0.190 | 0.174 | 0.157 | 0.140 | 0.122 |
| 0.0900 | 0.282 | 0.271 | 0.258 | 0.245 | 0.232 | 0.217 | 0.202 | 0.186 | 0.170 | 0.153 | 0.135 | 0.117 | 0.097 |

# Table 2 - (continued)

VALUES OF A
CURB DISTANCE= 10 inches ( 254 mm)

| | Z | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| So | 16 | 20 | 24 | 28 | 32 | 36 | 40 | 44 | 48 | 52 | 56 | 60 | 64 |
| 0.0050 | 0.274 | 0.280 | 0.286 | 0.290 | 0.294 | 0.298 | 0.300 | 0.302 | 0.304 | 0.304 | 0.304 | 0.303 | 0.302 |
| 0.0100 | 0.288 | 0.293 | 0.297 | 0.301 | 0.304 | 0.306 | 0.308 | 0.308 | 0.309 | 0.308 | 0.307 | 0.305 | 0.303 |
| 0.0150 | 0.300 | 0.304 | 0.307 | 0.310 | 0.311 | 0.313 | 0.313 | 0.313 | 0.312 | 0.311 | 0.309 | 0.306 | 0.302 |
| 0.0200 | 0.310 | 0.313 | 0.315 | 0.317 | 0.318 | 0.318 | 0.317 | 0.316 | 0.314 | 0.312 | 0.308 | 0.305 | 0.300 |
| 0.0250 | 0.319 | 0.321 | 0.322 | 0.322 | 0.322 | 0.321 | 0.320 | 0.318 | 0.315 | 0.311 | 0.307 | 0.302 | 0.296 |
| 0.0300 | 0.326 | 0.327 | 0.327 | 0.326 | 0.325 | 0.323 | 0.321 | 0.318 | 0.314 | 0.309 | 0.304 | 0.298 | 0.291 |
| 0.0350 | 0.332 | 0.331 | 0.331 | 0.329 | 0.327 | 0.324 | 0.320 | 0.316 | 0.311 | 0.305 | 0.299 | 0.292 | 0.284 |
| 0.0400 | 0.336 | 0.334 | 0.332 | 0.330 | 0.327 | 0.323 | 0.318 | 0.313 | 0.307 | 0.300 | 0.292 | 0.284 | 0.276 |
| 0.0450 | 0.338 | 0.336 | 0.333 | 0.329 | 0.325 | 0.320 | 0.314 | 0.308 | 0.301 | 0.293 | 0.285 | 0.275 | 0.266 |
| 0.0500 | 0.339 | 0.336 | 0.332 | 0.327 | 0.322 | 0.316 | 0.309 | 0.301 | 0.293 | 0.285 | 0.275 | 0.265 | 0.254 |
| 0.0550 | 0.338 | 0.334 | 0.329 | 0.323 | 0.317 | 0.310 | 0.302 | 0.293 | 0.284 | 0.275 | 0.264 | 0.253 | 0.241 |
| 0.0600 | 0.336 | 0.331 | 0.325 | 0.318 | 0.310 | 0.302 | 0.293 | 0.284 | 0.274 | 0.263 | 0.251 | 0.239 | 0.226 |
| 0.0650 | 0.332 | 0.326 | 0.319 | 0.311 | 0.302 | 0.293 | 0.283 | 0.273 | 0.262 | 0.250 | 0.237 | 0.224 | 0.210 |
| 0.0700 | 0.327 | 0.319 | 0.311 | 0.302 | 0.293 | 0.283 | 0.272 | 0.260 | 0.248 | 0.235 | 0.221 | 0.207 | 0.192 |
| 0.0750 | 0.320 | 0.311 | 0.302 | 0.292 | 0.282 | 0.271 | 0.259 | 0.246 | 0.233 | 0.219 | 0.204 | 0.189 | 0.173 |
| 0.0800 | 0.311 | 0.302 | 0.292 | 0.281 | 0.269 | 0.257 | 0.244 | 0.230 | 0.216 | 0.201 | 0.185 | 0.169 | 0.152 |
| 0.0850 | 0.301 | 0.291 | 0.279 | 0.267 | 0.255 | 0.241 | 0.227 | 0.213 | 0.197 | 0 181 | 0.165 | 0.147 | 0.129 |
| 0.0900 | 0.290 | 0.278 | 0.266 | 0.253 | 0.239 | 0.225 | 0.210 | 0.194 | 0.177 | 0.160 | 0.143 | 0.124 | 0.105 |

VALUES OF A
CURB DISTANCE= 15 inches ( 381 mm)

| | Z | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| So | 16 | 20 | 24 | 28 | 32 | 36 | 40 | 44 | 48 | 52 | 56 | 60 | 64 |
| 0.0050 | 0.277 | 0.283 | 0.289 | 0.293 | 0.297 | 0.301 | 0.303 | 0.305 | 0.306 | 0.307 | 0.307 | 0.306 | 0.305 |
| 0.0100 | 0.291 | 0.296 | 0.300 | 0.304 | 0.307 | 0.309 | 0.310 | 0.311 | 0.312 | 0.311 | 0.310 | 0.308 | 0.306 |
| 0.0150 | 0.303 | 0.307 | 0.310 | 0.312 | 0.314 | 0.316 | 0.316 | 0.316 | 0.315 | 0.314 | 0.311 | 0.309 | 0.305 |
| 0.0200 | 0.313 | 0.316 | 0.318 | 0.320 | 0.321 | 0.321 | 0.320 | 0.319 | 0.317 | 0.315 | 0.311 | 0.307 | 0.303 |
| 0.0250 | 0.322 | 0.324 | 0.325 | 0.325 | 0.325 | 0.324 | 0.323 | 0.320 | 0.318 | 0.314 | 0.310 | 0.305 | 0.299 |
| 0.0300 | 0.329 | 0.330 | 0.330 | 0.329 | 0.328 | 0.326 | 0.324 | 0.320 | 0.316 | 0.312 | 0.307 | 0.301 | 0.294 |
| 0.0350 | 0.335 | 0.334 | 0.333 | 0.332 | 0.330 | 0.327 | 0.323 | 0.319 | 0.314 | 0.308 | 0.302 | 0.295 | 0.287 |
| 0.0400 | 0.339 | 0.337 | 0.335 | 0.333 | 0.329 | 0.325 | 0.321 | 0.315 | 0.309 | 0.303 | 0.295 | 0.287 | 0.279 |
| 0.0450 | 0.341 | 0.339 | 0.336 | 0.332 | 0.328 | 0.323 | 0.317 | 0.311 | 0.304 | 0.296 | 0.287 | 0.278 | 0.269 |
| 0.0500 | 0.342 | 0.339 | 0.335 | 0.330 | 0.325 | 0.318 | 0.312 | 0.304 | 0.296 | 0.287 | 0.278 | 0.268 | 0.257 |
| 0.0550 | 0.341 | 0.337 | 0.332 | 0.326 | 0.320 | 0.313 | 0.305 | 0.296 | 0.287 | 0.277 | 0.267 | 0.256 | 0.244 |
| 0.0600 | 0.339 | 0.334 | 0.328 | 0.321 | 0.313 | 0.305 | 0.296 | 0.287 | 0.277 | 0.266 | 0.254 | 0.242 | 0.229 |
| 0.0650 | 0.335 | 0.329 | 0.322 | 0.314 | 0.305 | 0.296 | 0.286 | 0.276 | 0.265 | 0.253 | 0.240 | 0.227 | 0.213 |
| 0.0700 | 0.330 | 0.322 | 0.314 | 0.305 | 0.296 | 0.286 | 0.275 | 0.263 | 0.251 | 0.238 | 0.224 | 0.210 | 0.195 |
| 0.0750 | 0.323 | 0.314 | 0.305 | 0.295 | 0.285 | 0.273 | 0.261 | 0.249 | 0.236 | 0.222 | 0.207 | 0.192 | 0.176 |
| 0.0800 | 0.314 | 0.305 | 0.295 | 0.284 | 0.272 | 0.260 | 0.247 | 0.233 | 0.219 | 0.204 | 0.188 | 0.172 | 0.155 |
| 0.0850 | 0.304 | 0.294 | 0.282 | 0.270 | 0.258 | 0.244 | 0.230 | 0.216 | 0.200 | 0.184 | 0.167 | 0.150 | 0.132 |
| 0.0900 | 0.293 | 0.281 | 0.269 | 0.256 | 0.242 | 0.228 | 0.212 | 0.197 | 0.180 | 0.163 | 0.145 | 0.127 | 0.108 |

# Table 2 - (continued)

VALUES OF A
CURB DISTANCE= 20 inches ( 508 mm)

| | Z | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| So | 16 | 20 | 24 | 28 | 32 | 36 | 40 | 44 | 48 | 52 | 56 | 60 | 64 |
| 0.0050 | 0.276 | 0.282 | 0.287 | 0.292 | 0.296 | 0.299 | 0.302 | 0.303 | 0.305 | 0.305 | 0.305 | 0.304 | 0.303 |
| 0.0100 | 0.289 | 0.294 | 0.298 | 0.302 | 0.305 | 0.307 | 0.309 | 0.310 | 0.310 | 0.309 | 0.308 | 0.306 | 0.304 |
| 0.0150 | 0.301 | 0.305 | 0.308 | 0.311 | 0.313 | 0.314 | 0.314 | 0.314 | 0.313 | 0.312 | 0.310 | 0.307 | 0.30 |
| 0.0200 | 0.311 | 0.314 | 0.316 | 0.318 | 0.319 | 0.319 | 0.319 | 0.317 | 0.315 | 0.313 | 0.310 | 0.306 | 0.301 |
| 0.0250 | 0.320 | 0.322 | 0.323 | 0.324 | 0.323 | 0.323 | 0.321 | 0.319 | 0.316 | 0.312 | 0.308 | 0.303 | 0.297 |
| 0.0300 | 0.327 | 0.328 | 0.328 | 0.328 | 0.326 | 0.325 | 0.322 | 0.319 | 0.315 | 0.310 | 0.305 | 0.299 | 0.292 |
| 0.0350 | 0.333 | 0.333 | 0.332 | 0.330 | 0.328 | 0.325 | 0.321 | 0.317 | 0.312 | 0.306 | 0.300 | 0.293 | 0.285 |
| 0.0400 | 0.337 | 0.336 | 0.334 | 0.331 | 0.328 | 0.324 | 0.319 | 0.314 | 0.308 | 0.301 | 0.294 | 0.286 | 0.277 |
| 0.0450 | 0.339 | 0.337 | 0.334 | 0.330 | 0.326 | 0.321 | 0.315 | 0.309 | 0.302 | 0.294 | 0.286 | 0.277 | 0.267 |
| 0.0500 | 0.340 | 0.337 | 0.333 | 0.328 | 0.323 | 0.317 | 0.310 | 0.303 | 0.295 | 0.286 | 0.276 | 0.266 | 0.255 |
| 0.0550 | 0.340 | 0.335 | 0.330 | 0.324 | 0.318 | 0.311 | 0.303 | 0.295 | 0.286 | 0.276 | 0.265 | 0.254 | 0.242 |
| 0.0600 | 0.337 | 0.332 | 0.326 | 0.319 | 0.312 | 0.303 | 0.295 | 0.285 | 0.275 | 0.264 | 0.253 | 0.240 | 0.227 |
| 0.0650 | 0.334 | 0.327 | 0.320 | 0.312 | 0.304 | 0.294 | 0.285 | 0.274 | 0.263 | 0.251 | 0.238 | 0.225 | 0.211 |
| 0.0700 | 0.328 | 0.321 | 0.312 | 0.304 | 0.294 | 0.284 | 0.273 | 0.261 | 0.249 | 0.236 | 0.223 | 0.208 | 0.193 |
| 0.0750 | 0.321 | 0.313 | 0.303 | 0.294 | 0.283 | 0.272 | 0.260 | 0.247 | 0.234 | 0.220 | 0.205 | 0.190 | 0.174 |
| 0.0800 | 0.313 | 0.303 | 0.293 | 0.282 | 0.270 | 0.258 | 0.245 | 0.231 | 0.217 | 0.202 | 0.186 | 0.170 | 0.153 |
| 0.0850 | 0.303 | 0.292 | 0.281 | 0.269 | 0.256 | 0.243 | 0.229 | 0.214 | 0.199 | 0.183 | 0.166 | 0.148 | 0.130 |
| 0.0900 | 0.291 | 0.279 | 0.267 | 0.254 | 0.240 | 0.226 | 0.211 | 0.195 | 0.179 | 0.162 | 0.144 | 0.125 | 0.106 |

VALUES OF A
CURB DISTANCE= 25 inches ( 635 mm)

| | Z | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| So | 16 | 20 | 24 | 28 | 32 | 36 | 40 | 44 | 48 | 52 | 56 | 60 | 64 |
| 0.0050 | 0.269 | 0.275 | 0.281 | 0.285 | 0.289 | 0.293 | 0.295 | 0.297 | 0.298 | 0.299 | 0.299 | 0.298 | 0.297 |
| 0.0100 | 0.283 | 0.288 | 0.292 | 0.296 | 0.299 | 0.301 | 0.303 | 0.303 | 0.304 | 0.303 | 0.302 | 0.300 | 0.298 |
| 0.0150 | 0.295 | 0.299 | 0.302 | 0.305 | 0.306 | 0.308 | 0.308 | 0.308 | 0.307 | 0.306 | 0.304 | 0.301 | 0.297 |
| 0.0200 | 0.305 | 0.308 | 0.310 | 0.312 | 0.313 | 0.313 | 0.312 | 0.311 | 0.309 | 0.307 | 0.303 | 0.300 | 0.295 |
| 0.0250 | 0.314 | 0.316 | 0.317 | 0.317 | 0.317 | 0.316 | 0.315 | 0.313 | 0.310 | 0.306 | 0.302 | 0.297 | 0.291 |
| 0.0300 | 0.321 | 0.322 | 0.322 | 0.321 | 0.320 | 0.318 | 0.316 | 0.312 | 0.309 | 0.304 | 0.299 | 0.293 | 0.286 |
| 0.0350 | 0.327 | 0.326 | 0.325 | 0.324 | 0.322 | 0.319 | 0.315 | 0.311 | 0.306 | 0.300 | 0.294 | 0.287 | 0.279 |
| 0.0400 | 0.331 | 0.329 | 0.327 | 0.325 | 0.322 | 0.318 | 0.313 | 0.308 | 0.302 | 0.295 | 0.287 | 0.279 | 0.271 |
| 0.0450 | 0.333 | 0.331 | 0.328 | 0.324 | 0.320 | 0.315 | 0.309 | 0.303 | 0.296 | 0.288 | 0.280 | 0.270 | 0.261 |
| 0.0500 | 0.334 | 0.331 | 0.327 | 0.322 | 0.317 | 0.311 | 0.304 | 0.296 | 0.288 | 0.280 | 0.270 | 0.260 | 0.249 |
| 0.0550 | 0.333 | 0.329 | 0.324 | 0.318 | 0.312 | 0.305 | 0.297 | 0.288 | 0.279 | 0.269 | 0.259 | 0.248 | 0.236 |
| 0.0600 | 0.331 | 0.326 | 0.320 | 0.313 | 0.305 | 0.297 | 0.288 | 0.279 | 0.269 | 0.258 | 0.246 | 0.234 | 0.221 |
| 0.0650 | 0.327 | 0.321 | 0.314 | 0.306 | 0.297 | 0.288 | 0.278 | 0.268 | 0.257 | 0.245 | 0.232 | 0.219 | 0.205 |
| 0.0700 | 0.322 | 0.314 | 0.306 | 0.297 | 0.288 | 0.278 | 0.267 | 0.255 | 0.243 | 0.230 | 0.216 | 0.202 | 0.187 |
| 0.0750 | 0.315 | 0.306 | 0.297 | 0.287 | 0.277 | 0.265 | 0.254 | 0.241 | 0.228 | 0.214 | 0.199 | 0.184 | 0.168 |
| 0.0800 | 0.306 | 0.297 | 0.287 | 0.276 | 0.264 | 0.252 | 0.239 | 0.225 | 0.211 | 0.196 | 0.180 | 0.164 | 0.147 |
| 0.0850 | 0.296 | 0.286 | 0.274 | 0.262 | 0.250 | 0.236 | 0.222 | 0.208 | 0.192 | 0.176 | 0.160 | 0.142 | 0.124 |
| 0.0900 | 0.285 | 0.273 | 0.261 | 0.248 | 0.234 | 0.220 | 0.205 | 0.189 | 0.172 | 0.155 | 0.138 | 0.119 | 0.100 |

# Table 2 - (continued)

VALUES OF A
CURB DISTANCE= 30 inches ( 762 mm)

| | Z | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| So | 16 | 20 | 24 | 28 | 32 | 36 | 40 | 44 | 48 | 52 | 56 | 60 | 64 |
| 0.0050 | 0.259 | 0.265 | 0.270 | 0.275 | 0.279 | 0.282 | 0.284 | 0.286 | 0.288 | 0.288 | 0.288 | 0.287 | 0.286 |
| 0.0100 | 0.272 | 0.277 | 0.281 | 0.285 | 0.288 | 0.290 | 0.292 | 0.293 | 0.293 | 0.292 | 0.291 | 0.289 | 0.287 |
| 0.0150 | 0.284 | 0.288 | 0.291 | 0.294 | 0.296 | 0.297 | 0.297 | 0.297 | 0.296 | 0.295 | 0.293 | 0.290 | 0.286 |
| 0.0200 | 0.294 | 0.297 | 0.299 | 0.301 | 0.302 | 0.302 | 0.301 | 0.300 | 0.298 | 0.296 | 0.293 | 0.289 | 0.284 |
| 0.0250 | 0.303 | 0.305 | 0.306 | 0.307 | 0.306 | 0.306 | 0.304 | 0.302 | 0.299 | 0.295 | 0.291 | 0.286 | 0.280 |
| 0.0300 | 0.310 | 0.311 | 0.311 | 0.311 | 0.309 | 0.308 | 0.305 | 0.302 | 0.298 | 0.293 | 0.288 | 0.282 | 0.275 |
| 0.0350 | 0.316 | 0.316 | 0.315 | 0.313 | 0.311 | 0.308 | 0.304 | 0.300 | 0.295 | 0.289 | 0.283 | 0.276 | 0.268 |
| 0.0400 | 0.320 | 0.319 | 0.317 | 0.314 | 0.311 | 0.307 | 0.302 | 0.297 | 0.291 | 0.284 | 0.277 | 0.269 | 0.260 |
| 0.0450 | 0.322 | 0.320 | 0.317 | 0.313 | 0.309 | 0.304 | 0.298 | 0.292 | 0.285 | 0.277 | 0.269 | 0.260 | 0.250 |
| 0.0500 | 0.323 | 0.320 | 0.316 | 0.311 | 0.306 | 0.300 | 0.293 | 0.286 | 0.277 | 0.269 | 0.259 | 0.249 | 0.238 |
| 0.0550 | 0.323 | 0.318 | 0.313 | 0.307 | 0.301 | 0.294 | 0.286 | 0.278 | 0.268 | 0.259 | 0.248 | 0.237 | 0.225 |
| 0.0600 | 0.320 | 0.315 | 0.309 | 0.302 | 0.295 | 0.286 | 0.278 | 0.268 | 0.258 | 0.247 | 0.236 | 0.223 | 0.210 |
| 0.0650 | 0.316 | 0.310 | 0.303 | 0.295 | 0.287 | 0.277 | 0.268 | 0.257 | 0.246 | 0.234 | 0.221 | 0.208 | 0.194 |
| 0.0700 | 0.311 | 0.304 | 0.295 | 0.287 | 0.277 | 0.267 | 0.256 | 0.244 | 0.232 | 0.219 | 0.206 | 0.191 | 0.176 |
| 0.0750 | 0.304 | 0.296 | 0.286 | 0.276 | 0.266 | 0.255 | 0.243 | 0.230 | 0.217 | 0.203 | 0.188 | 0.173 | 0.157 |
| 0.0800 | 0.296 | 0.286 | 0.276 | 0.265 | 0.253 | 0.241 | 0.228 | 0.214 | 0.200 | 0.185 | 0.169 | 0.153 | 0.136 |
| 0.0850 | 0.285 | 0.275 | 0.264 | 0.252 | 0.239 | 0.226 | 0.212 | 0.197 | 0.182 | 0.165 | 0.149 | 0.131 | 0.113 |
| 0.0900 | 0.274 | 0.262 | 0.250 | 0.237 | 0.223 | 0.209 | 0.194 | 0.178 | 0.162 | 0.144 | 0.127 | 0.108 | 0.089 |

VALUES OF A
CURB DISTANCE= 35 inches ( 889 mm)

| | Z | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| So | 16 | 20 | 24 | 28 | 32 | 36 | 40 | 44 | 48 | 52 | 56 | 60 | 64 |
| 0.0050 | 0.243 | 0.249 | 0.255 | 0.259 | 0.263 | 0.266 | 0.269 | 0.271 | 0.272 | 0.273 | 0.273 | 0.272 | 0.271 |
| 0.0100 | 0.257 | 0.262 | 0.266 | 0.270 | 0.272 | 0.275 | 0.276 | 0.277 | 0.277 | 0.277 | 0.276 | 0.274 | 0.271 |
| 0.0150 | 0.269 | 0.272 | 0.276 | 0.278 | 0.280 | 0.281 | 0.282 | 0.282 | 0.281 | 0.280 | 0.277 | 0.274 | 0.271 |
| 0.0200 | 0.279 | 0.282 | 0.284 | 0.286 | 0.286 | 0.287 | 0.286 | 0.285 | 0.283 | 0.280 | 0.277 | 0.273 | 0.269 |
| 0.0250 | 0.288 | 0.289 | 0.291 | 0.291 | 0.291 | 0.290 | 0.289 | 0.286 | 0.283 | 0.280 | 0.276 | 0.271 | 0.265 |
| 0.0300 | 0.295 | 0.296 | 0.296 | 0.295 | 0.294 | 0.292 | 0.290 | 0.286 | 0.282 | 0.278 | 0.272 | 0.266 | 0.260 |
| 0.0350 | 0.300 | 0.300 | 0.299 | 0.298 | 0.295 | 0.293 | 0.289 | 0.285 | 0.280 | 0.274 | 0.268 | 0.261 | 0.253 |
| 0.0400 | 0.304 | 0.303 | 0.301 | 0.299 | 0.295 | 0.291 | 0.287 | 0.281 | 0.275 | 0.269 | 0.261 | 0.253 | 0.244 |
| 0.0450 | 0.307 | 0.305 | 0.302 | 0.298 | 0.294 | 0.289 | 0.283 | 0.277 | 0.270 | 0.262 | 0.253 | 0.244 | 0.234 |
| 0.0500 | 0.308 | 0.304 | 0.300 | 0.296 | 0.290 | 0.284 | 0.278 | 0.270 | 0.262 | 0.253 | 0.244 | 0.234 | 0.223 |
| 0.0550 | 0.307 | 0.303 | 0.298 | 0.292 | 0.286 | 0.278 | 0.271 | 0.262 | 0.253 | 0.243 | 0.233 | 0.222 | 0.210 |
| 0.0600 | 0.305 | 0.299 | 0.293 | 0.287 | 0.279 | 0.271 | 0.262 | 0.253 | 0.243 | 0.232 | 0.220 | 0.208 | 0.195 |
| 0.0650 | 0.301 | 0.295 | 0.287 | 0.280 | 0.271 | 0.262 | 0.252 | 0.242 | 0.230 | 0.219 | 0.206 | 0.193 | 0.179 |
| 0.0700 | 0.296 | 0.288 | 0.280 | 0.271 | 0.262 | 0.251 | 0.241 | 0.229 | 0.217 | 0.204 | 0.190 | 0.176 | 0.161 |
| 0.0750 | 0.289 | 0.280 | 0.271 | 0.261 | 0.251 | 0.239 | 0.227 | 0.215 | 0.201 | 0.187 | 0.173 | 0.157 | 0.141 |
| 0.0800 | 0.280 | 0.271 | 0.260 | 0.249 | 0.238 | 0.226 | 0.213 | 0.199 | 0.185 | 0.170 | 0.154 | 0.137 | 0.120 |
| 0.0850 | 0.270 | 0.259 | 0.248 | 0.236 | 0.224 | 0.210 | 0.196 | 0.182 | 0.166 | 0.150 | 0.133 | 0.116 | 0.093 |
| 0.0900 | 0.258 | 0.247 | 0.234 | 0.221 | 0.208 | 0.193 | 0.178 | 0.163 | 0.146 | 0.129 | 0.111 | 0.093 | 0.074 |

Submerged flow. - An equation was developed in volume 4 for a 1.75-in (44.4-mm) wide slot in the submerged flow zone.

$$L = 0.394 \; Q^{0.649} S_o^{0.410} Z^{0.445} / n^{0.811} \quad (2\text{-}5)$$

Values computed with equation 2-5 agree closely with the new data.

A new regression analysis was done to develop the following equation for L for a 1.00-in (25.4-mm) wide slot in the submerged flow zone.

$$L = 0.464 \; Q^{0.648} S_o^{0.223} Z^{0.329} / n^{0.811} \quad (2\text{-}6)$$

The exponents on Q and n are essentially the same in equations 2-5 and 2-6. A submerged flow equation was not developed for the 2.5-in (63.5-mm) wide slot since the maximum flow of 5.3 $ft^3/s$ (0.15 $m^3/s$) was not sufficient to produce submerged flow.

The Total Flow Capture Design Method.- The following list outlines the steps necessary to determine L for slots from 1.00 to 2.50 in (25.4 and 63.5 mm) wide at curb distances from 0 to 30 in (0 to 889 mm) over a range of slopes from So = 0 to 0.09 and Z = 16 to 64.

1. Determine the exponent A in the weir flow equation (2-3) from table 2.

2. Compute L using equations 2-5 or 2-6 (depending on the slot width) and 2-3 for a given set of slope and flow conditions (So, Z, Q, n). The larger value of L controls.

3. For a slot width of 2.50 in (63.5 mm) use equation 2-3 to compute L, for flows less than 5.5 $ft^3/s$ (.16 $m^3/s$).

The weir flow equation will control L in most field installations. Figures 44 through 67 are comparisons of measured vs. calculated values of L using the design method described above. It should be noted that a 10 percent error in the calculation of L will result in only a 1 percent error in the amount of flow captured, since the flow is very shallow in the downstream portion (see chapter 3 on partial flow interception).

CHAPTER 3

## PARTIAL FLOW INTERCEPTION

### Introduction

More flow is captured in the upstream portion of slot than in the downstream part, since the flow is deepest at the upstream end. Therefore, more flow is captured per unit length of slot if a portion of the flow is bypassed. A method was developed to determine the efficiency (E) of a given length of slot (LA) for an SV-1.75-6-3.5 slot installation in volume 4. The purpose of the additional work described in volume 5 is to extend the design method to a wider range of installations.

Partial flow interception tests were conducted using various slot widths, curb distances and back slopes (see table 1). Solid vertical transverse bars spaced at 6 in (152.4 mm) were used for all testing.

### Test Results and Analysis

The data collected is presented in graphical form in figures 68 through 120. The plots are grouped so three sequential graphs can be compared to illustrate the effect of slot width on efficiency. For example, figures 68, 69, and 70 contain results for slot widths of 1.00, 1.75, and 2.50 in (25.4, 44.45, and 63.5 mm) respectively, while the other parameters are held constant.

Back slope. - For tests with the curb 15 in (381 mm) from the slot, back slopes of 1/16 and 1/24 were tested. When the flow vs. efficiency plots are compared, no discernible effect of back slope on efficiency can be detected. For example, in figures 81 and 90 (SV-1.75-6-15; Z = 32), the plots for B.S. = 16 and B.S. = 24 are essentially identical. Comparisons of other graphs also show very little effect due to back slope. Therefore, data with back slopes of 1/16 and 1/24 were grouped together for futher analysis.

Curb distance and slot width. - When plots with different curb distances and slot widths were compared it was obvious that the flow interception efficiency was affected by these two parameters (figures 69 vs. 78 and figures 68 vs. 69 and 70). Therefore, the data were grouped according to curb distance and slot width for separate analysis. At a 15-in (381-mm) curb distance the two back slopes (BS = 16 and 24) were grouped together. Table 4 lists the groups of data.

Table 3. - Data groups for efficiency regression analysis

| | | |
|---|---|---|
| SV-1.00-0 | SV-1.75-0 | SV-2.50-0 |
| SV-1.00-15 | SV-1.75-15 | SV-2.50-15 |

The following equation was developed in volume 4 for a SV-1.75-3.5 slot installation.

$$(E/100) = 1 - 0.918\ (1 - LA/L)^{1.769} \qquad (3\text{-}1)$$

were

E = Flow interception efficiency (percent)
LA = Actual slot length
L = Total flow interception slot length

Equation 3-1 can be expressed in the following general form:

$$(E/100) = 1 - C\ (1\text{-}LA/L)^{B} \qquad (3\text{-}2)$$

By regression anaysis of all partial flow data, coefficients C and B were related to curb distance (CD in inches) and slot width (SW in inches) in the following two equations:

$$C = 1.07029(SW) - (CD)^2/1970.6 - (CD)/75.344 - 0.32898\ (SW)^2 + (SW)(CD)/113.98 + 0.0514 \qquad (3\text{-}3)$$

$$B = 2.9738(SW) - 0.9148(SW)^2 + (SW)(CD)/33.993 - (CD)/16.893 + (CD)^2/2330.6 - 0.6112 \qquad (3\text{-}4)$$

Slot width is the most significant parameter in both coefficients; however, curb distance is more important in the computation of C than B. Tables 4 and 5 list values of C and B computed with equations 3-3 and 3-4 for various curb distances and slot widths.

The values computed with equations 3-2, 3-3, and 3-4 are displayed (in addition to the data) on figures 68 through 120. The majority of the computed values fit the data closely, however some of the computed values for LA = 8 ft (2.44 m) in the low efficiency range do not match the data (see figure 68). For short slot lengths in the low efficiency range (E < 50%) the total flow capture length (L) is much greater than LA. These flow conditions are out of the range of most of the data collected and the equations are not valid. Furthermore, it would not be efficient to design a field installation using a short slot length in a very low efficiency range.

Therefore, it is recommended that equations 3-2, 3-3, and 3-4 be used only for LA/L > 1/6 and in the high efficiency range (E > 50 percent). The standard error of estimate between the measured and calculated values using this method is 7.86 percent.

The accuracy of the calculated values is best for SW = 1.75 in (44.4 mm), where the standard error of estimate was 7.83 percent for all data including E < 50 percent.

Data for a SV-1.00-15 installation was used to scale to SV-1.75-26 and SV-2.50-38 slot installations according to the Froude law. Table 6 summarizes the results of eight spot checks made using this method.

These spot checks indicate that equations 3-2, 3-3 and 3-4 give close predictions for curb distance = 26 in (660 mm) with mild longitudinal slopes. They should be applied with caution for larger curb distances and for steep longitudinal slopes.

Partial Flow Capture Design Method

The following list outlines the steps necessary to determine the efficiency (E) of a given length of slot (LA) for a given set of physical conditions (So, Z, CD, SW, n, Q).

1. Determine the total flow capture length (L), using the method outlined in chapter 2. (LA must be less than L.)

2. Determine the coefficients C and B from tables 4 and 5.

3. Compute the efficiency (E) using equation 3-2.

4. Equation 3-2 applies to $\frac{LA}{L} > \frac{1}{6}$ and E > 50 percent.

Table 4. - Computed Values of C in Equation 3-2

| C.D. | Slot width 1.00 | 1.25 | 1.50 | 1.75 | 2.00 | 2.25 | 2.50 |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.793 | 0.875 | 0.917 | 0.917 | 0.876 | 0.794 | 0.671 |
| 3.0 | 0.775 | 0.864 | 0.912 | 0.919 | 0.884 | 0.809 | 0.692 |
| 6.0 | 0.747 | 0.843 | 0.898 | 0.911 | 0.883 | 0.815 | 0.705 |
| 9.0 | 0.711 | 0.813 | 0.875 | 0.895 | 0.873 | 0.811 | 0.708 |
| 12.0 | 0.666 | 0.775 | 0.842 | 0.869 | 0.854 | 0.799 | 0.702 |
| 15.0 | 0.611 | 0.726 | 0.801 | 0.834 | 0.826 | 0.777 | 0.687 |
| 18.0 | 0.547 | 0.669 | 0.750 | 0.790 | 0.789 | 0.746 | 0.663 |
| 21.0 | 0.474 | 0.603 | 0.691 | 0.737 | 0.742 | 0.706 | 0.629 |
| 24.0 | 0.392 | 0.528 | 0.622 | 0.675 | 0.686 | 0.657 | 0.587 |
| 27.0 | 0.301 | 0.443 | 0.544 | 0.603 | 0.622 | 0.599 | 0.535 |
| 30.0 | 0.201 | 0.349 | 0.457 | 0.523 | 0.548 | 0.531 | 0.474 |

Table 5. - Computed Values of B in Equation 3-2

| C.D. | Slot width 1.00 | 1.25 | 1.50 | 1.75 | 2.00 | 2.25 | 2.50 |
|---|---|---|---|---|---|---|---|
| 0.0 | 1.448 | 1.676 | 1.791 | 1.791 | 1.676 | 1.448 | 1.105 |
| 3.0 | 1.362 | 1.613 | 1.749 | 1.772 | 1.679 | 1.473 | 1.152 |
| 6.0 | 1.284 | 1.557 | 1.716 | 1.760 | 1.690 | 1.505 | 1.206 |
| 9.0 | 1.214 | 1.509 | 1.690 | 1.756 | 1.708 | 1.545 | 1.269 |
| 12.0 | 1.152 | 1.469 | 1.672 | 1.760 | 1.734 | 1.593 | 1.339 |
| 15.0 | 1.097 | 1.437 | 1.661 | 1.772 | 1.768 | 1.649 | 1.416 |
| 18.0 | 1.051 | 1.412 | 1.659 | 1.791 | 1.809 | 1.713 | 1.502 |
| 21.0 | 1.011 | 1.395 | 1.664 | 1.818 | 1.858 | 1.784 | 1.595 |
| 24.0 | 0.980 | 1.385 | 1.676 | 1.853 | 1.915 | 1.863 | 1.696 |
| 27.0 | 0.956 | 1.384 | 1.697 | 1.895 | 1.980 | 1.949 | 1.805 |
| 30.0 | 0.940 | 1.390 | 1.725 | 1.946 | 2.052 | 2.044 | 1.921 |

Table 6. - Comparison of measured vs. calculated efficiencies for curb distances greater than 15 in (381 mm)

| Slot installation | Q ($ft^3/s$) | So | Z | L (ft) | LA (ft) | E (percent) Measured | E (percent) Calculated |
|---|---|---|---|---|---|---|---|
| SV-1.75-26 | 3.32 | 0.005 | 64 | 36.6 | 14 | 75.0 | 73.5 |
| SV-1.75-26 | 2.75 | 0.005 | 32 | 19.8 | 14 | 95.5 | 93.4 |
| SV-1.75-26 | 2.03 | 0.020 | 32 | 23.3 | 14 | 89.0 | 87.6 |
| SV-2.50-38 | 4.94 | 0.020 | 32 | 37.8 | 20 | 89.0 | 95.1 |
| SV-1.75-26 | 4.46 | 0.020 | 16 | 18.8 | 14 | 95.4 | 94.9 |
| SV-1.75-26 | 3.07 | 0.090 | 16 | 26.9 | 14 | 78.3 | 83.5 |
| SV-2.50-38 | 8.10 | 0.005 | 32 | 35.1 | 20 | 92.3 | 96.0 |
| SV-1.75-26 | 3.32 | 0.005 | 32 | 21.3 | 14 | 92.3 | 91.9 |

## CHAPTER 4

## SUMMARY

Additonal tests were conducted to extend the design procedures developed in volume 4 to a wider range of field installations. The additional testing included:

1. Total flow interception tests for:
   a. Cross slope, 1/Z = 1/16, 1/32, 1/64
   b. Longitudinal slopes, So = 0.005, 0.02, 0.09
   c. Slot widths, SW = 1.00, 1.75, 2.50 in (25.4, 44.4, 63.5 mm)
   d. Back slopes, 1/B.S. = 1/24, 1/16
   e. Curb distances, C.D. = 0 and 15 in (0 and 381 mm)
2. Partial flow interception tests at the same conditions listed above for 8 and 24 ft (2.4 and 7.3 m) slot lengths.

The results reported in volume 4 remain valid for the conditions they were developed for; however, volume 5 covers a wider range of installations.

The following points summarize the test results:

1. For most field conditions weir flow controls the total capture length (L). The weir flow equation reported in volume 4 is accurate for Z = 16 to 48; however, additional data indicated that the calculated lengths are in error at Z = 64. The following equation predicts L in the weir flow zone for Z = 16 to 64.

$$L = 1.257\ Q^{0.404} S_o^{A}\ Z^{0.841} / n^{0.235} \qquad (2\text{-}3)$$

Table 2 lists values of A for various slopes and curb distances.

2. The submerged flow equation presented in volume 4 for a SV-1.75-6-3.5 slot installation was found valid for a 1.75 in (44.4 mm) wide slot under a wider range of conditions:

$$L = 0.394\ Q^{0.649} S_o^{0.410}\ Z^{0.445} / n^{0.811} \qquad (2\text{-}5)$$

A new equation was developed to determine L for 1.00 in (25.4 mm) wide slot:

$$L = 0.464\ Q^{0.649} S_o^{0.223}\ Z^{0.329} / n^{0.811} \qquad (2\text{-}6)$$

Back slope does not affect L in the range tested.

3. The partial flow capture equation developed in volume 4 was extended to cover a range of slot widths and curb distances. The following equation can be used to determine how much flow will be intercepted for a given length of slot (LA).

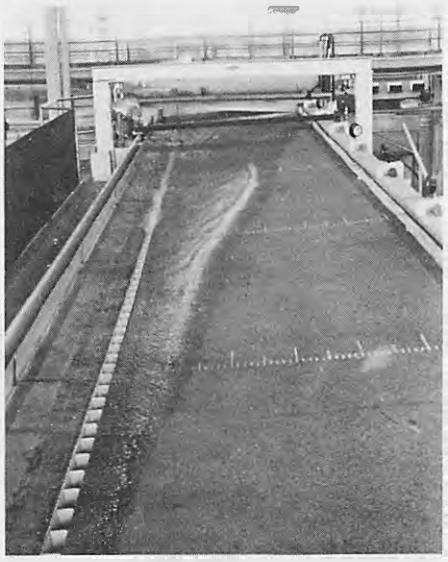
$$(E/100) = 1 - C\ (1 - LA/L)^{B} \qquad (3\text{-}2)$$

where the coefficients C and B are listed in tables 4 and 5 for a range of curb distances and slot widths.

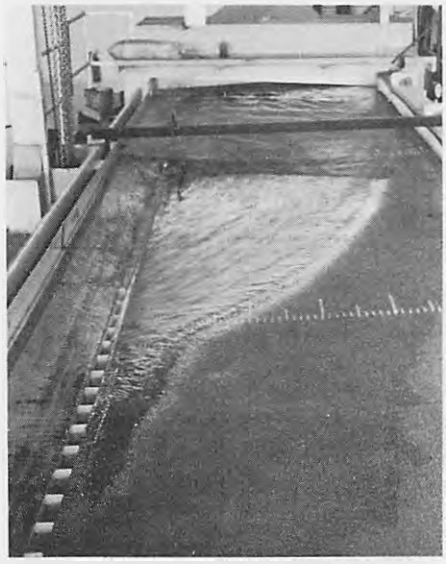
Back slope does not affect the partial flow interception efficiency in the range measured (BS = 16 to 24).

4. Characteristics of slotted drain in a sump condition, sheet flow interception efficiency, and debris handling characteristics are covered in volume 4.

a. Q = 3.00 $ft^3/s$ (0.085 $m^3/s$),
S.W. = 2.50 in (63.5 mm),
C.D. = 15 in (381 mm),
BS = 16, So = 0.005, Z = 64,
L = 37.1 ft (11.31 m)



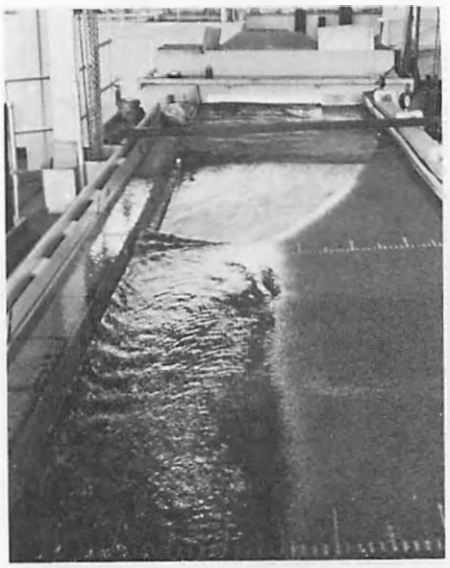
b. Q = 3.00 $ft^3/s$ (0.085 $m^3/s$),
S.W. = 2.50 in (63.5 mm),
So = 0.090, Z = 16,
C.D. = 15 in (381 mm),
BS = 24, L = 26.0 ft (7.93 m)



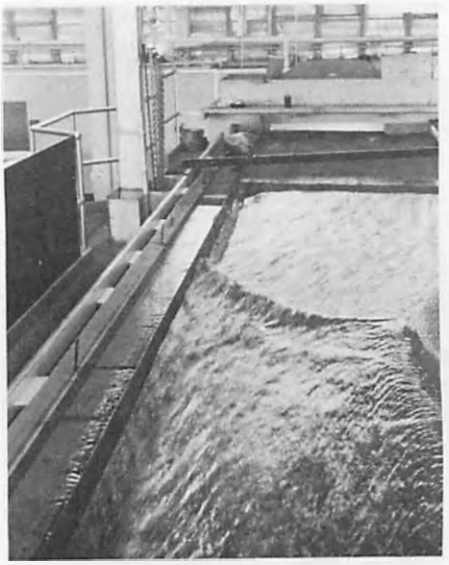
c. Q = 3.00 $ft^3/s$ (0.085 $m^3/s$),
S.W. = 2.50 in (63.5 mm),
C.D. =15 in (381 mm),
So = 0.005, Z = 16,
L = 12.4 ft (3.78 m)

d. Q = 4.00 $ft^3/s$ (0.107 $m^3/s$),
S.W. = 2.50 in (63.5 mm),
C.D. = 0, So = 0.020, Z = 32,
L = 36.7 ft (11.19 m)

Figure 1. - Total flow capture tests

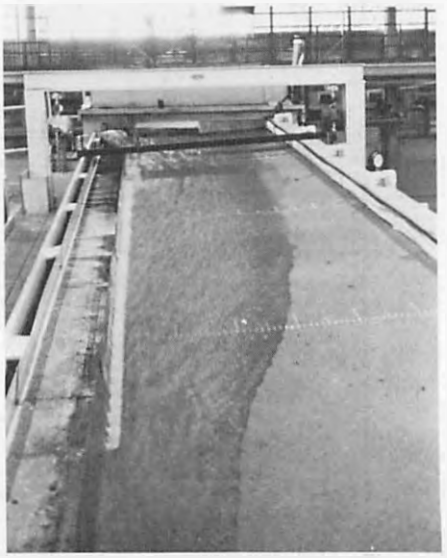


a. Q = 2.40 $ft^3/s$ (0.068 $m^3/s$), LA = 8 ft (2.44 m), S.W. = 2.50 in (63.5 mm), E = 85.8 percent, C.D. = 0, So = 0.005, Z = 16



b. Q = 3.95 $ft^3/s$ (0.112 $m^3/s$), LA = 8 ft (2.44 m), S.W. = 2.50 in (63.5 mm), E = 80.7 percent, C.D. = 0, So = 0.020, Z = 16

c. Q = 4.0 $ft^3/s$ (0.113 $m^3/s$), LA = 24 ft (7.32 m), S.W. = 2.50 in (63.5 mm), E = 74.3 percent, C.D. = 15 (381 mm), So = 0.020, Z = 64, BS = 24



d. Q = 4.30 $ft^3/s$ (0.122 $m^3/s$), LA = 24 ft (7.32 m), S.W. = 2.50 in (63.5 mm), E = 89.1 percent, C.D. = 0, So = 0.090, Z = 16

Figure 2. - Partial flow capture tests

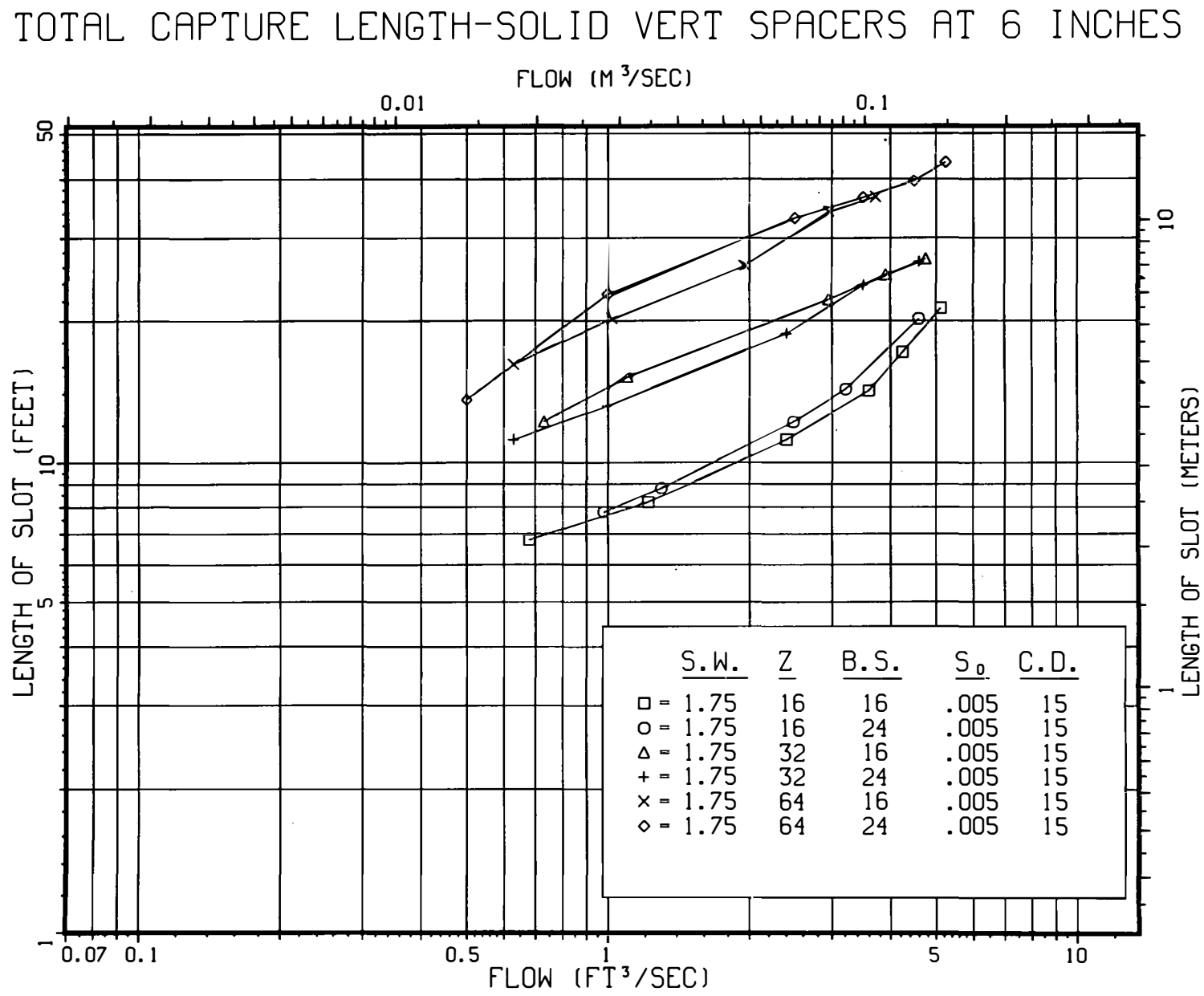

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.75 16 16 .005 15
○ = 1.75 16 24 .005 15
△ = 1.75 32 16 .005 15
+ = 1.75 32 24 .005 15
× = 1.75 64 16 .005 15
◇ = 1.75 64 24 .005 15

Figure 3.

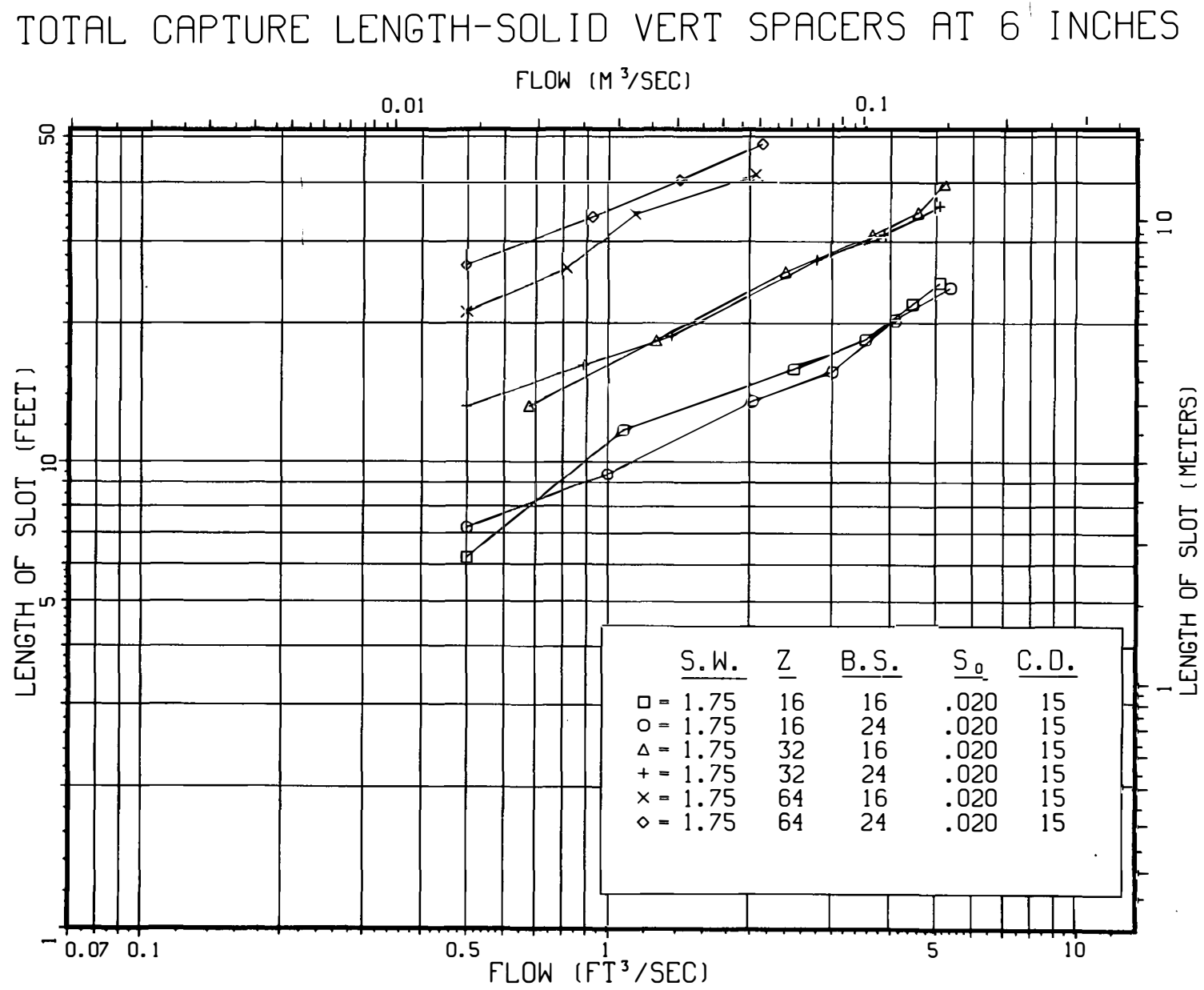

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S0 C.D.
□ = 1.75 16 16 .020 15
○ = 1.75 16 24 .020 15
△ = 1.75 32 16 .020 15
+ = 1.75 32 24 .020 15
× = 1.75 64 16 .020 15
◇ = 1.75 64 24 .020 15

Figure 4.

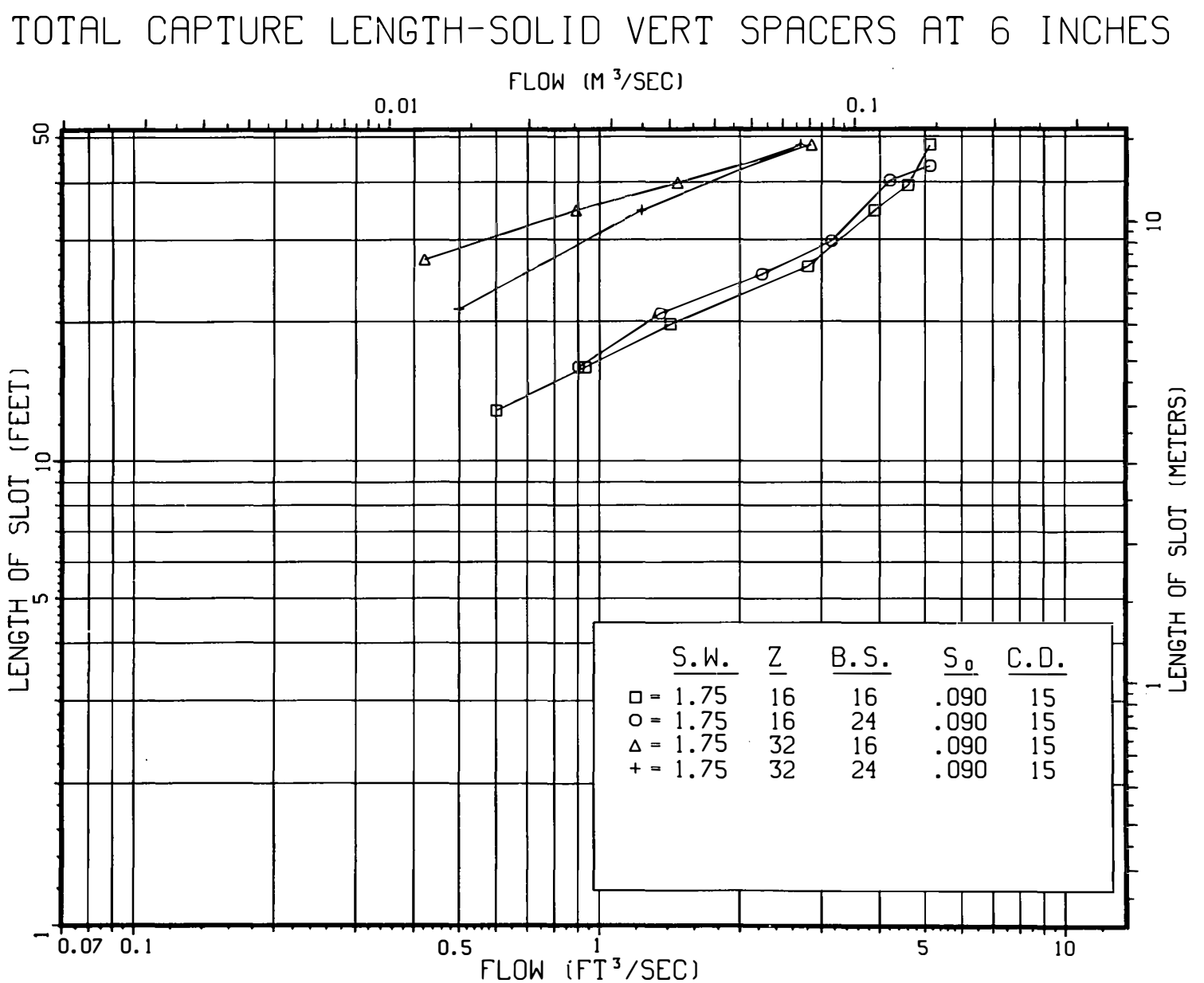

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M 3/SEC)
0.01
0.1
50
10
5
1
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
0.07
0.1
0.5
1
5
10
FLOW (FT 3/SEC)
S.W. Z B.S. S0 C.D.
□ = 1.75 16 16 .090 15
○ = 1.75 16 24 .090 15
△ = 1.75 32 16 .090 15
+ = 1.75 32 24 .090 15

**Figure 5.**

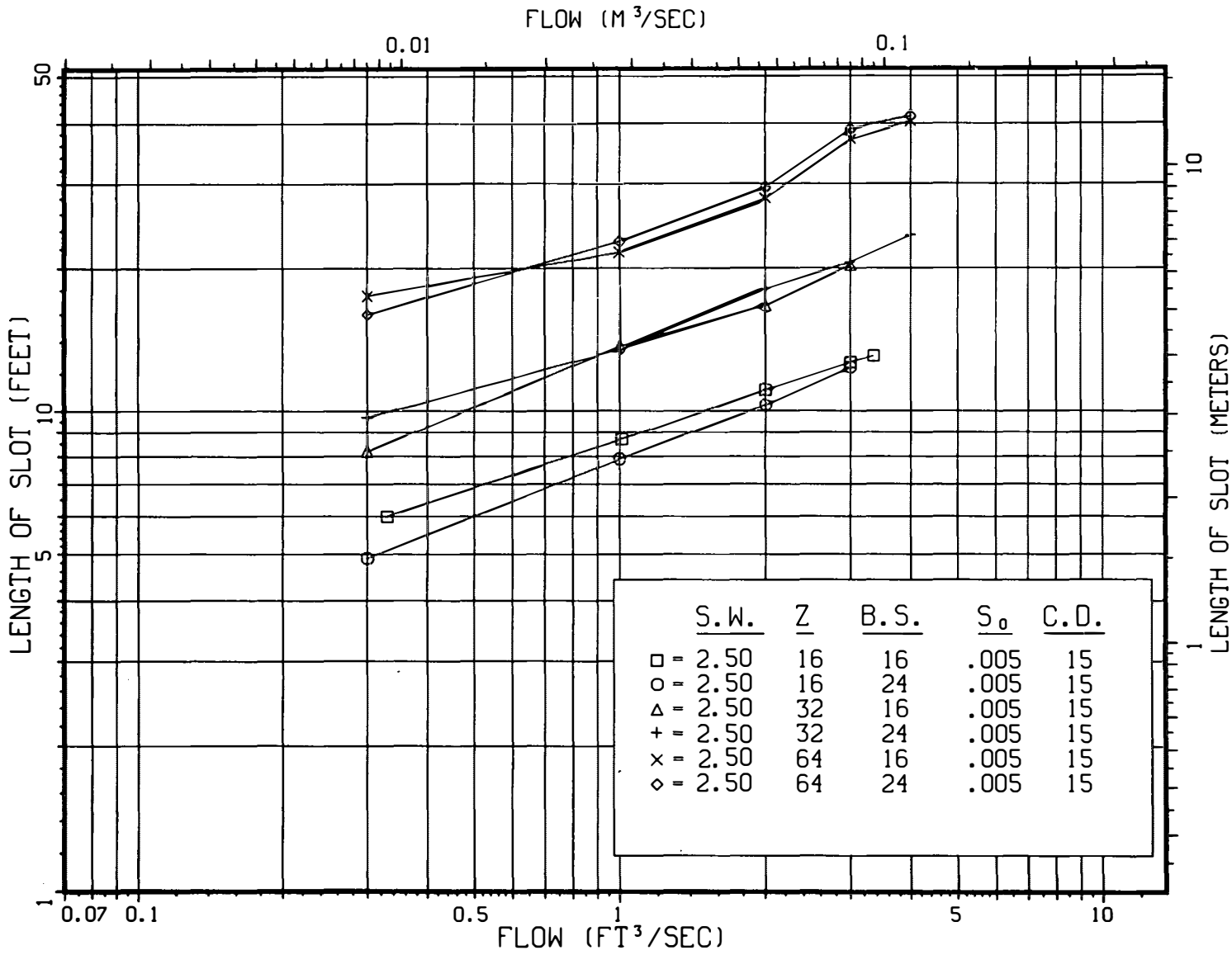

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
50
10
5
1
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 2.50 16 16 .005 15
○ = 2.50 16 24 .005 15
△ = 2.50 32 16 .005 15
+ = 2.50 32 24 .005 15
× = 2.50 64 16 .005 15
◇ = 2.50 64 24 .005 15

Figure 6.

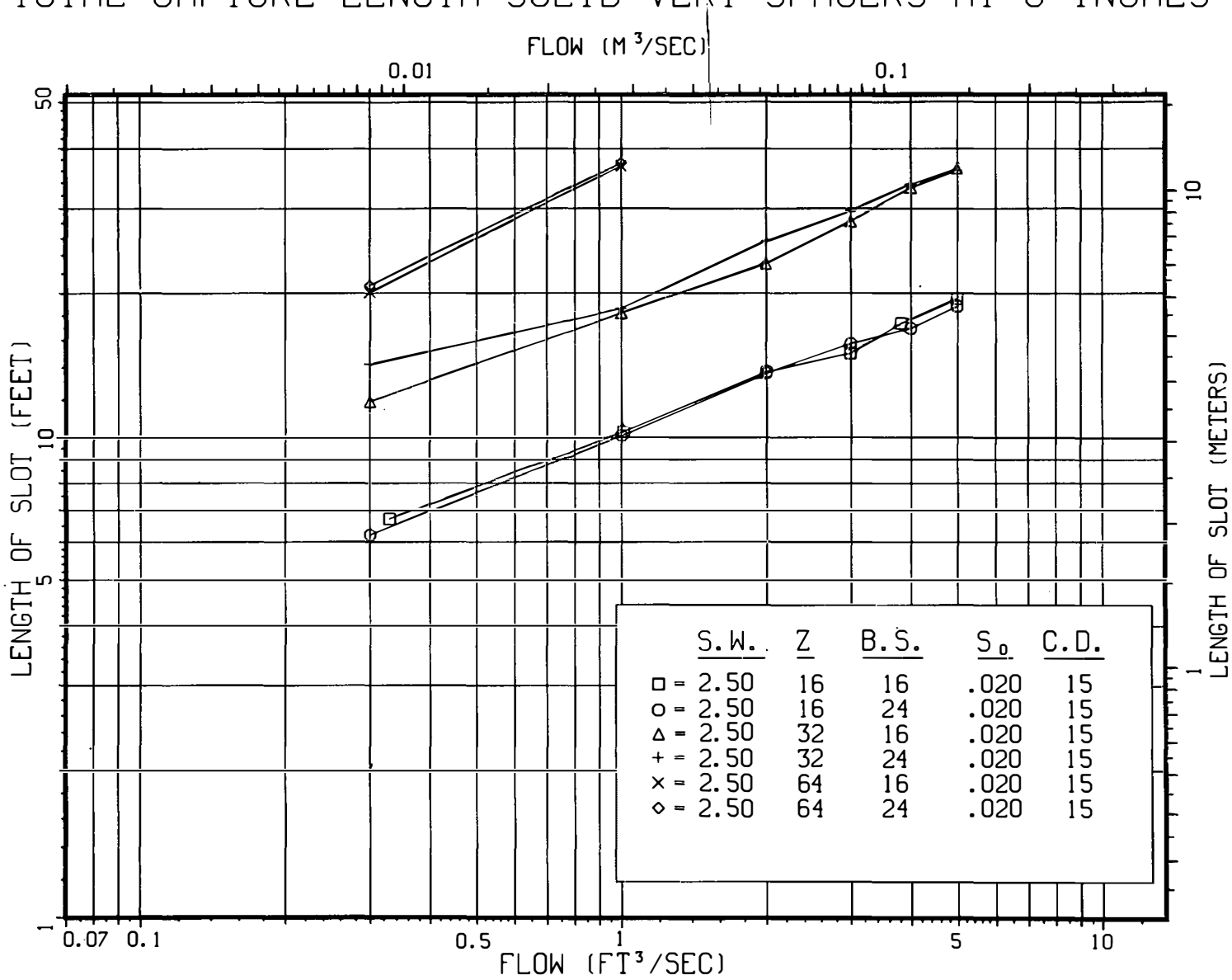

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 2.50 16 16 .020 15
○ = 2.50 16 24 .020 15
△ = 2.50 32 16 .020 15
+ = 2.50 32 24 .020 15
× = 2.50 64 16 .020 15
◇ = 2.50 64 24 .020 15

Figure 7.

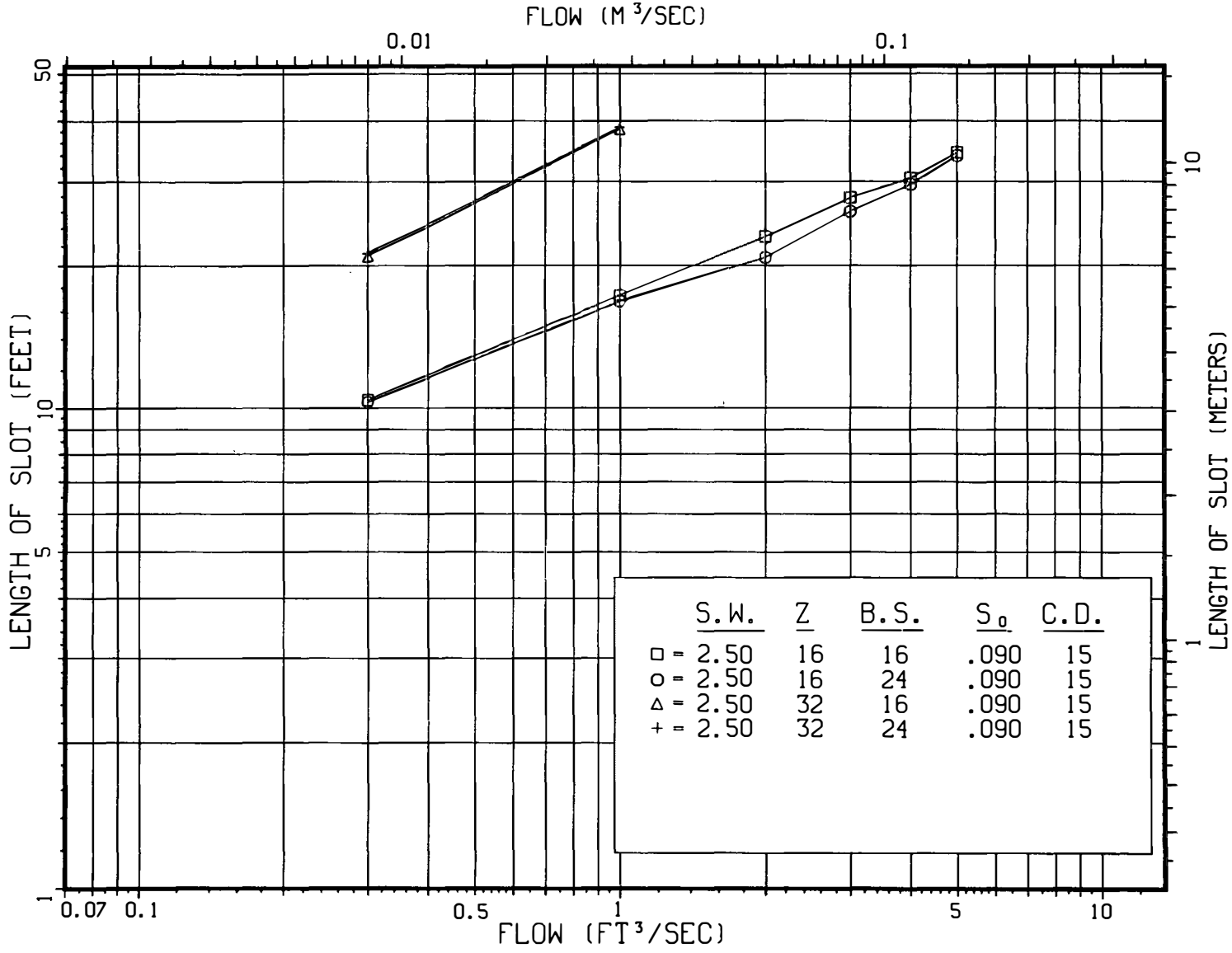

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 2.50 16 16 .090 15
○ = 2.50 16 24 .090 15
△ = 2.50 32 16 .090 15
+ = 2.50 32 24 .090 15

**Figure 8.**

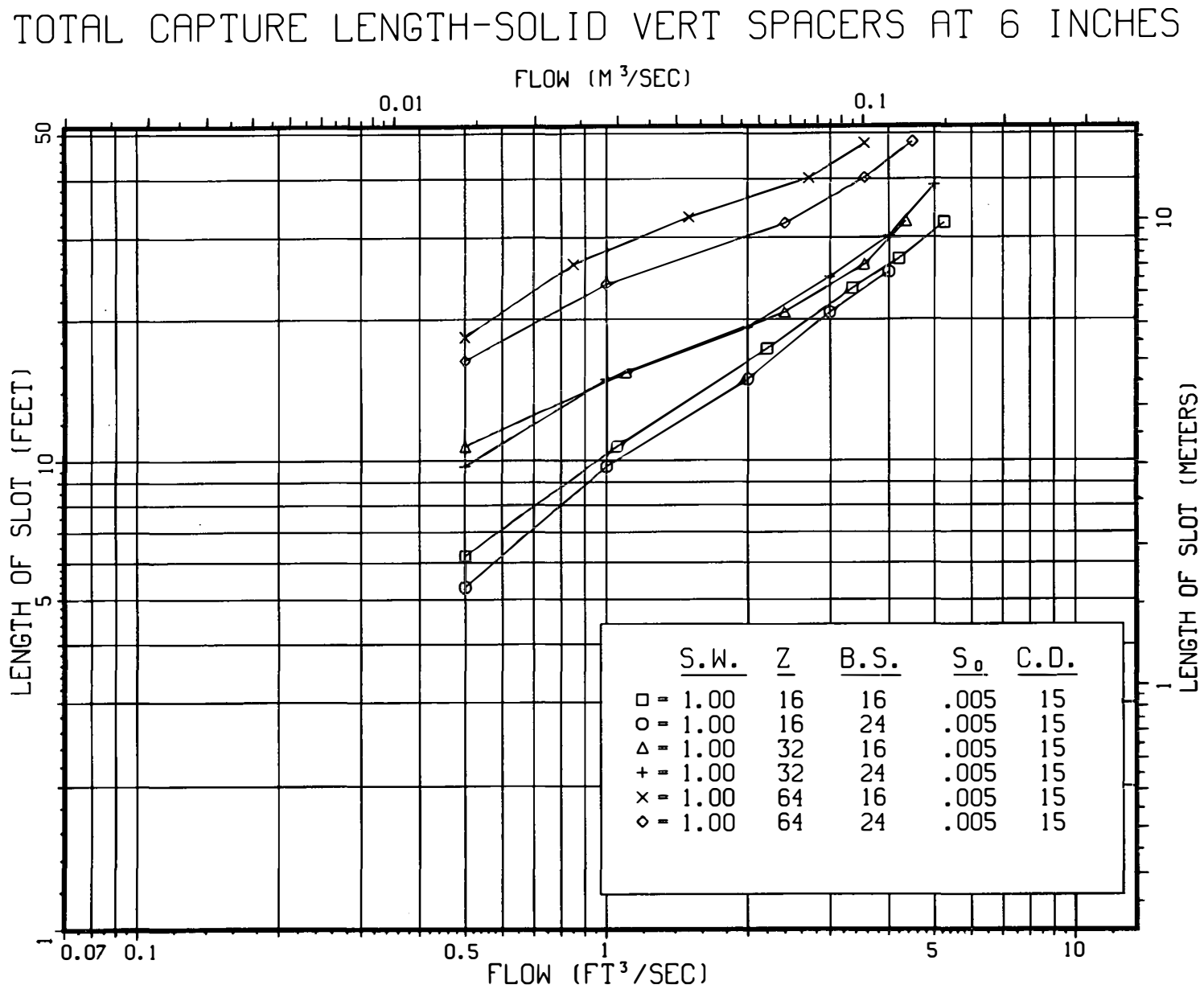

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 16 16 .005 15
○ = 1.00 16 24 .005 15
△ = 1.00 32 16 .005 15
+ = 1.00 32 24 .005 15
× = 1.00 64 16 .005 15
◇ = 1.00 64 24 .005 15

**Figure 9.**

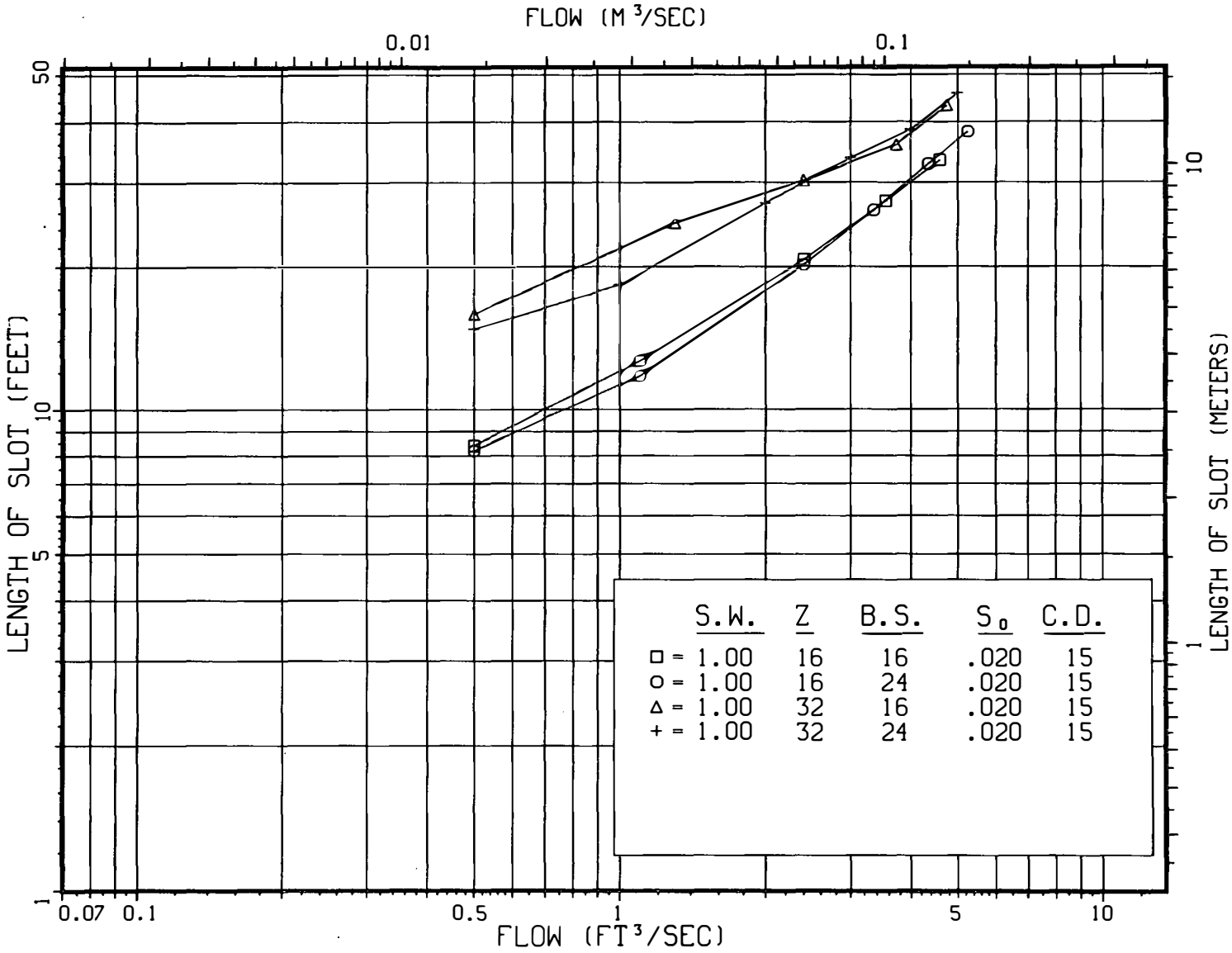

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
50
10
5
1
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 16 16 .020 15
○ = 1.00 16 24 .020 15
△ = 1.00 32 16 .020 15
+ = 1.00 32 24 .020 15

Figure 10.

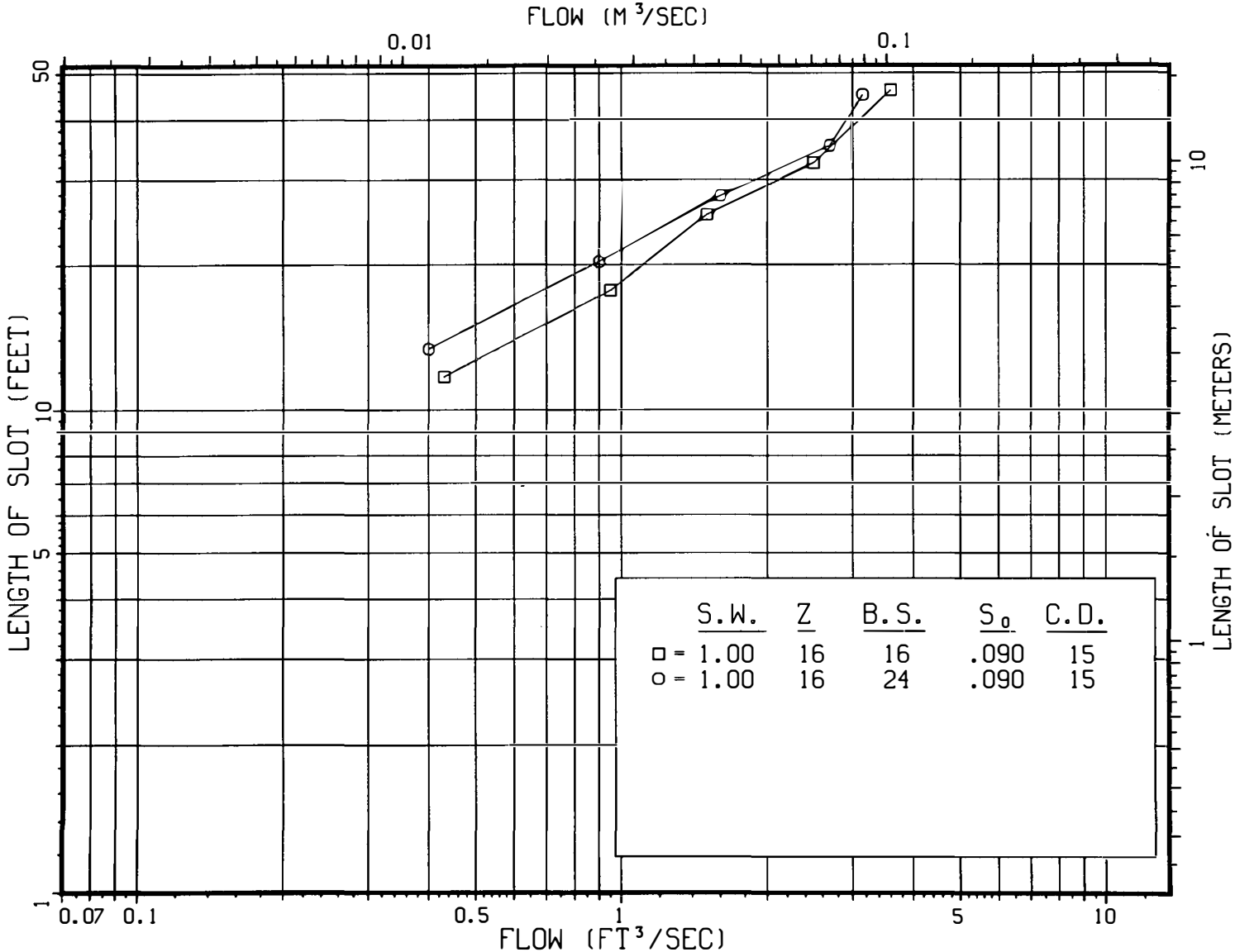

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
50
10
5
1
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 16 16 .090 15
○ = 1.00 16 24 .090 15

**Figure 11.**

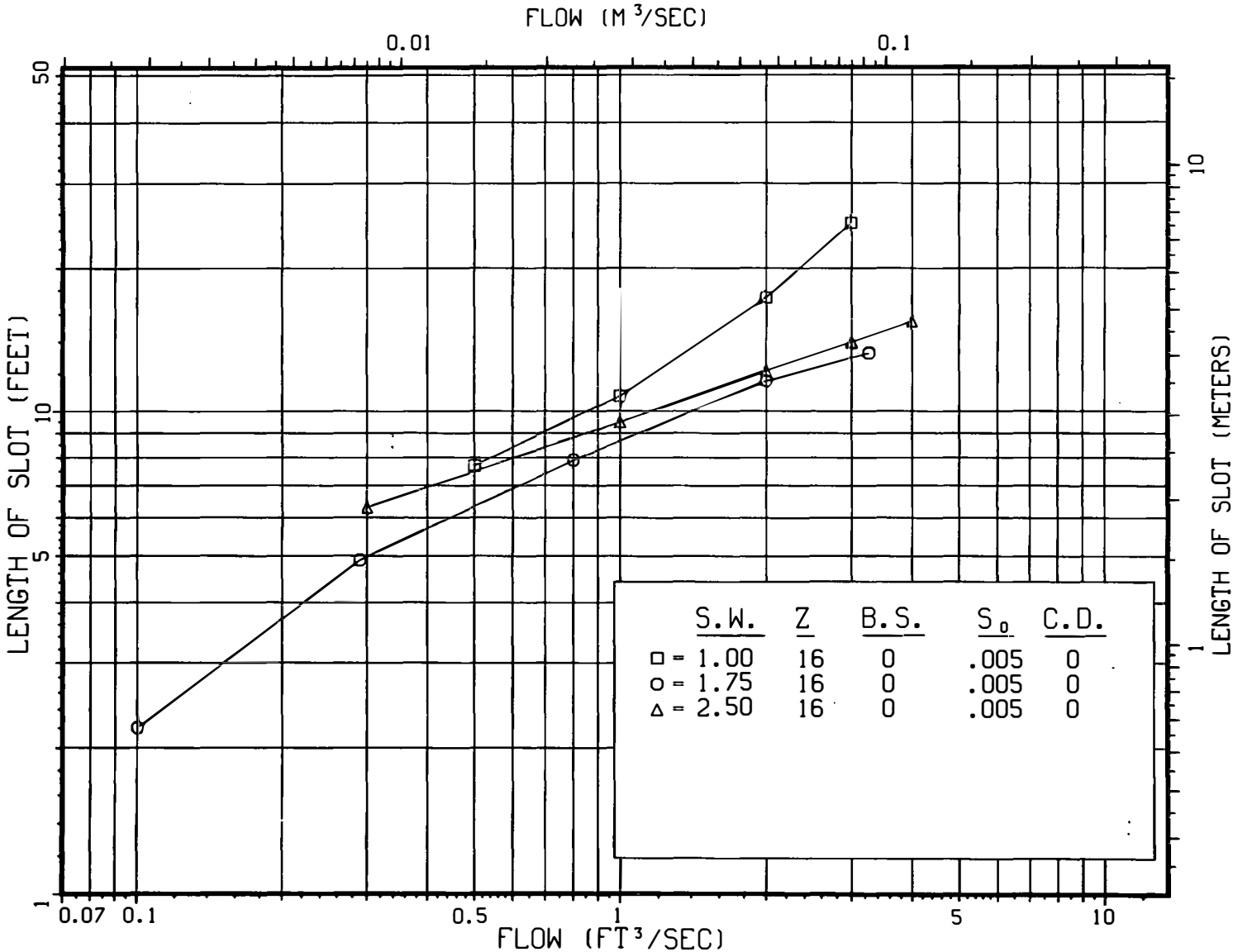

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 16 0 .005 0
○ = 1.75 16 0 .005 0
△ = 2.50 16 0 .005 0

**Figure 12.**

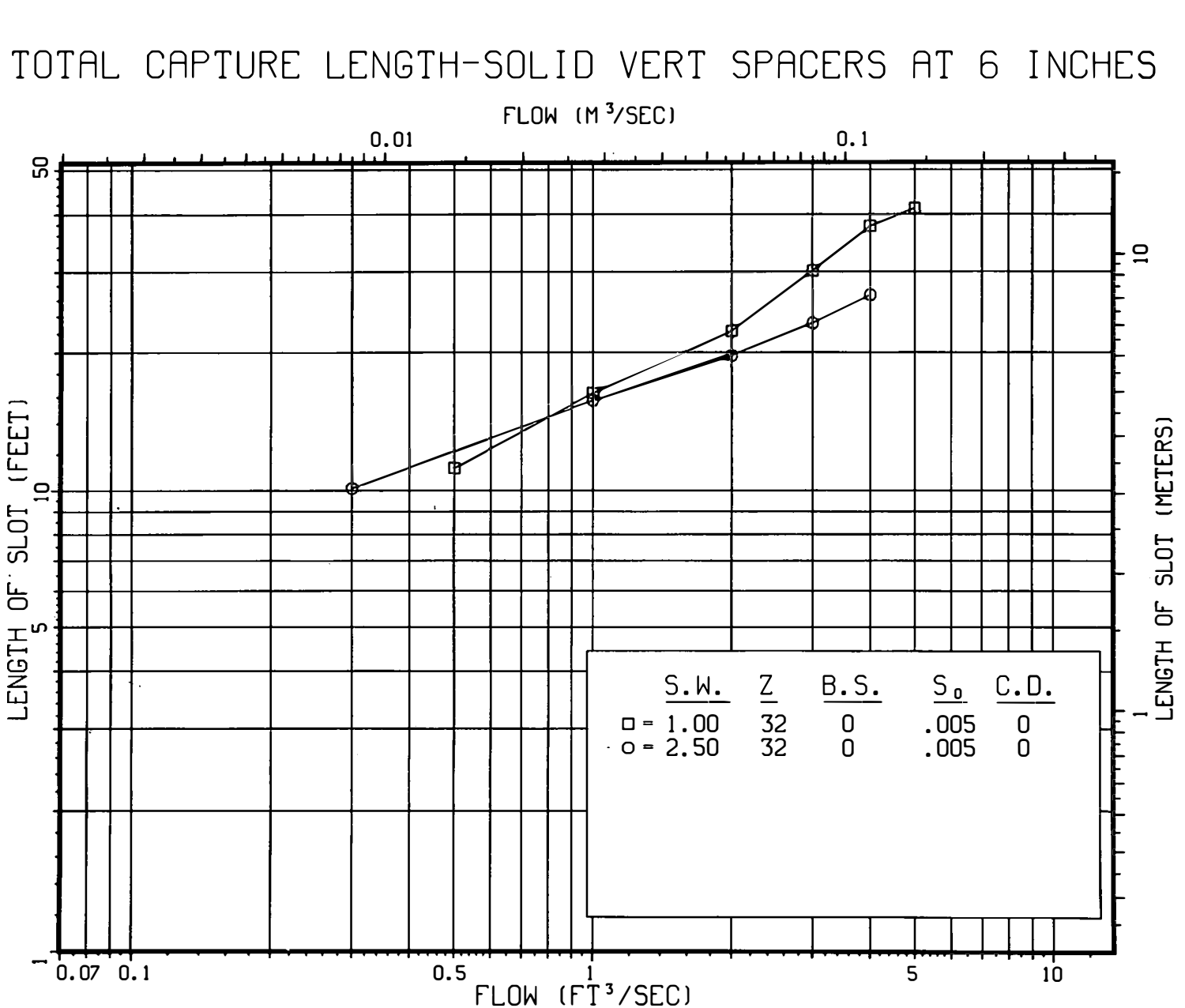

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 32 0 .005 0
○ = 2.50 32 0 .005 0

**Figure 13.**

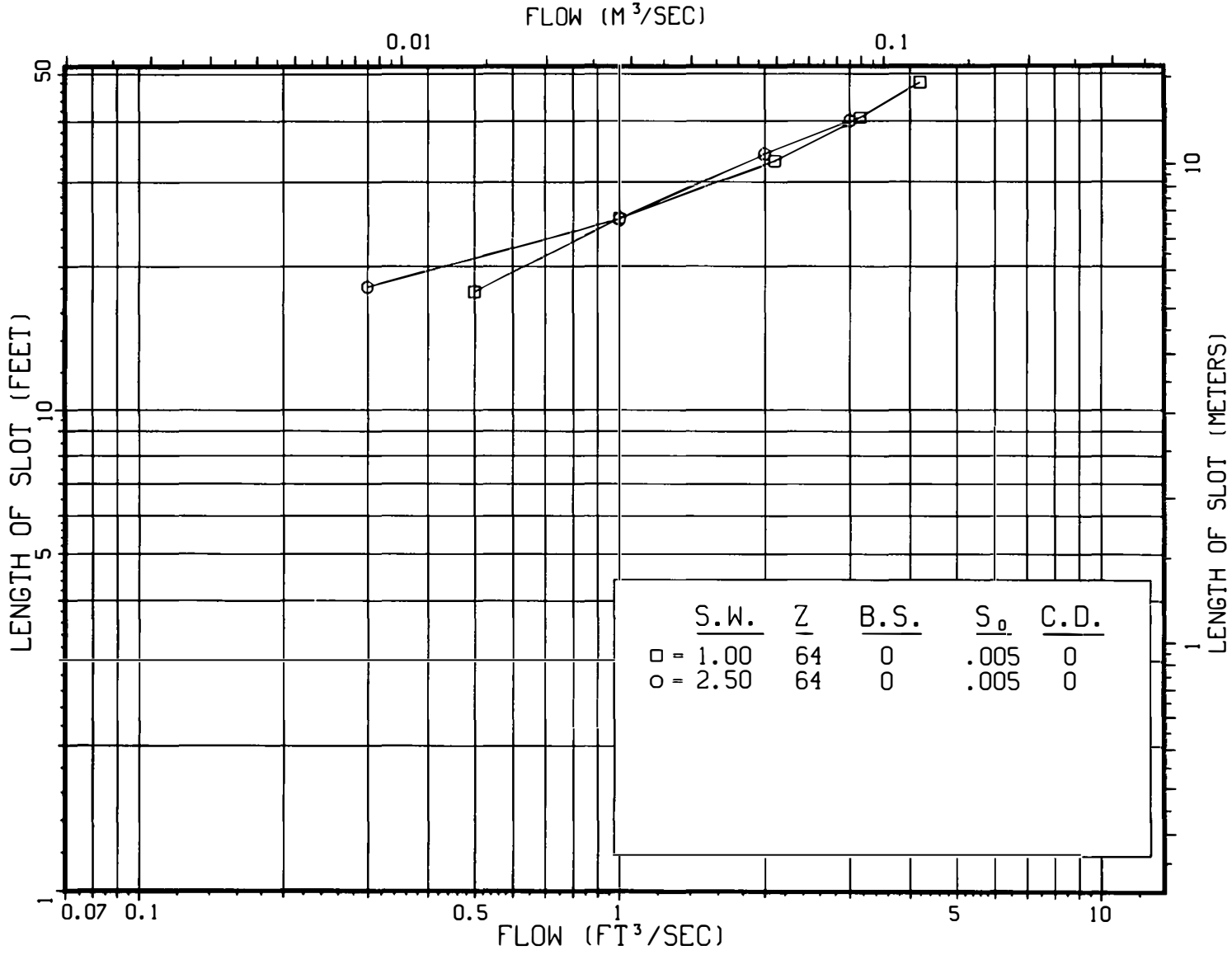

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 64 0 .005 0
○ = 2.50 64 0 .005 0

**Figure 14.**

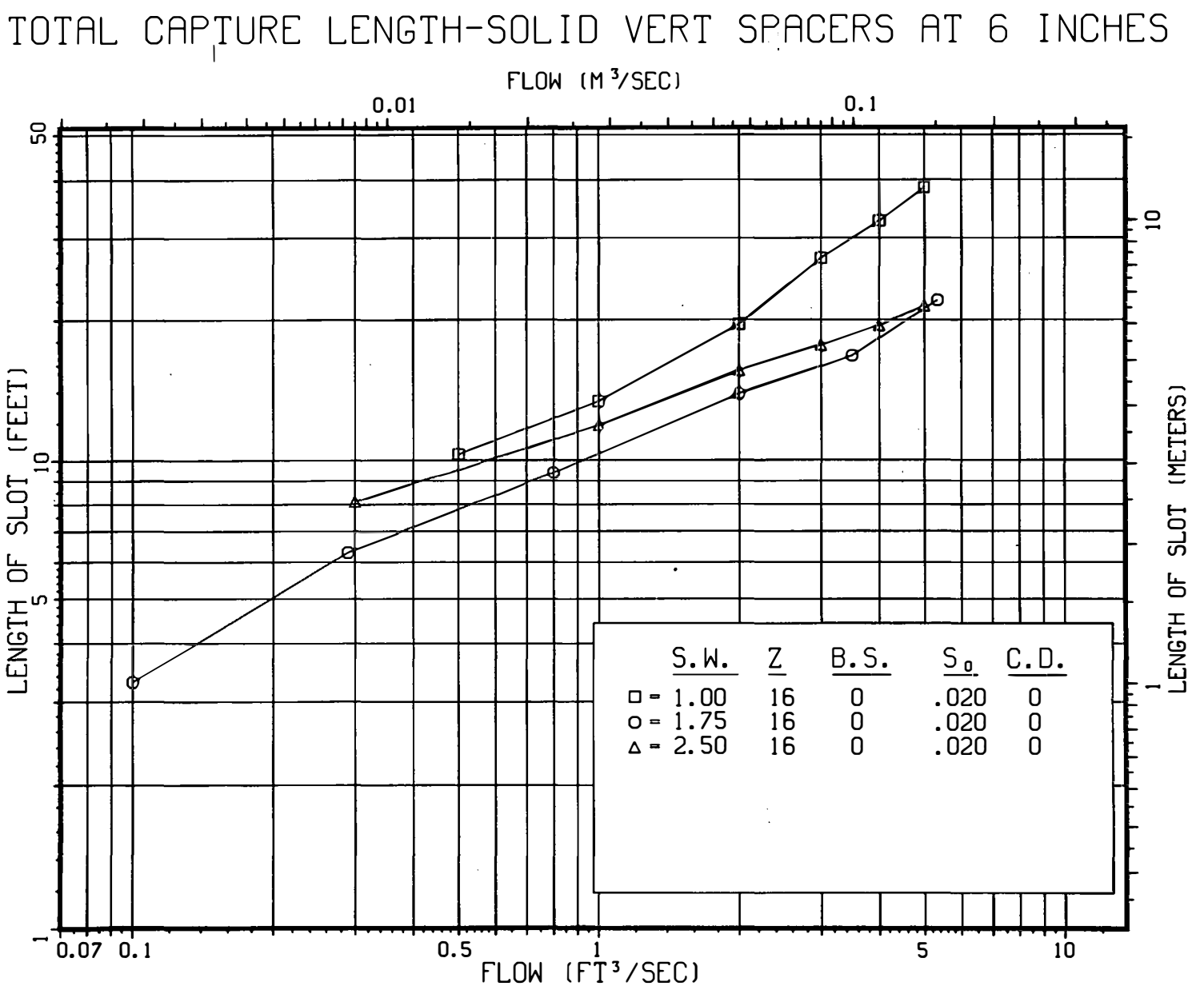

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
50
10
5
1
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. Sa C.D.
□ = 1.00 16 0 .020 0
○ = 1.75 16 0 .020 0
△ = 2.50 16 0 .020 0

**Figure 15.**

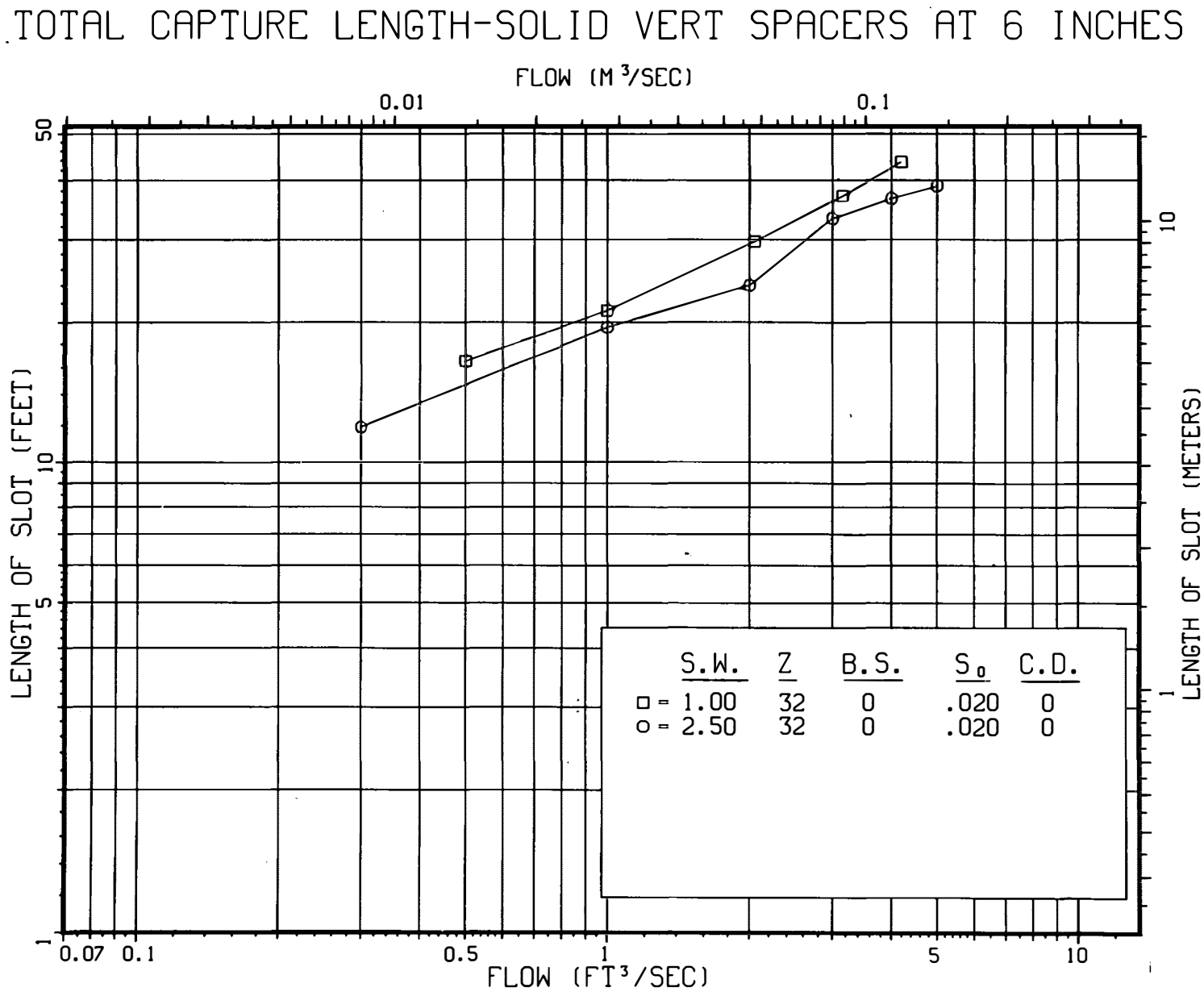

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 32 0 .020 0
○ = 2.50 32 0 .020 0

Figure 16.

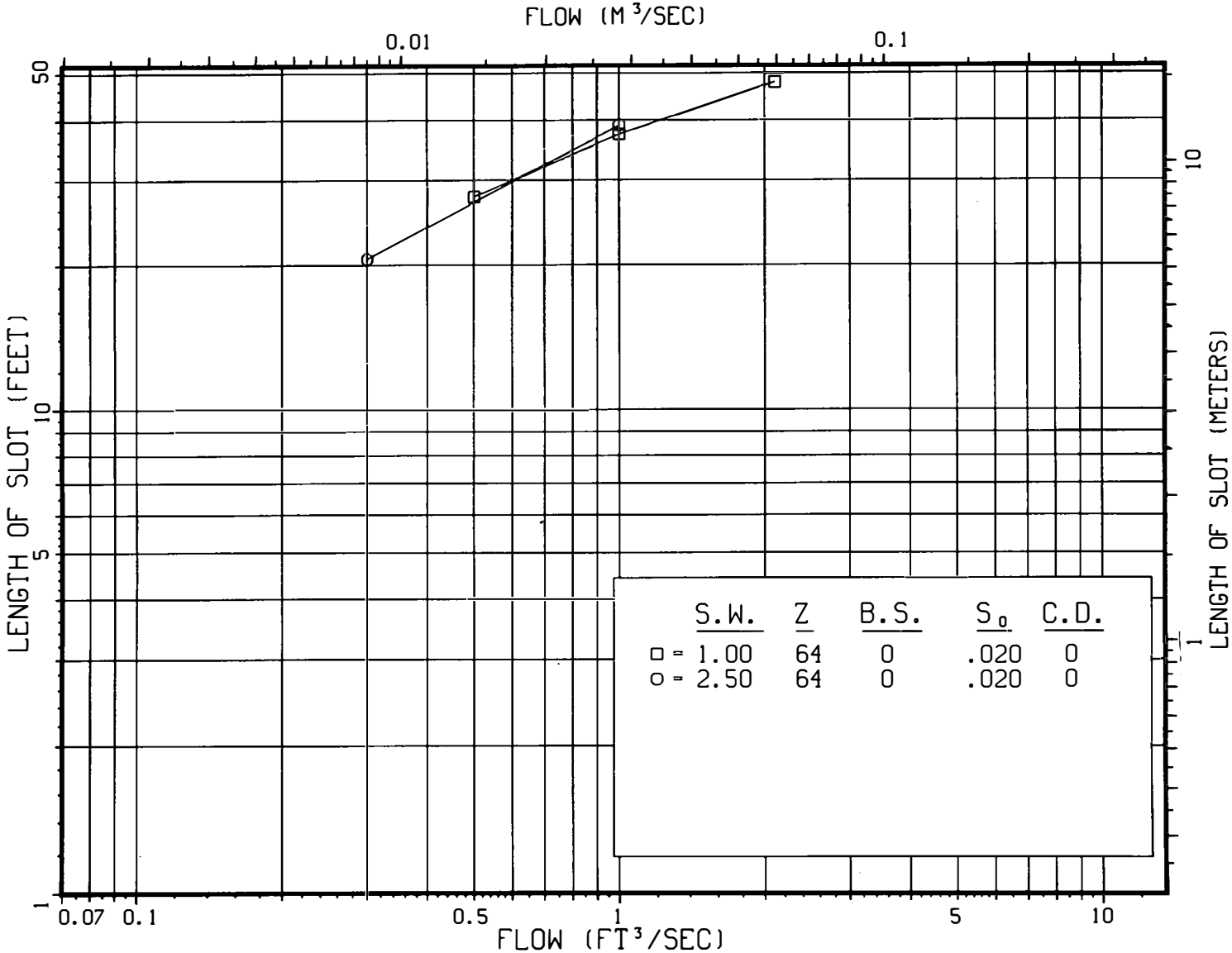

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 64 0 .020 0
○ = 2.50 64 0 .020 0

**Figure 17.**

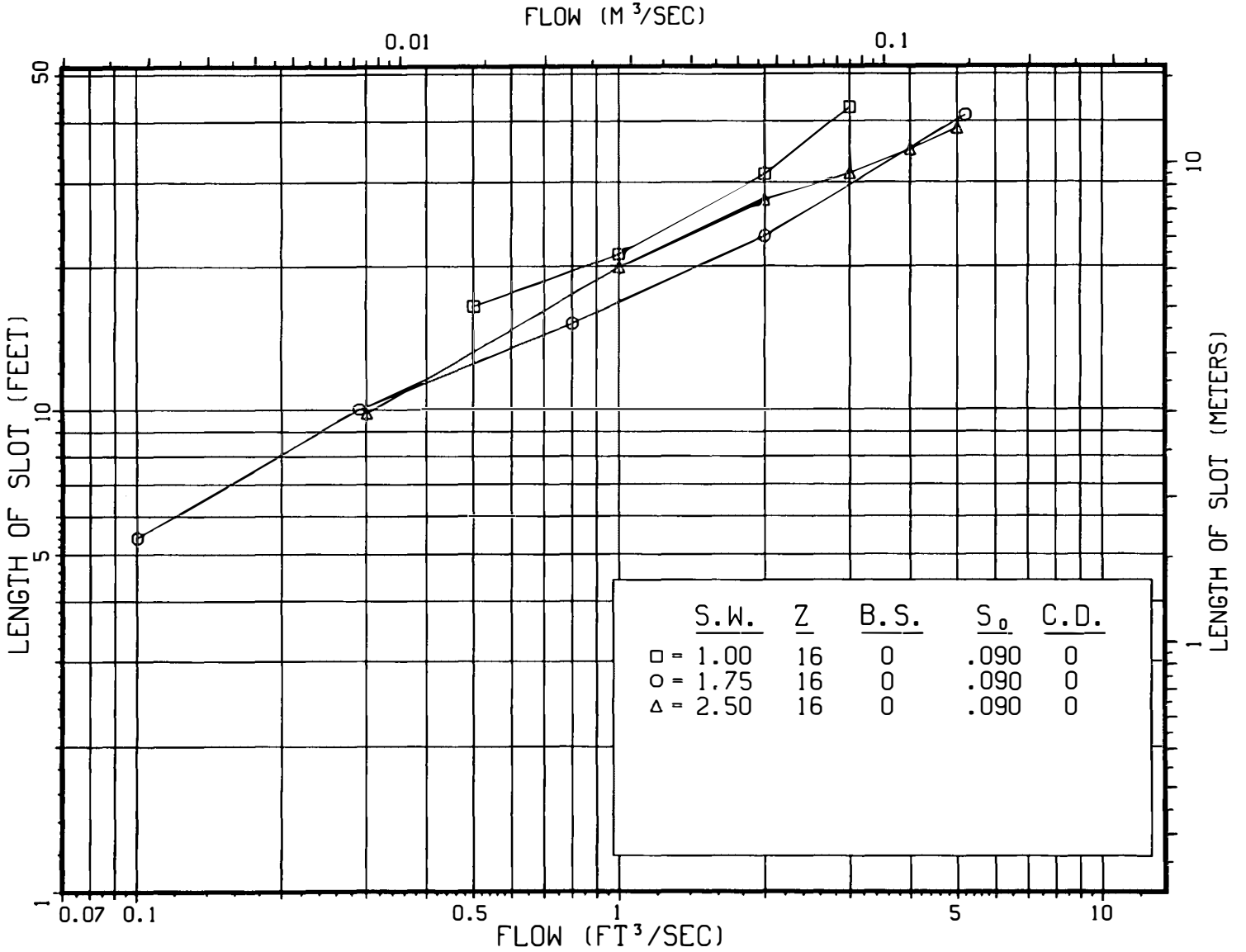

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 16 0 .090 0
○ = 1.75 16 0 .090 0
△ = 2.50 16 0 .090 0

**Figure 18.**

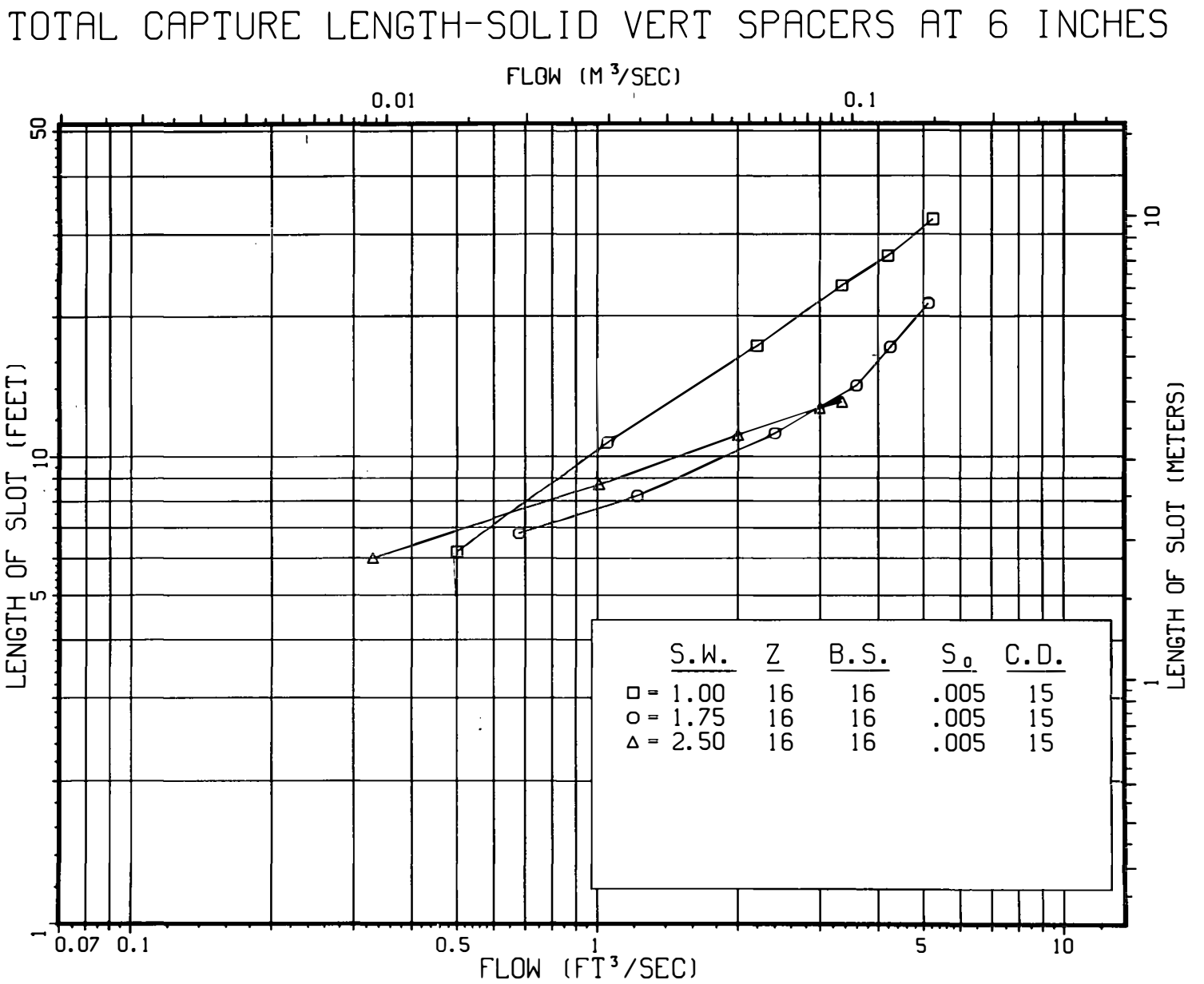

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 16 16 .005 15
○ = 1.75 16 16 .005 15
△ = 2.50 16 16 .005 15

**Figure 19.**

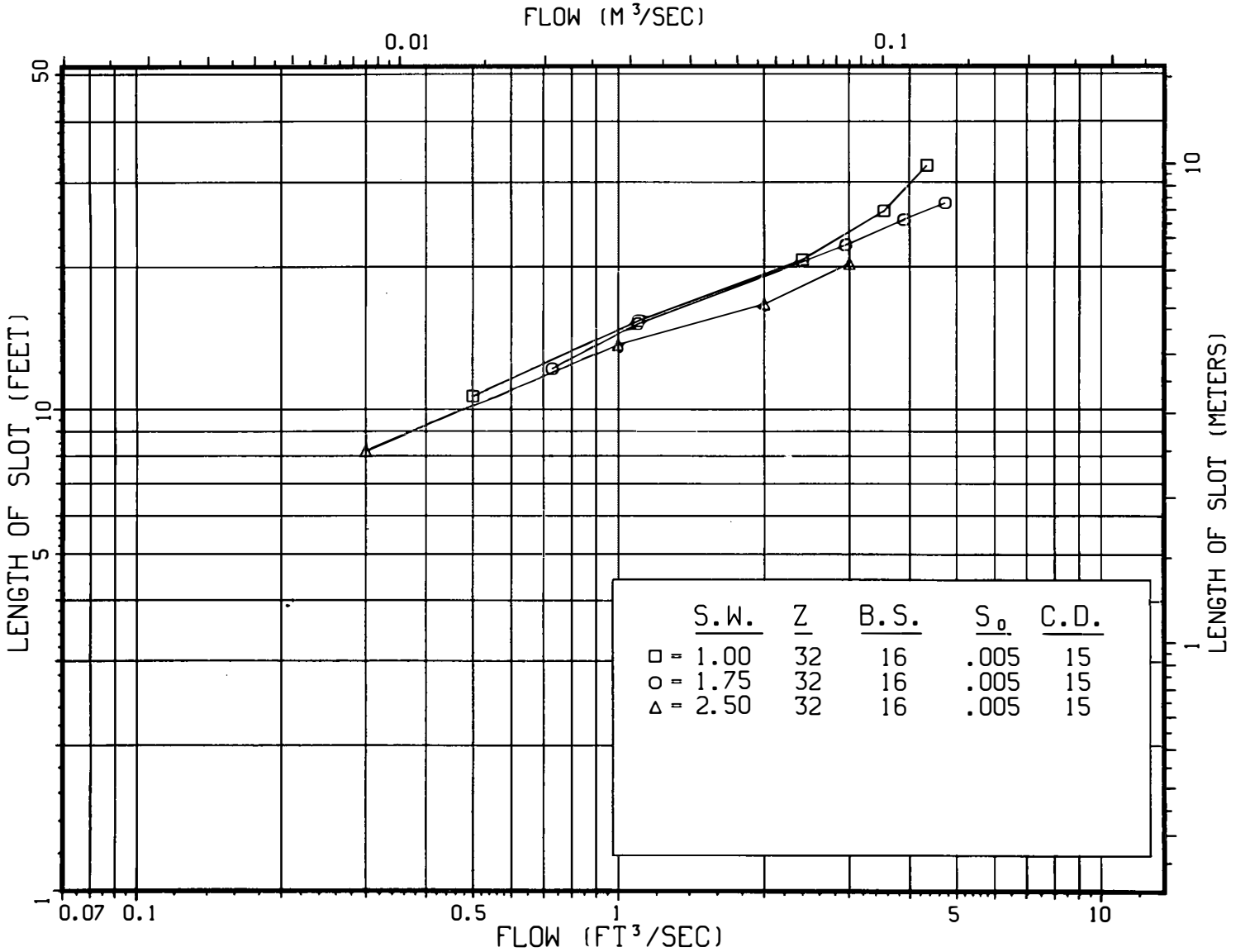

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 32 16 .005 15
○ = 1.75 32 16 .005 15
△ = 2.50 32 16 .005 15

Figure 20.

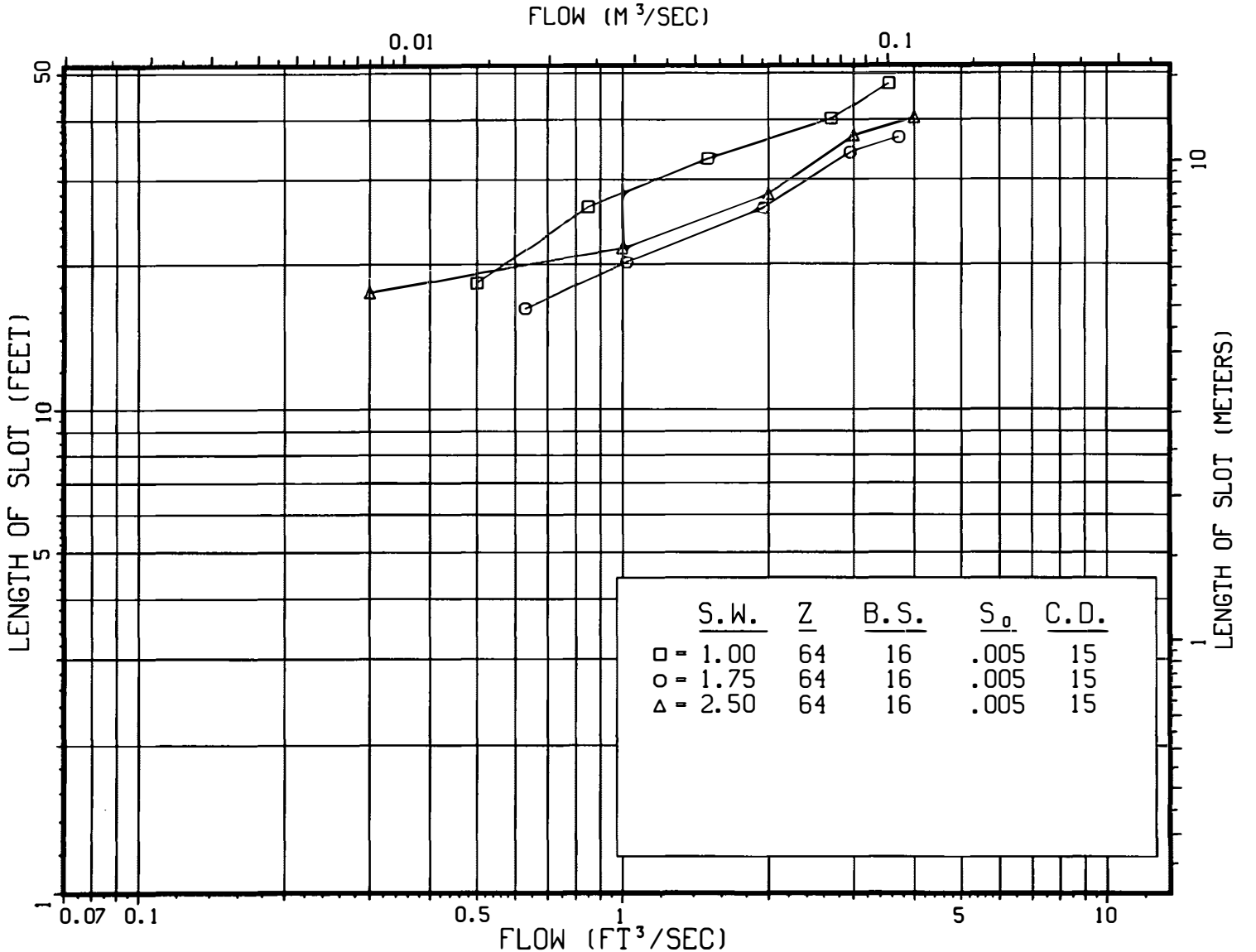

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 64 16 .005 15
○ = 1.75 64 16 .005 15
△ = 2.50 64 16 .005 15

**Figure 21.**

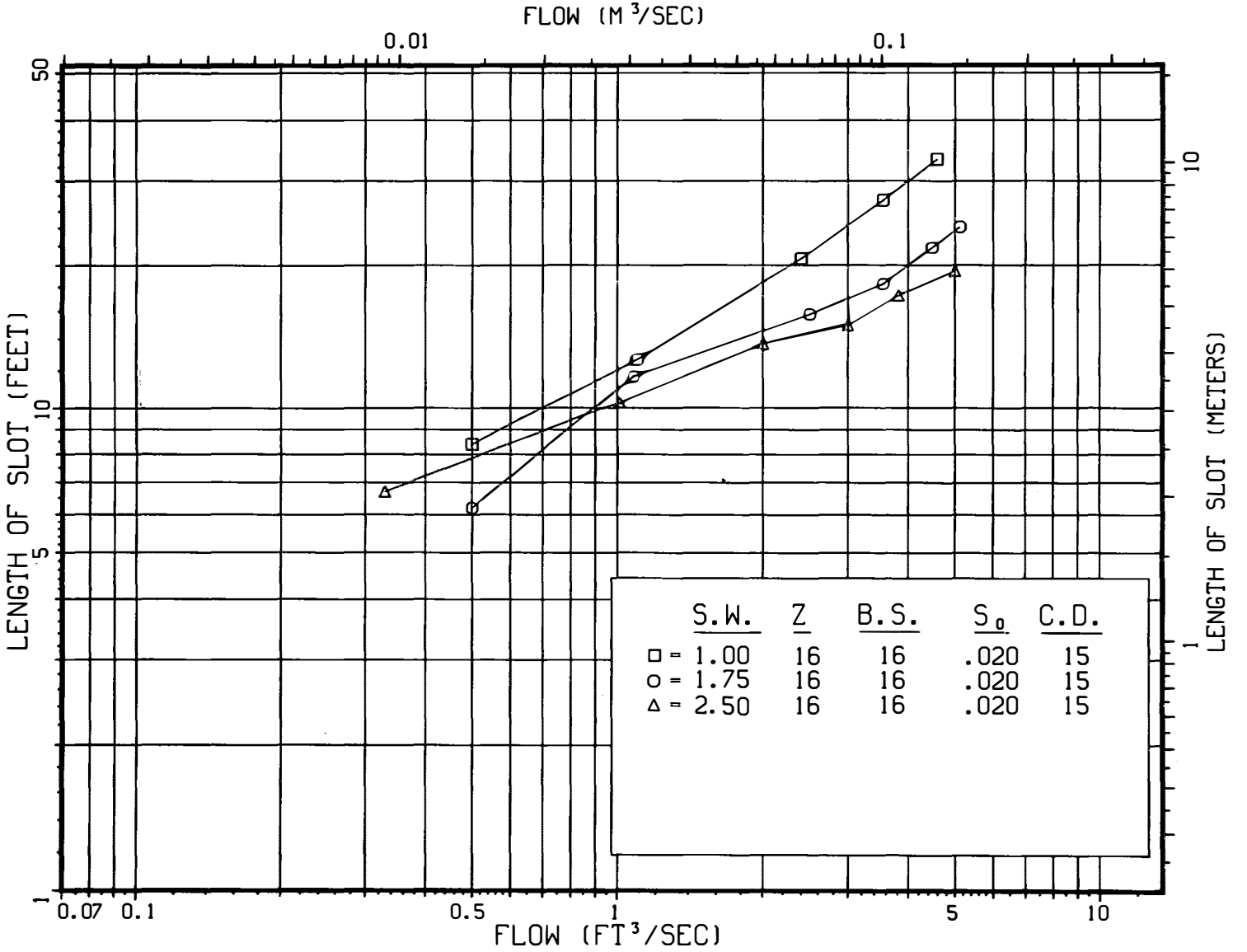

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 16 16 .020 15
○ = 1.75 16 16 .020 15
△ = 2.50 16 16 .020 15

**Figure 22.**

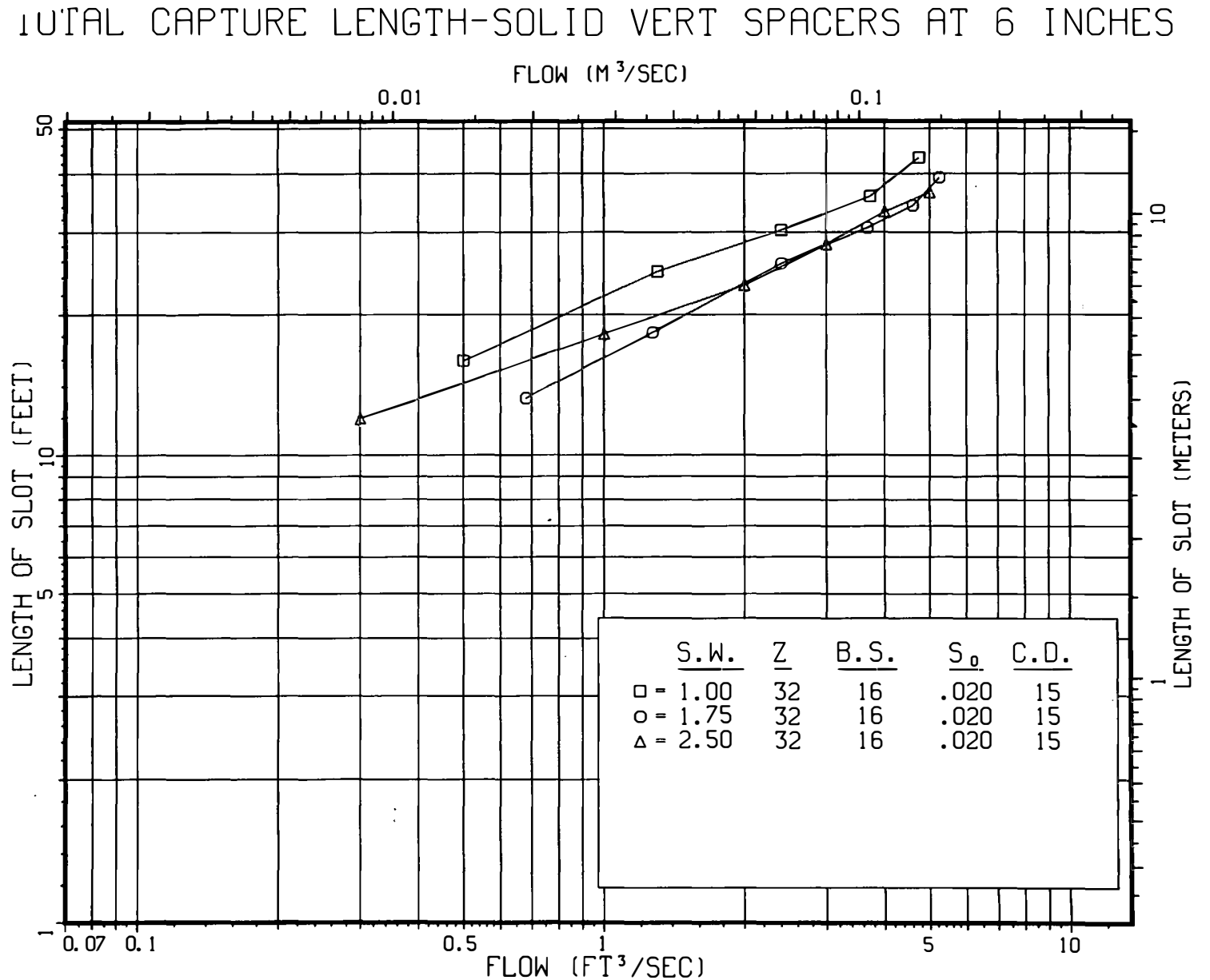

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 32 16 .020 15
○ = 1.75 32 16 .020 15
△ = 2.50 32 16 .020 15

**Figure 23.**

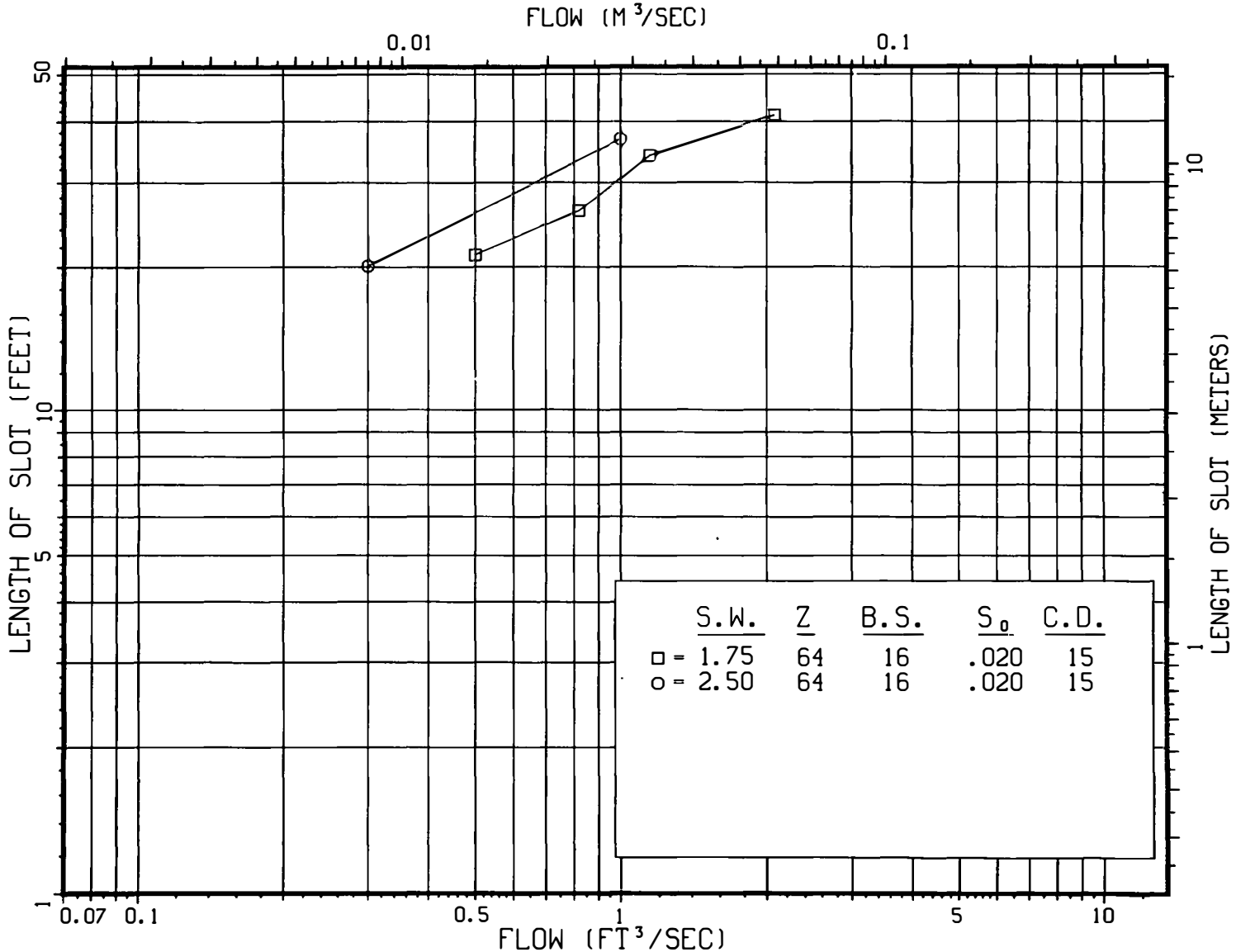

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
50
10
5
1
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.75 64 16 .020 15
o = 2.50 64 16 .020 15

Figure 24.

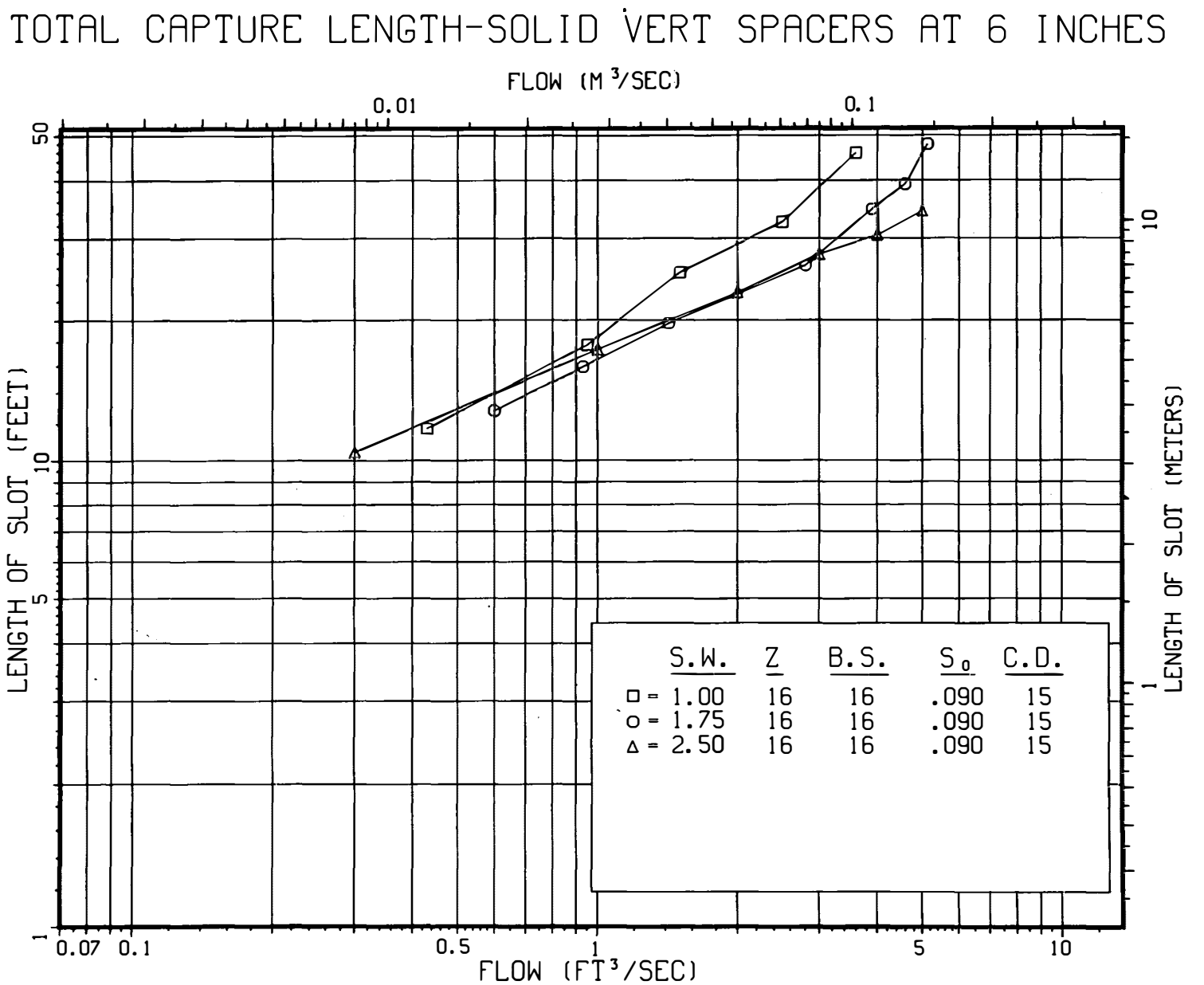

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M 3/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT 3/SEC)
S.W. Z B.S. So C.D.
□ = 1.00 16 16 .090 15
o = 1.75 16 16 .090 15
Δ = 2.50 16 16 .090 15

**Figure 25.**

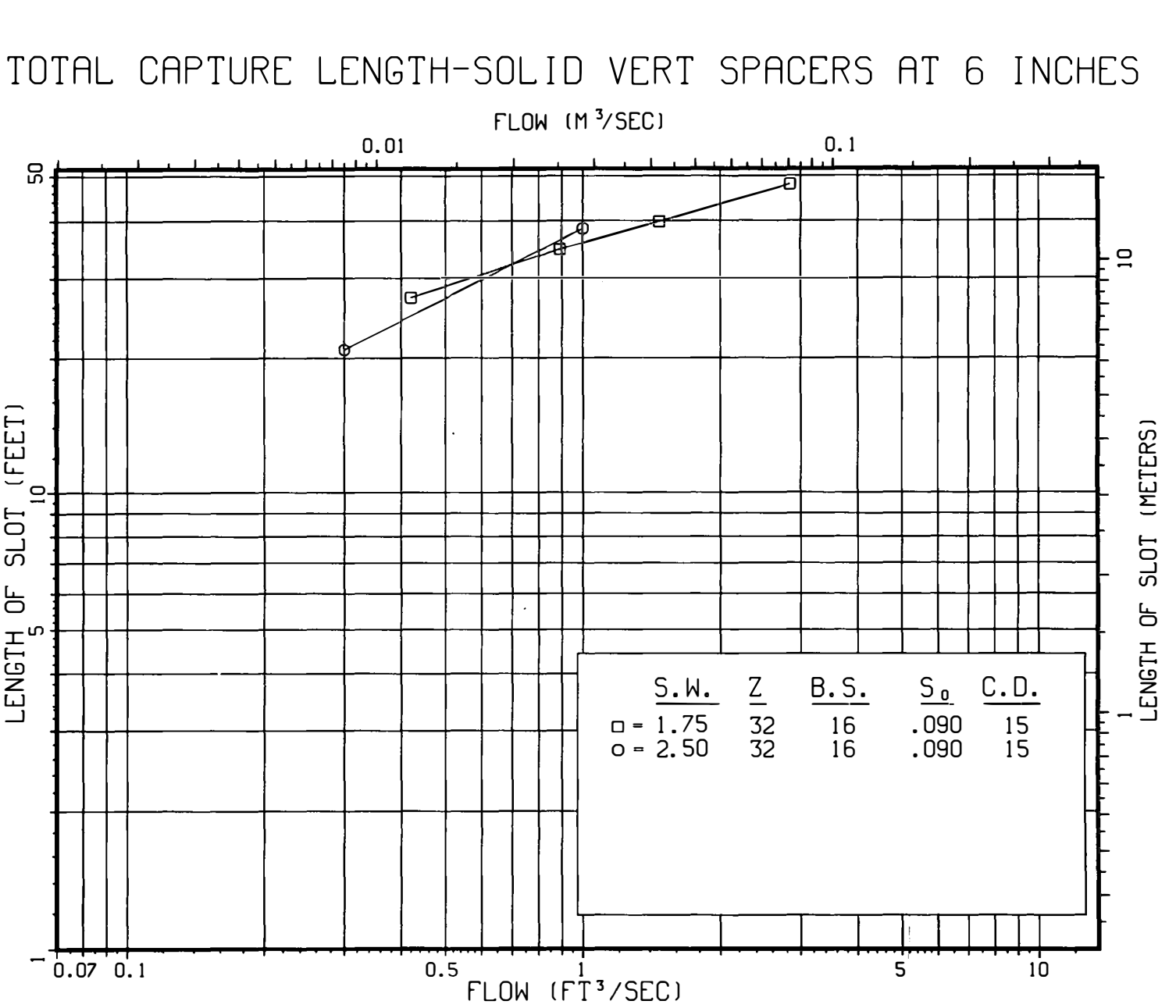

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.75 32 16 .090 15
o = 2.50 32 16 .090 15

Figure 26.

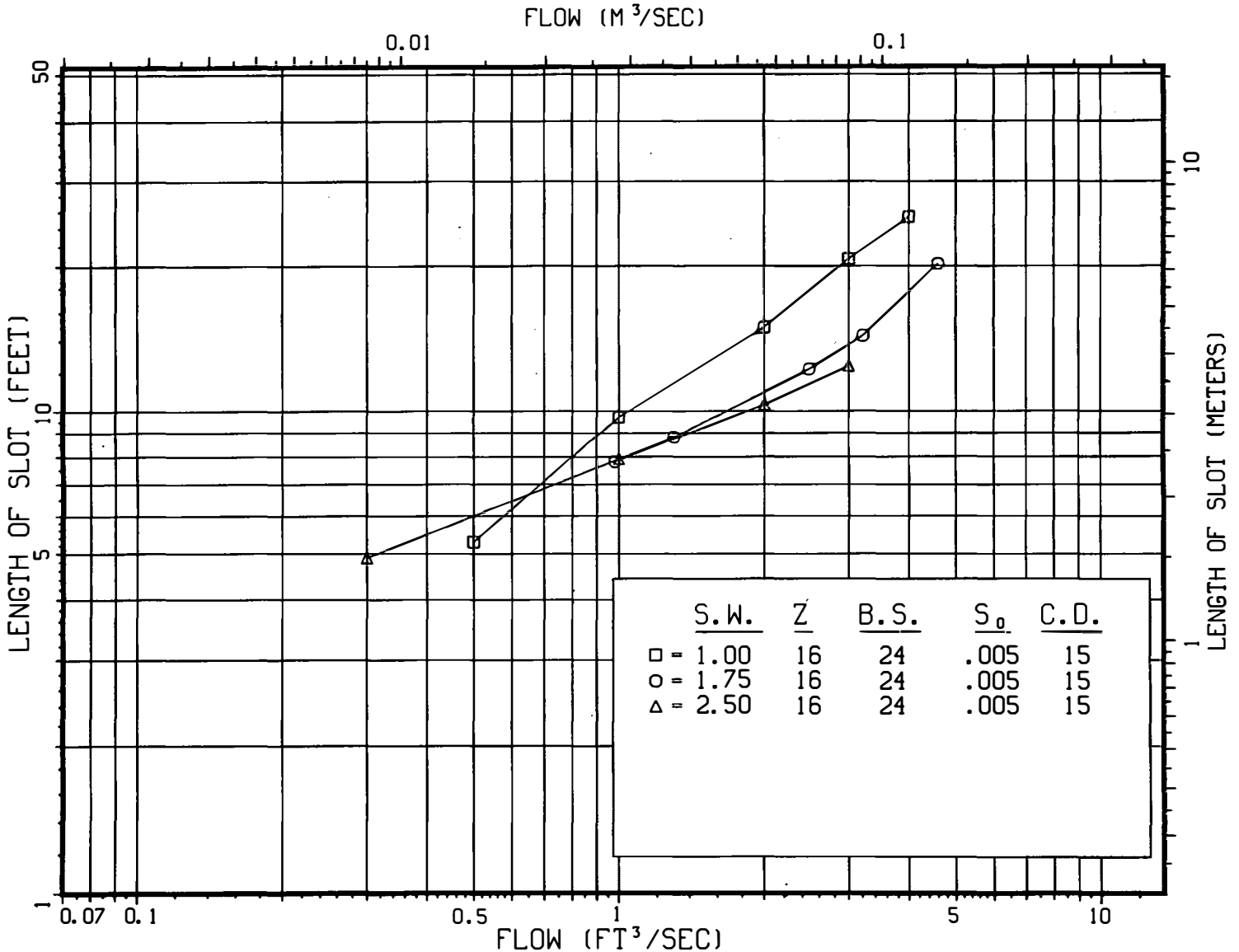

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 16 24 .005 15
○ = 1.75 16 24 .005 15
△ = 2.50 16 24 .005 15

Figure 27.

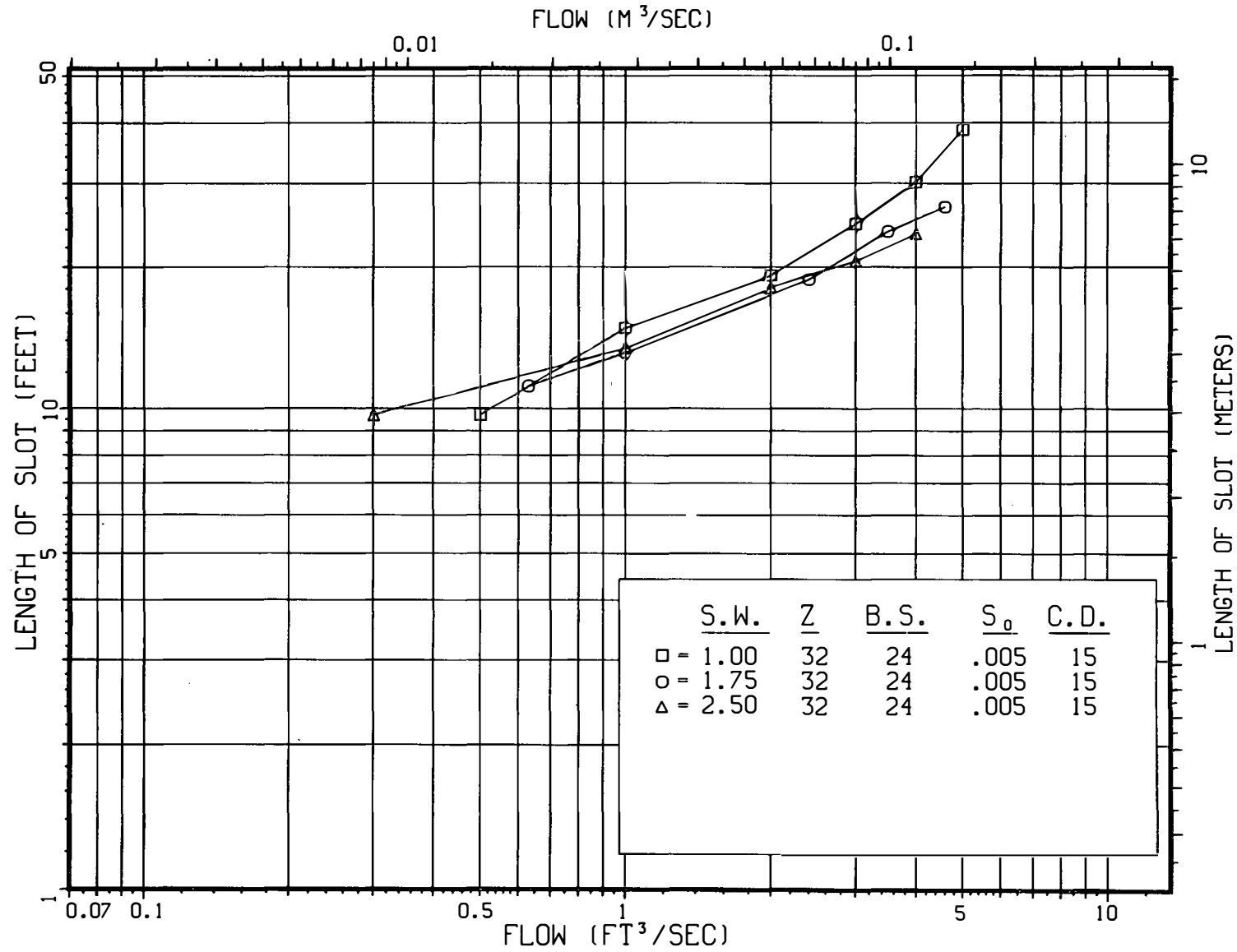

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 32 24 .005 15
○ = 1.75 32 24 .005 15
△ = 2.50 32 24 .005 15

Figure 28.

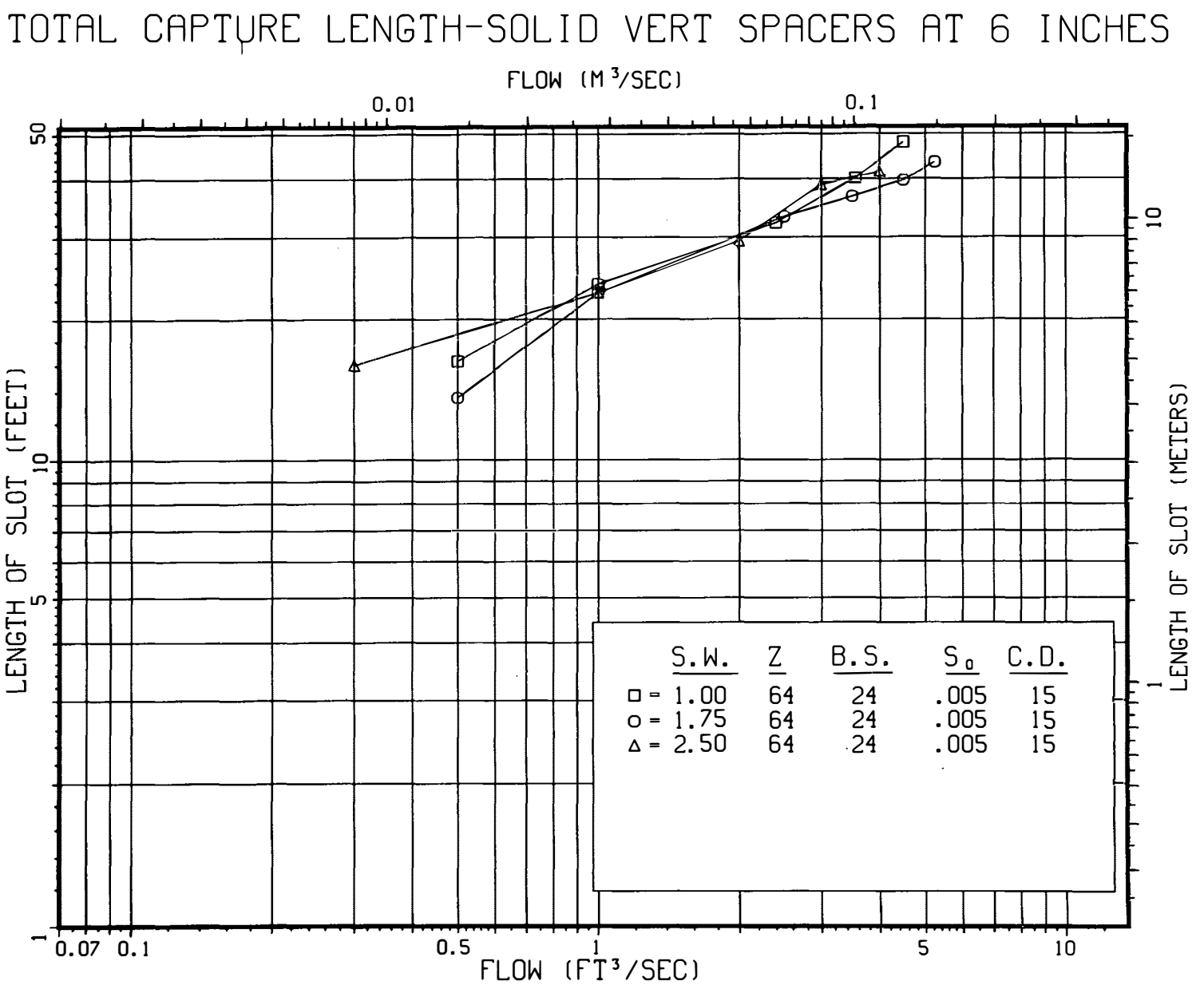

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 64 24 .005 15
○ = 1.75 64 24 .005 15
△ = 2.50 64 24 .005 15

Figure 29.

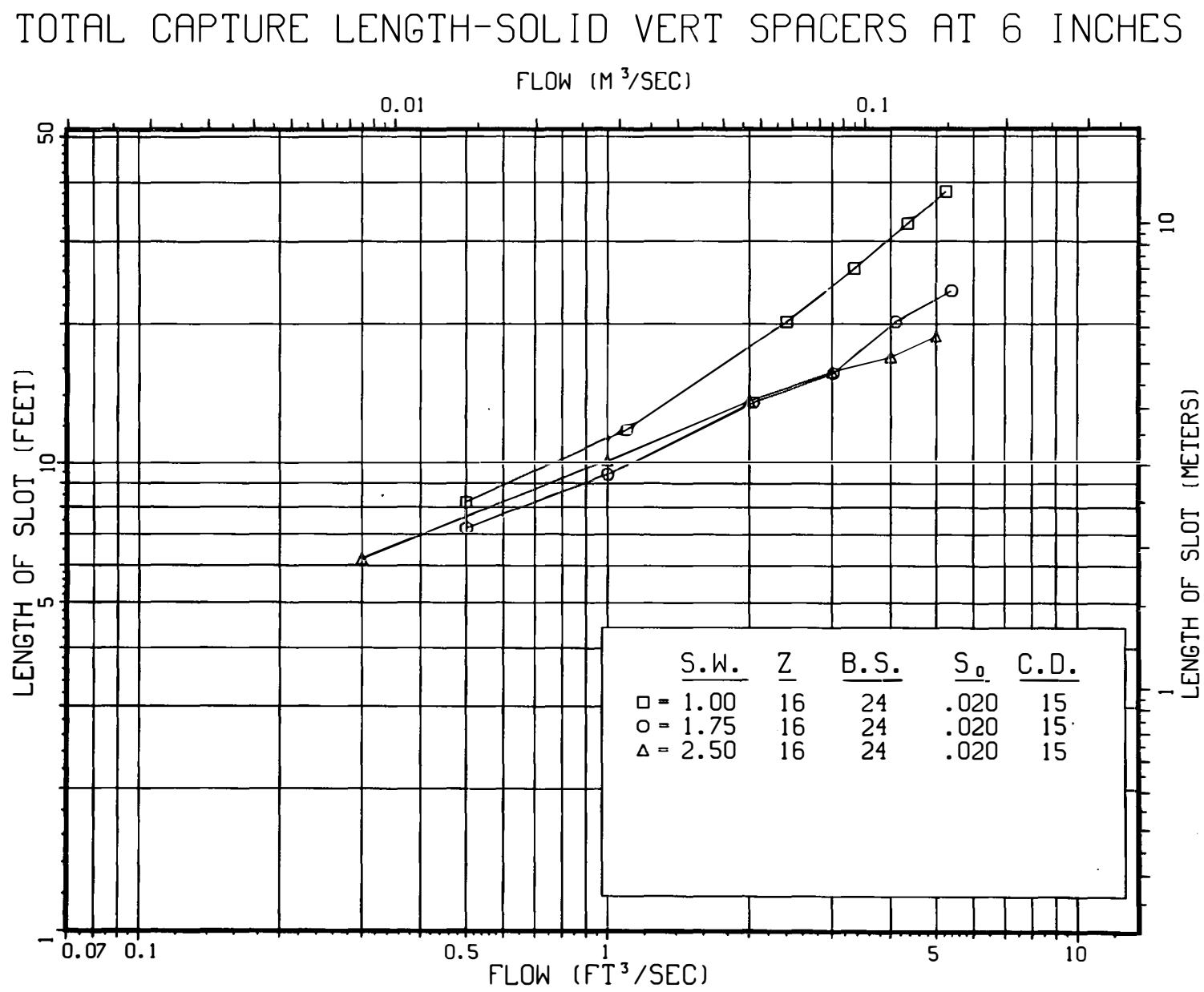

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 16 24 .020 15
○ = 1.75 16 24 .020 15
△ = 2.50 16 24 .020 15

**Figure 30.**

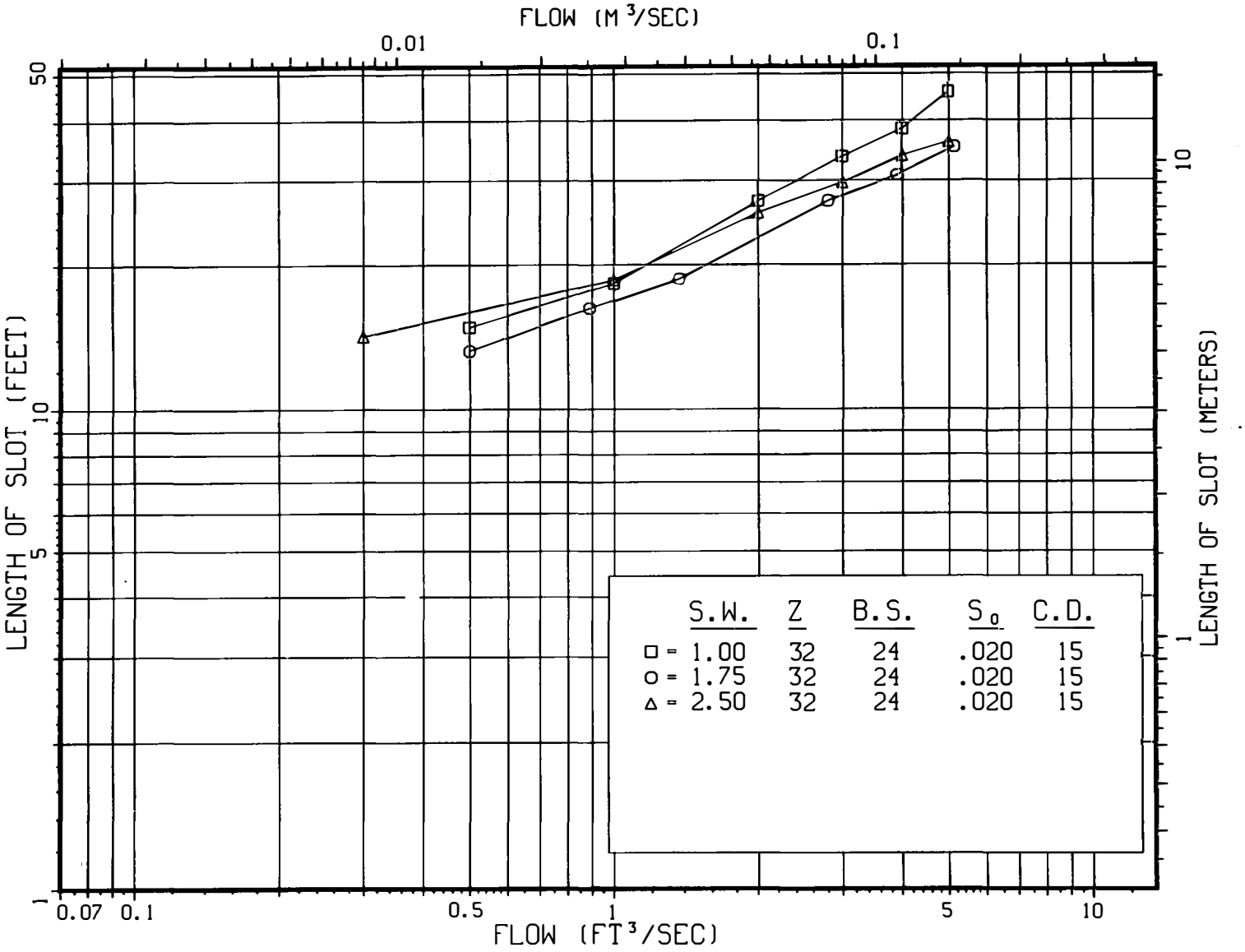

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 32 24 .020 15
○ = 1.75 32 24 .020 15
△ = 2.50 32 24 .020 15

**Figure 31.**

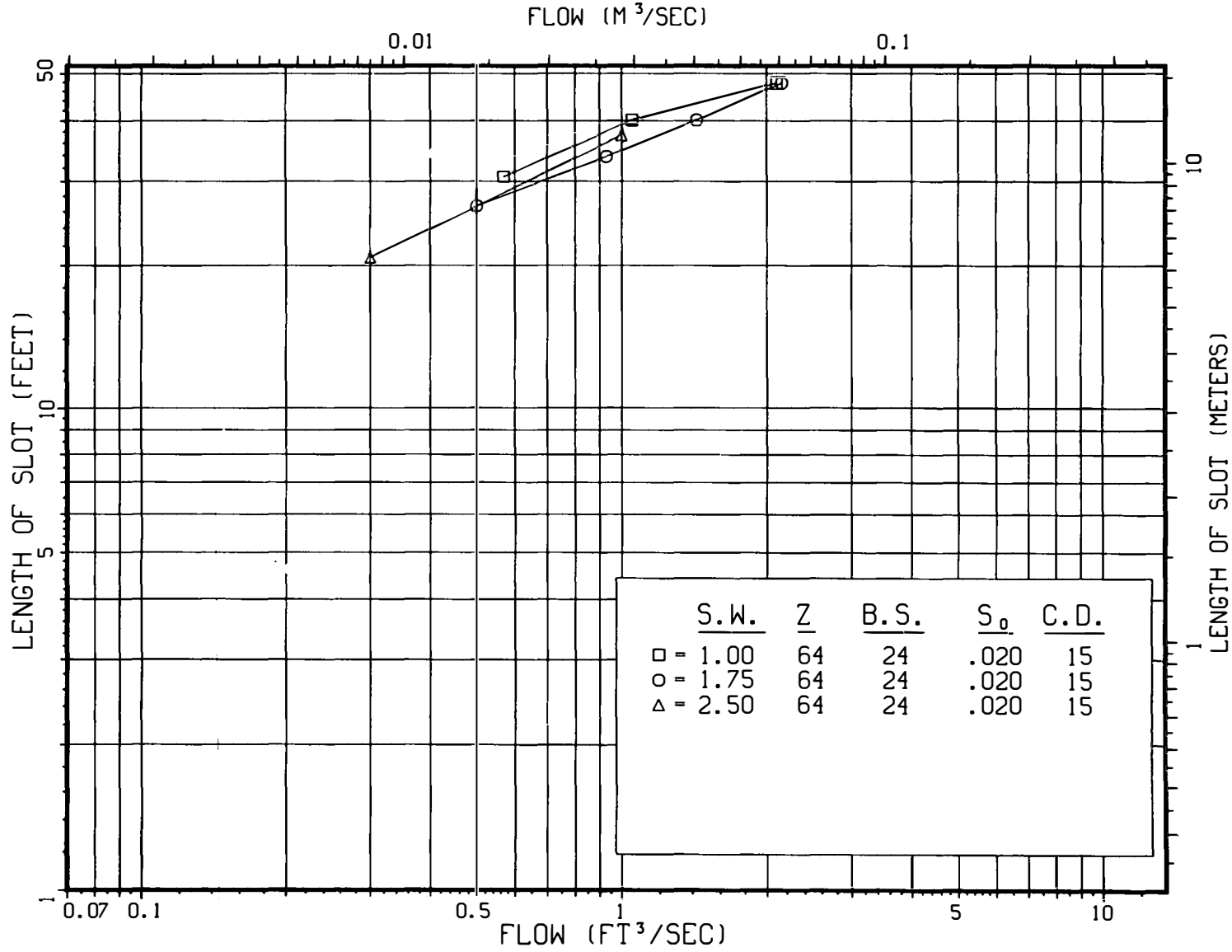

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 64 24 .020 15
○ = 1.75 64 24 .020 15
△ = 2.50 64 24 .020 15

Figure 32.

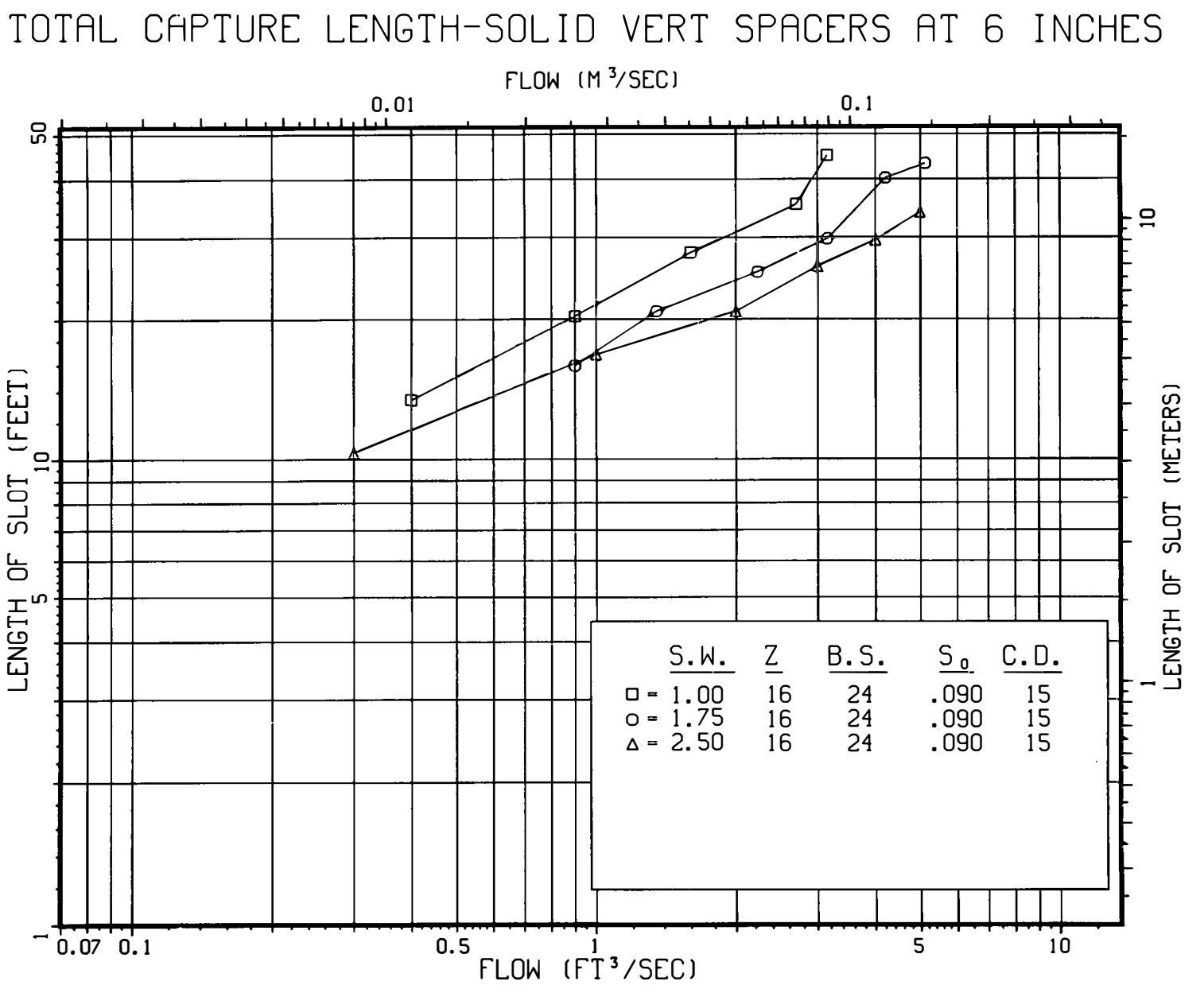

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 16 24 .090 15
○ = 1.75 16 24 .090 15
△ = 2.50 16 24 .090 15

**Figure 33.**

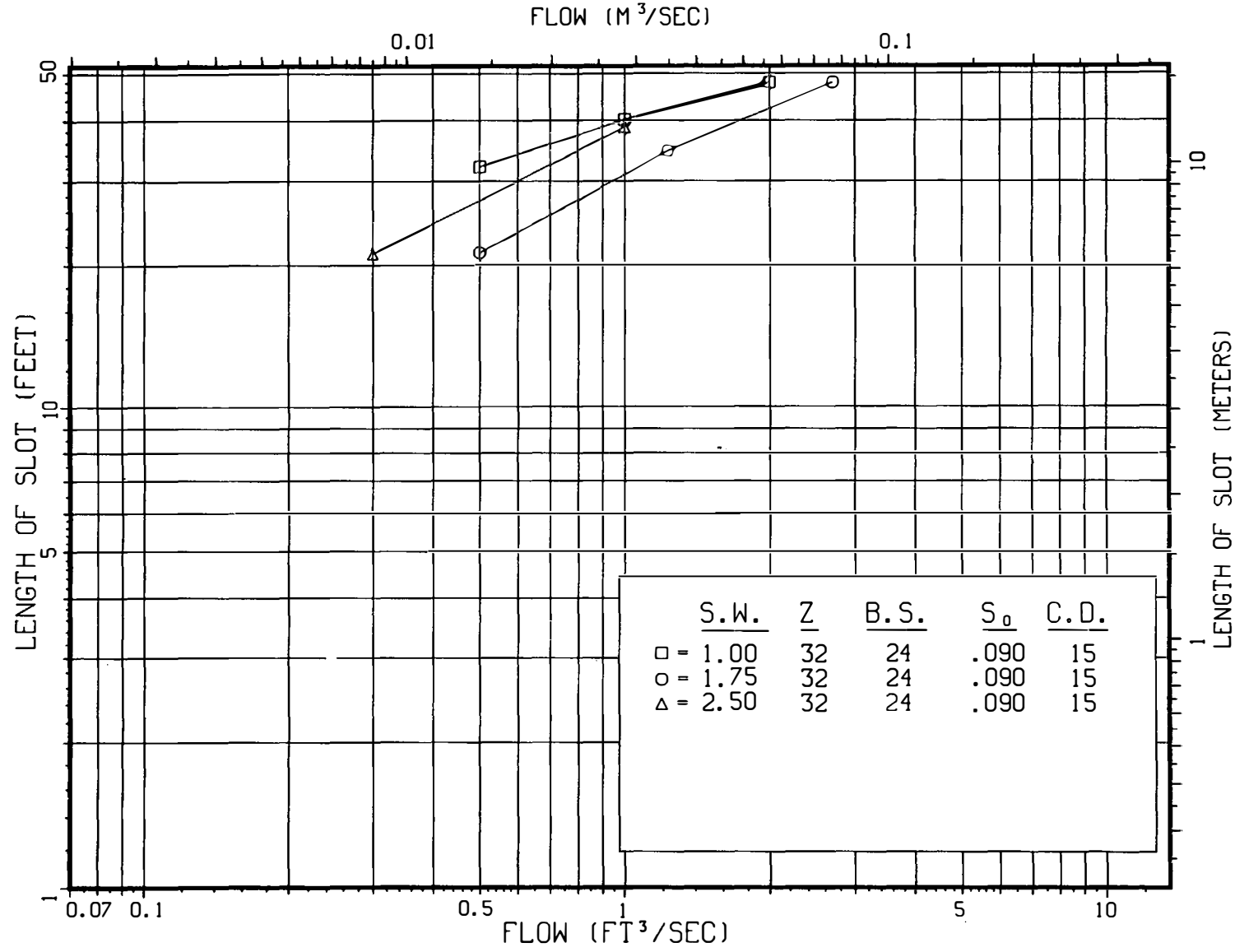

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
50
10
5
1
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 32 24 .090 15
○ = 1.75 32 24 .090 15
△ = 2.50 32 24 .090 15

**Figure 34.**

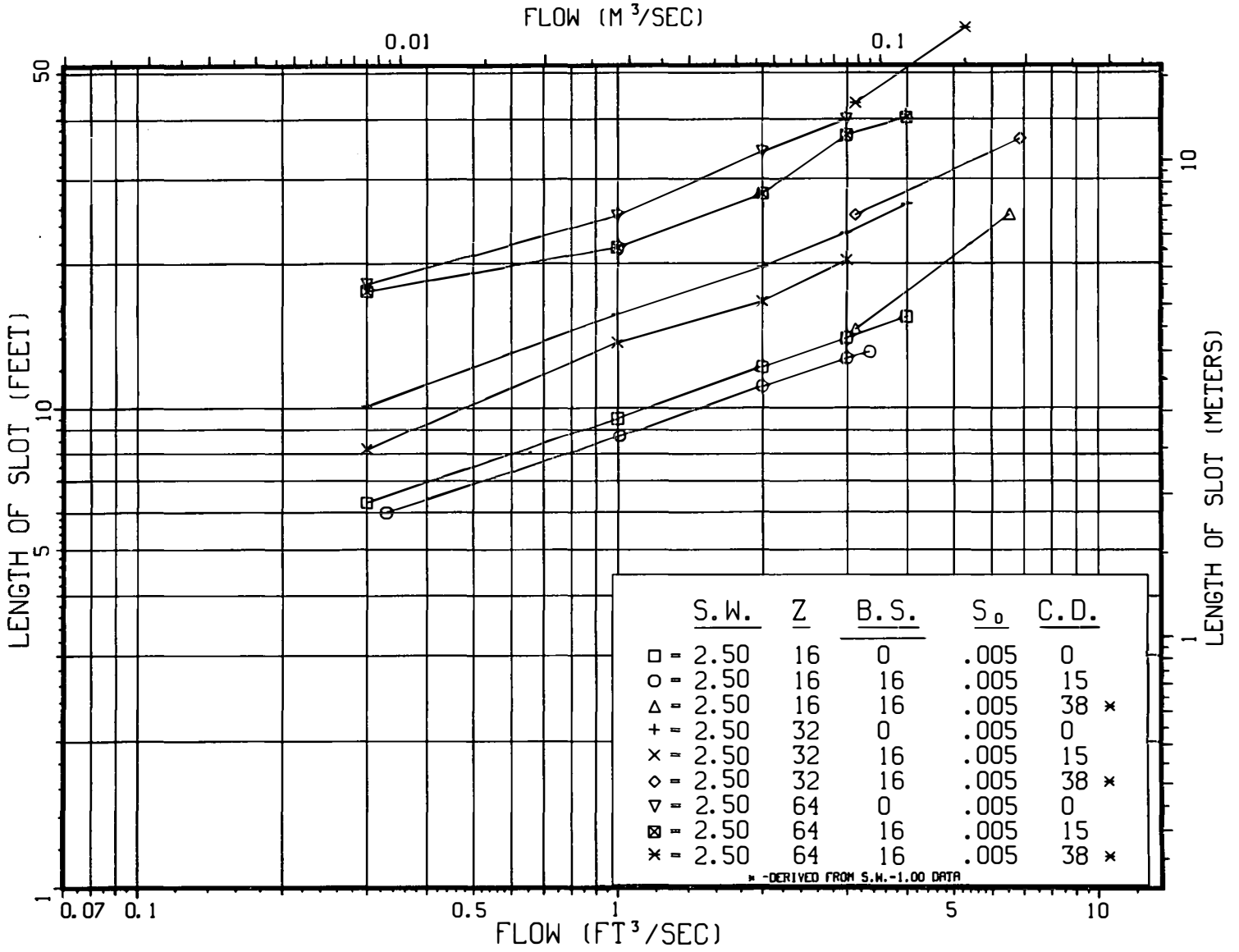

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
50
10
5
1
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 2.50 16 0 .005 0
○ = 2.50 16 16 .005 15
△ = 2.50 16 16 .005 38 *
+ = 2.50 32 0 .005 0
× = 2.50 32 16 .005 15
◇ = 2.50 32 16 .005 38 *
▽ = 2.50 64 0 .005 0
⊠ = 2.50 64 16 .005 15
* = 2.50 64 16 .005 38 *
* -DERIVED FROM S.W.-1.00 DATA

**Figure 35.**

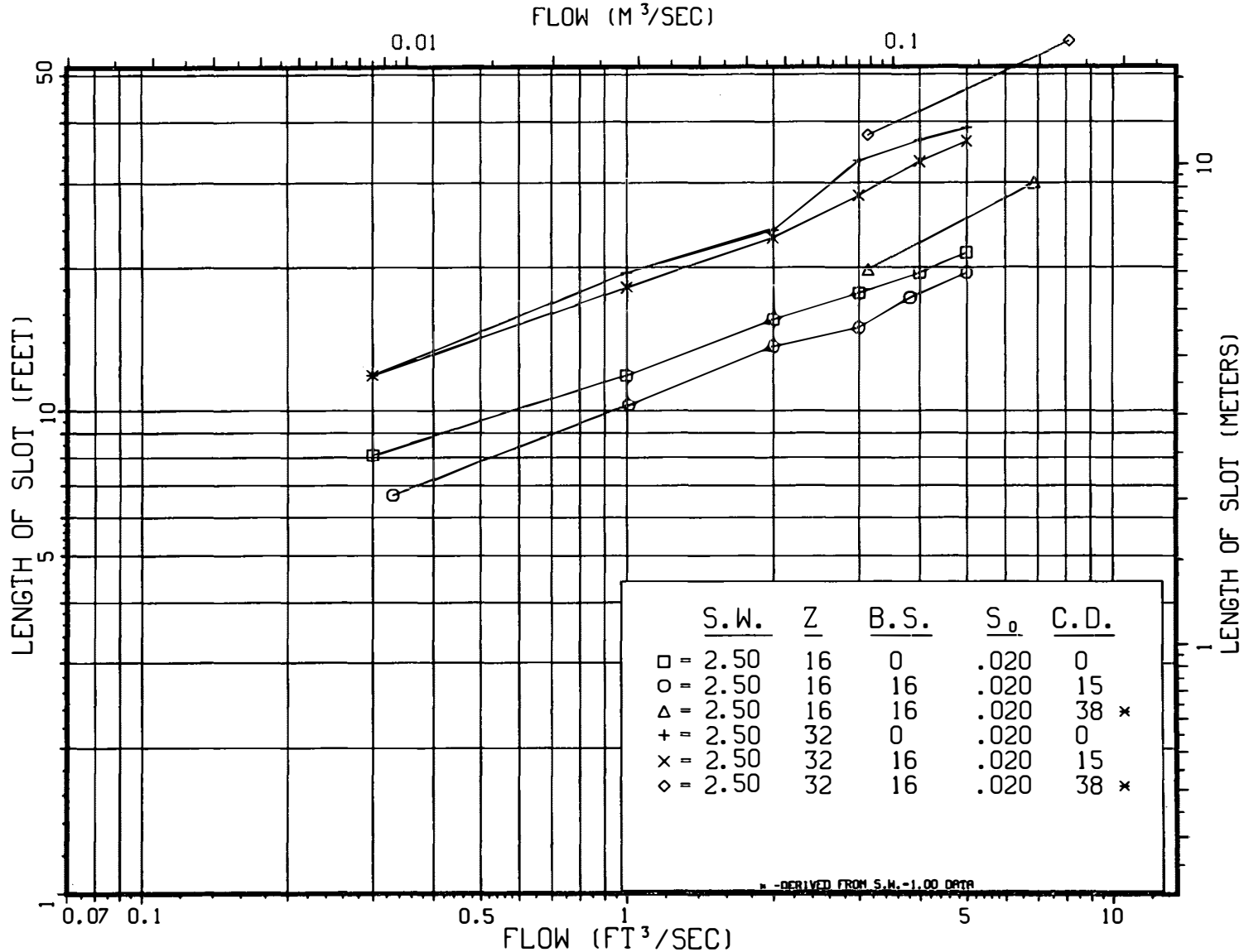

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S0 C.D.
□ = 2.50 16 0 .020 0
○ = 2.50 16 16 .020 15
△ = 2.50 16 16 .020 38 *
+ = 2.50 32 0 .020 0
× = 2.50 32 16 .020 15
◇ = 2.50 32 16 .020 38 *
* -DERIVED FROM S.W.=1.00 DATA

Figure 36.

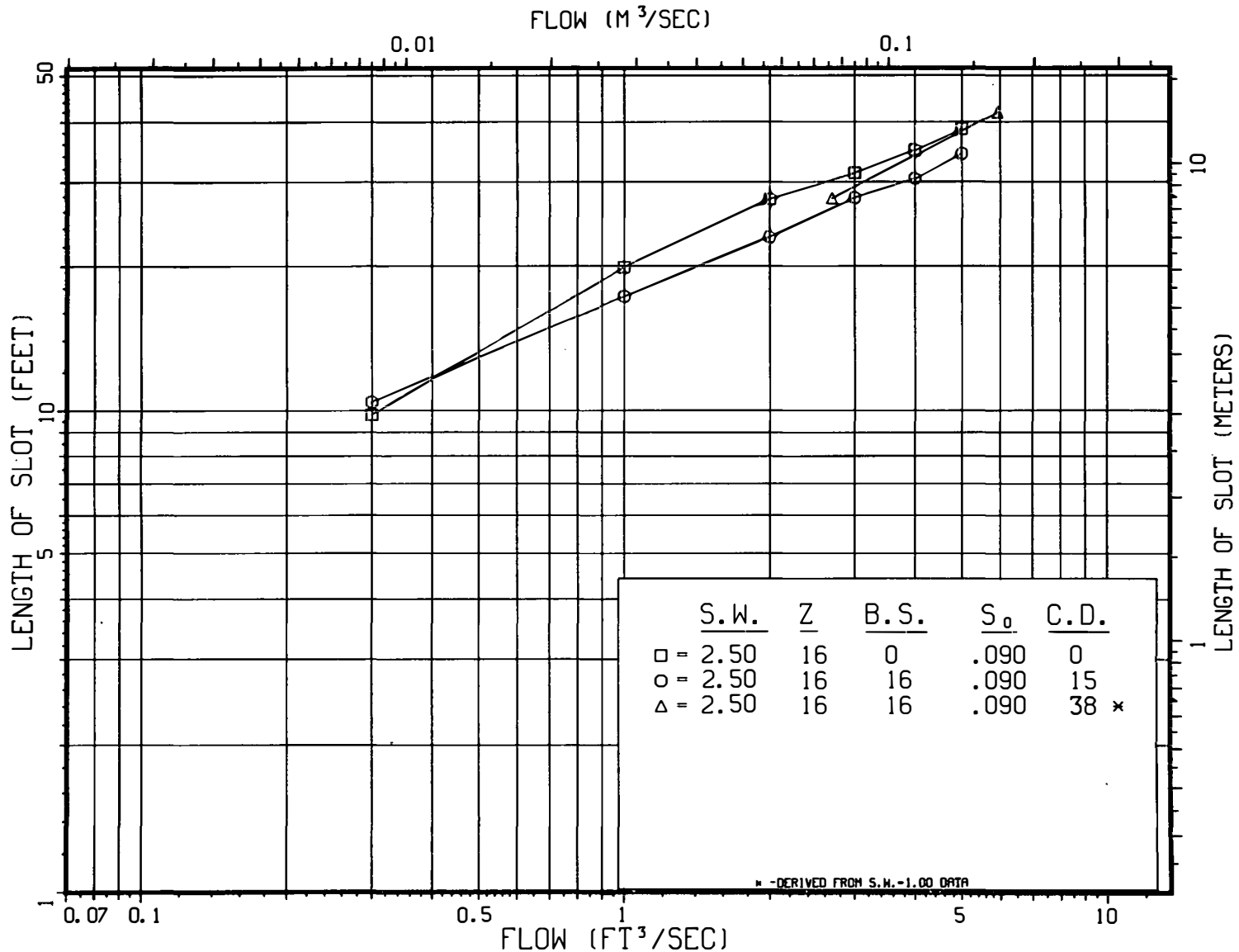

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 2.50 16 0 .090 0
○ = 2.50 16 16 .090 15
△ = 2.50 16 16 .090 38 *
* -DERIVED FROM S.W.-1.00 DATA

Figure 37.

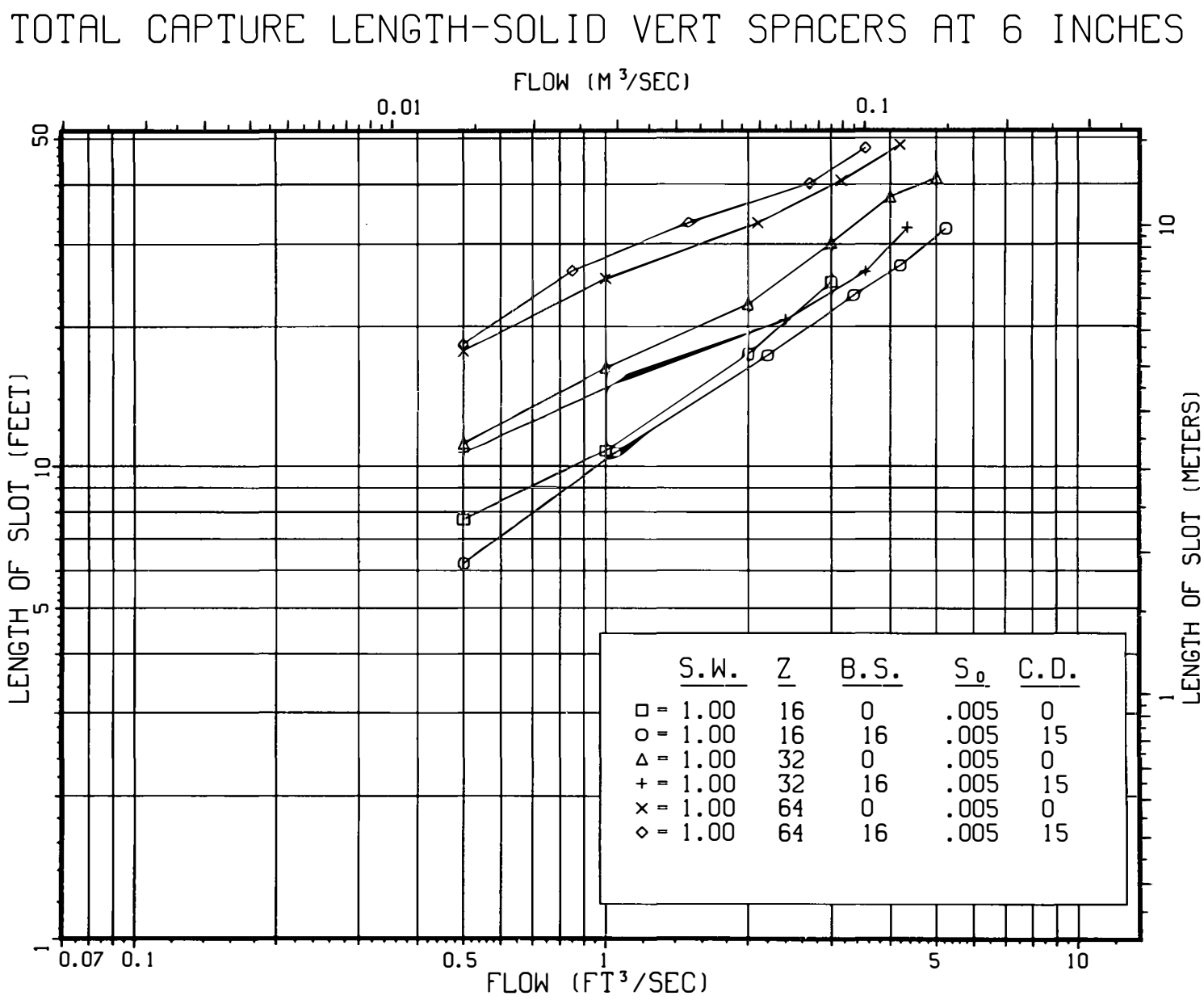

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
50
10
5
1
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 16 0 .005 0
○ = 1.00 16 16 .005 15
△ = 1.00 32 0 .005 0
+ = 1.00 32 16 .005 15
× = 1.00 64 0 .005 0
◇ = 1.00 64 16 .005 15

Figure 38.

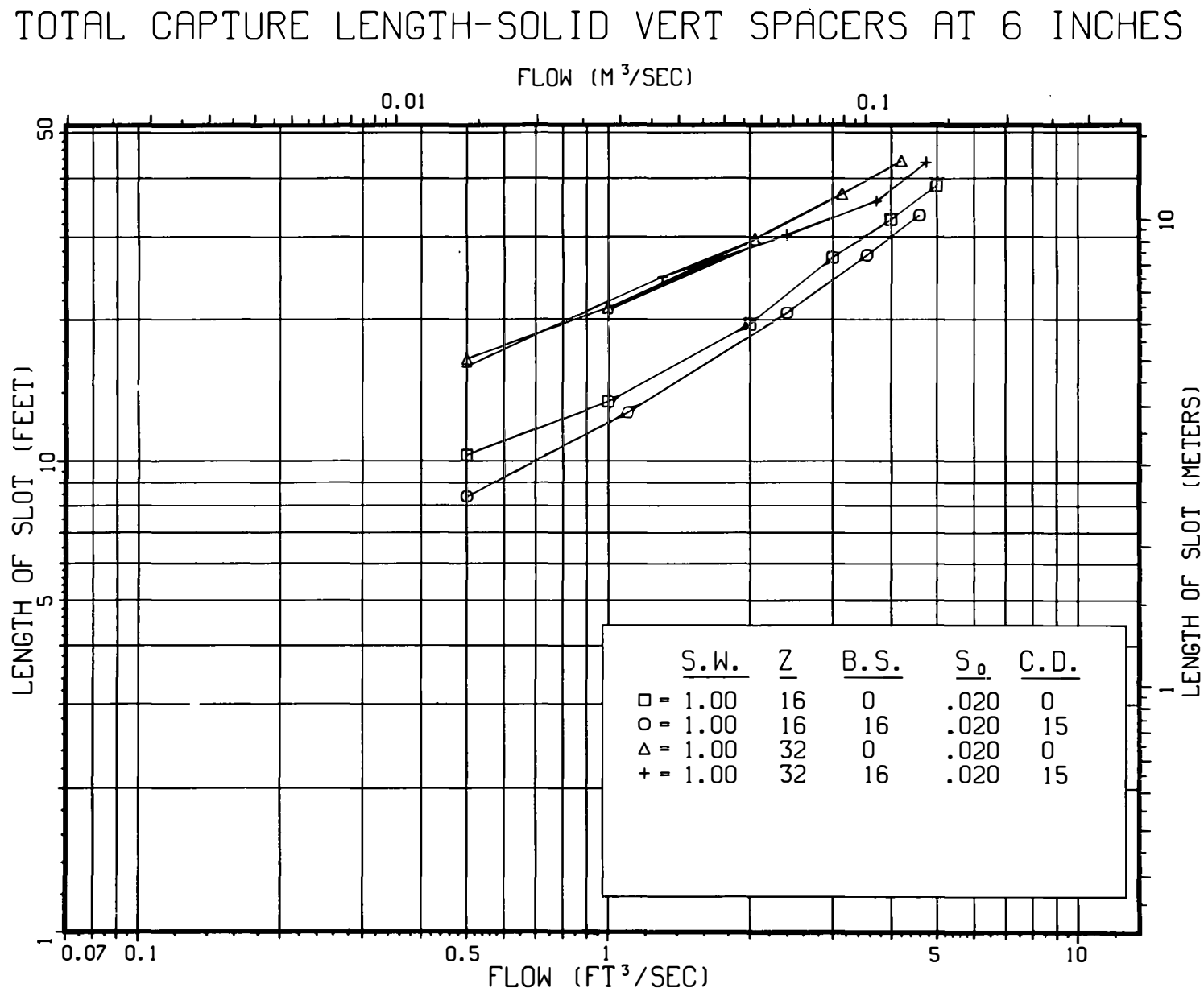

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 16 0 .020 0
○ = 1.00 16 16 .020 15
△ = 1.00 32 0 .020 0
+ = 1.00 32 16 .020 15

**Figure 39.**

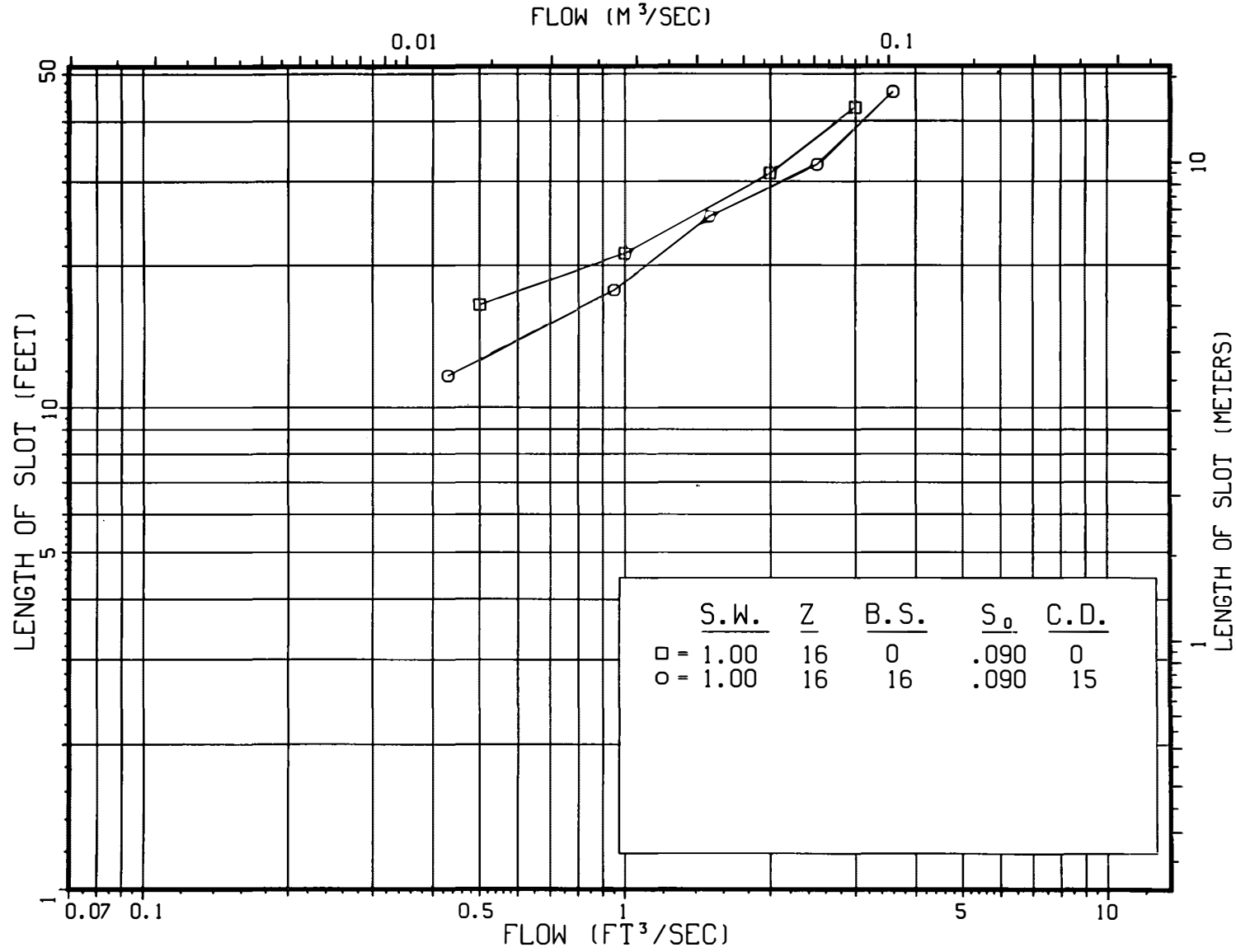

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 16 0 .090 0
○ = 1.00 16 16 .090 15

Figure 40.

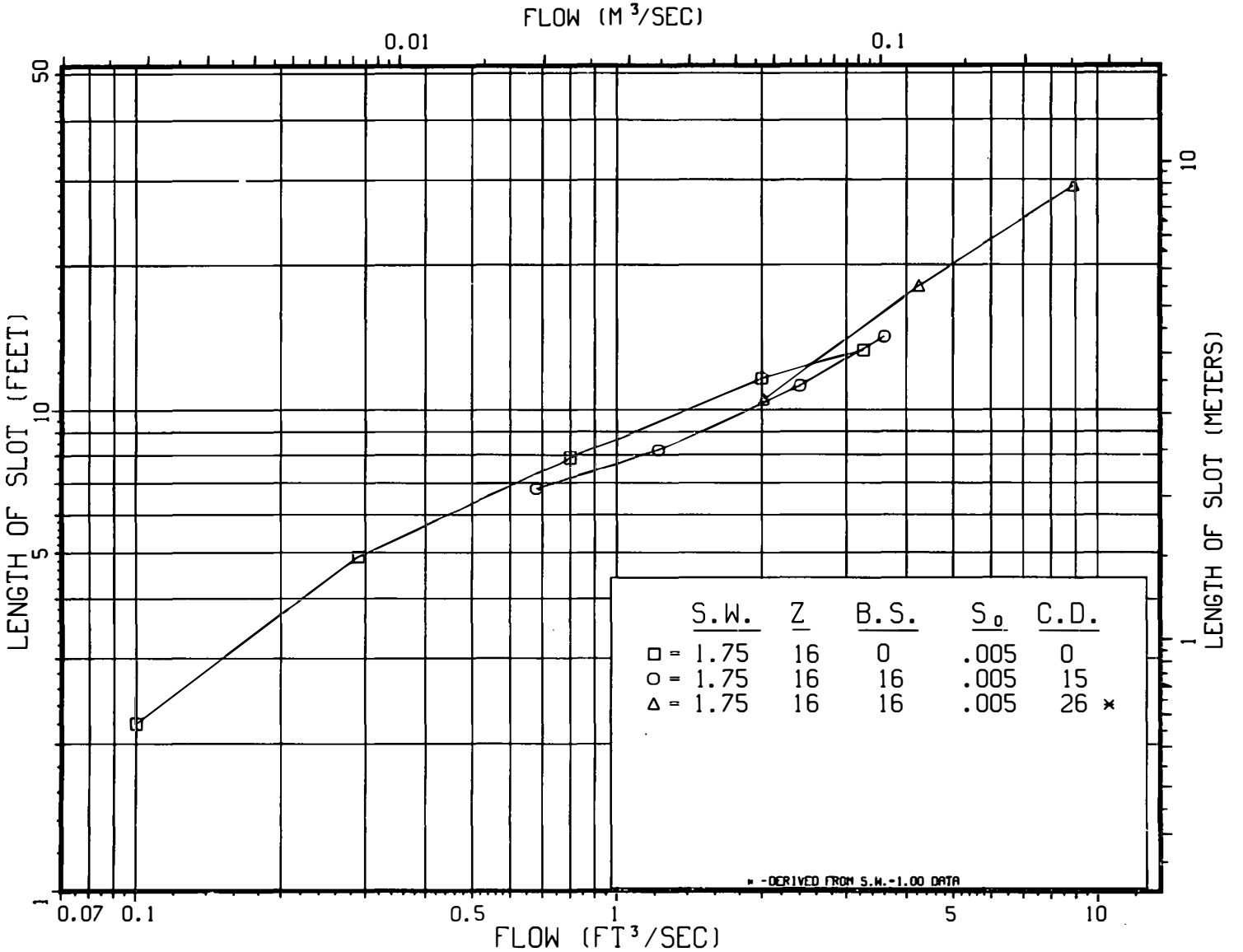

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.75 16 0 .005 0
○ = 1.75 16 16 .005 15
△ = 1.75 16 16 .005 26 *
* -DERIVED FROM S.W.-1.00 DATA

**Figure 41.**

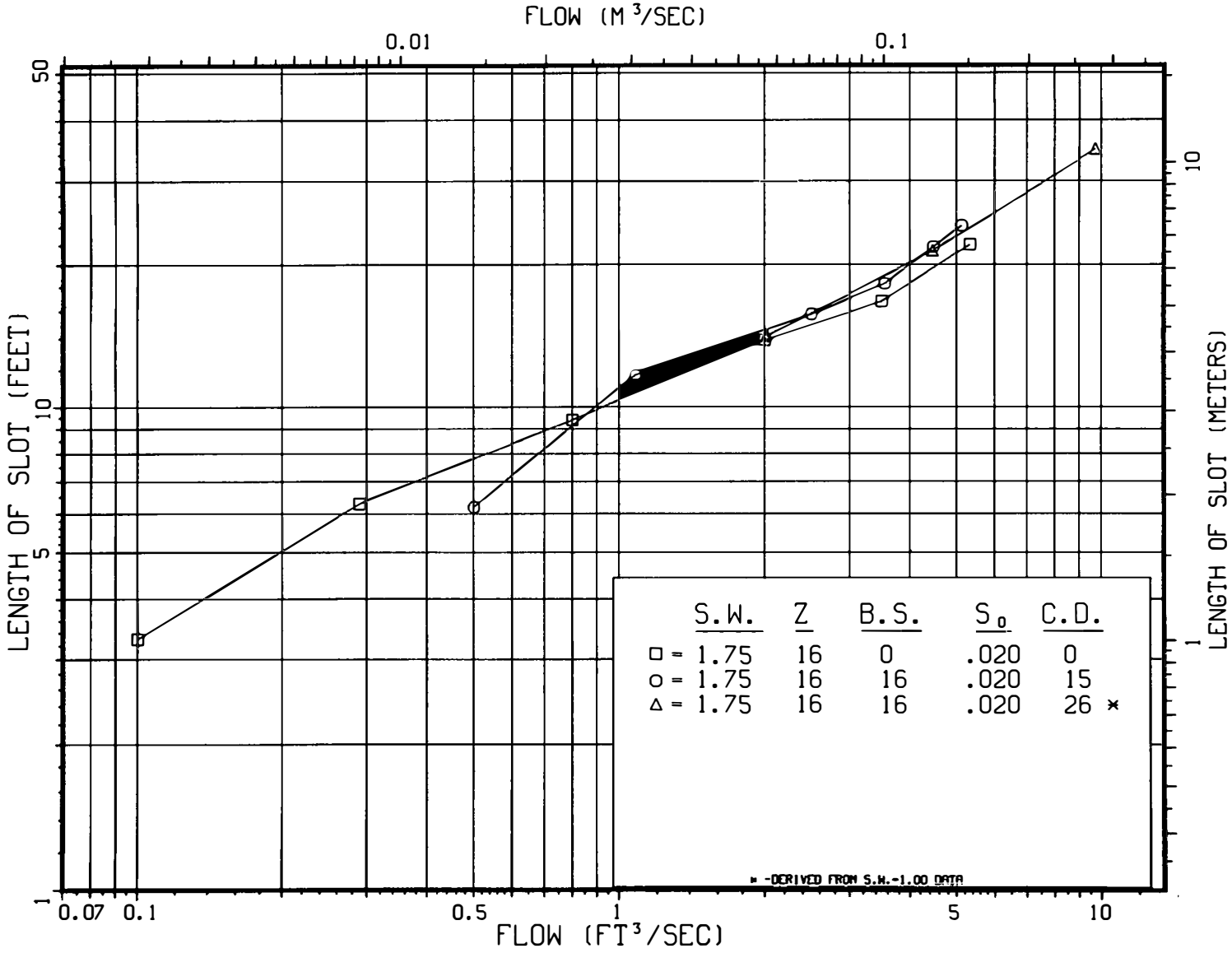

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.75 16 0 .020 0
○ = 1.75 16 16 .020 15
△ = 1.75 16 16 .020 26 *
* -DERIVED FROM S.W.-1.00 DATA

**Figure 42.**

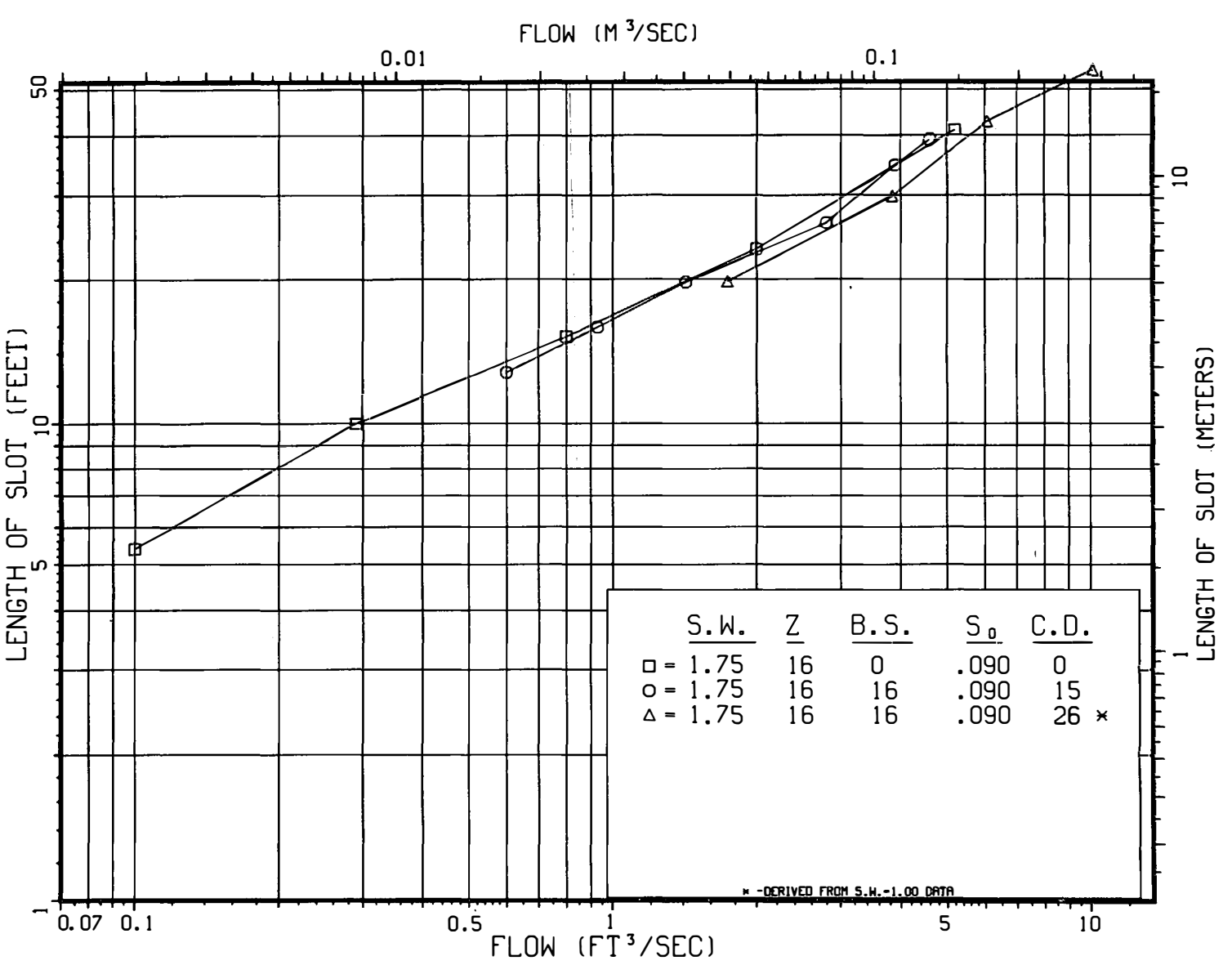

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S0 C.D.
□ = 1.75 16 0 .090 0
○ = 1.75 16 16 .090 15
△ = 1.75 16 16 .090 26 *
* -DERIVED FROM S.W.-1.00 DATA

Figure 43.

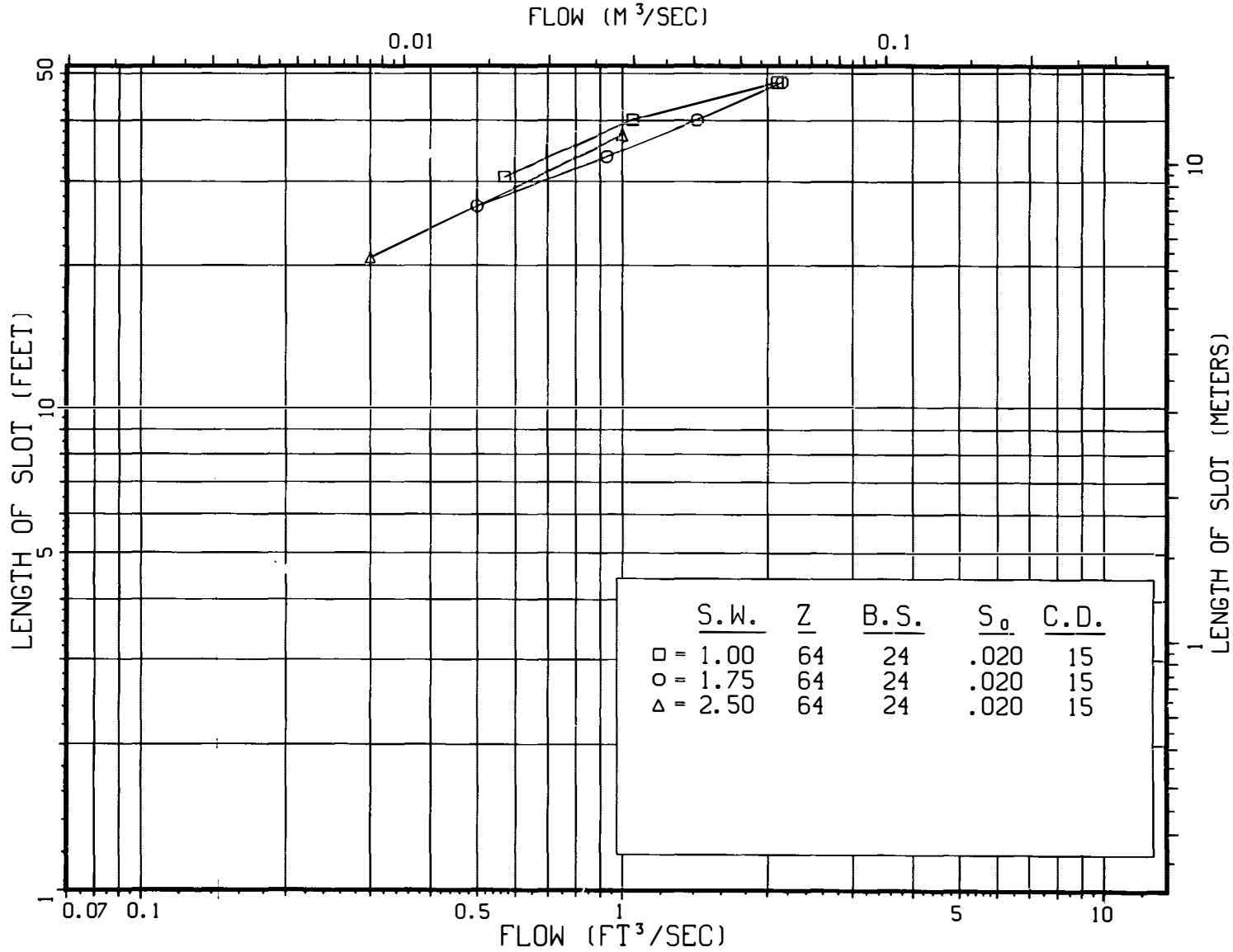

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 64 24 .020 15
○ = 1.75 64 24 .020 15
△ = 2.50 64 24 .020 15

**Figure 32.**

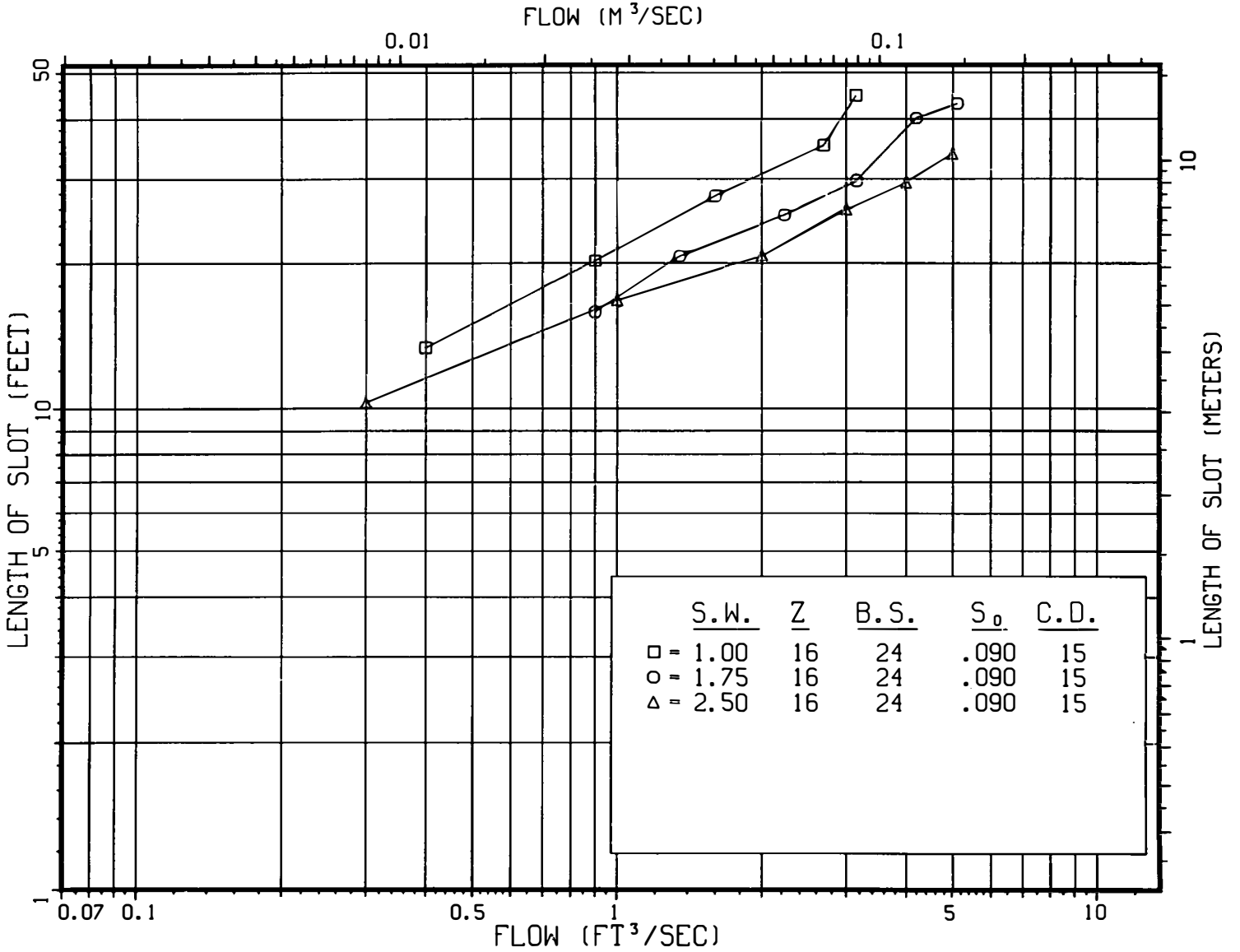

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 16 24 .090 15
○ = 1.75 16 24 .090 15
△ = 2.50 16 24 .090 15

**Figure 33.**

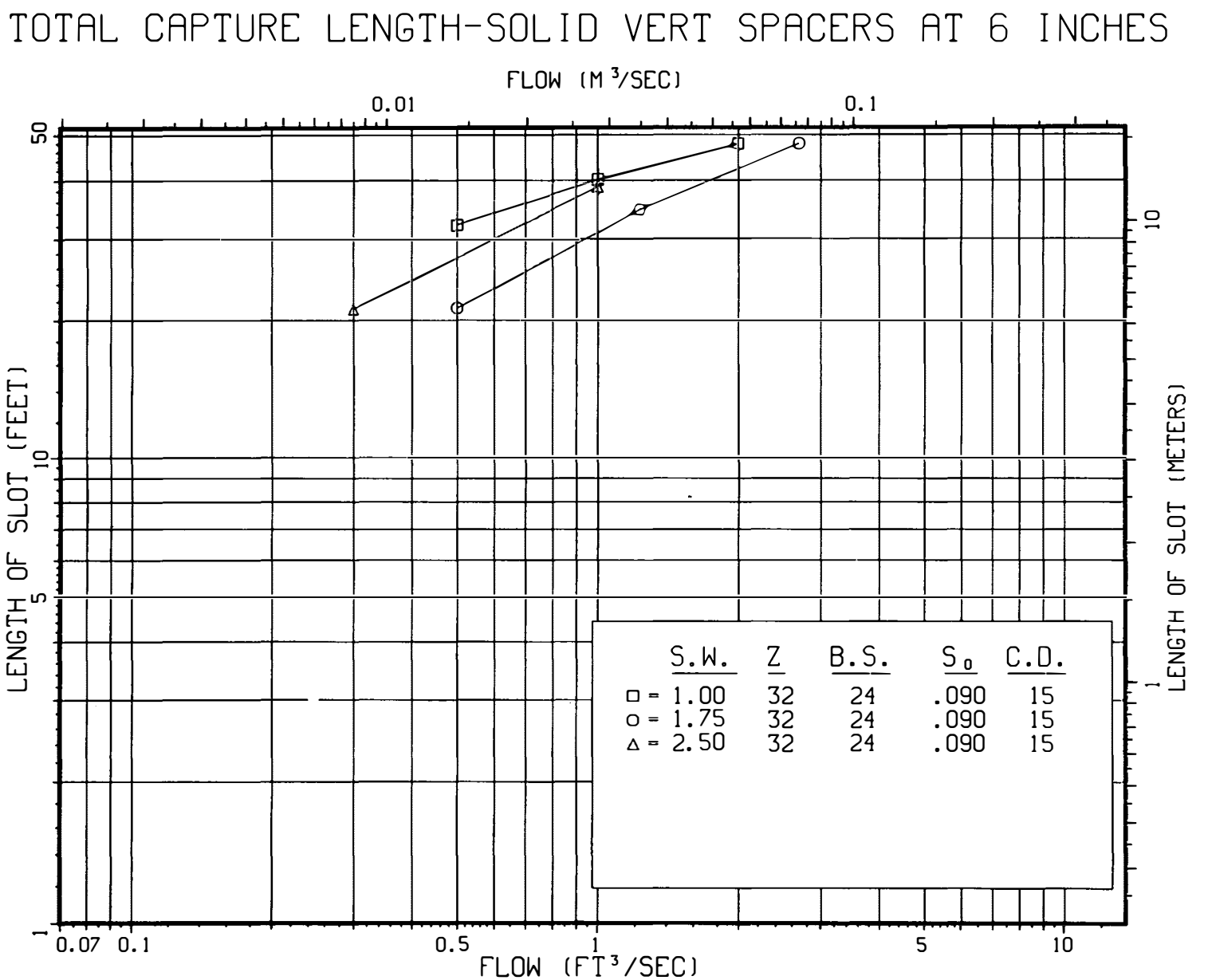

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
50
10
5
1
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 32 24 .090 15
○ = 1.75 32 24 .090 15
△ = 2.50 32 24 .090 15

Figure 34.

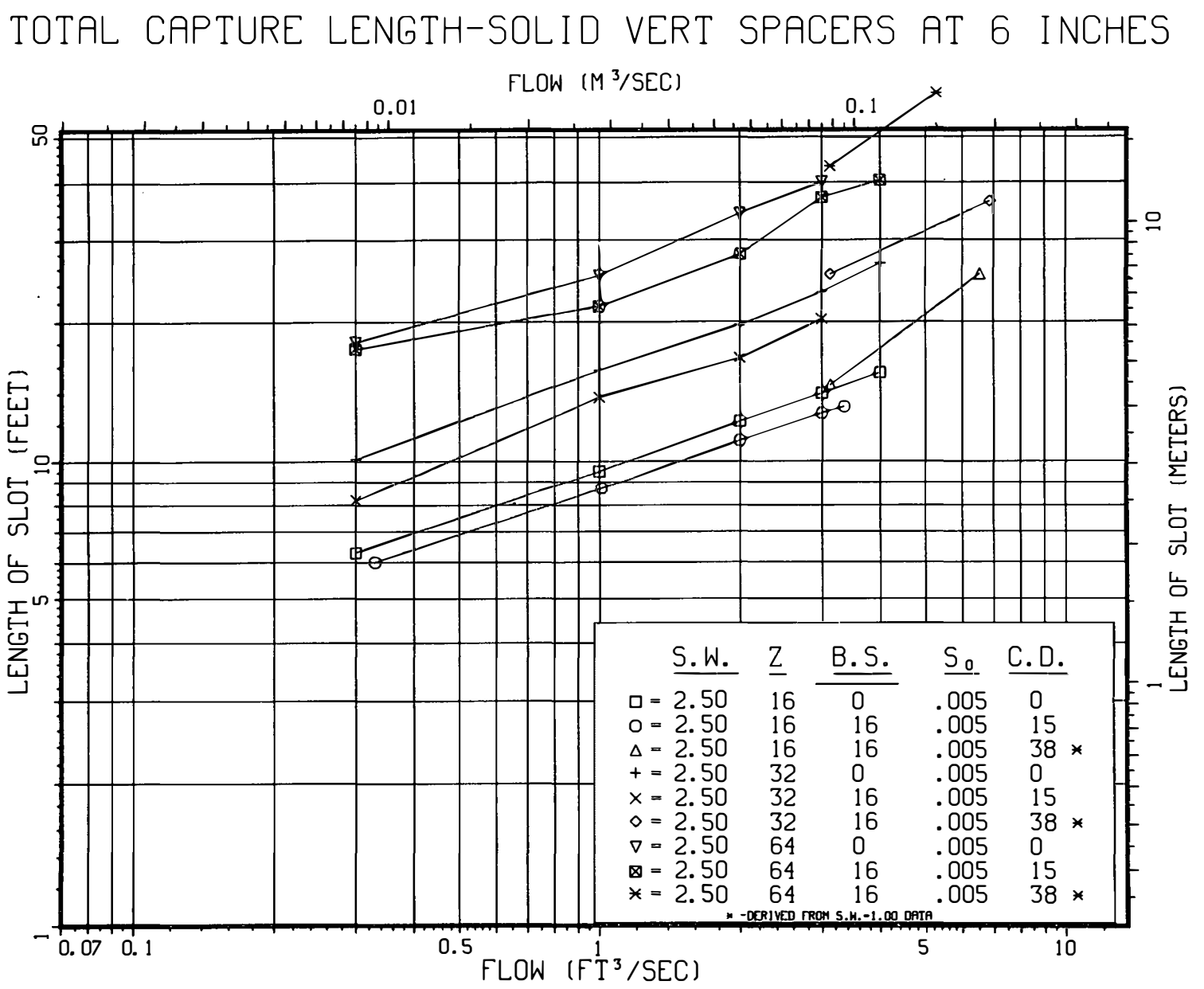

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
50
10
5
1
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 2.50 16 0 .005 0
○ = 2.50 16 16 .005 15
△ = 2.50 16 16 .005 38 *
+ = 2.50 32 0 .005 0
× = 2.50 32 16 .005 15
◇ = 2.50 32 16 .005 38 *
▽ = 2.50 64 0 .005 0
⊠ = 2.50 64 16 .005 15
* = 2.50 64 16 .005 38 *
* -DERIVED FROM S.W.-1.00 DATA

**Figure 35.**

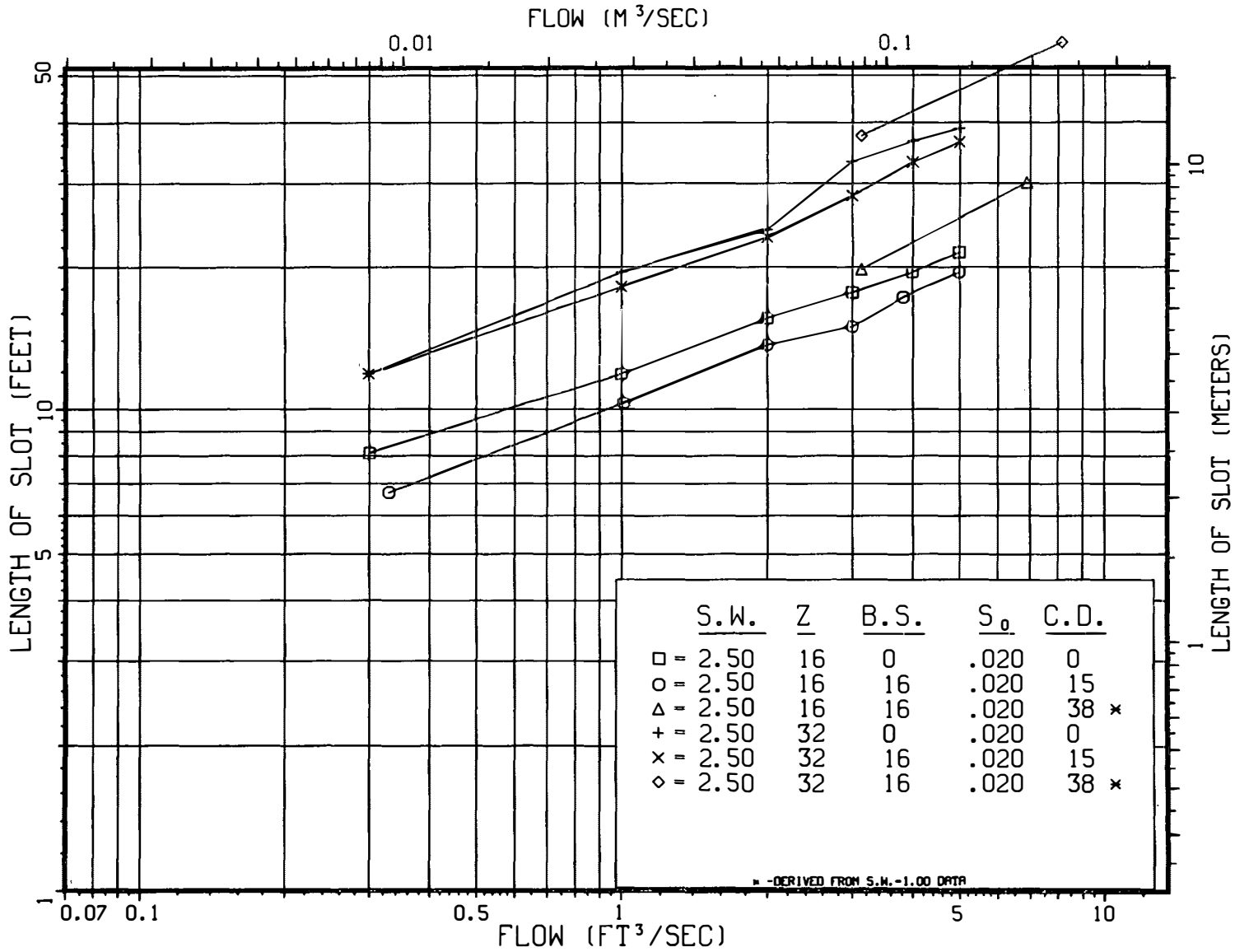

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M 3/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT3/SEC)
S.W. Z B.S. S0 C.D.
□ = 2.50 16 0 .020 0
○ = 2.50 16 16 .020 15
△ = 2.50 16 16 .020 38 *
+ = 2.50 32 0 .020 0
× = 2.50 32 16 .020 15
◇ = 2.50 32 16 .020 38 *
* -DERIVED FROM S.W.-1.00 DATA

**Figure 36.**

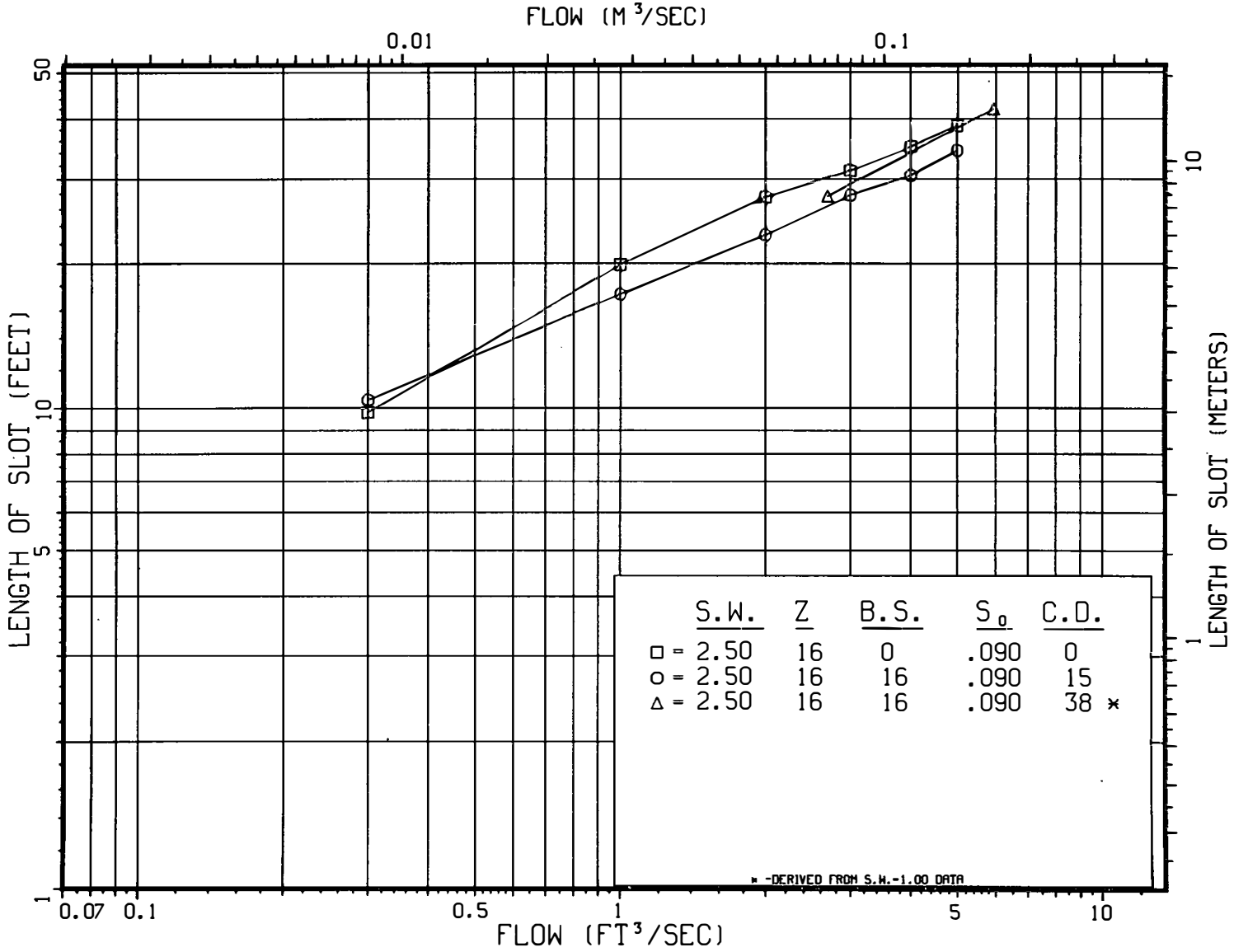

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
50
10
5
1
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 2.50 16 0 .090 0
○ = 2.50 16 16 .090 15
△ = 2.50 16 16 .090 38 *
* -DERIVED FROM S.W.-1.00 DATA

Figure 37.

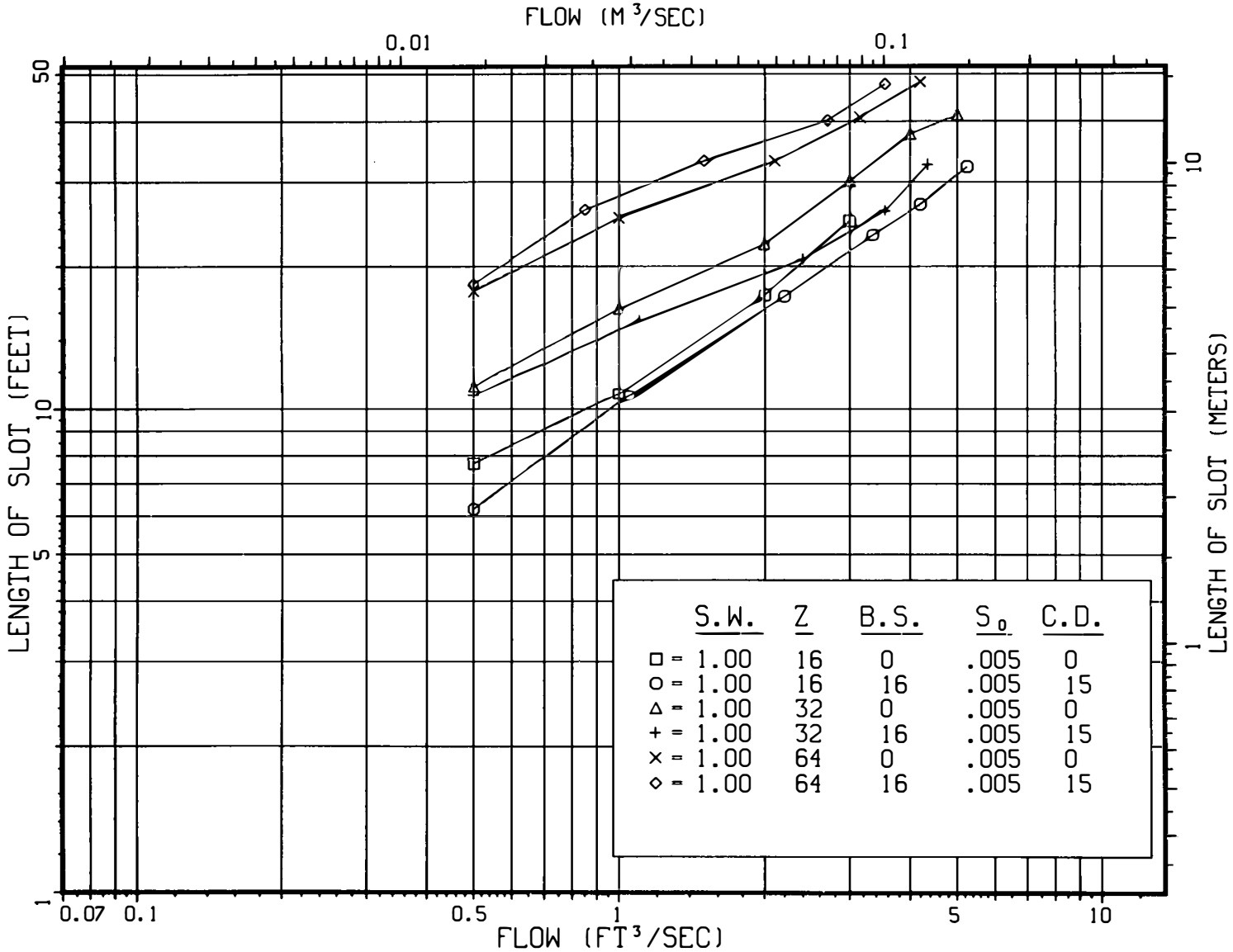

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 16 0 .005 0
○ = 1.00 16 16 .005 15
△ = 1.00 32 0 .005 0
+ = 1.00 32 16 .005 15
× = 1.00 64 0 .005 0
◇ = 1.00 64 16 .005 15

Figure 38.

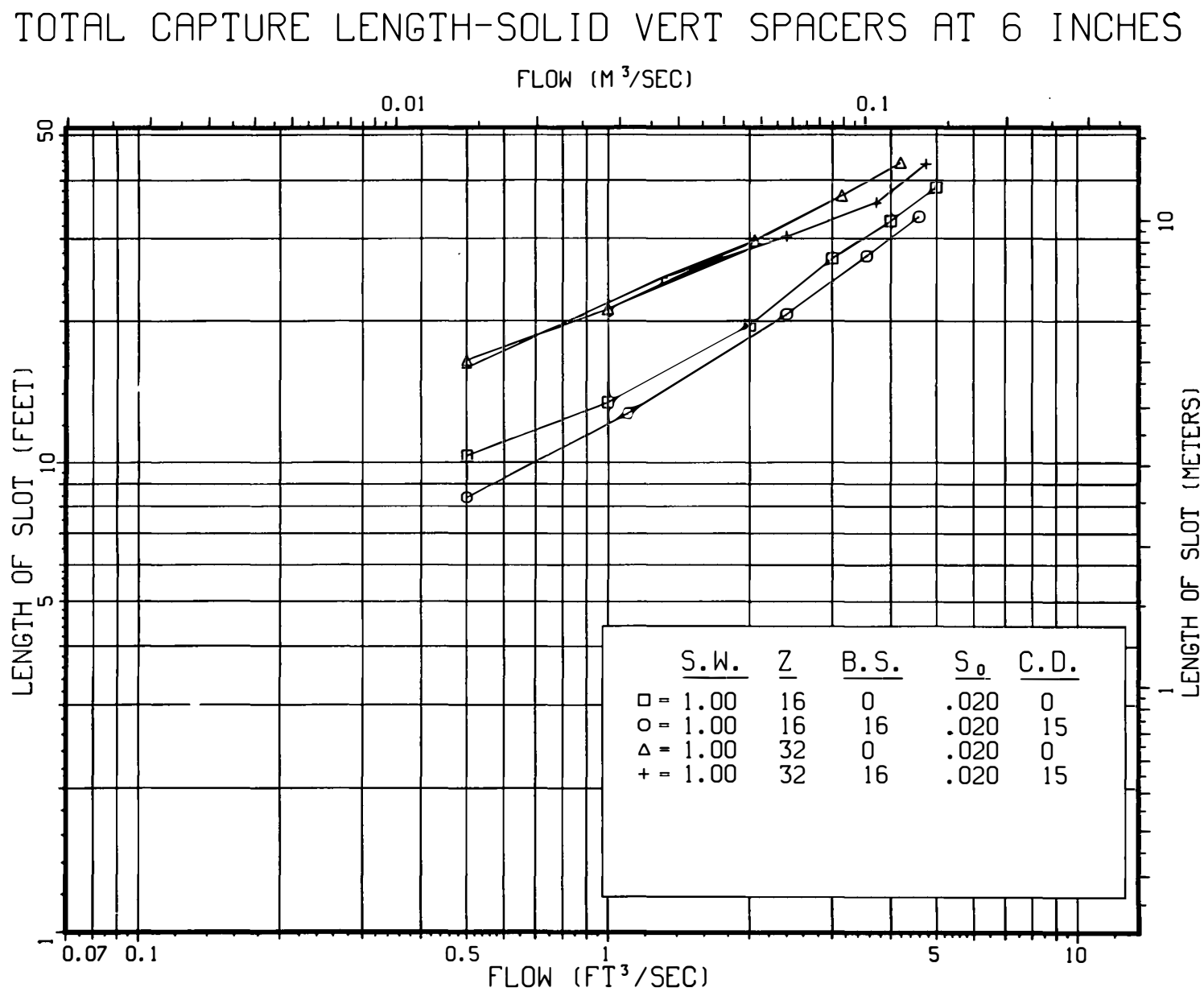

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 16 0 .020 0
○ = 1.00 16 16 .020 15
△ = 1.00 32 0 .020 0
+ = 1.00 32 16 .020 15

**Figure 39.**

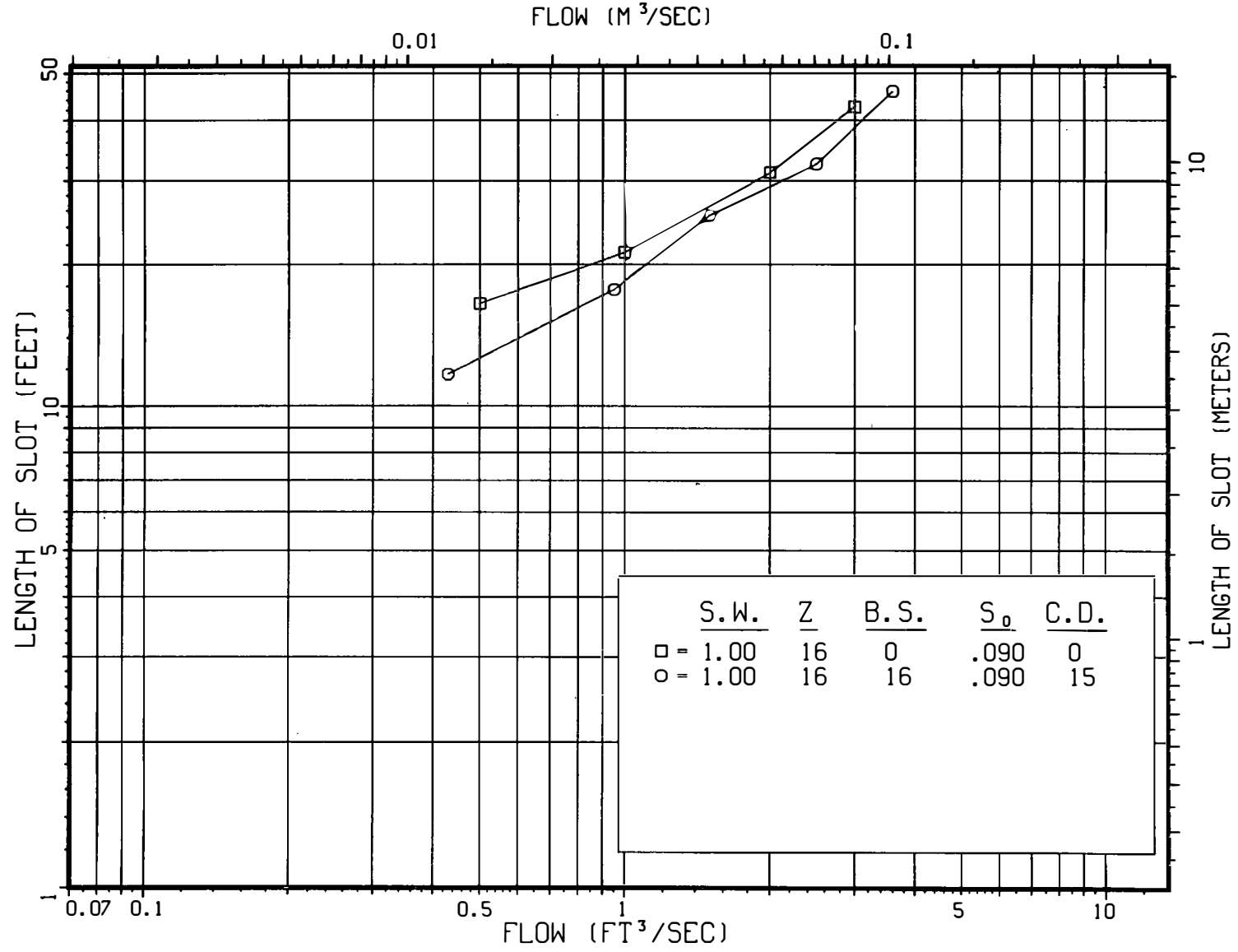

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.00 16 0 .090 0
○ = 1.00 16 16 .090 15

**Figure 40.**

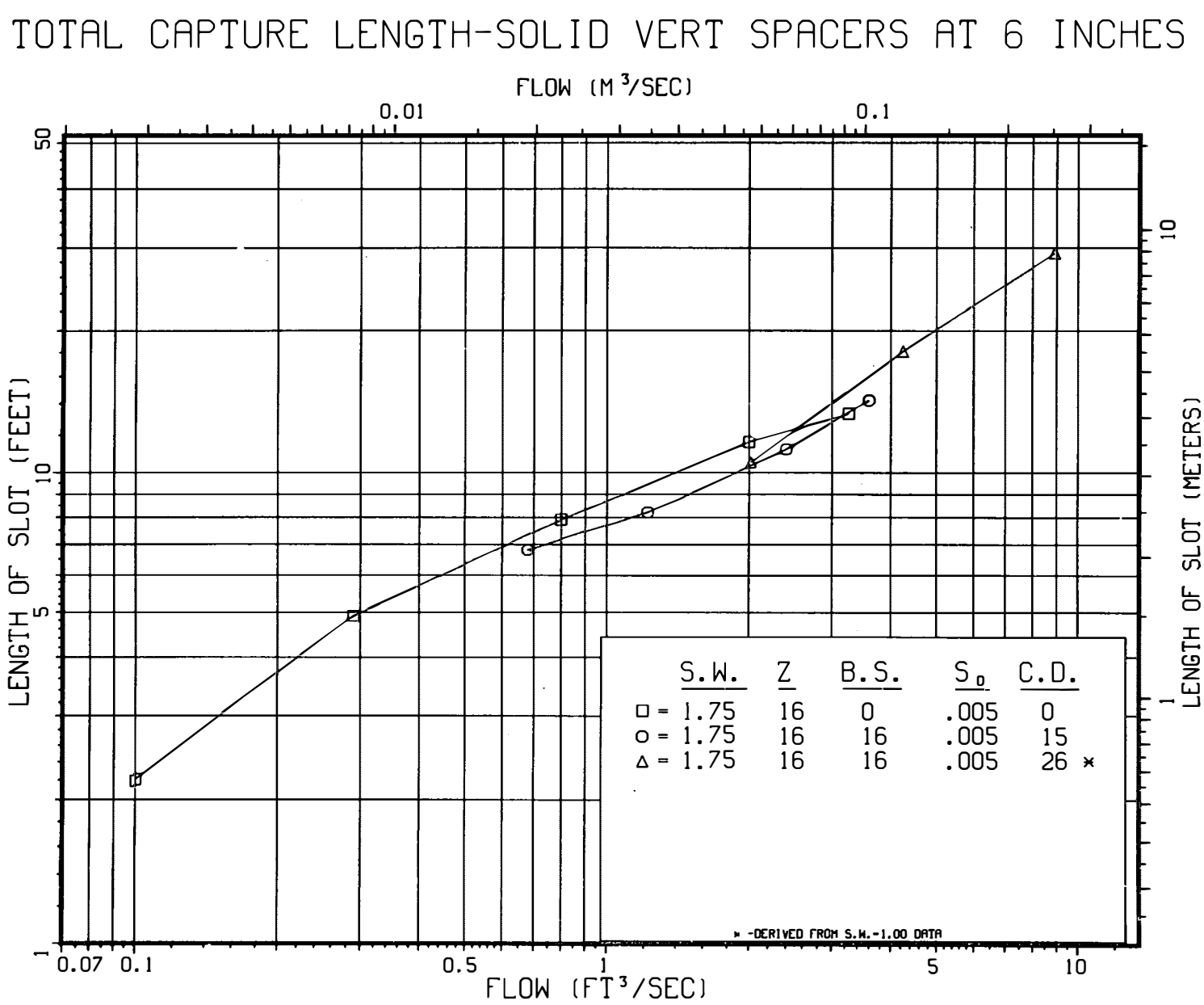

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
50
10
5
1
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.75 16 0 .005 0
○ = 1.75 16 16 .005 15
△ = 1.75 16 16 .005 26 *
* -DERIVED FROM S.W.-1.00 DATA

**Figure 41.**

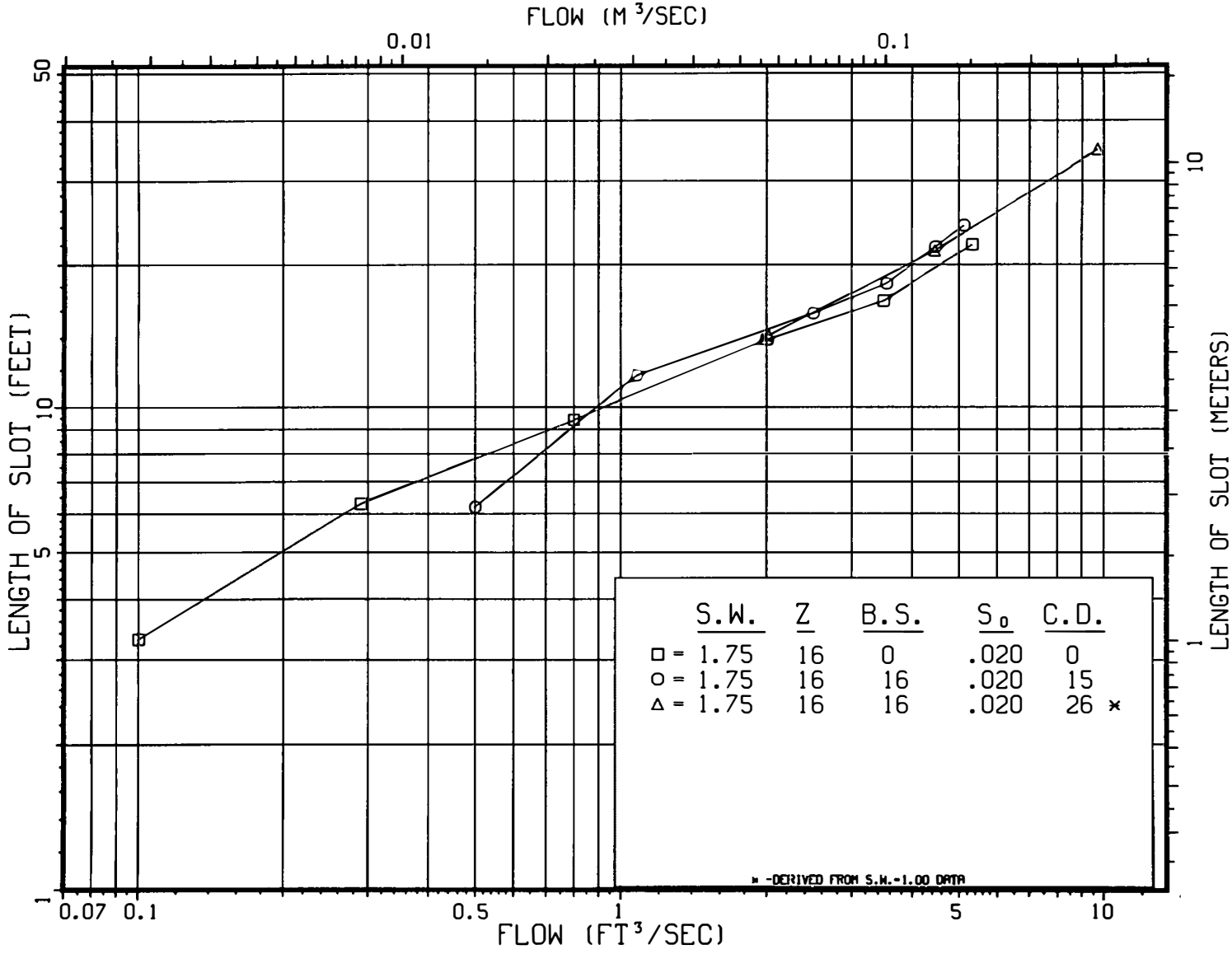

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
50
10
5
1
LENGTH OF SLOT (METERS)
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.75 16 0 .020 0
○ = 1.75 16 16 .020 15
△ = 1.75 16 16 .020 26 *
* -DERIVED FROM S.W.-1.00 DATA

Figure 42.

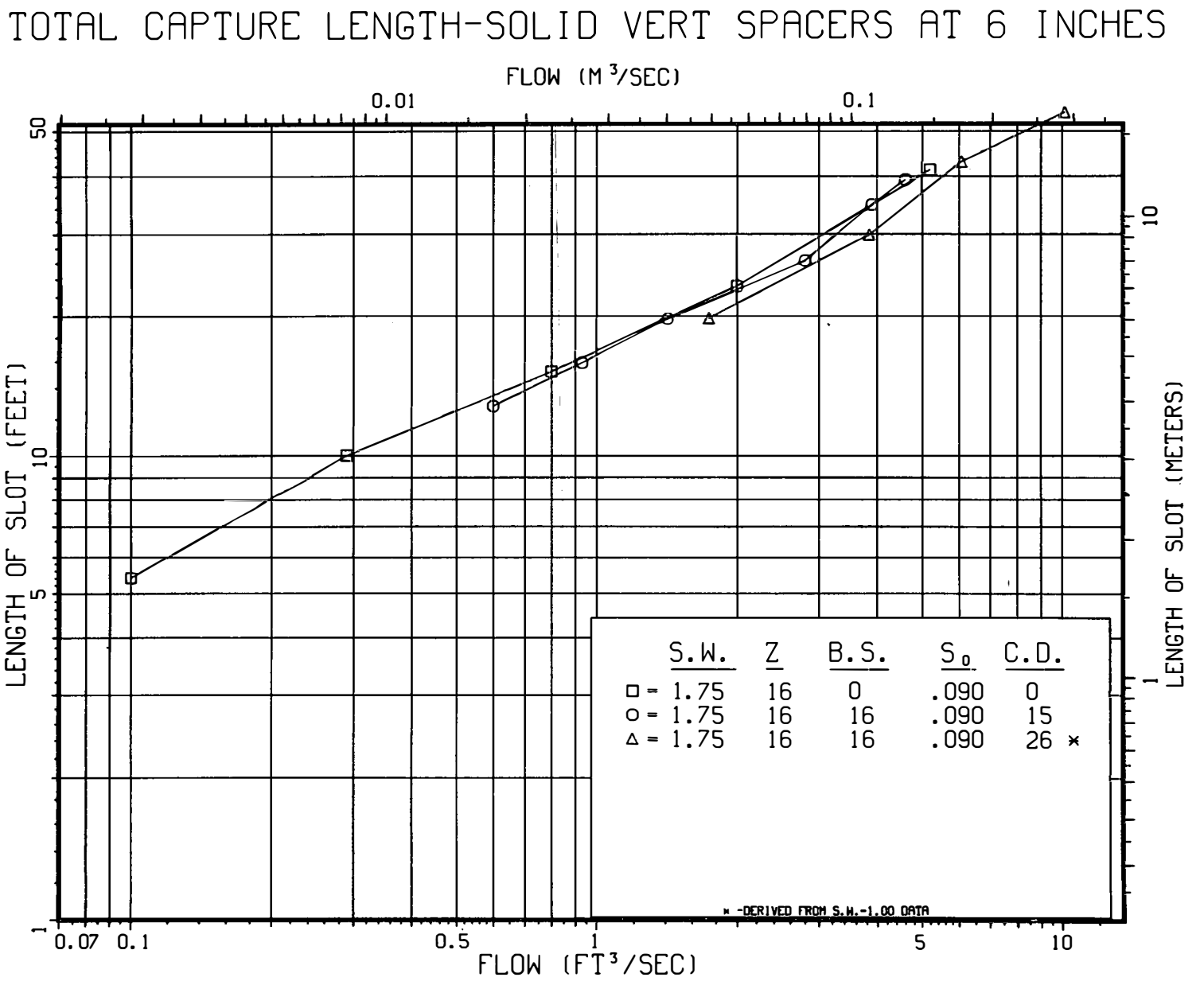

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.01
0.1
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
50
10
5
1
10
1
0.07
0.1
0.5
1
5
10
FLOW (FT³/SEC)
S.W. Z B.S. S₀ C.D.
□ = 1.75 16 0 .090 0
○ = 1.75 16 16 .090 15
△ = 1.75 16 16 .090 26 *
* -DERIVED FROM S.W.-1.00 DATA

**Figure 43.**

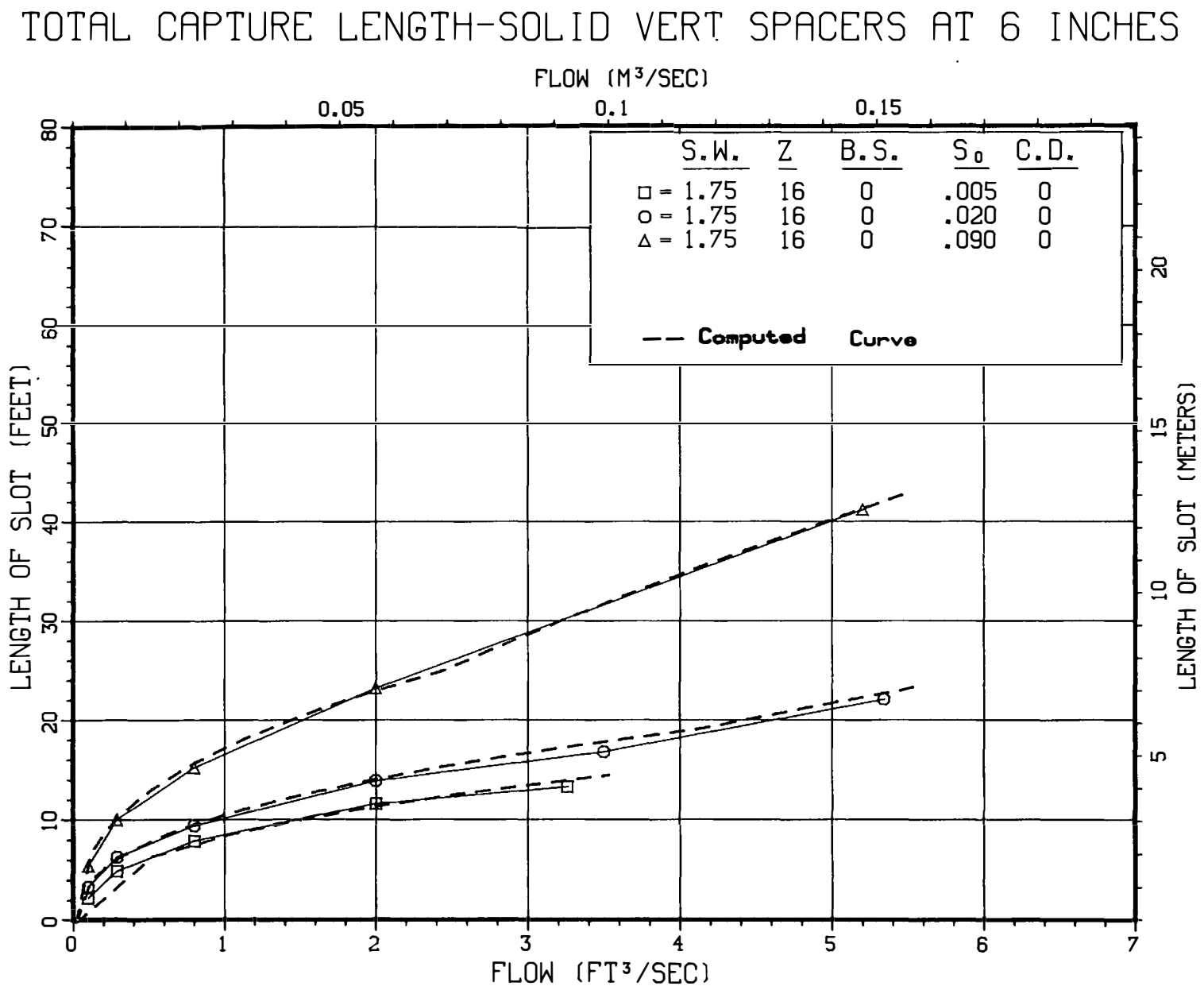

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.05
0.1
0.15
S.W. Z B.S. S₀ C.D.
□ = 1.75 16 0 .005 0
○ = 1.75 16 0 .020 0
△ = 1.75 16 0 .090 0
Computed Curve
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
FLOW (FT³/SEC)
0
10
20
30
40
50
60
70
80
5
15
1
2
3
4
5
6
7

Figure 44.

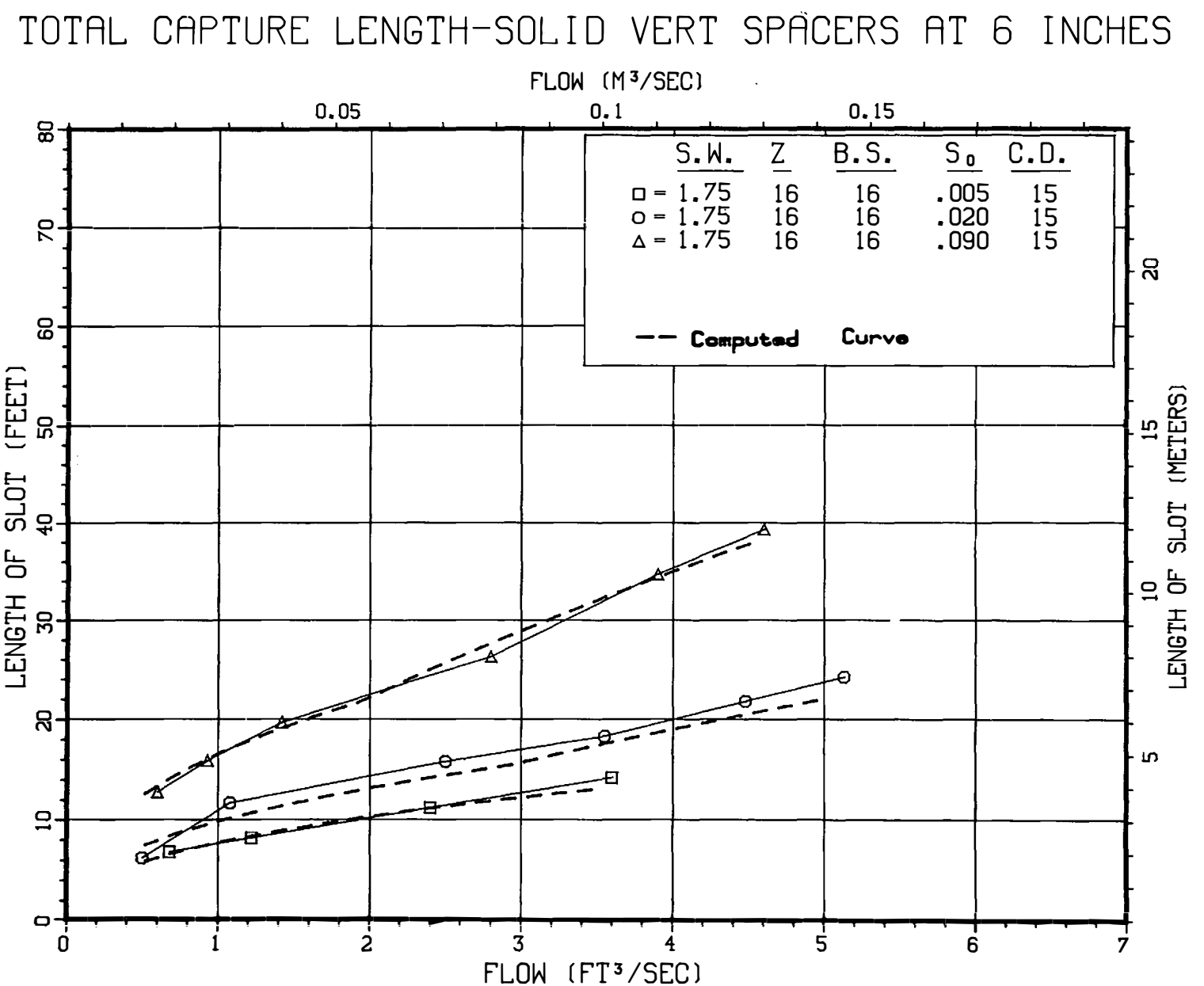

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.05
0.1
0.15
S.W. Z B.S. S₀ C.D.
□ = 1.75 16 16 .005 15
○ = 1.75 16 16 .020 15
△ = 1.75 16 16 .090 15
Computed Curve
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
FLOW (FT³/SEC)
0
10
20
30
40
50
60
70
80
1
2
3
4
5
6
7
5
10
15
20

Figure 45.

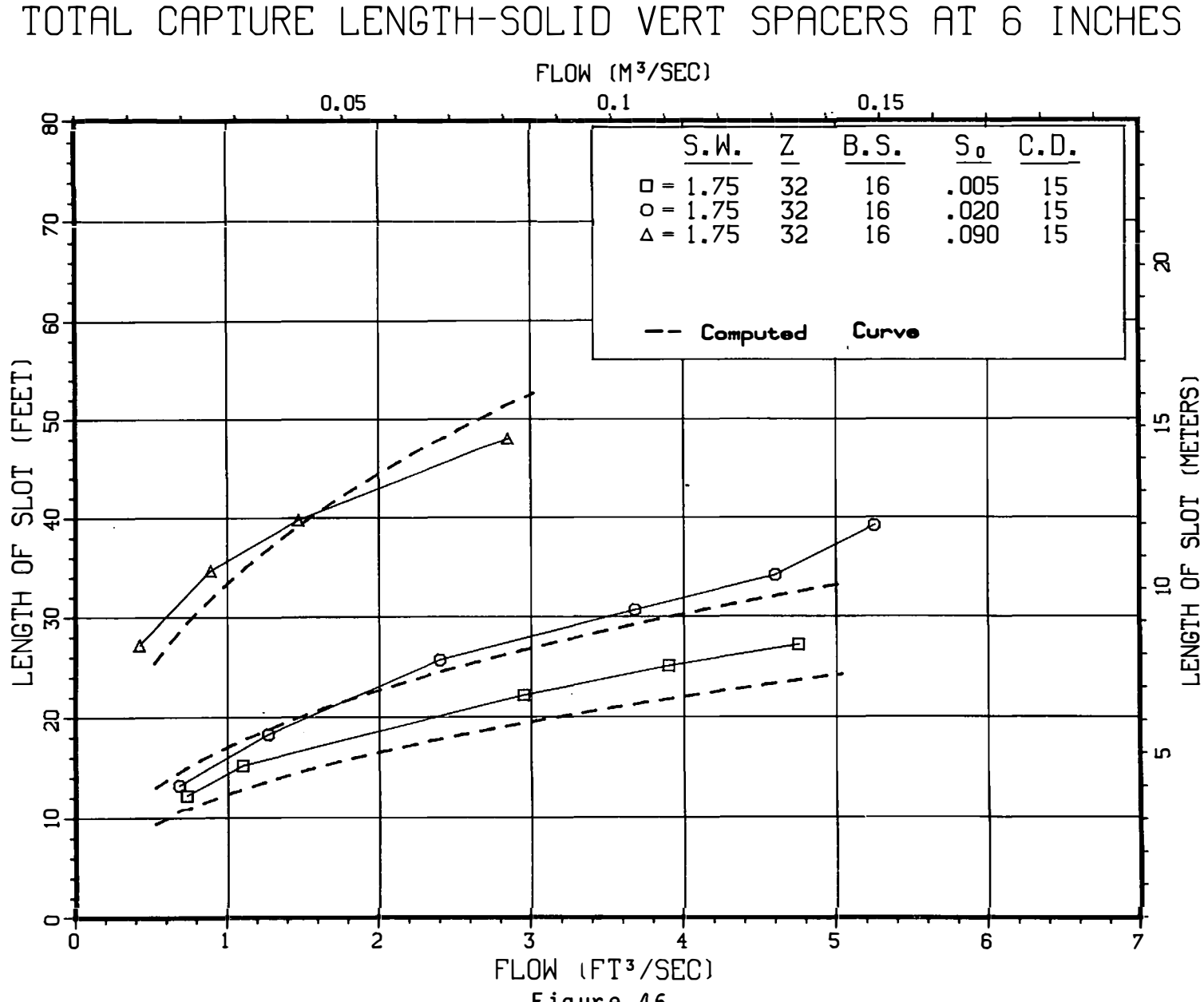

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.05
0.1
0.15
S.W. Z B.S. S₀ C.D.
□ = 1.75 32 16 .005 15
○ = 1.75 32 16 .020 15
△ = 1.75 32 16 .090 15
-- Computed Curve
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
FLOW (FT³/SEC)
0
10
20
30
40
50
60
70
80
1
2
3
4
5
6
7
5
10
15
20

Figure 46.

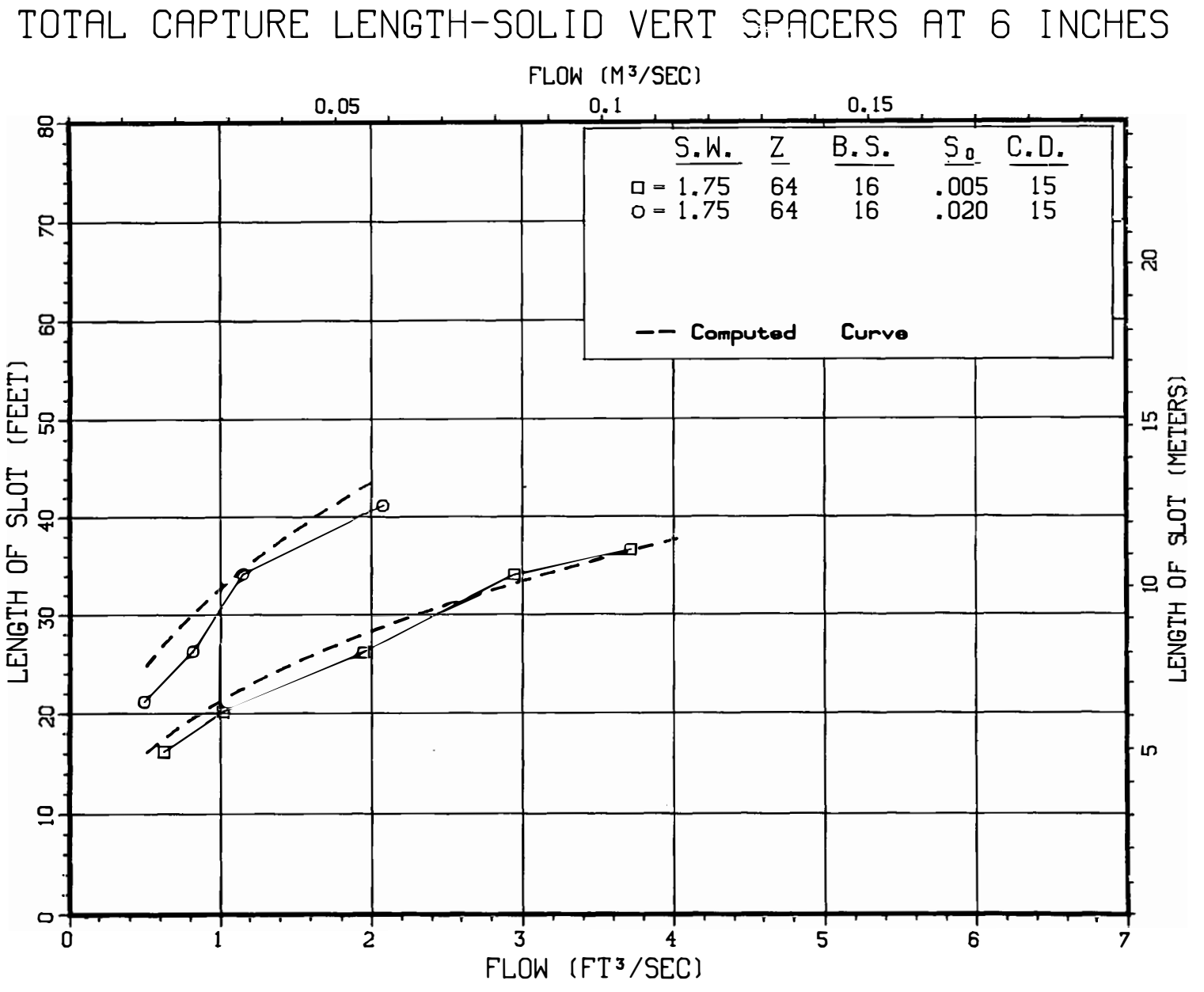

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.05
0.1
0.15
S.W. Z B.S. S₀ C.D.
□ = 1.75 64 16 .005 15
○ = 1.75 64 16 .020 15
-- Computed Curve
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
0
10
20
30
40
50
60
70
80
5
10
15
20
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)

Figure 47.

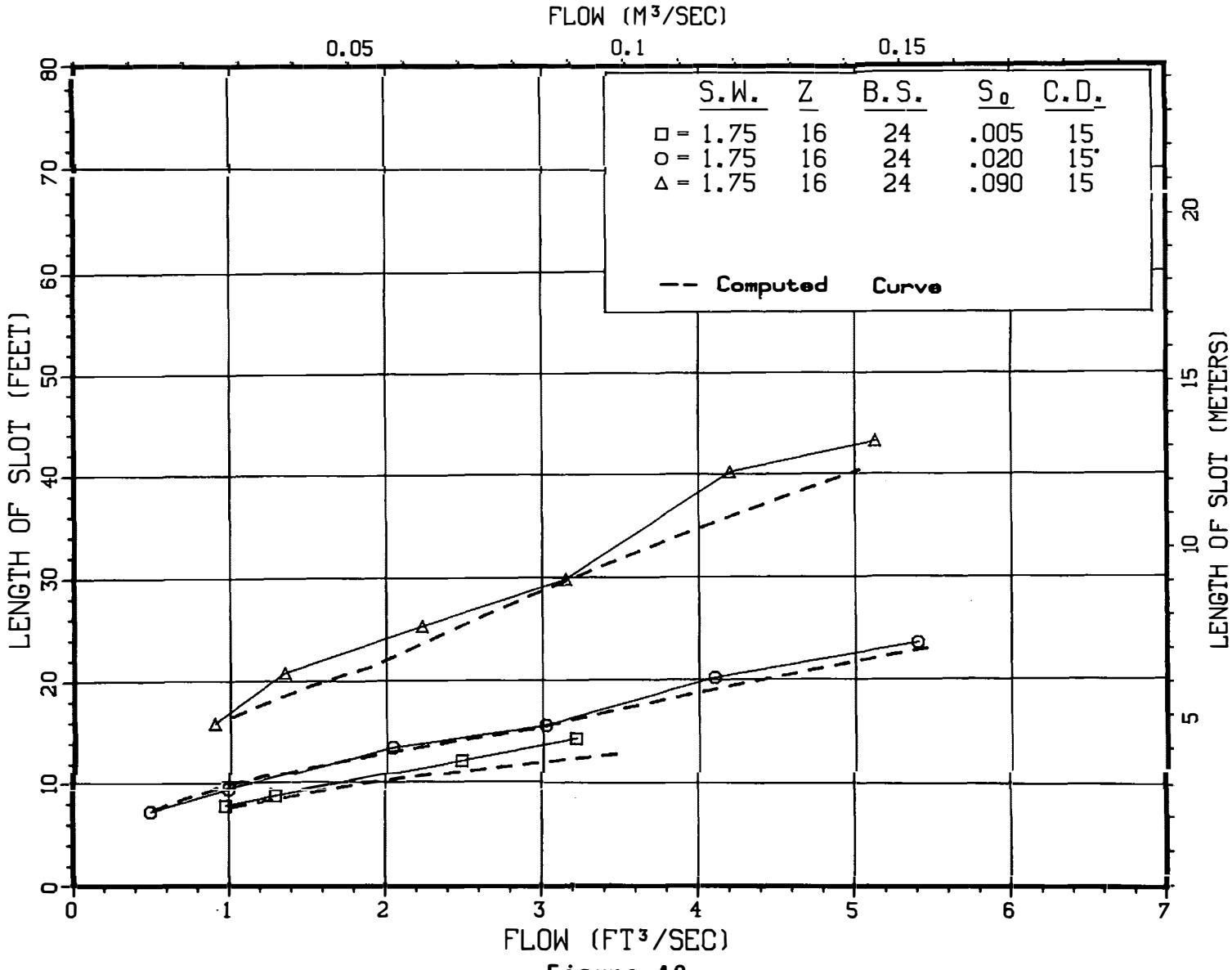

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.05
0.1
0.15
S.W. Z B.S. $S_0$ C.D.
□ = 1.75 16 24 .005 15
○ = 1.75 16 24 .020 15
△ = 1.75 16 24 .090 15
-- Computed Curve
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
FLOW (FT³/SEC)
0
10
20
30
40
50
60
70
80
5
10
15
20
1
2
3
4
5
6
7

Figure 48.

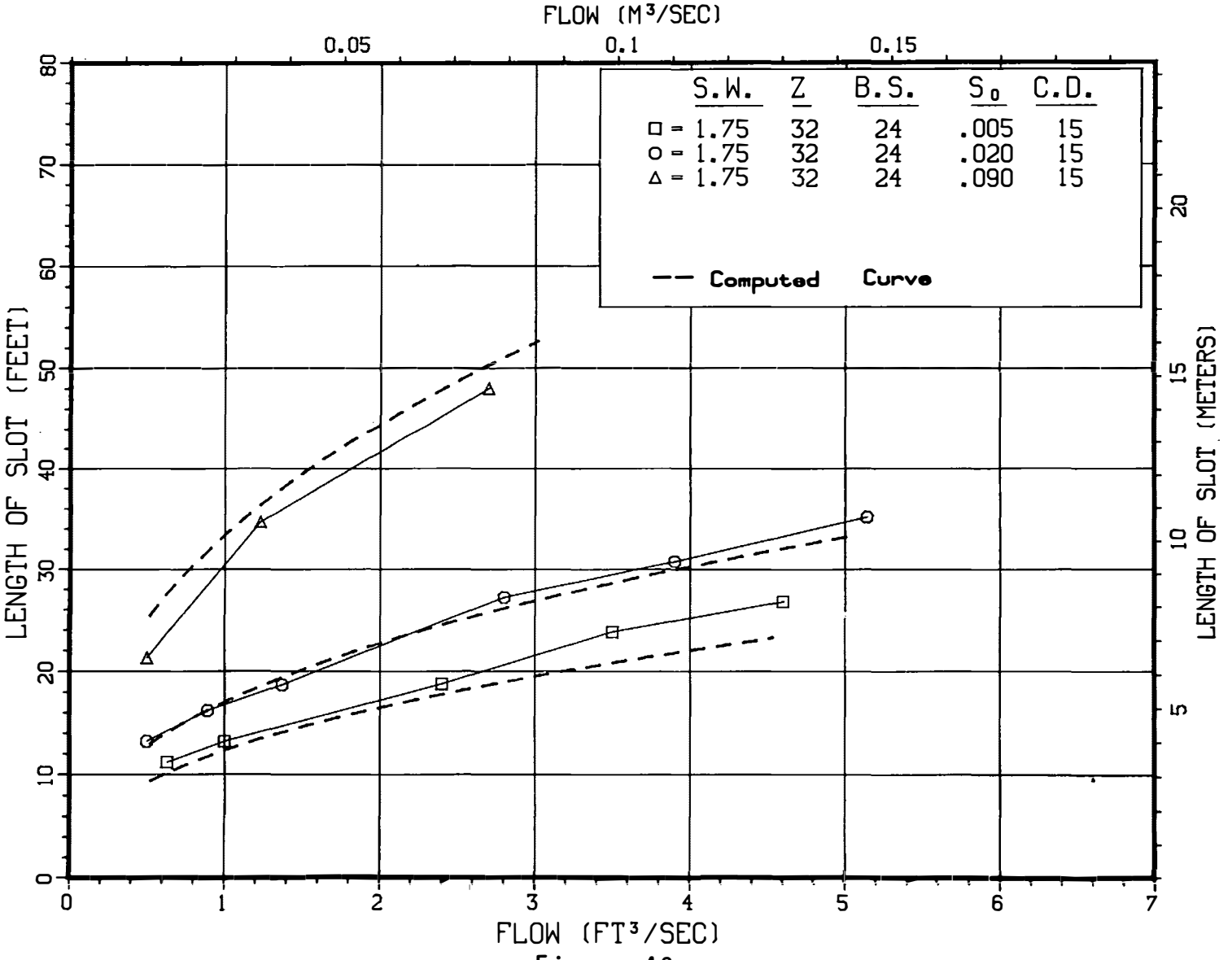

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.05
0.1
0.15
S.W. Z B.S. $S_0$ C.D.
□ = 1.75 32 24 .005 15
○ = 1.75 32 24 .020 15
△ = 1.75 32 24 .090 15
Computed Curve
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
FLOW (FT³/SEC)
0
10
20
30
40
50
60
70
80
1
2
3
4
5
6
7
5
10
15
20

Figure 49.

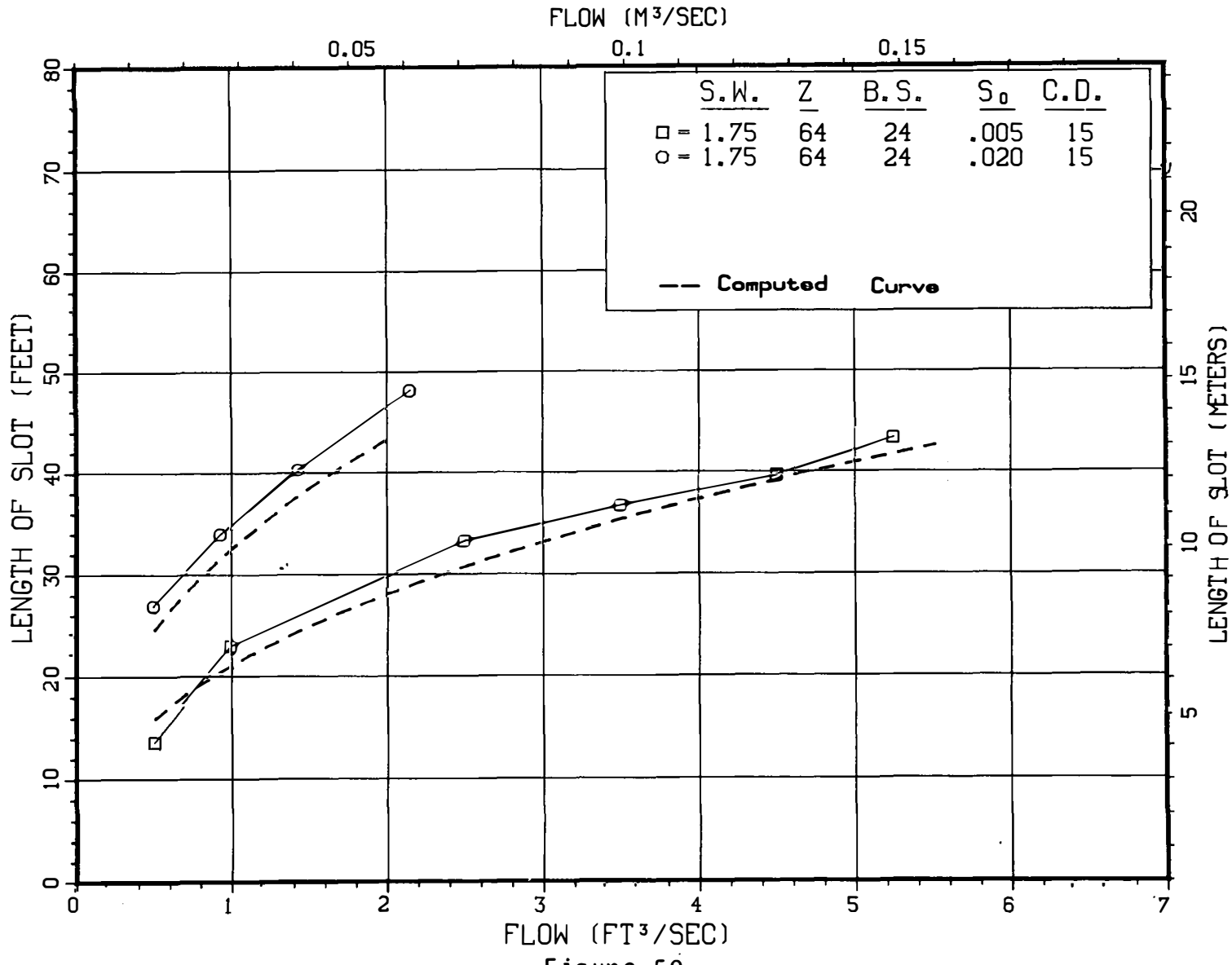

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.05
0.1
0.15
S.W. Z B.S. S₀ C.D.
□ = 1.75 64 24 .005 15
○ = 1.75 64 24 .020 15
— — Computed Curve
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
FLOW (FT³/SEC)
0
10
20
30
40
50
60
70
80
5
10
15
20
1
2
3
4
5
6
7

Figure 50.

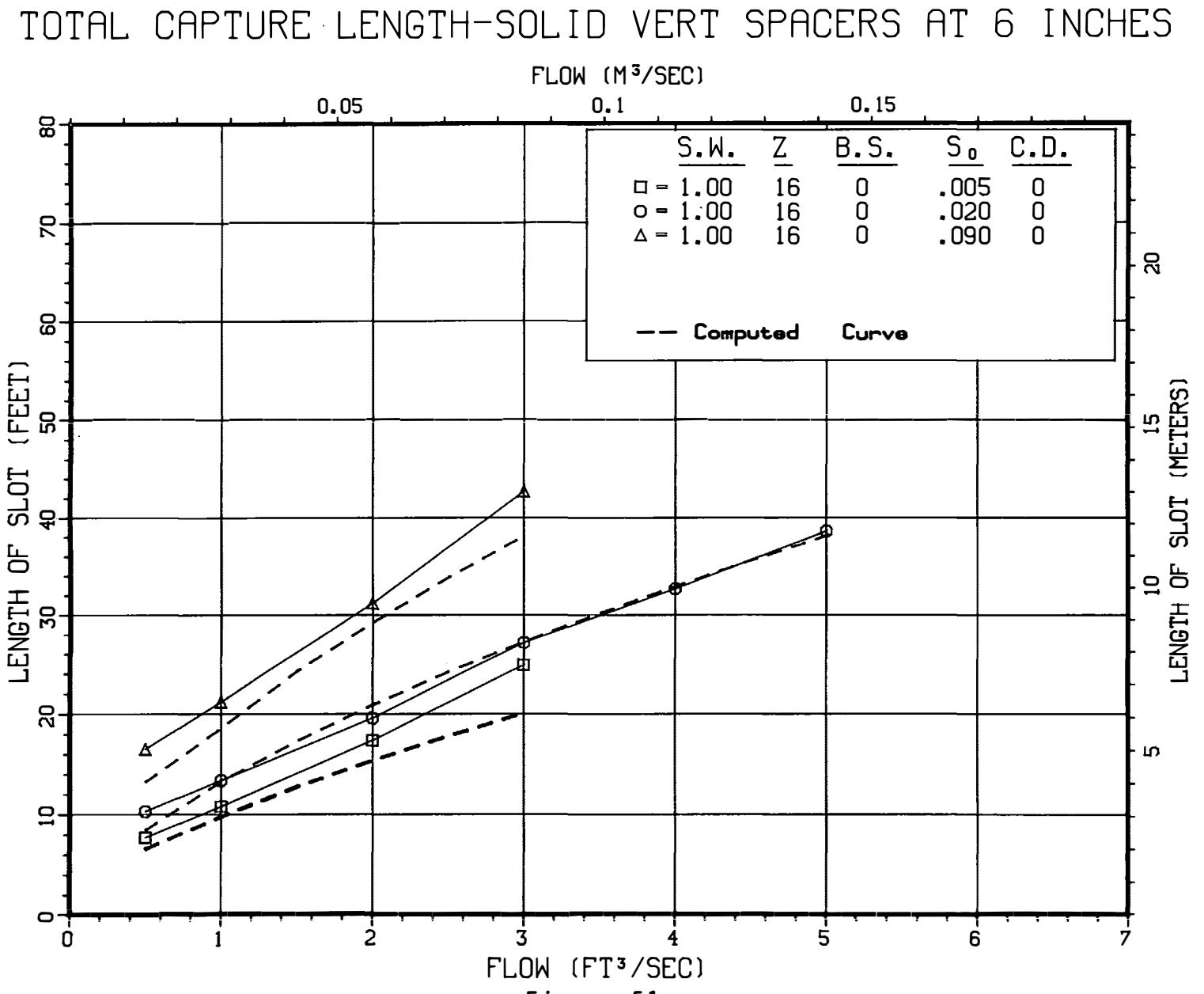

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.05
0.1
0.15
S.W. Z B.S. S₀ C.D.
□ = 1.00 16 0 .005 0
○ = 1.00 16 0 .020 0
△ = 1.00 16 0 .090 0
Computed Curve
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
FLOW (FT³/SEC)
0
10
20
30
40
50
60
70
80
1
2
3
4
5
6
7
5
10
15
20

Figure 51.

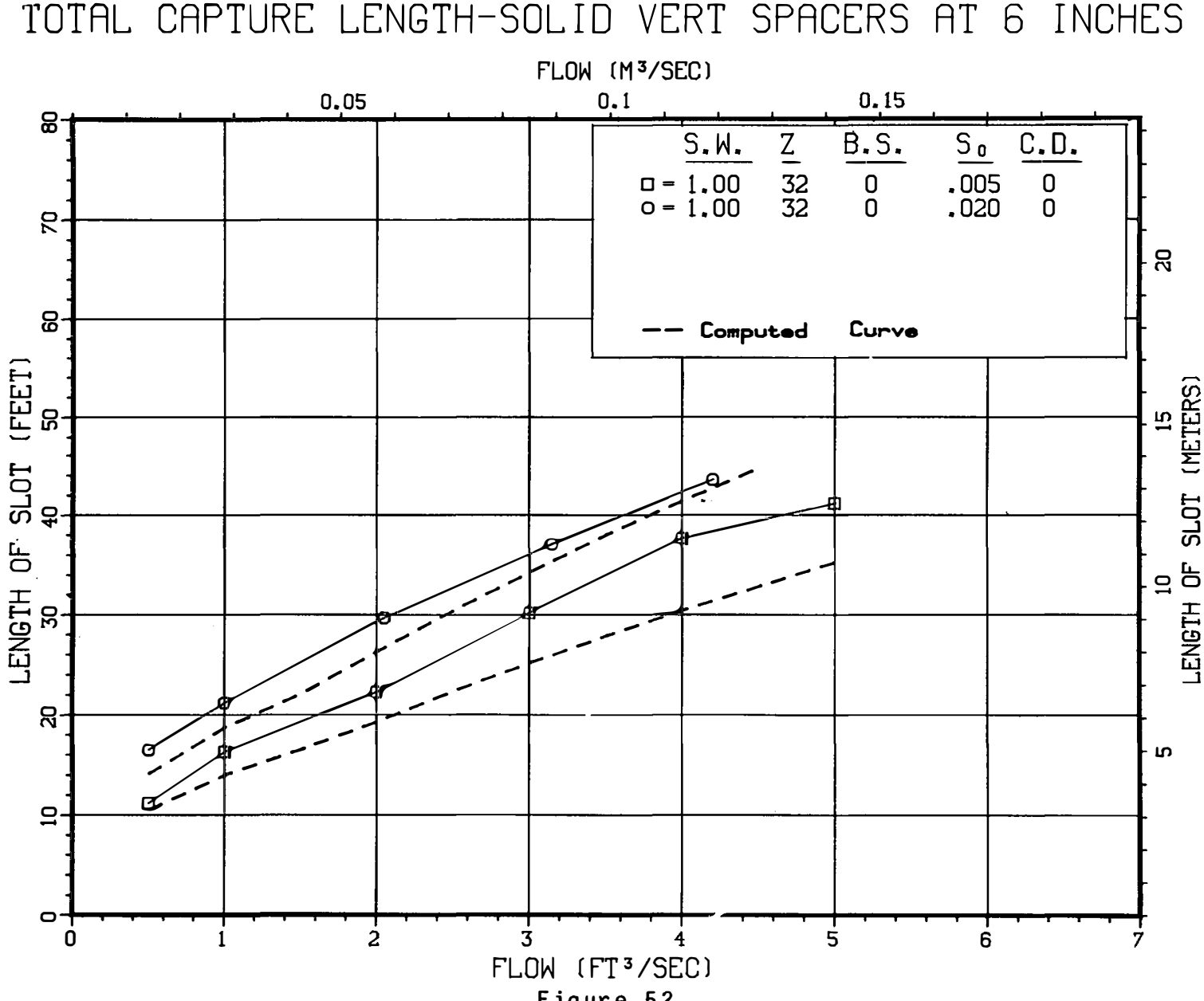

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.05
0.1
0.15
S.W. Z B.S. S₀ C.D.
□ = 1.00 32 0 .005 0
○ = 1.00 32 0 .020 0
Computed Curve
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
FLOW (FT³/SEC)
0
1
2
3
4
5
6
7
10
20
30
40
50
60
70
80
5
10
15
20

Figure 52.

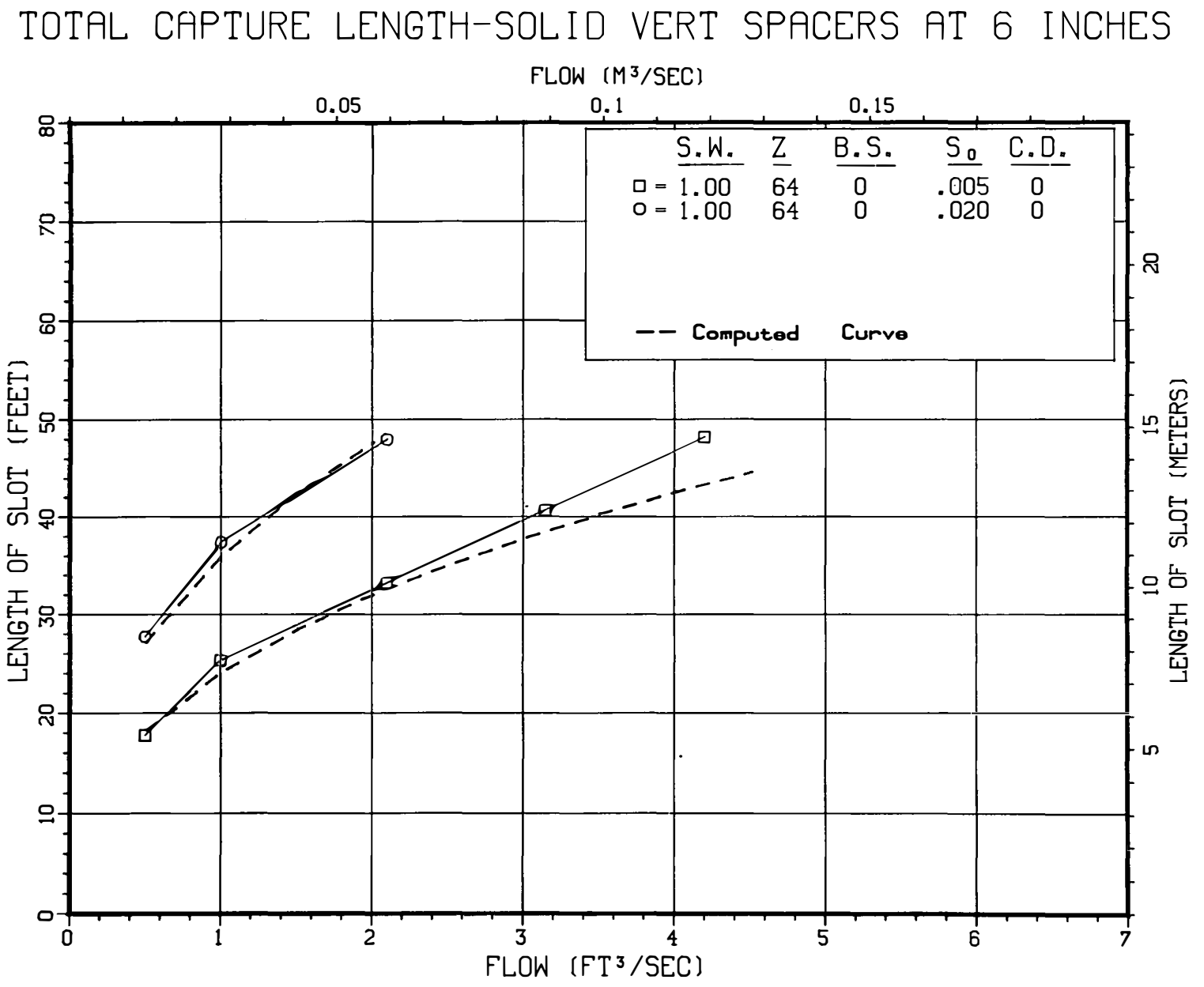

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.05
0.1
0.15
S.W. Z B.S. $S_o$ C.D.
□ = 1.00 64 0 .005 0
○ = 1.00 64 0 .020 0
Computed Curve
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
0
10
20
30
40
50
60
70
80
5
15
20
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)

Figure 53.

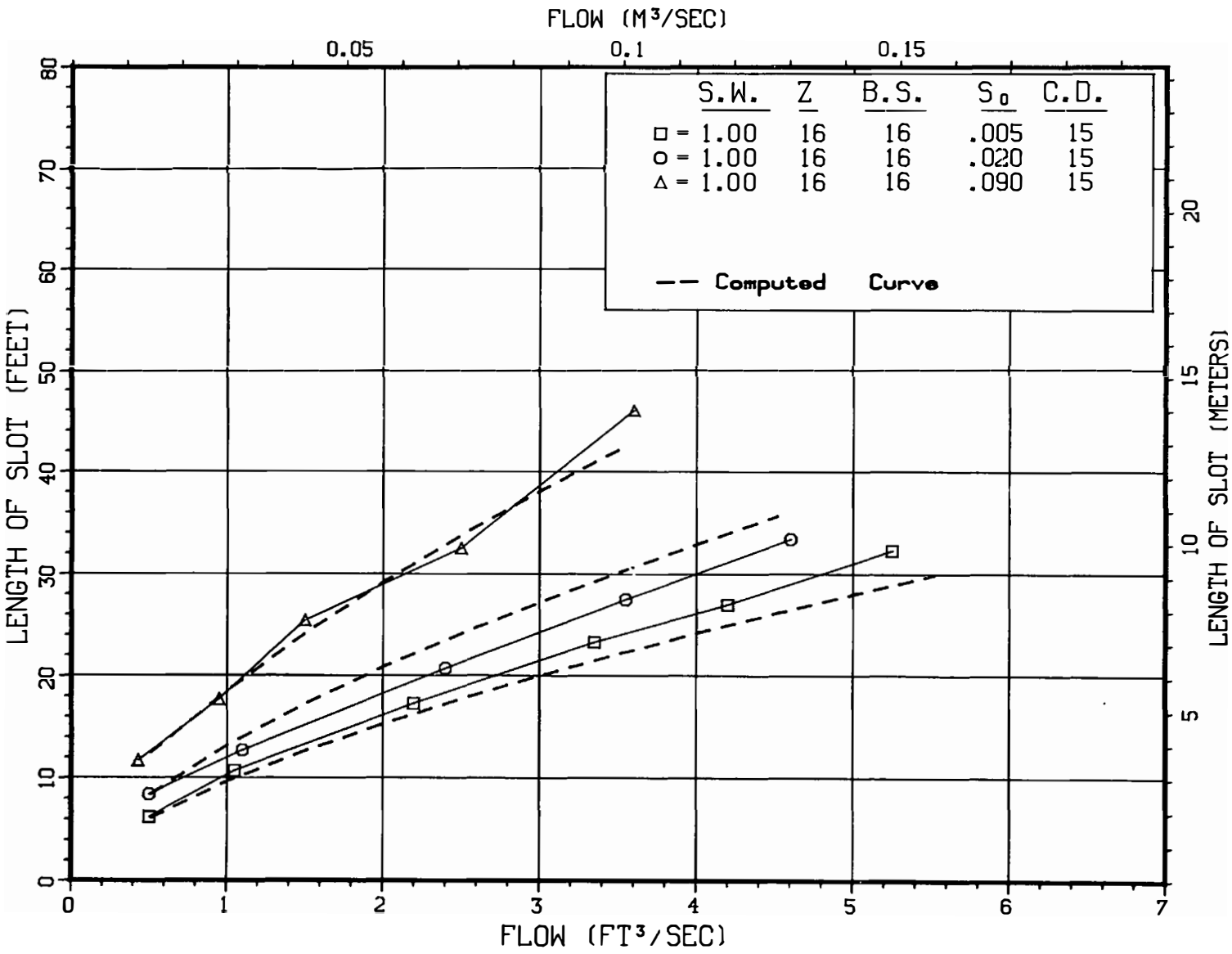

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.05
0.1
0.15
S.W. Z B.S. $S_0$ C.D.
□ = 1.00 16 16 .005 15
○ = 1.00 16 16 .020 15
△ = 1.00 16 16 .090 15
Computed Curve
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
FLOW (FT³/SEC)
0
10
20
30
40
50
60
70
80
1
2
3
4
5
6
7
5
10
15
20

Figure 54.

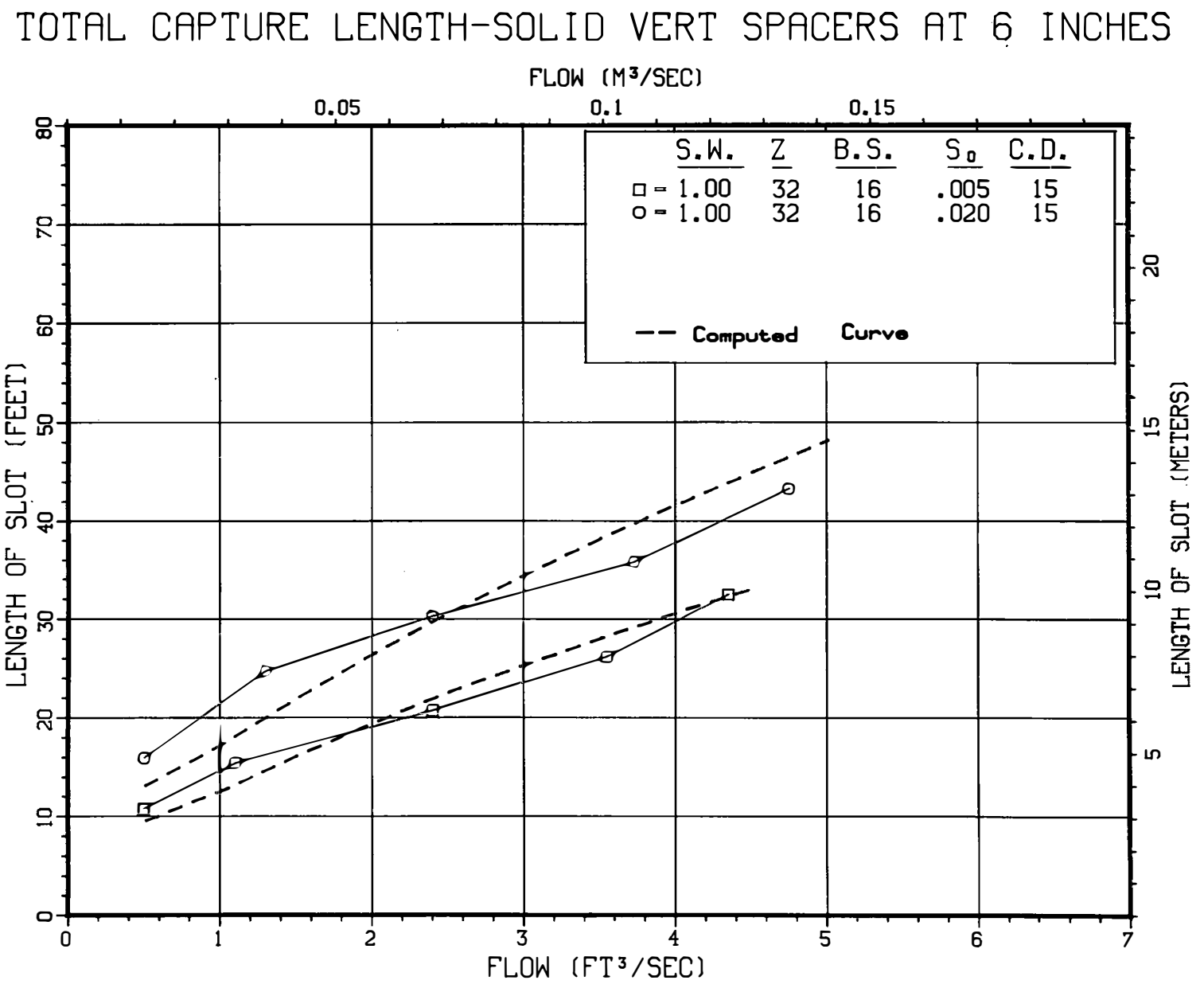

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.05
0.1
0.15
S.W. Z B.S. S₀ C.D.
□ = 1.00 32 16 .005 15
○ = 1.00 32 16 .020 15
Computed Curve
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
FLOW (FT³/SEC)
0
10
20
30
40
50
60
70
80
1
2
3
4
5
6
7
5
10
15
20

Figure 55.

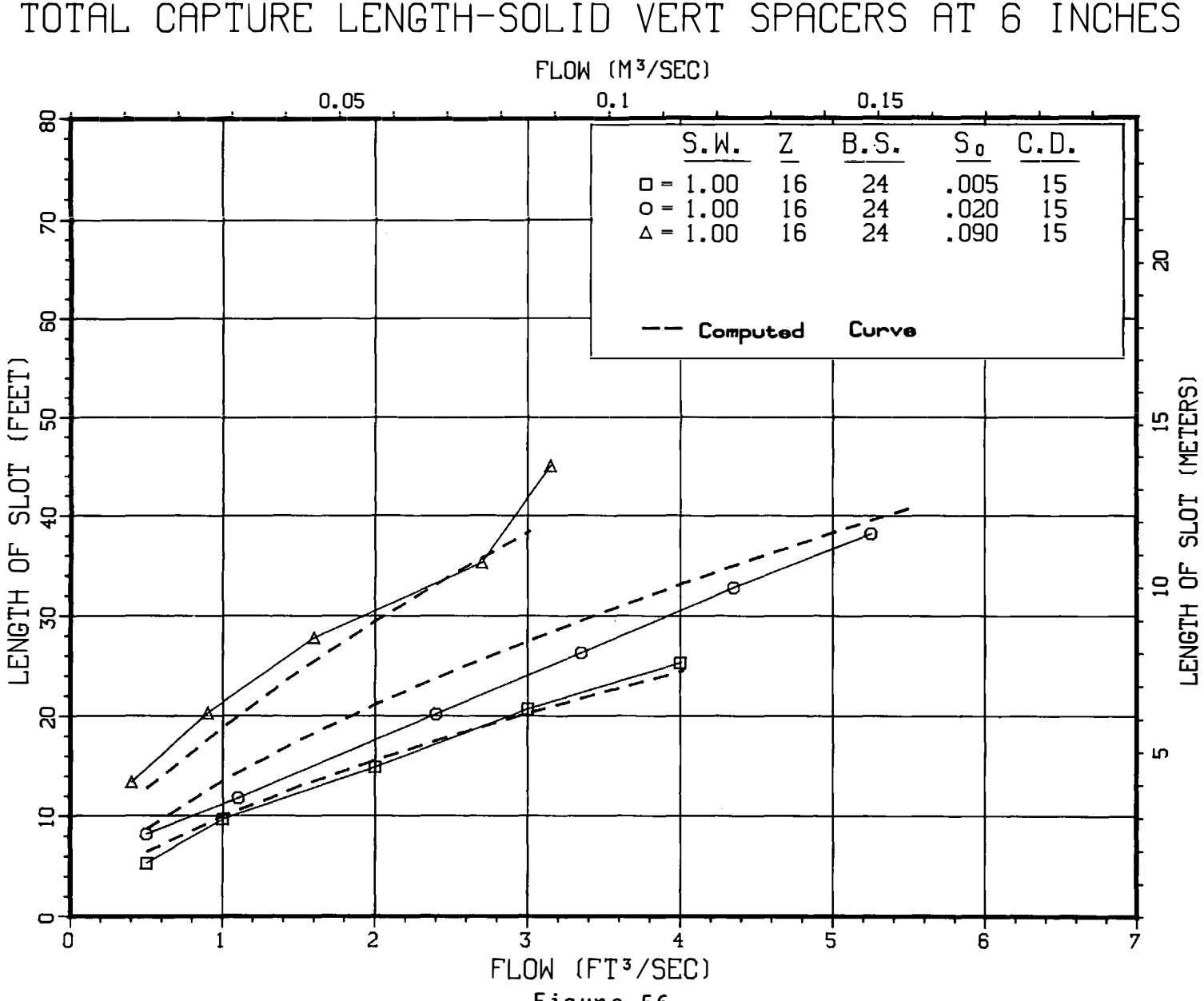

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.05
0.1
0.15
S.W. Z B.S. $S_0$ C.D.
□ = 1.00 16 24 .005 15
○ = 1.00 16 24 .020 15
△ = 1.00 16 24 .090 15
Computed Curve
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
FLOW (FT³/SEC)
0
10
20
30
40
50
60
70
80
5
10
15
20
1
2
3
4
5
6
7

Figure 56.

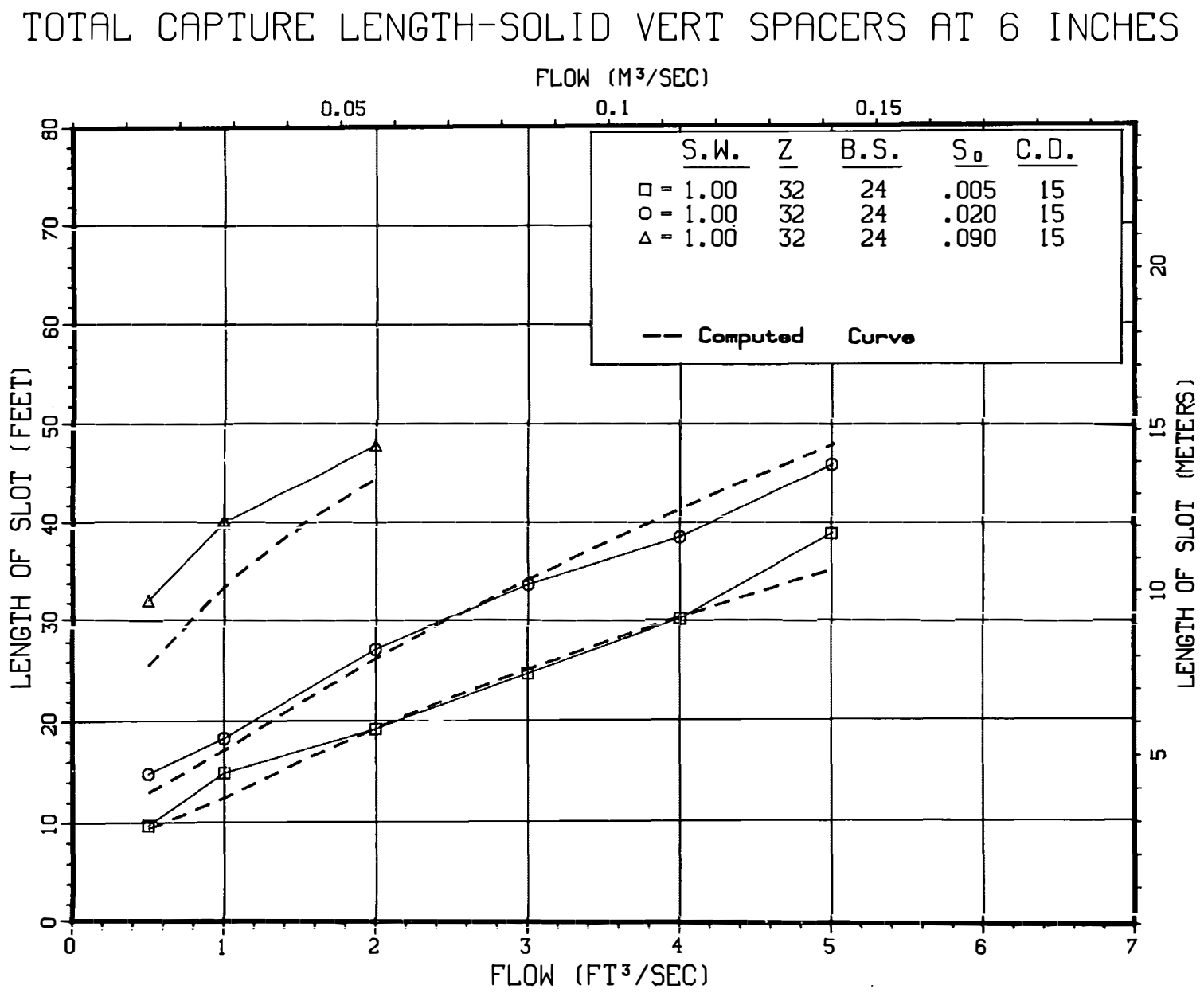

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.05
0.1
0.15
S.W. Z B.S. S₀ C.D.
□ = 1.00 32 24 .005 15
○ = 1.00 32 24 .020 15
△ = 1.00 32 24 .090 15
Computed Curve
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
FLOW (FT³/SEC)
0
10
20
30
40
50
60
70
80
1
2
3
4
5
6
7
5
10
15
20

Figure 57.

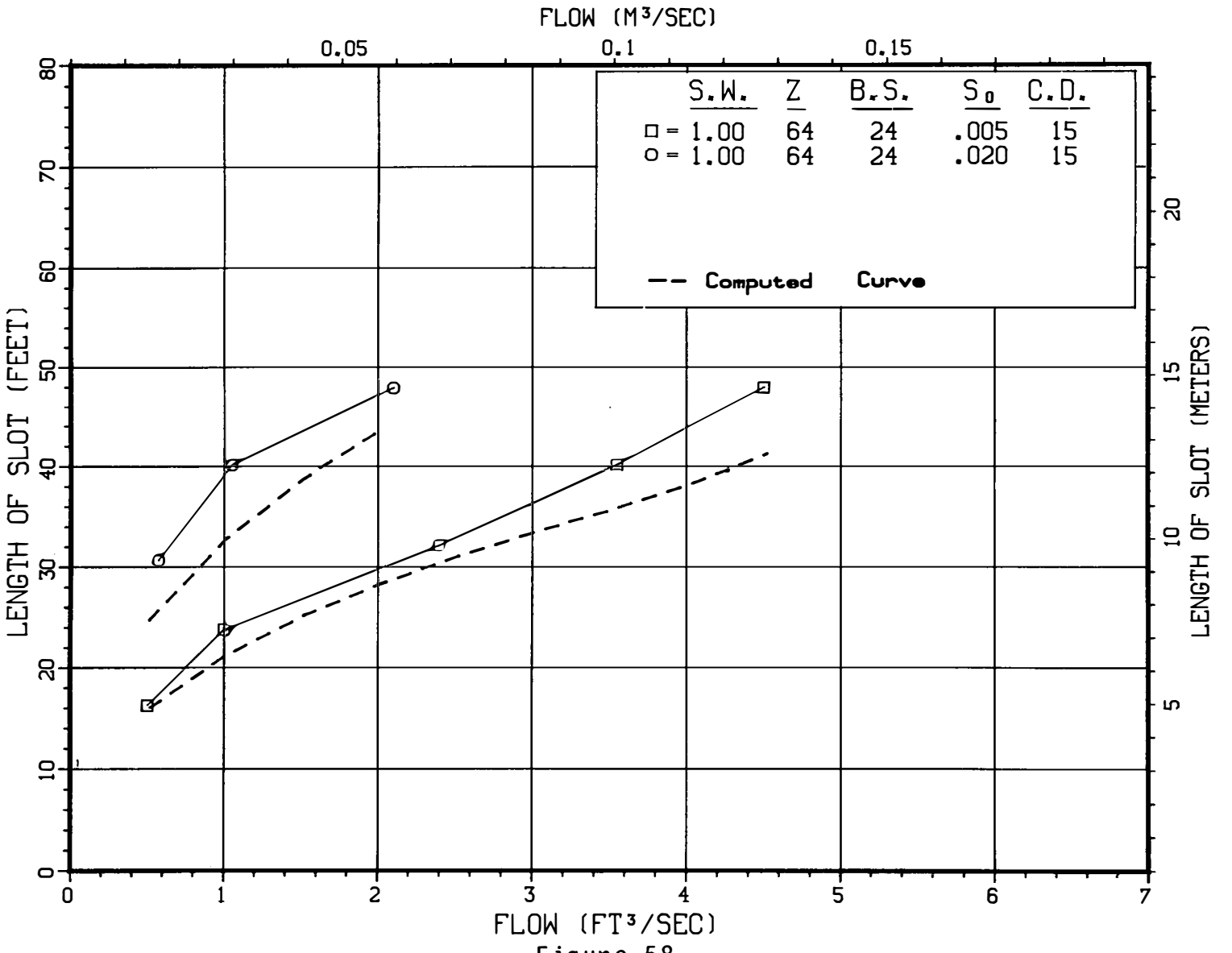

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.05
0.1
0.15
S.W. Z B.S. S₀ C.D.
□ = 1.00 64 24 .005 15
○ = 1.00 64 24 .020 15
Computed Curve
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
0
10
20
30
40
50
60
70
80
5
10
15
20
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)

Figure 58.

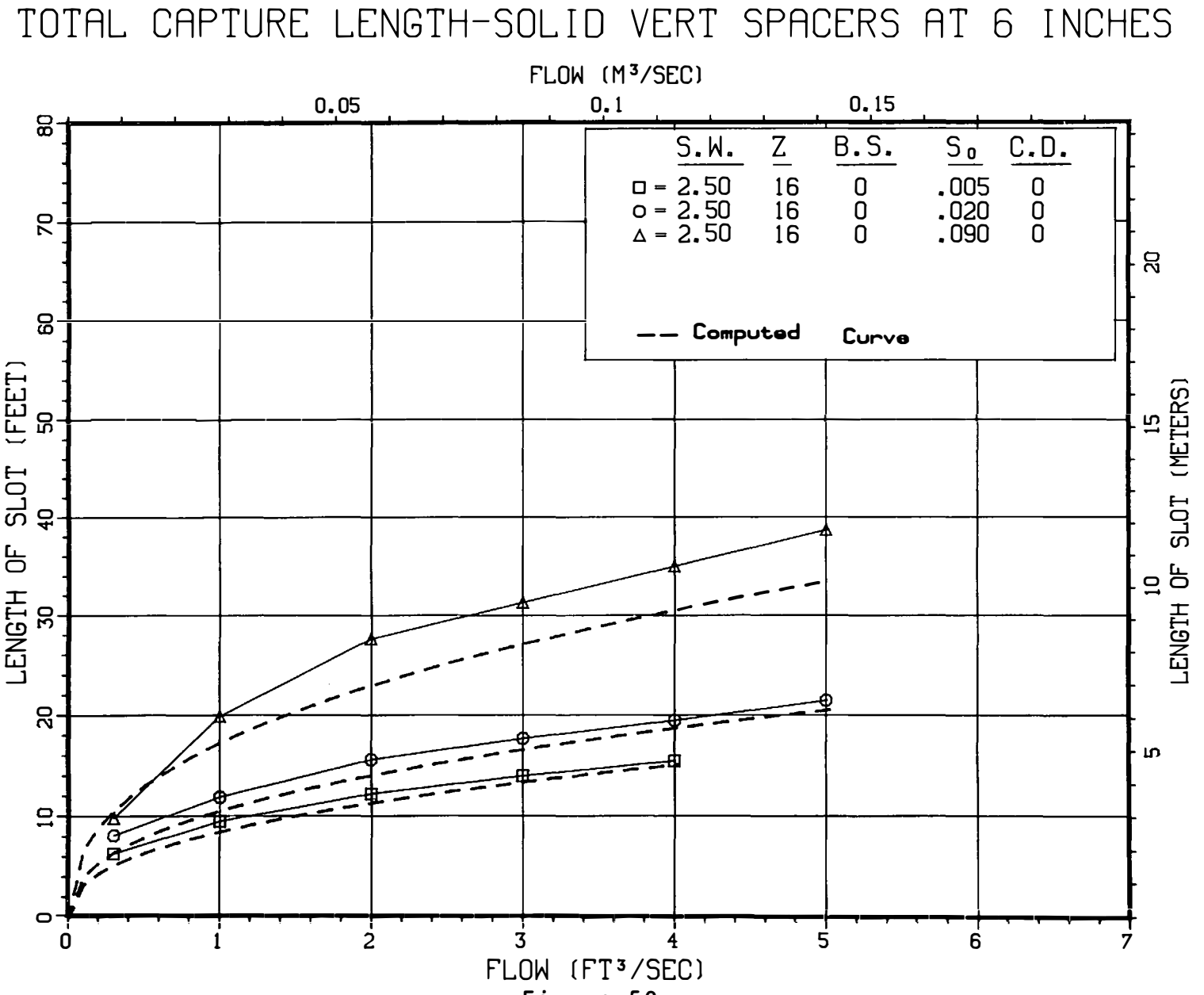

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.05
0.1
0.15
S.W. Z B.S. S₀ C.D.
□ = 2.50 16 0 .005 0
○ = 2.50 16 0 .020 0
△ = 2.50 16 0 .090 0
Computed Curve
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
0 10 20 30 40 50 60 70 80
0 5 10 15 20
0 1 2 3 4 5 6 7
FLOW (FT³/SEC)

Figure 59.

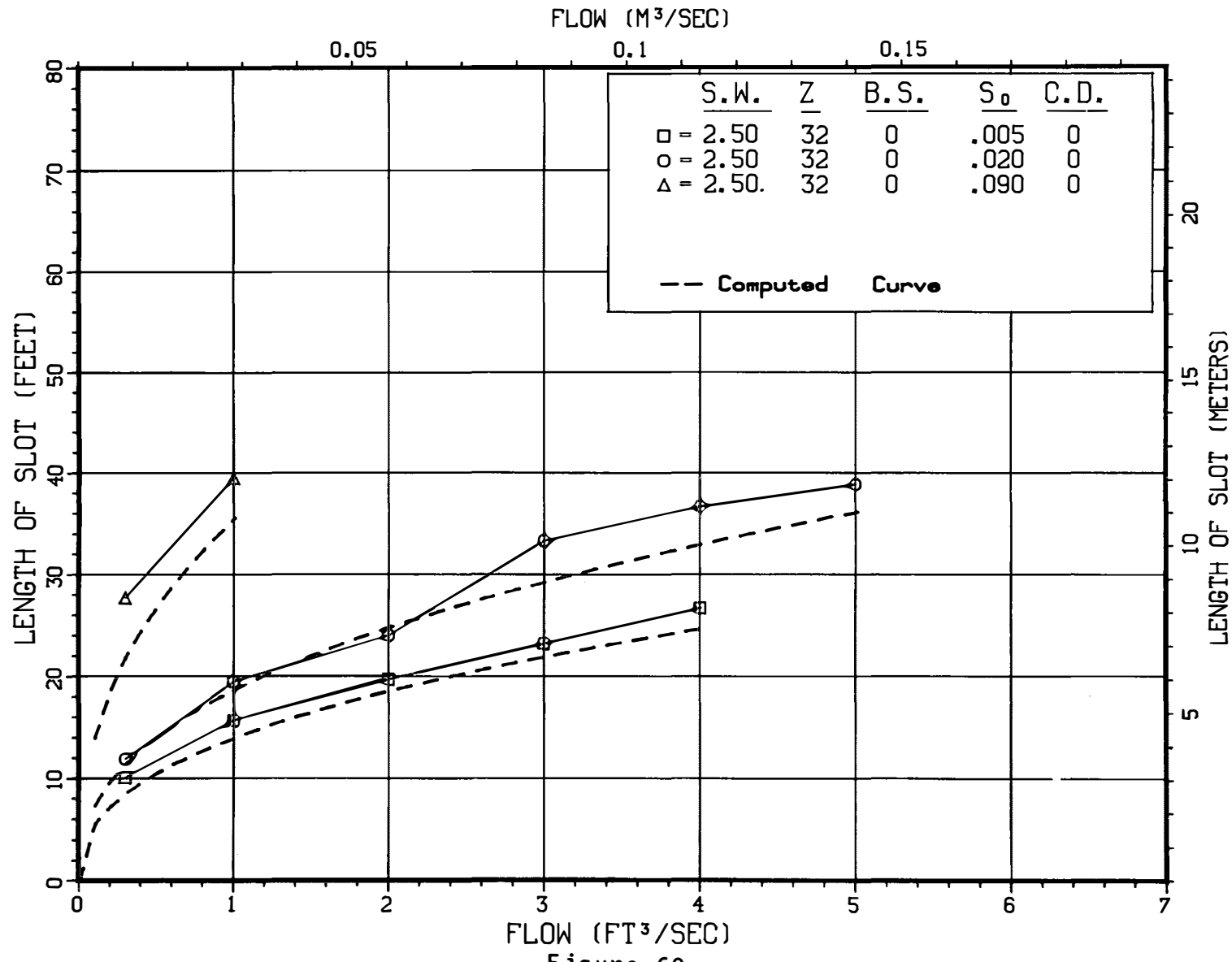

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.05
0.1
0.15
S.W. Z B.S. S₀ C.D.
□ = 2.50 32 0 .005 0
○ = 2.50 32 0 .020 0
△ = 2.50. 32 0 .090 0
— — Computed Curve
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
0
10
20
30
40
50
60
70
80
5
10
15
20
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)

Figure 60.

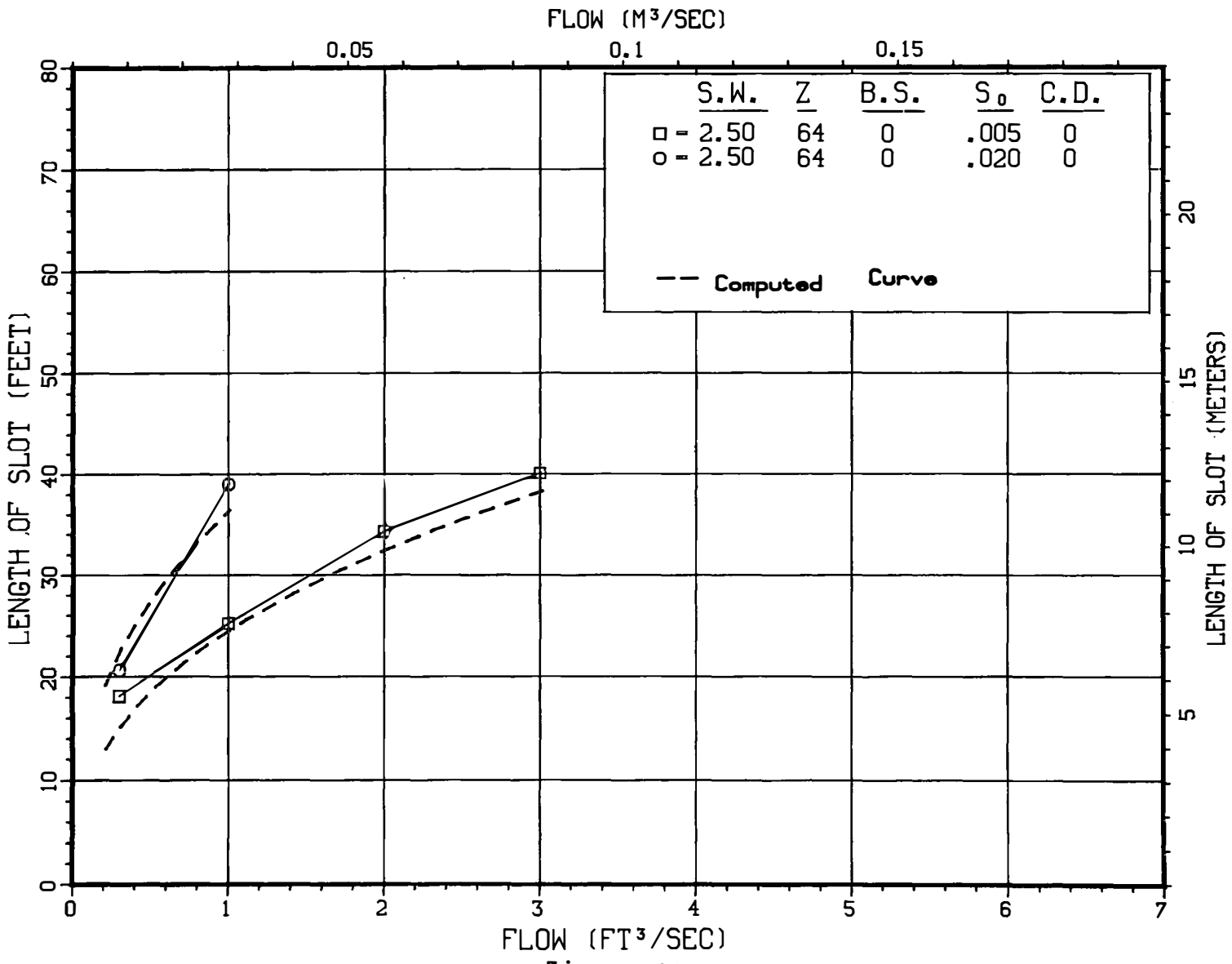
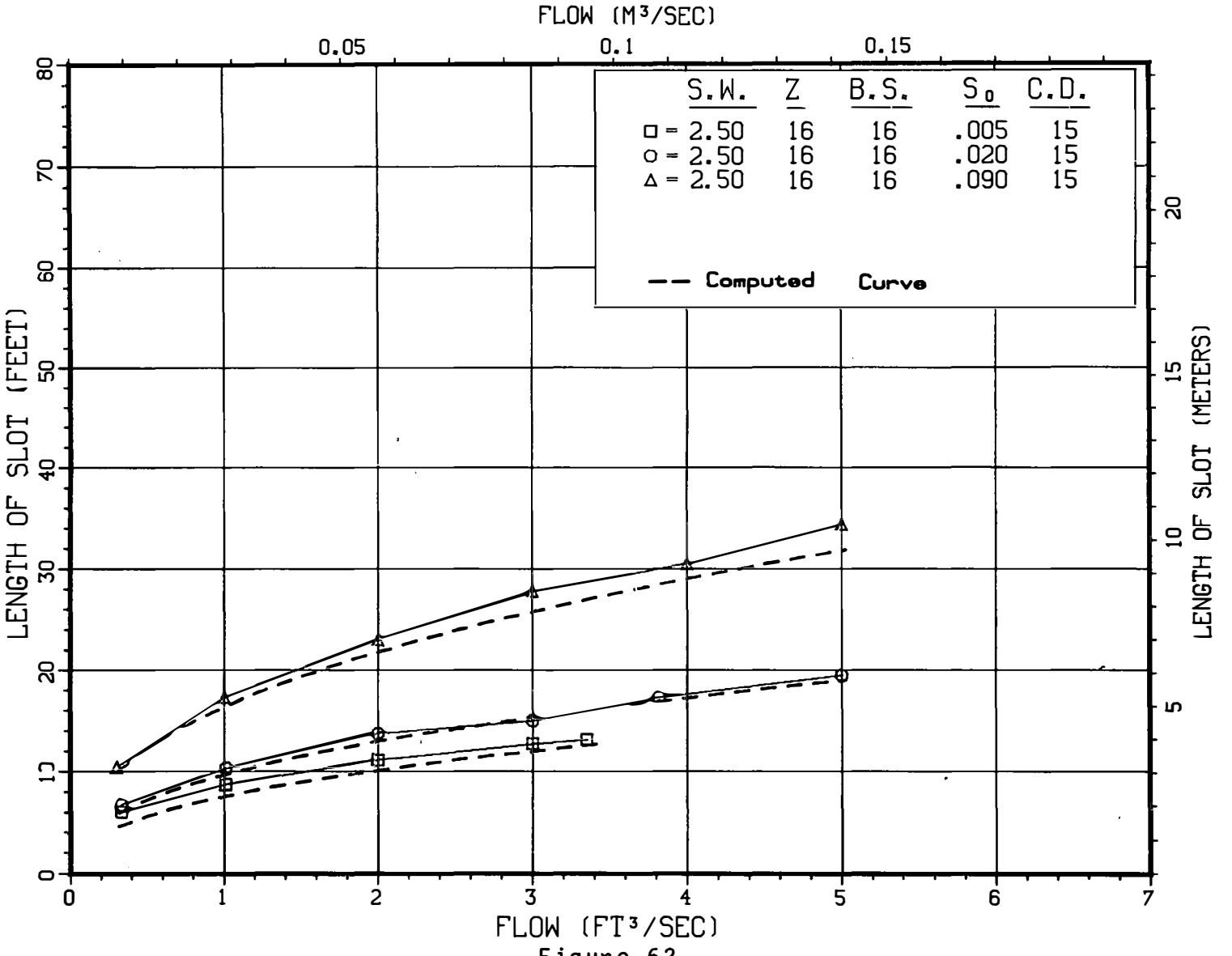

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.05
0.1
0.15
S.W. Z B.S. S₀ C.D.
□ = 2.50 64 0 .005 0
○ = 2.50 64 0 .020 0
Computed Curve
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
FLOW (FT³/SEC)
0
10
20
30
40
50
60
70
80
5
15
1
2
3
4
5
6
7

Figure 61.


TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.05
0.1
0.15
S.W. Z B.S. $S_o$ C.D.
□ = 2.50 16 16 .005 15
○ = 2.50 16 16 .020 15
△ = 2.50 16 16 .090 15
Computed Curve
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
FLOW (FT³/SEC)
0
10
20
30
40
50
60
70
80
5
10
15
20
1
2
3
4
5
6
7
Figure 62.

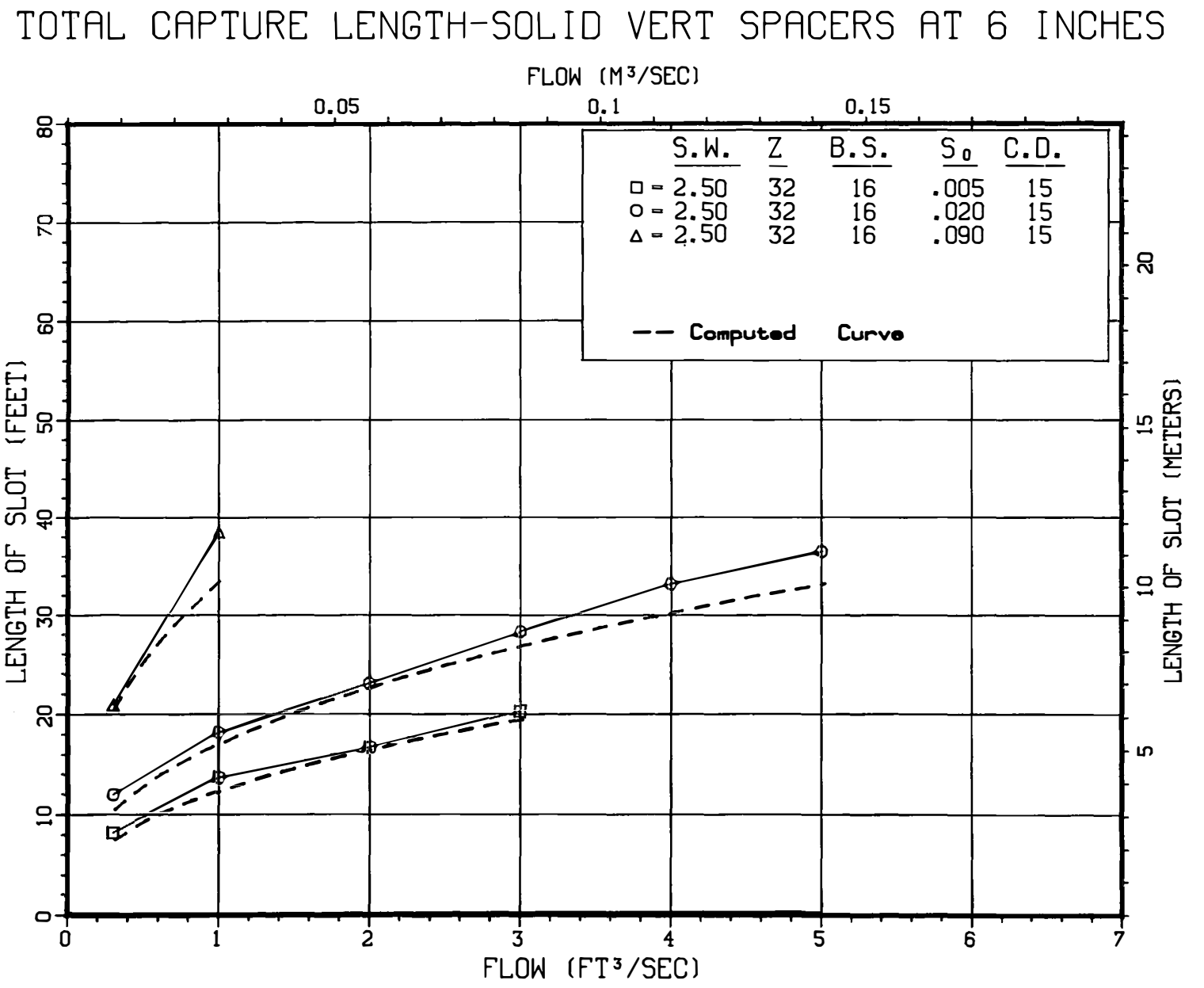

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.05
0.1
0.15
S.W. Z B.S. S₀ C.D.
□ = 2.50 32 16 .005 15
○ = 2.50 32 16 .020 15
△ = 2.50 32 16 .090 15
Computed Curve
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
FLOW (FT³/SEC)
0
10
20
30
40
50
60
70
80
5
10
15
20
1
2
3
4
5
6
7

Figure 63.

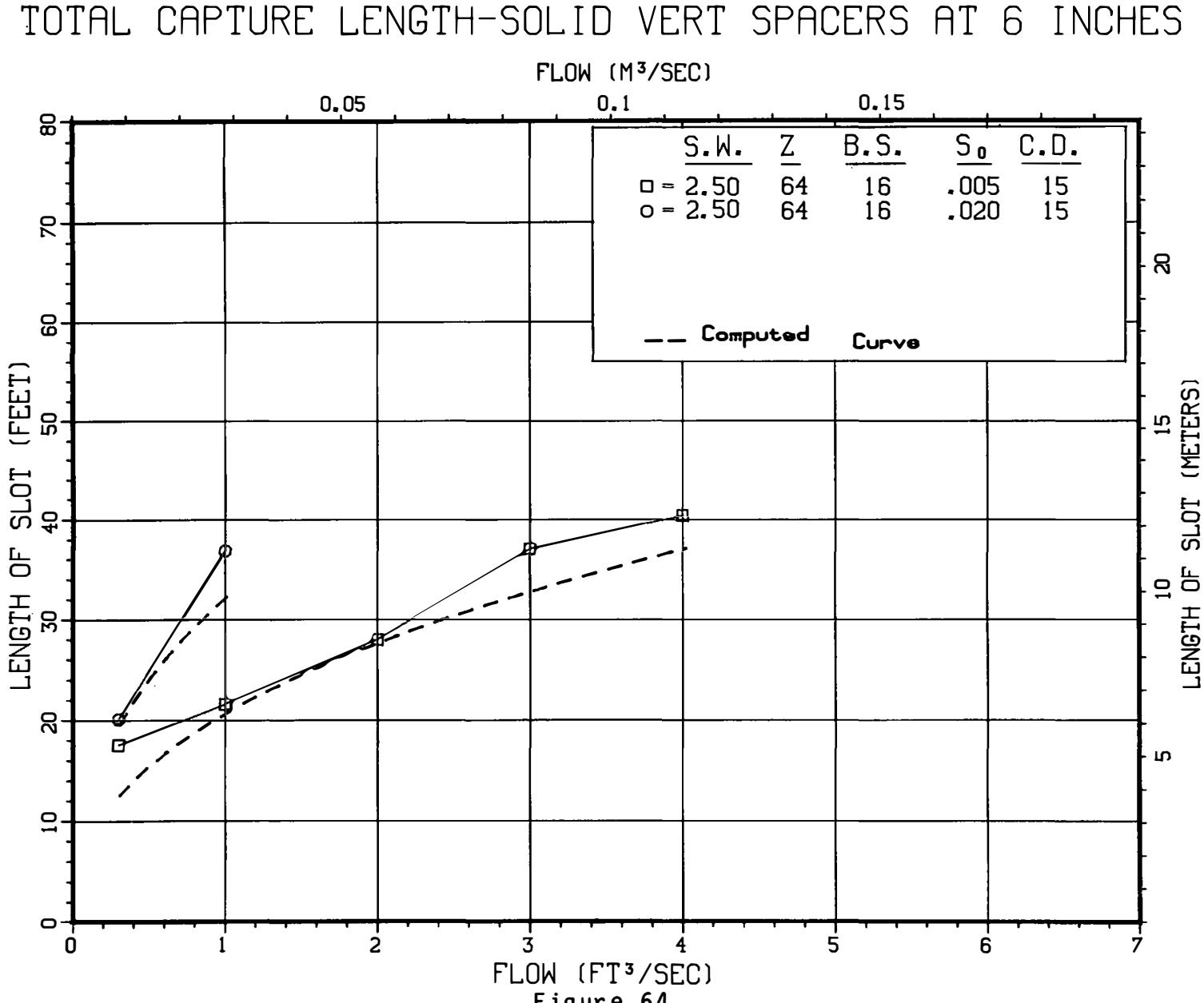

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.05
0.1
0.15
S.W. Z B.S. S₀ C.D.
□ = 2.50 64 16 .005 15
○ = 2.50 64 16 .020 15
Computed Curve
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
0 10 20 30 40 50 60 70 80
0 5 10 15 20
0 1 2 3 4 5 6 7
FLOW (FT³/SEC)

Figure 64.

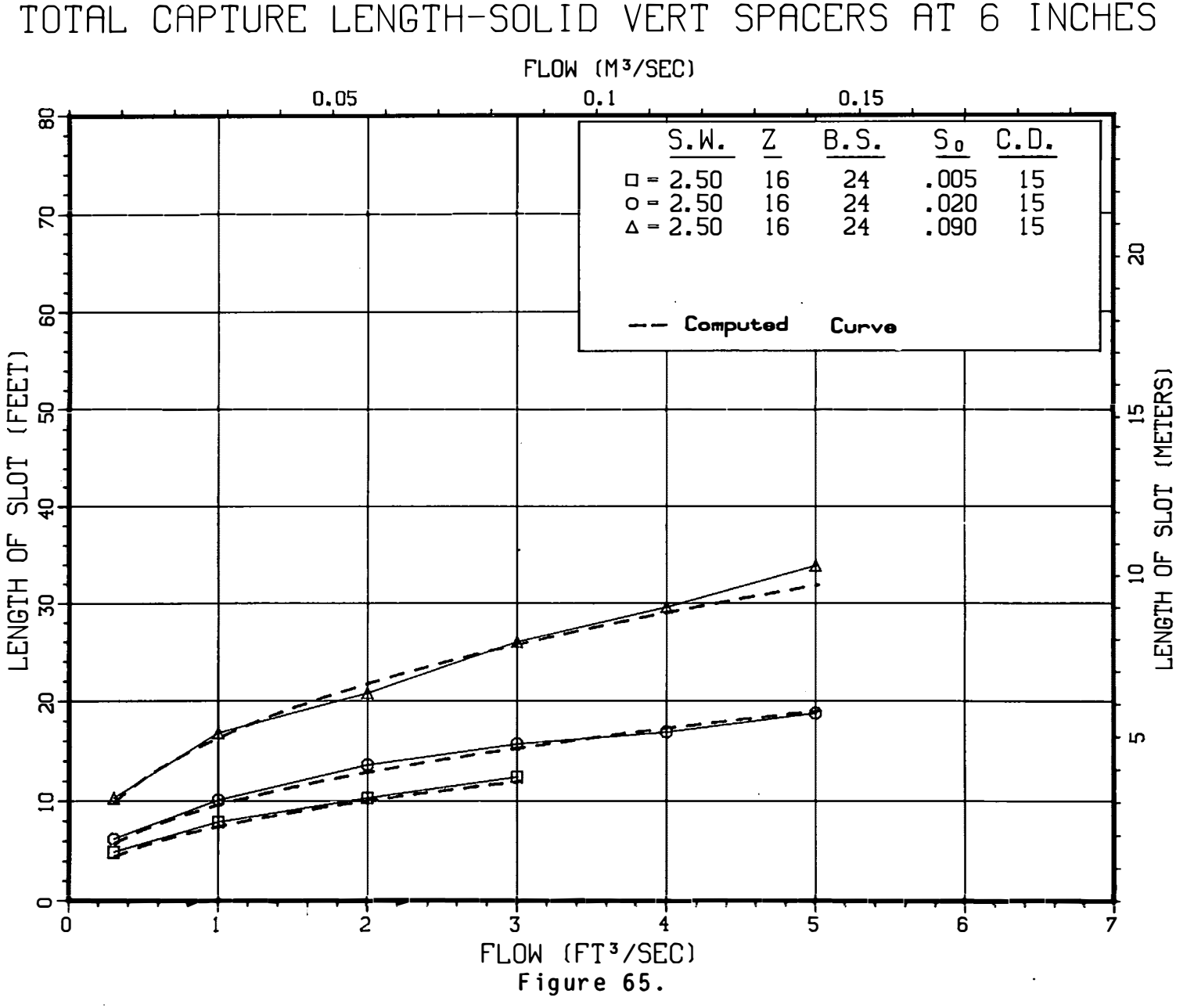

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.05
0.1
0.15
S.W. Z B.S. S₀ C.D.
□ = 2.50 16 24 .005 15
○ = 2.50 16 24 .020 15
△ = 2.50 16 24 .090 15
Computed Curve
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
FLOW (FT³/SEC)
0
10
20
30
40
50
60
70
80
5
15
1
2
3
4
6
7

Figure 65.

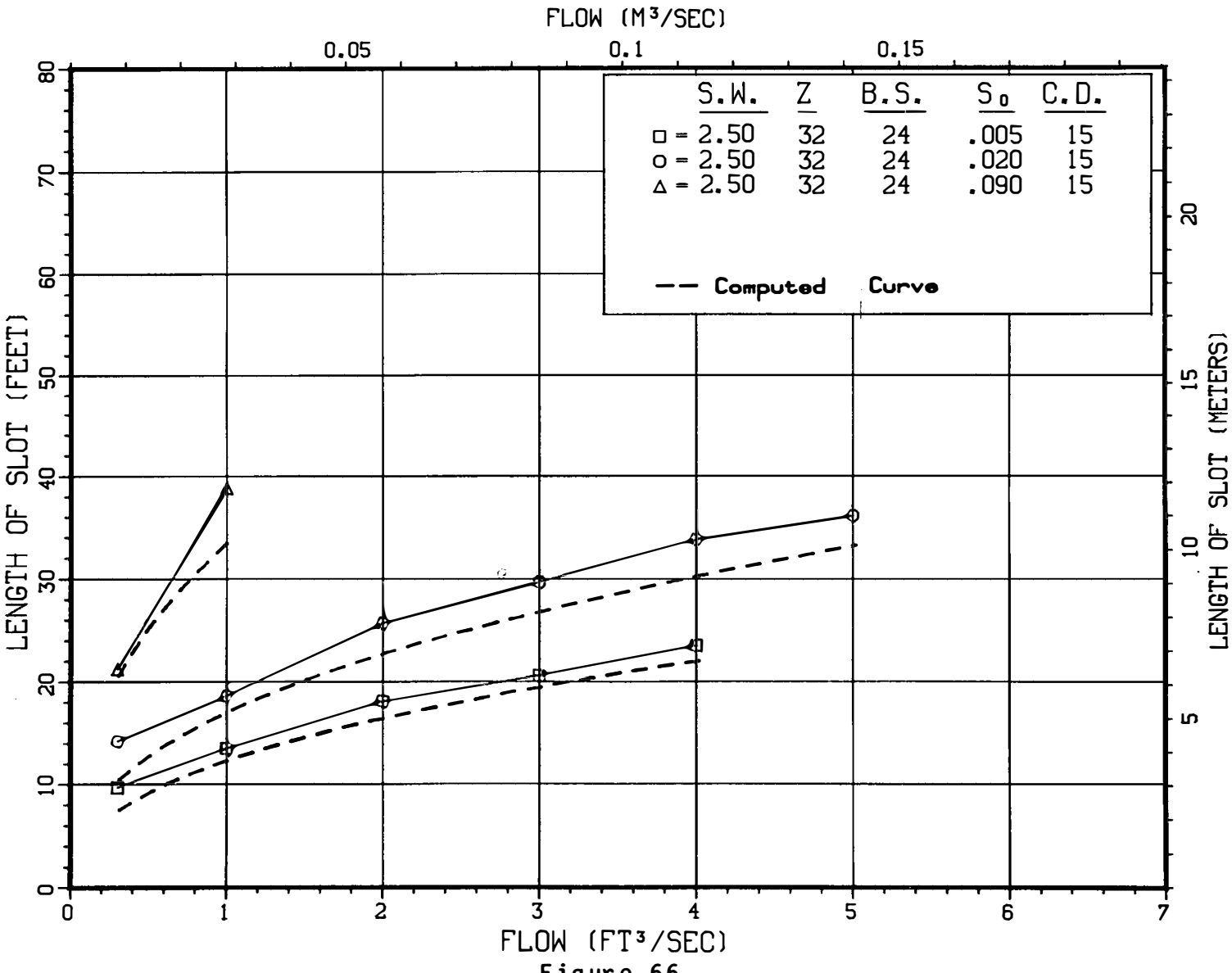

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.05
0.1
0.15
S.W. Z B.S. S₀ C.D.
□ = 2.50 32 24 .005 15
○ = 2.50 32 24 .020 15
△ = 2.50 32 24 .090 15
Computed Curve
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
FLOW (FT³/SEC)
0
10
20
30
40
50
60
70
80
1
2
3
4
5
6
7
5
10
15
20

Figure 66.

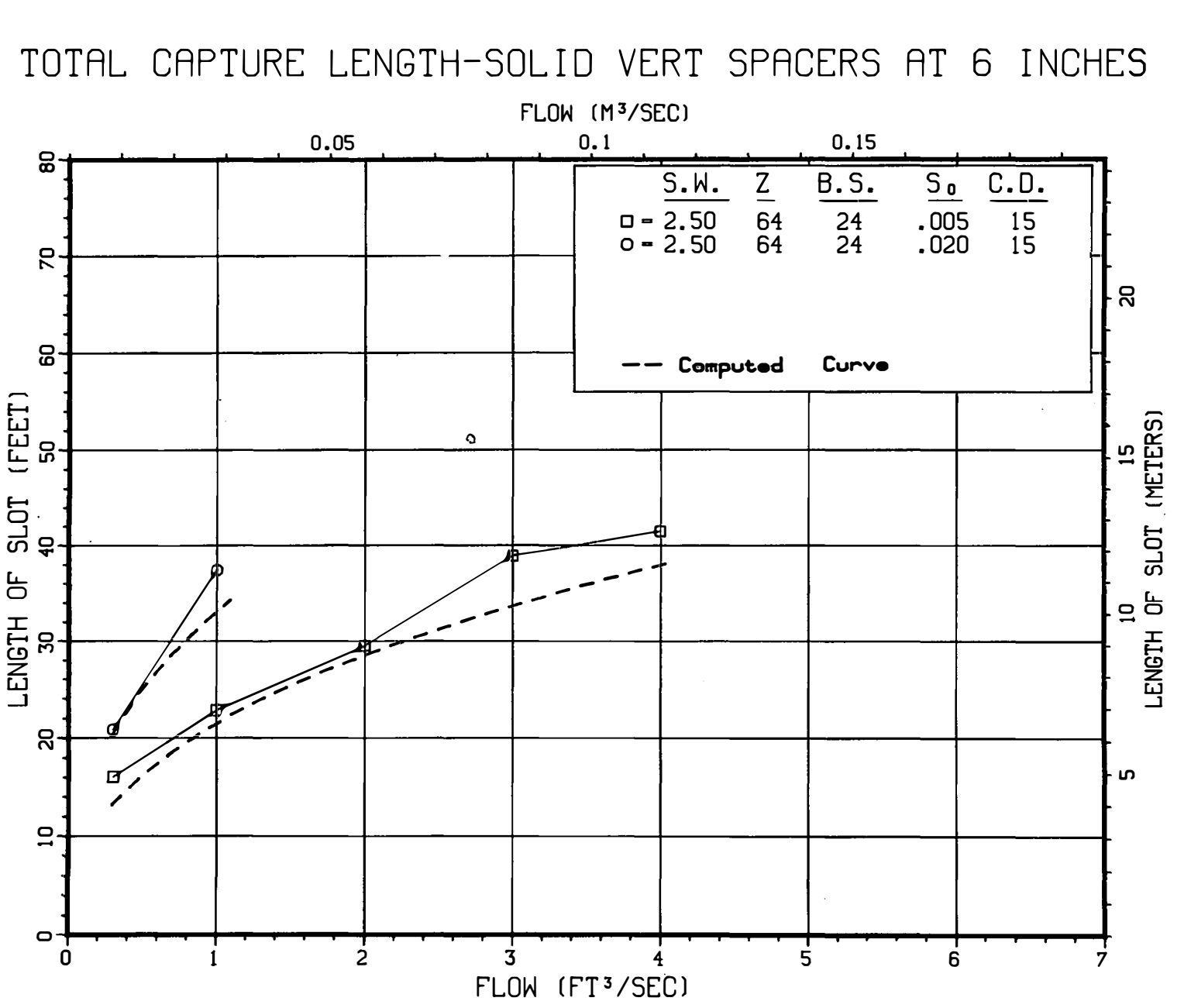

TOTAL CAPTURE LENGTH-SOLID VERT SPACERS AT 6 INCHES
FLOW (M³/SEC)
0.05
0.1
0.15
S.W. Z B.S. S₀ C.D.
□ = 2.50 64 24 .005 15
○ = 2.50 64 24 .020 15
Computed Curve
LENGTH OF SLOT (FEET)
LENGTH OF SLOT (METERS)
FLOW (FT³/SEC)
0
10
20
30
40
50
60
70
80
1
2
3
4
5
6
7
5
10
15
20

Figure 67.

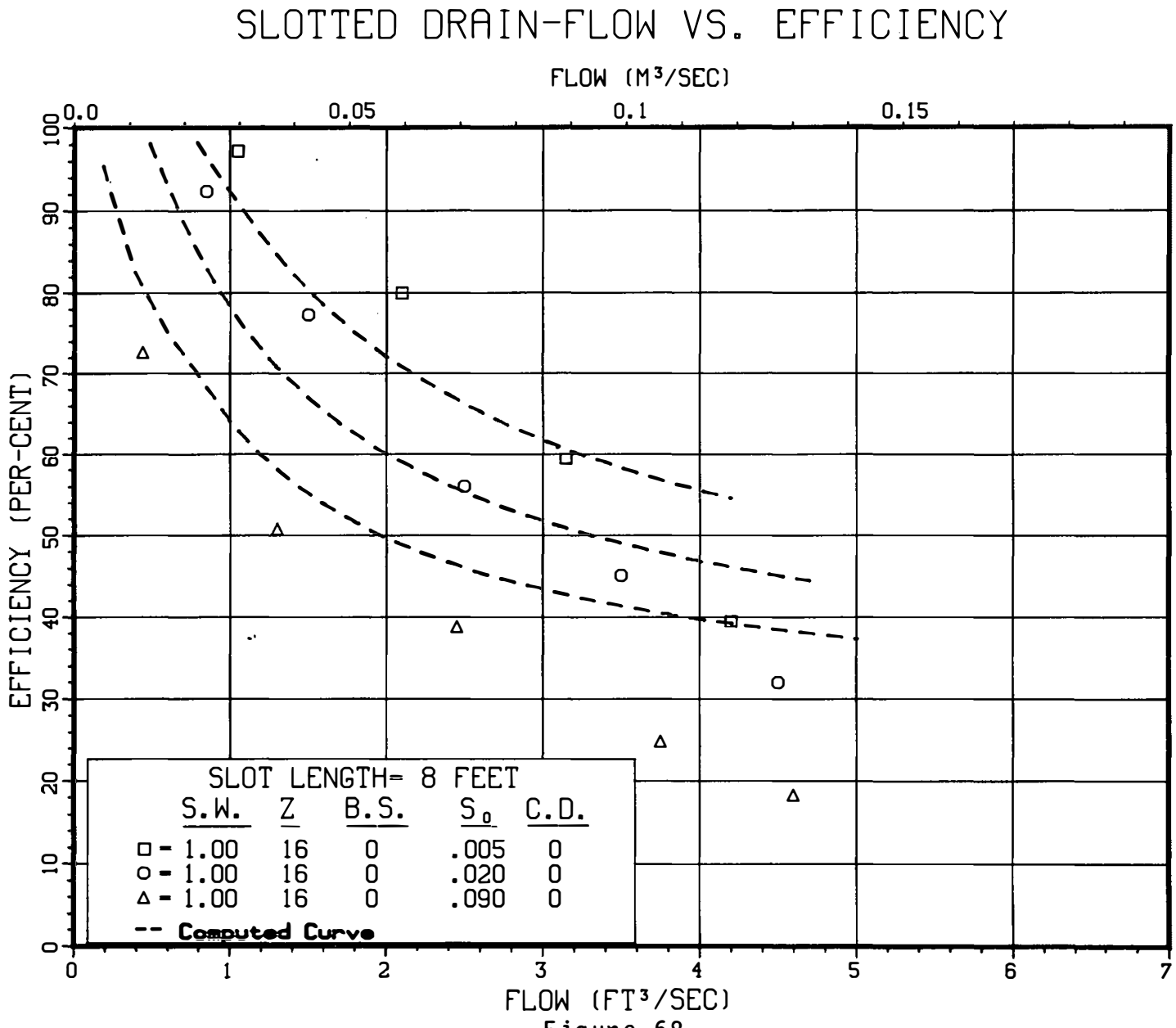

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH= 8 FEET
S.W. Z B.S. S₀ C.D.
□ = 1.00 16 0 .005 0
○ = 1.00 16 0 .020 0
△ = 1.00 16 0 .090 0
-- Computed Curve

Figure 68.

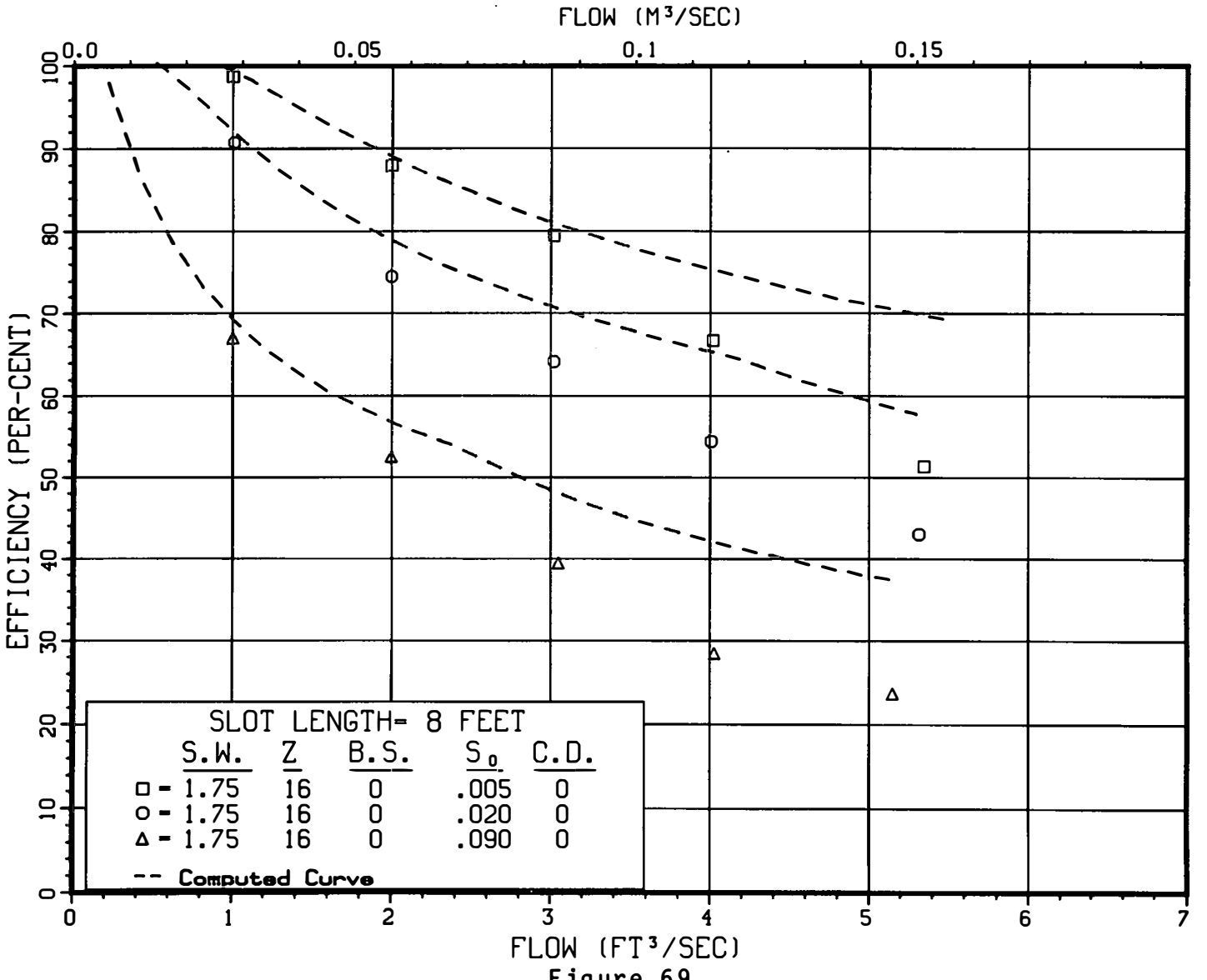

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH= 8 FEET
S.W. Z B.S. S₀ C.D.
□ = 1.75 16 0 .005 0
○ = 1.75 16 0 .020 0
△ = 1.75 16 0 .090 0
-- Computed Curve

Figure 69.

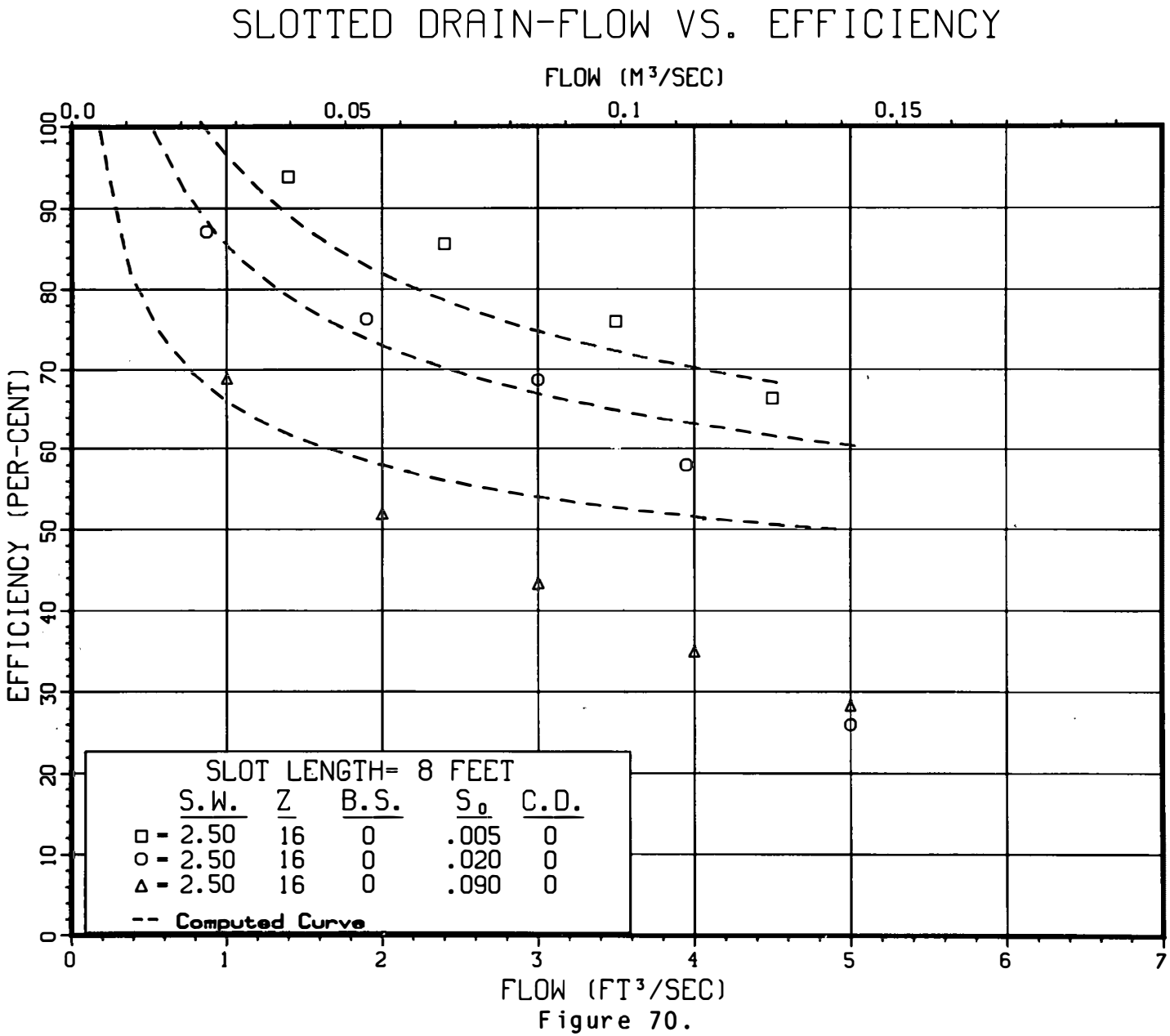

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH= 8 FEET
S.W. Z B.S. S₀ C.D.
□ - 2.50 16 0 .005 0
○ - 2.50 16 0 .020 0
△ - 2.50 16 0 .090 0
-- Computed Curve

Figure 70.

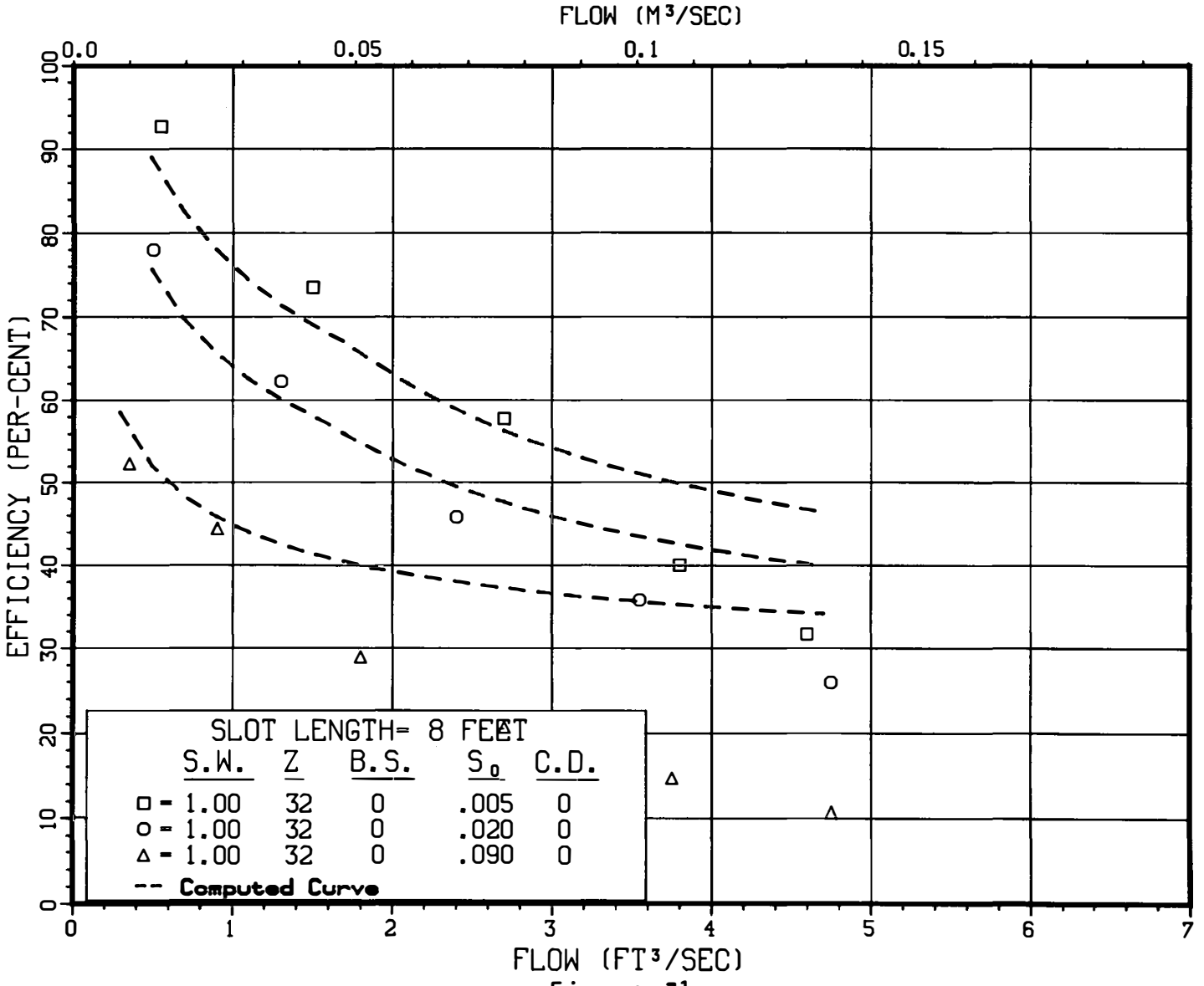

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH= 8 FEET
S.W. Z B.S. S₀ C.D.
□ = 1.00 32 0 .005 0
○ = 1.00 32 0 .020 0
△ = 1.00 32 0 .090 0
-- Computed Curve

Figure 71.

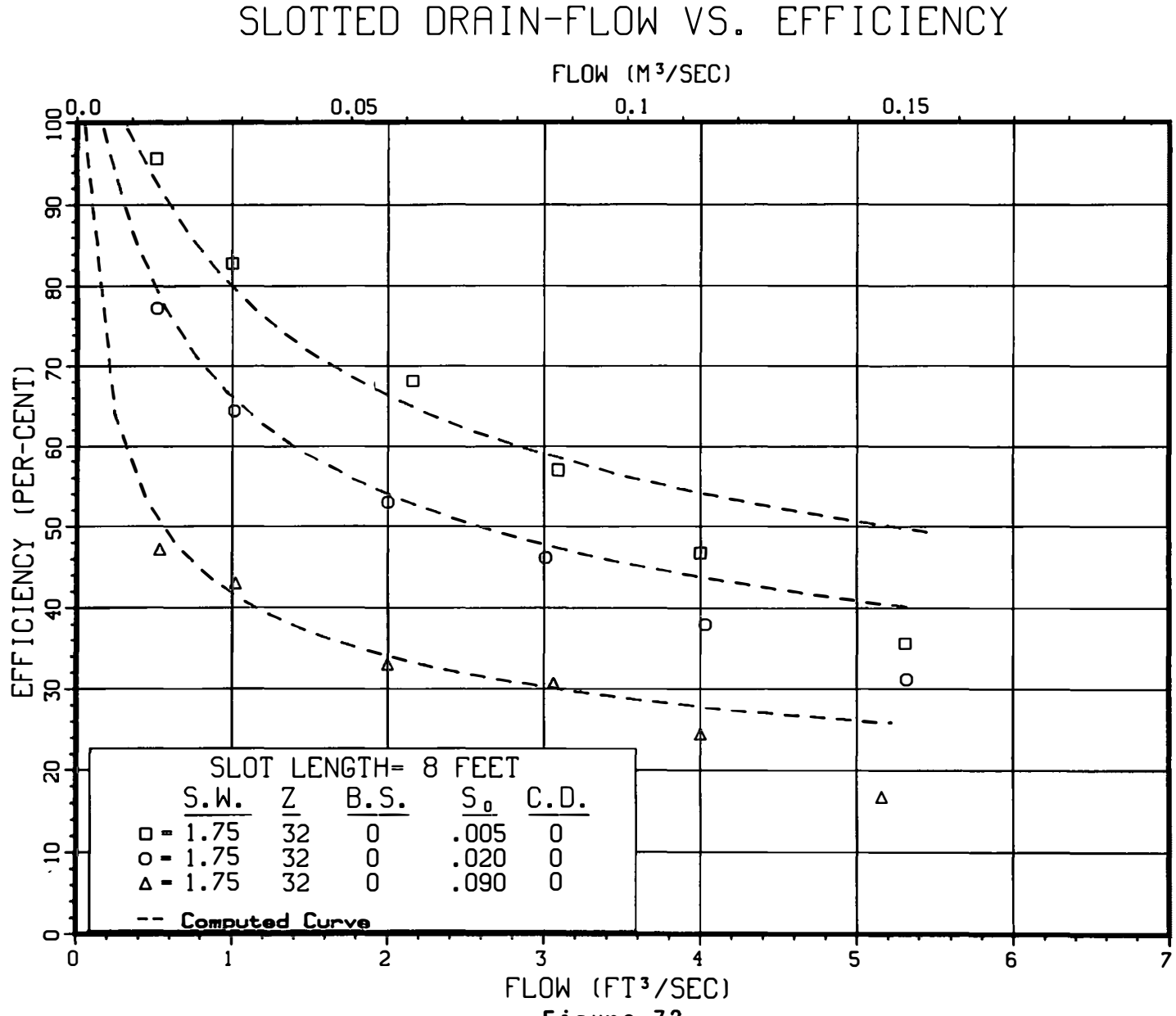

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
100
90
80
70
60
50
40
30
20
10
0
SLOT LENGTH= 8 FEET
S.W. Z B.S. S₀ C.D.
□ = 1.75 32 0 .005 0
○ = 1.75 32 0 .020 0
△ = 1.75 32 0 .090 0
-- Computed Curve
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)

Figure 72.

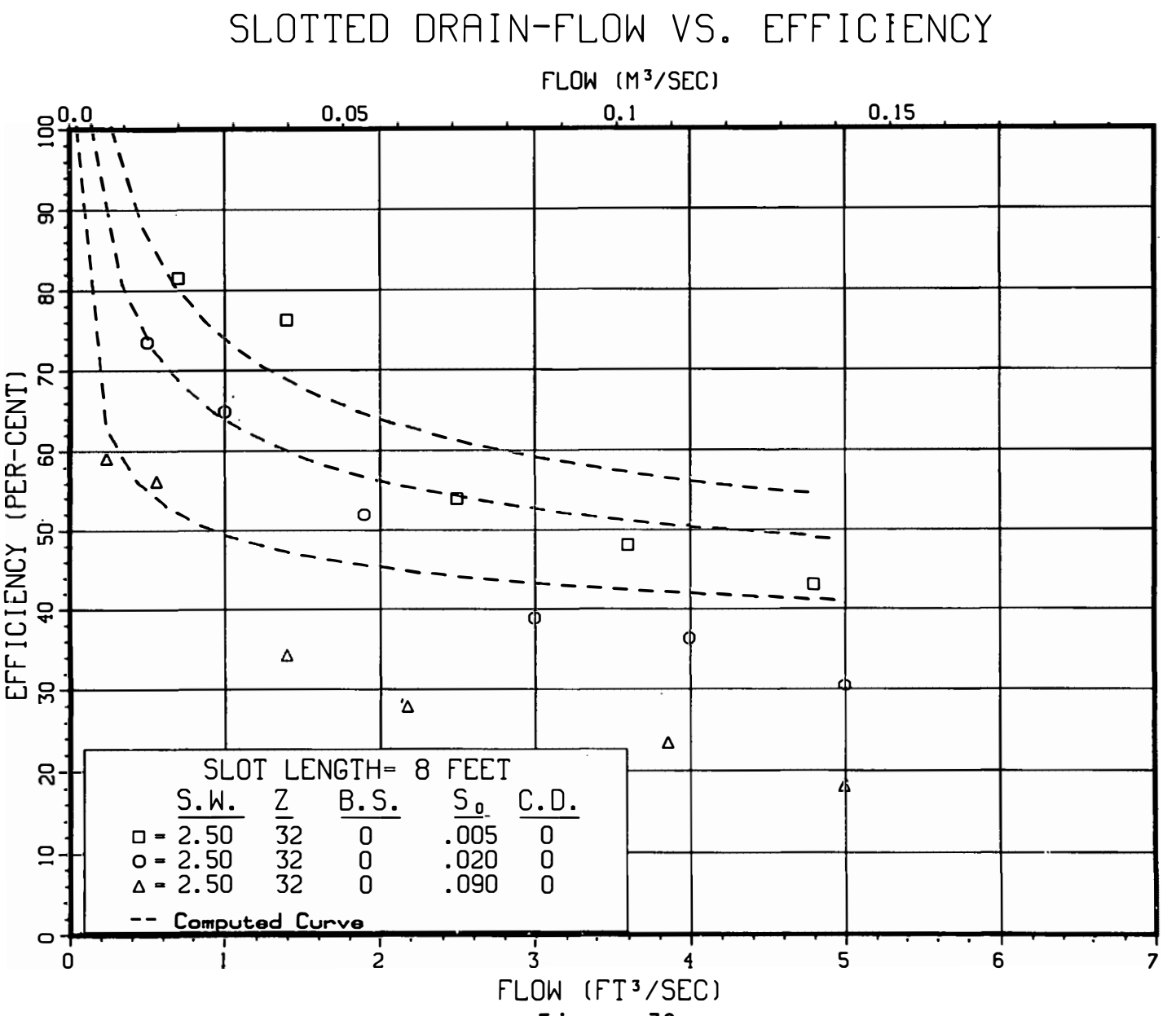

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH= 8 FEET
S.W. Z B.S. S0 C.D.
□ = 2.50 32 0 .005 0
o = 2.50 32 0 .020 0
Δ = 2.50 32 0 .090 0
-- Computed Curve

Figure 73.

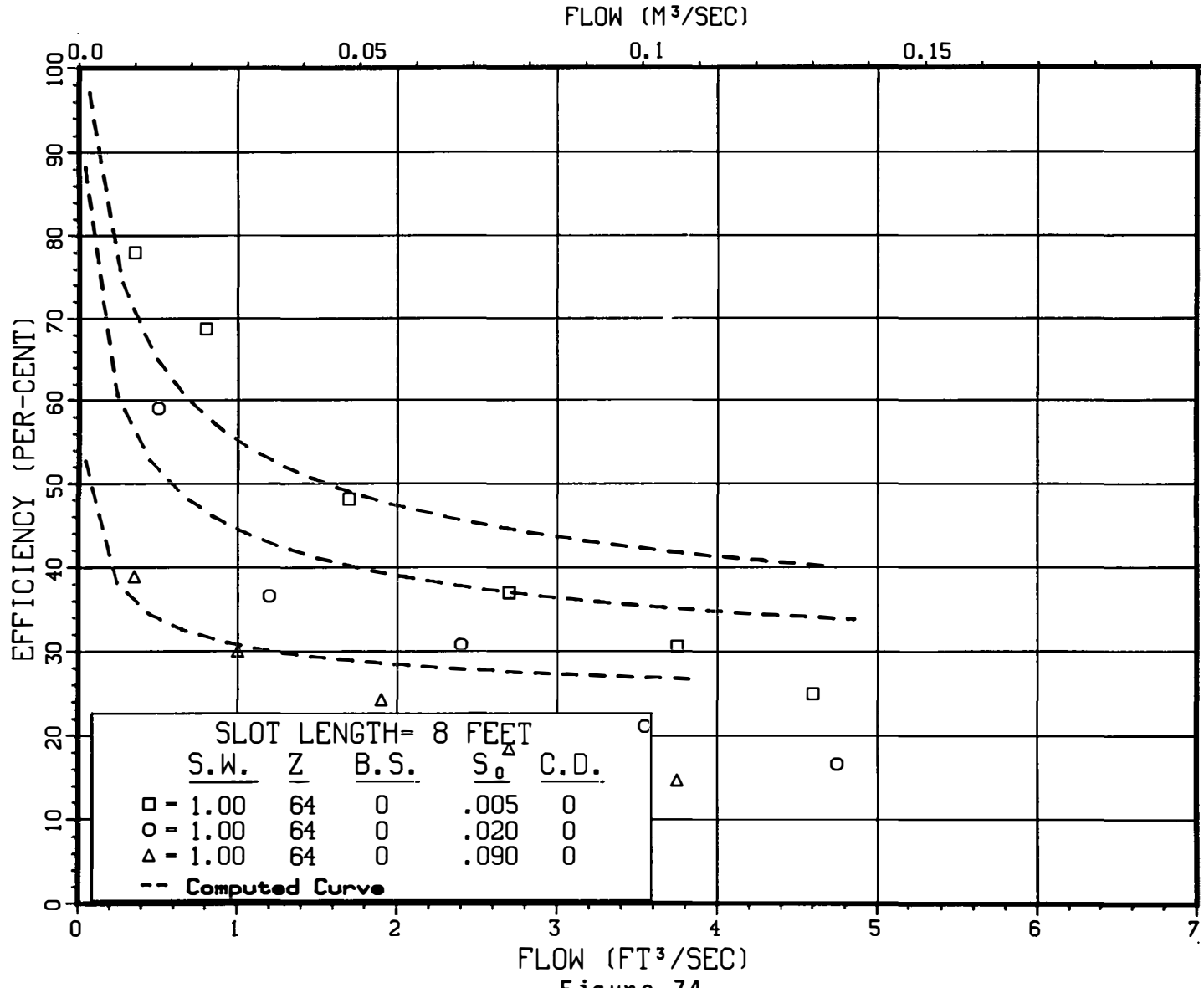

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH= 8 FEET
S.W. Z B.S. S₀ C.D.
□ = 1.00 64 0 .005 0
○ = 1.00 64 0 .020 0
△ = 1.00 64 0 .090 0
-- Computed Curve

Figure 74.

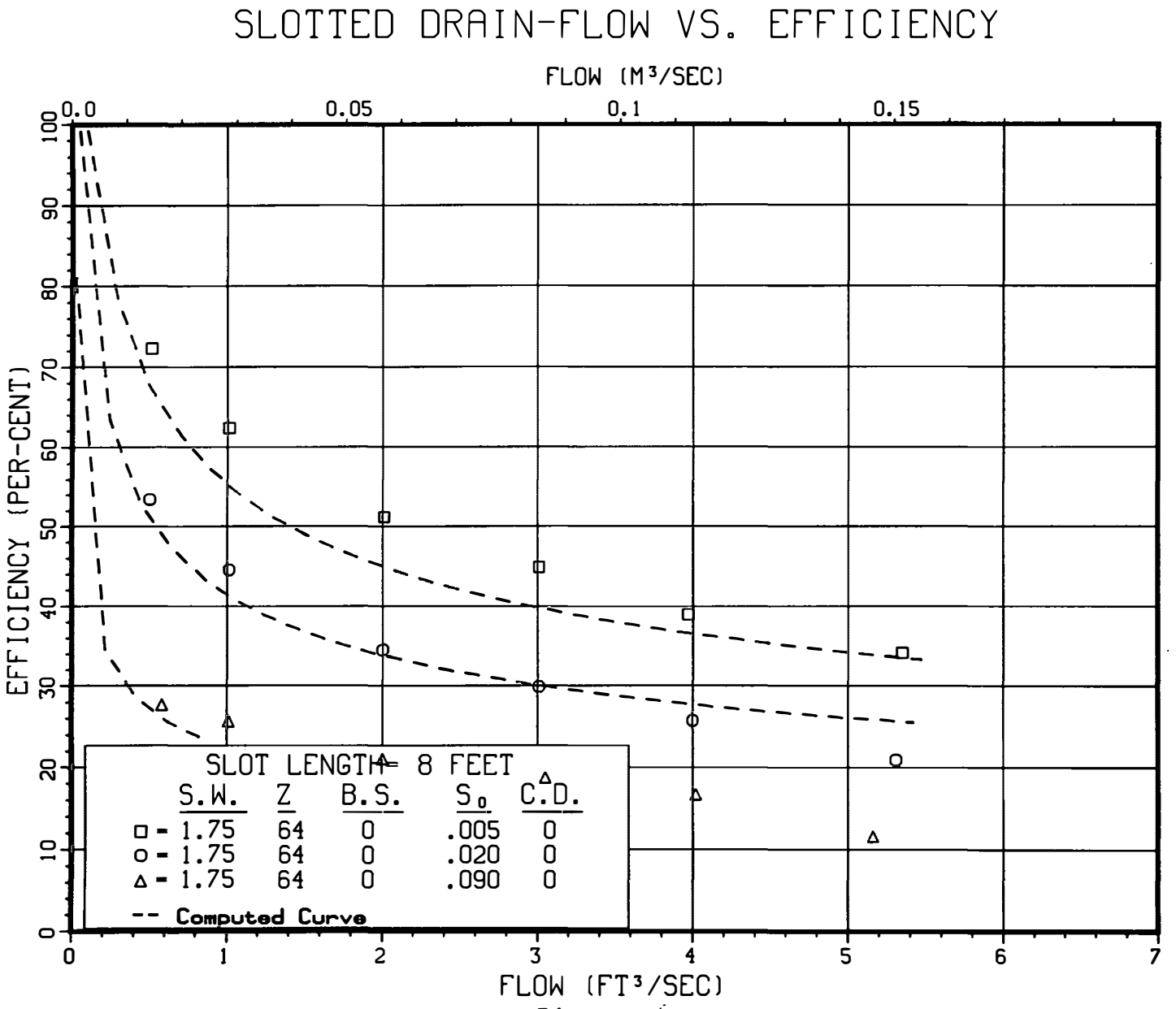

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH = 8 FEET
S.W. Z B.S. S₀ C.D.
□ = 1.75 64 0 .005 0
○ = 1.75 64 0 .020 0
△ = 1.75 64 0 .090 0
-- Computed Curve

Figure 75.

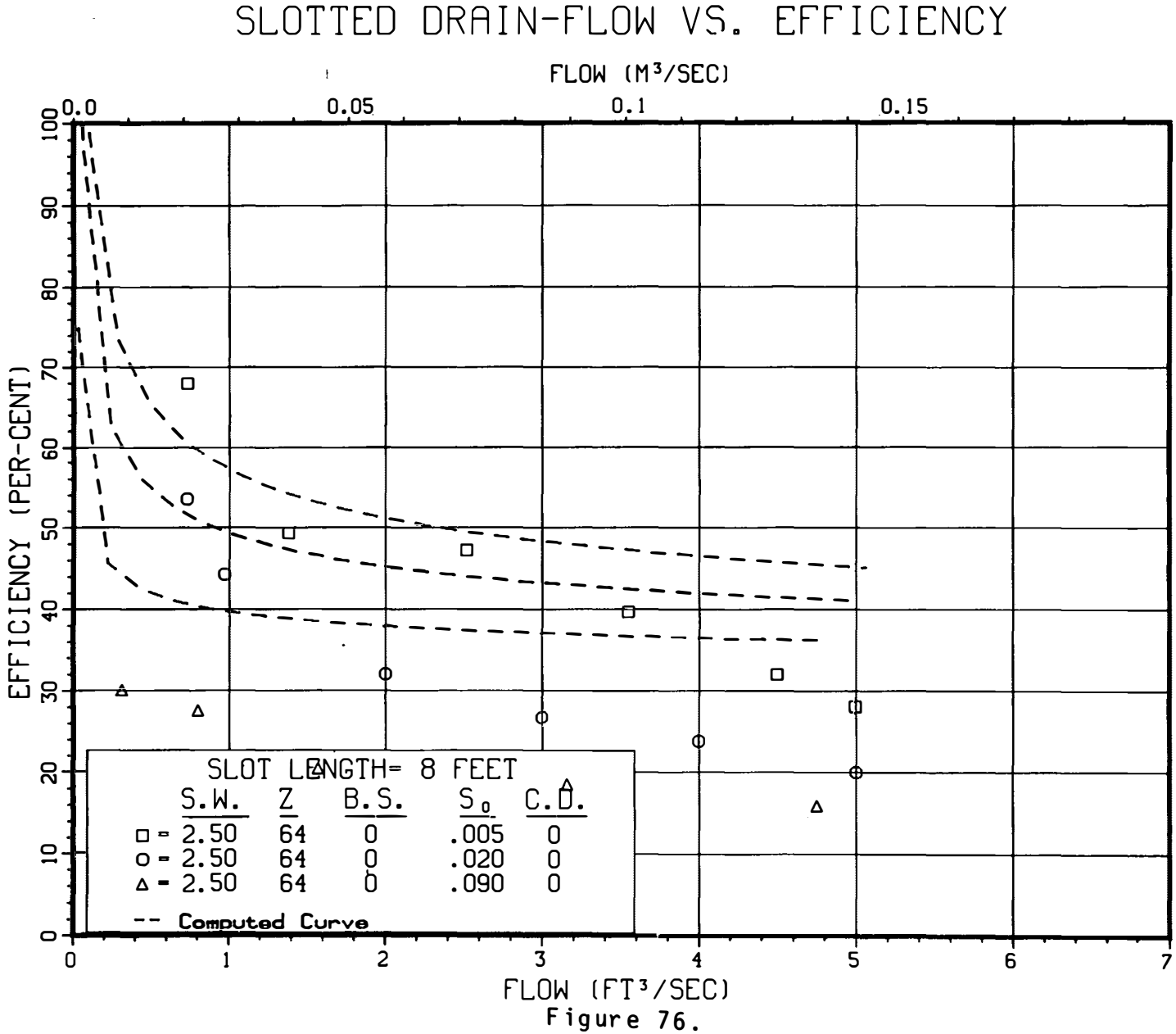

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH= 8 FEET
S.W. Z B.S. S₀ C.D.
□ = 2.50 64 0 .005 0
○ = 2.50 64 0 .020 0
△ = 2.50 64 0 .090 0
-- Computed Curve

Figure 76.

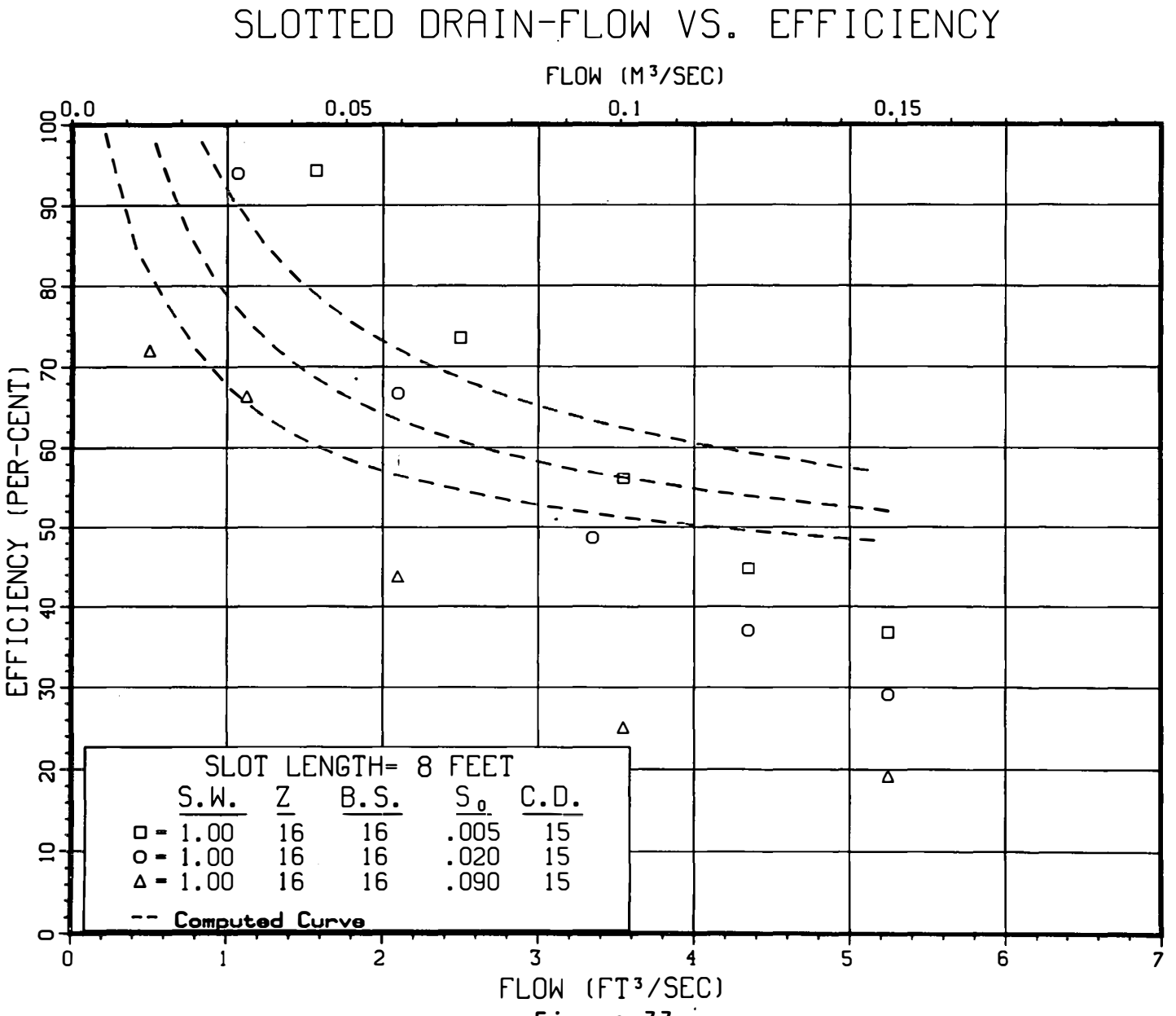

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH= 8 FEET
S.W. Z B.S. S₀ C.D.
□ = 1.00 16 16 .005 15
○ = 1.00 16 16 .020 15
△ = 1.00 16 16 .090 15
-- Computed Curve

Figure 77.

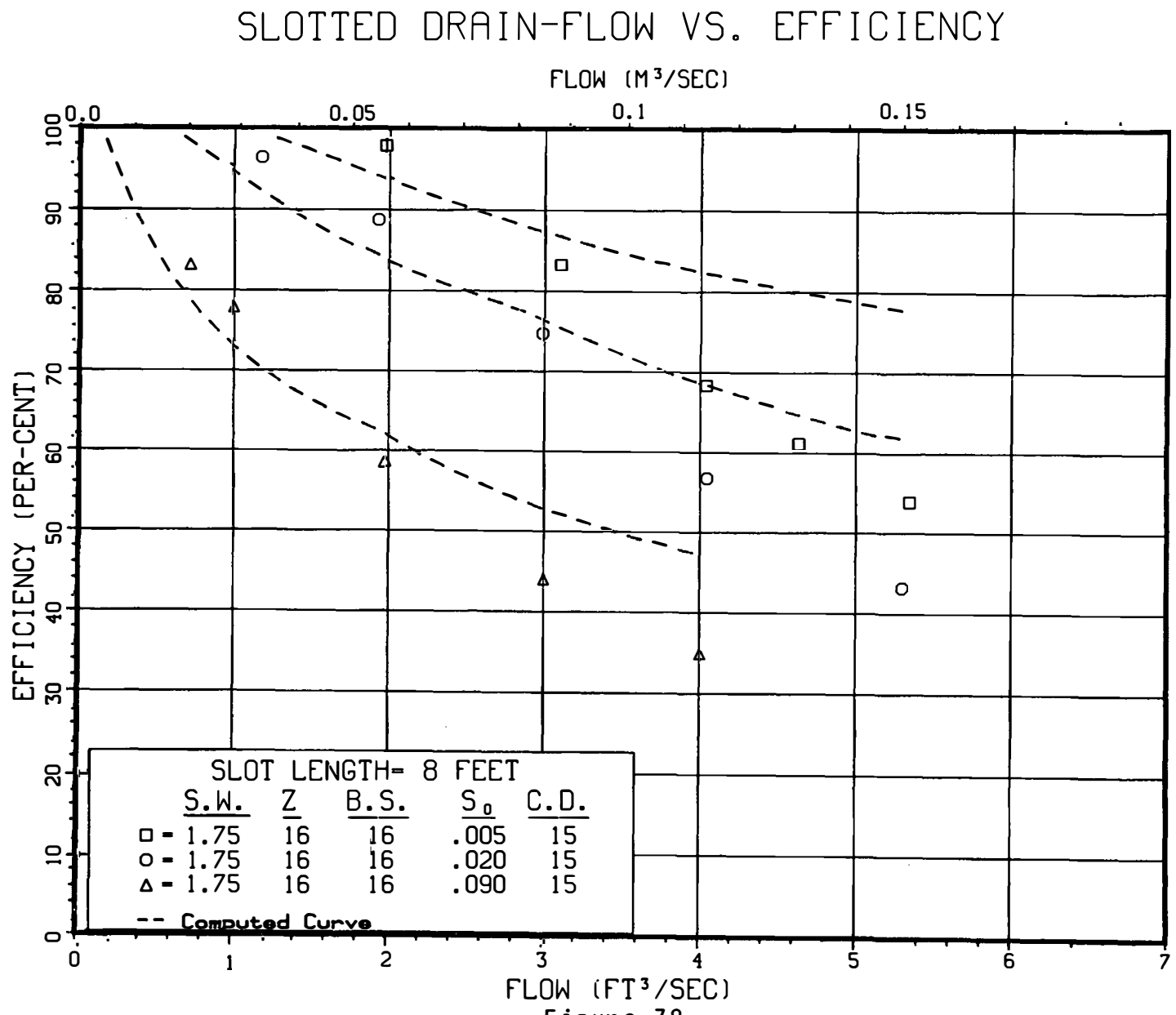

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH= 8 FEET
S.W. Z B.S. S0 C.D.
□ = 1.75 16 16 .005 15
○ = 1.75 16 16 .020 15
△ = 1.75 16 16 .090 15
-- Computed Curve

Figure 78.

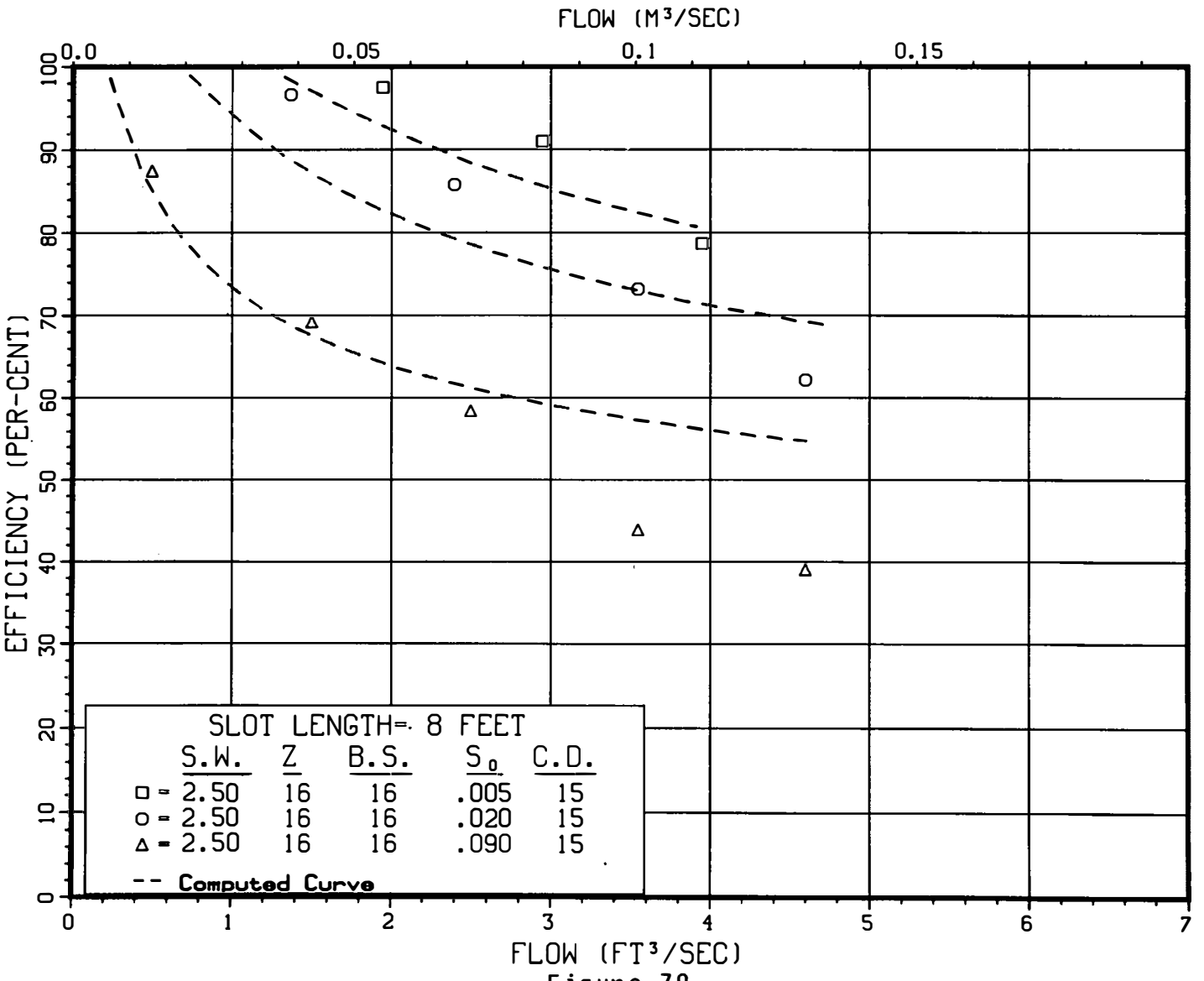

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH= 8 FEET
S.W. Z B.S. S₀ C.D.
□ = 2.50 16 16 .005 15
○ = 2.50 16 16 .020 15
△ = 2.50 16 16 .090 15
-- Computed Curve

Figure 79.

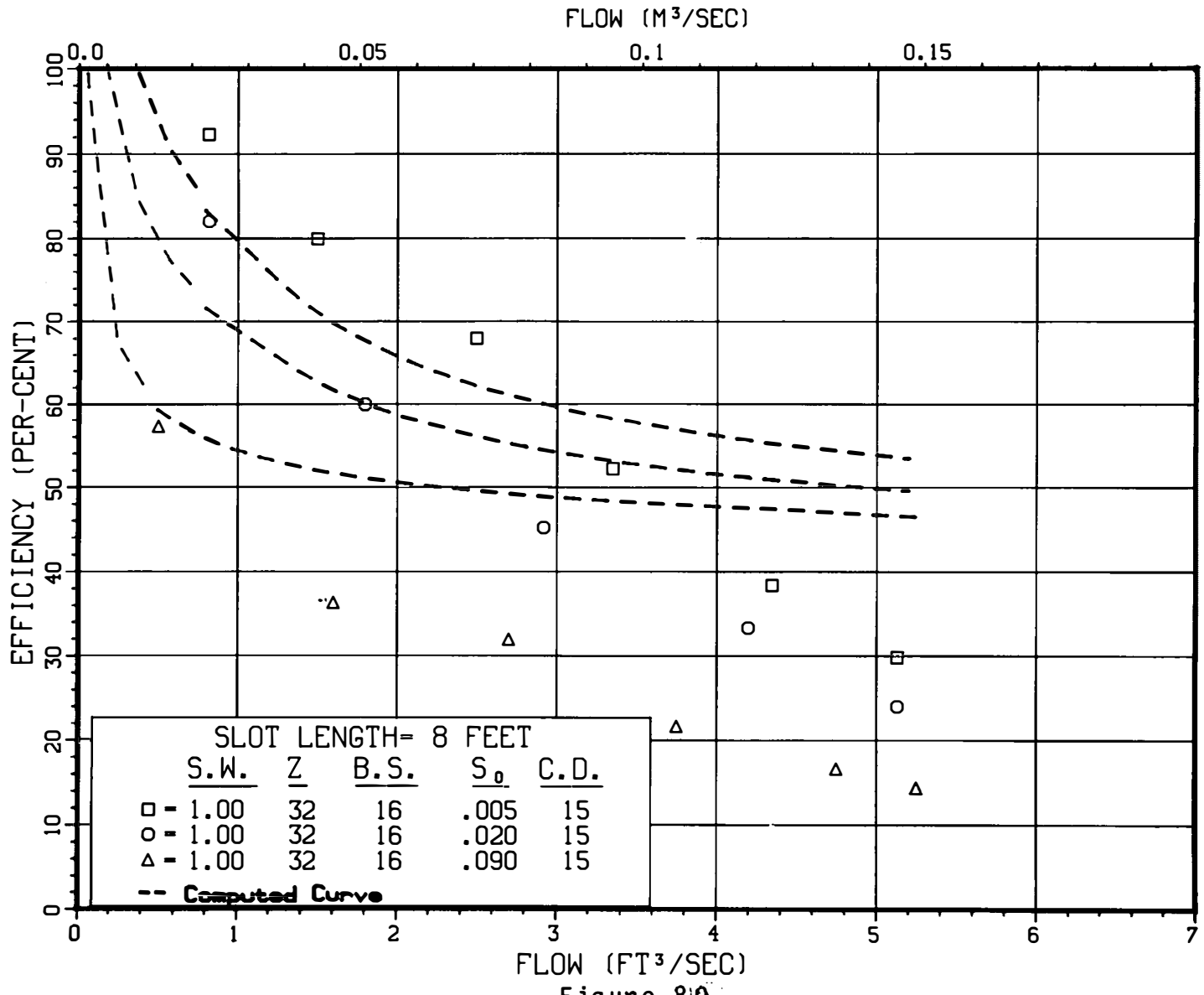

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH= 8 FEET
S.W. Z B.S. S0 C.D.
□ = 1.00 32 16 .005 15
○ = 1.00 32 16 .020 15
△ = 1.00 32 16 .090 15
-- Computed Curve

Figure 80.

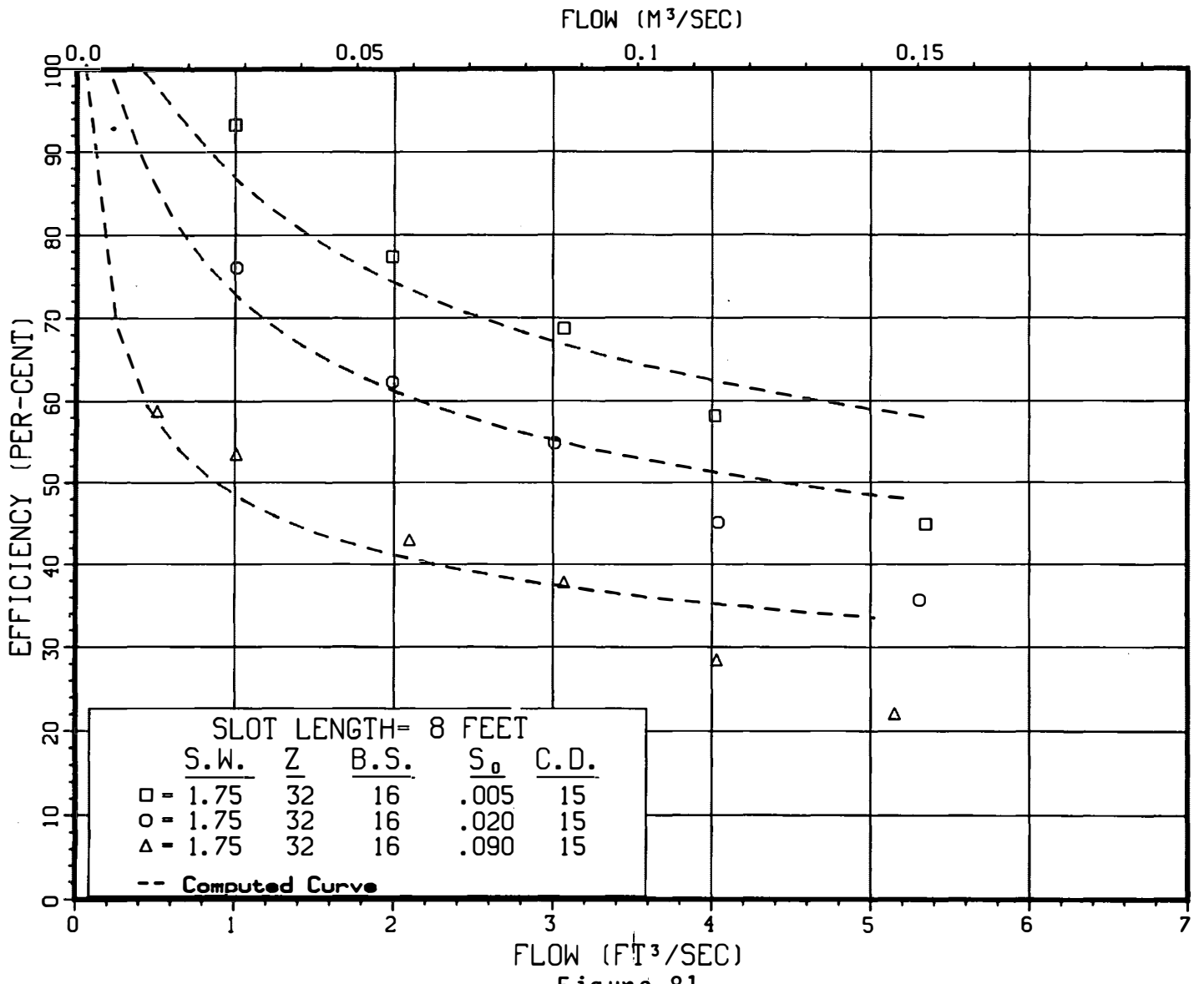

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH= 8 FEET
S.W. Z B.S. S₀ C.D.
□ = 1.75 32 16 .005 15
○ = 1.75 32 16 .020 15
△ = 1.75 32 16 .090 15
-- Computed Curve

Figure 81.

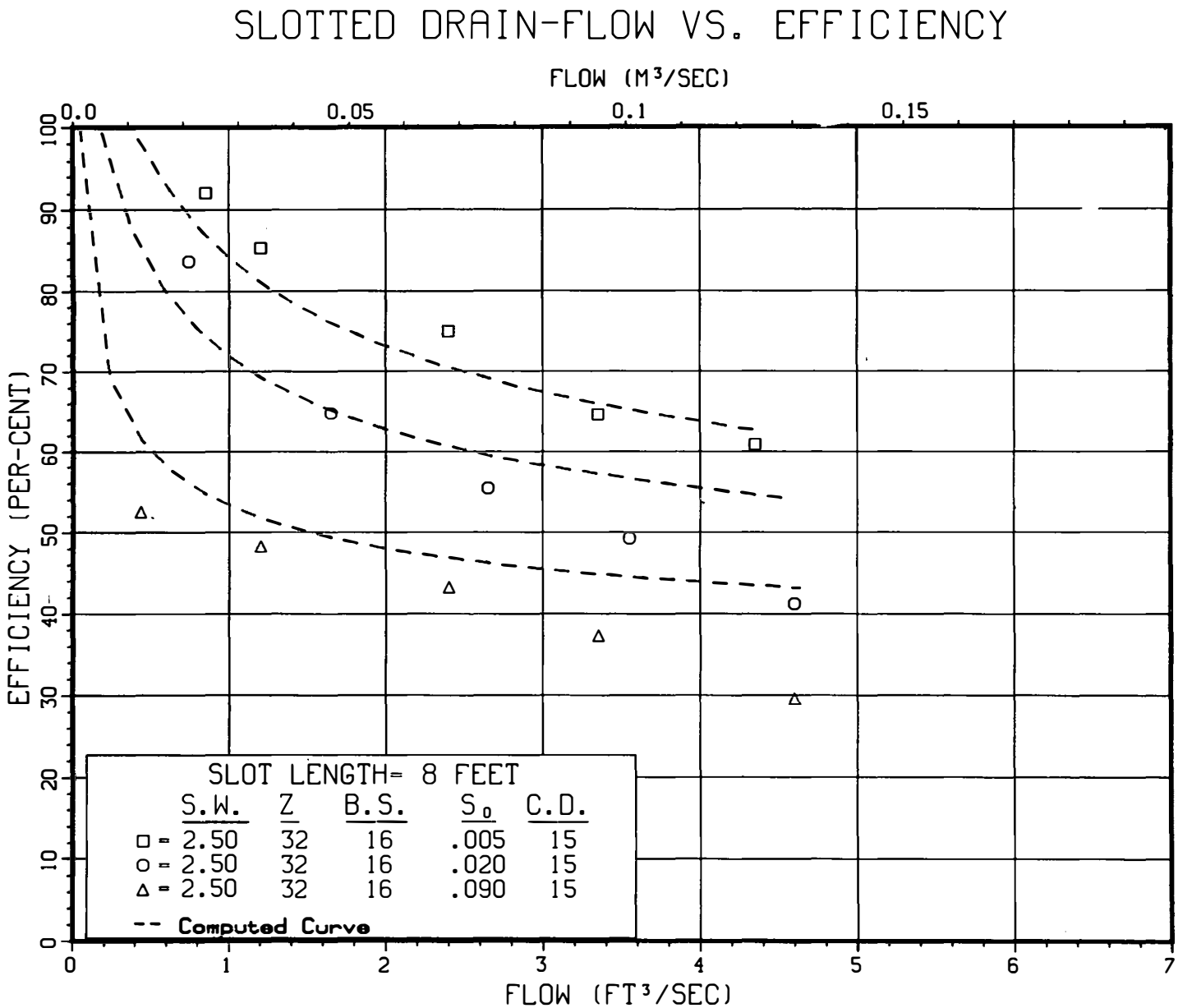

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH= 8 FEET
S.W. Z B.S. S₀ C.D.
□ = 2.50 32 16 .005 15
○ = 2.50 32 16 .020 15
△ = 2.50 32 16 .090 15
-- Computed Curve

Figure 82.

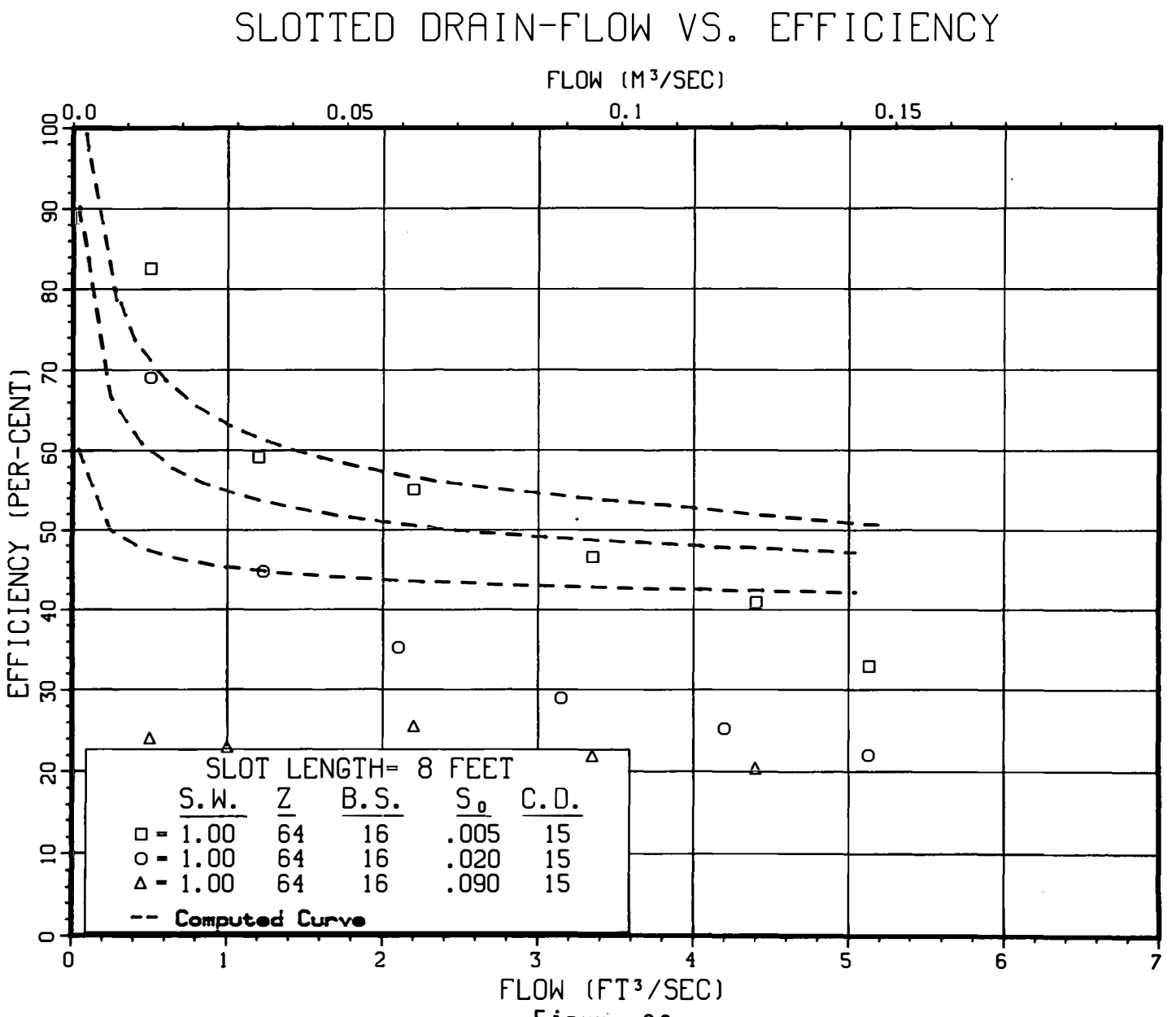

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH= 8 FEET
S.W. Z B.S. S0 C.D.
□ = 1.00 64 16 .005 15
○ = 1.00 64 16 .020 15
△ = 1.00 64 16 .090 15
-- Computed Curve

Figure 83.

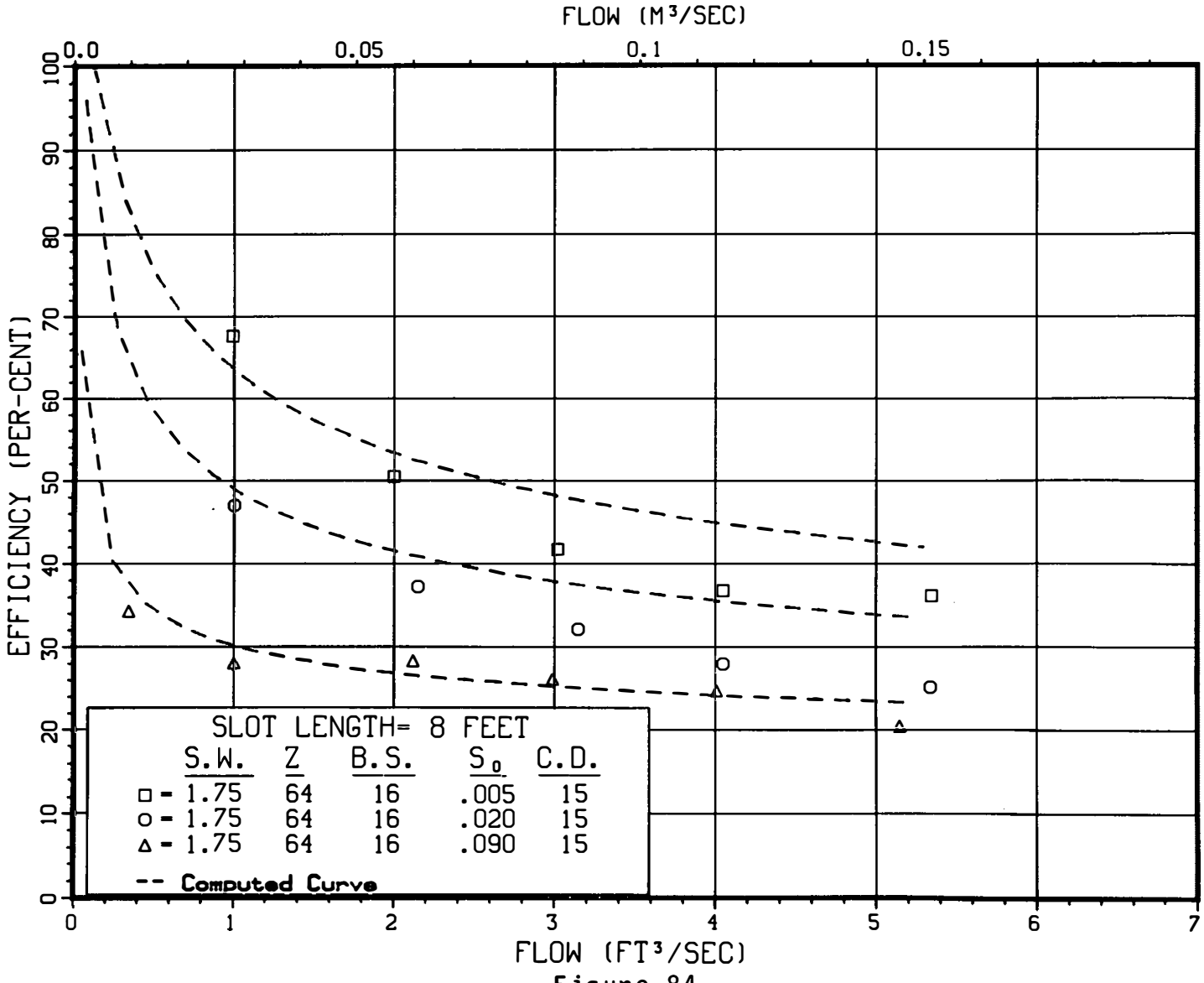

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH= 8 FEET
S.W. Z B.S. S₀ C.D.
□ = 1.75 64 16 .005 15
○ = 1.75 64 16 .020 15
△ = 1.75 64 16 .090 15
-- Computed Curve

Figure 84.

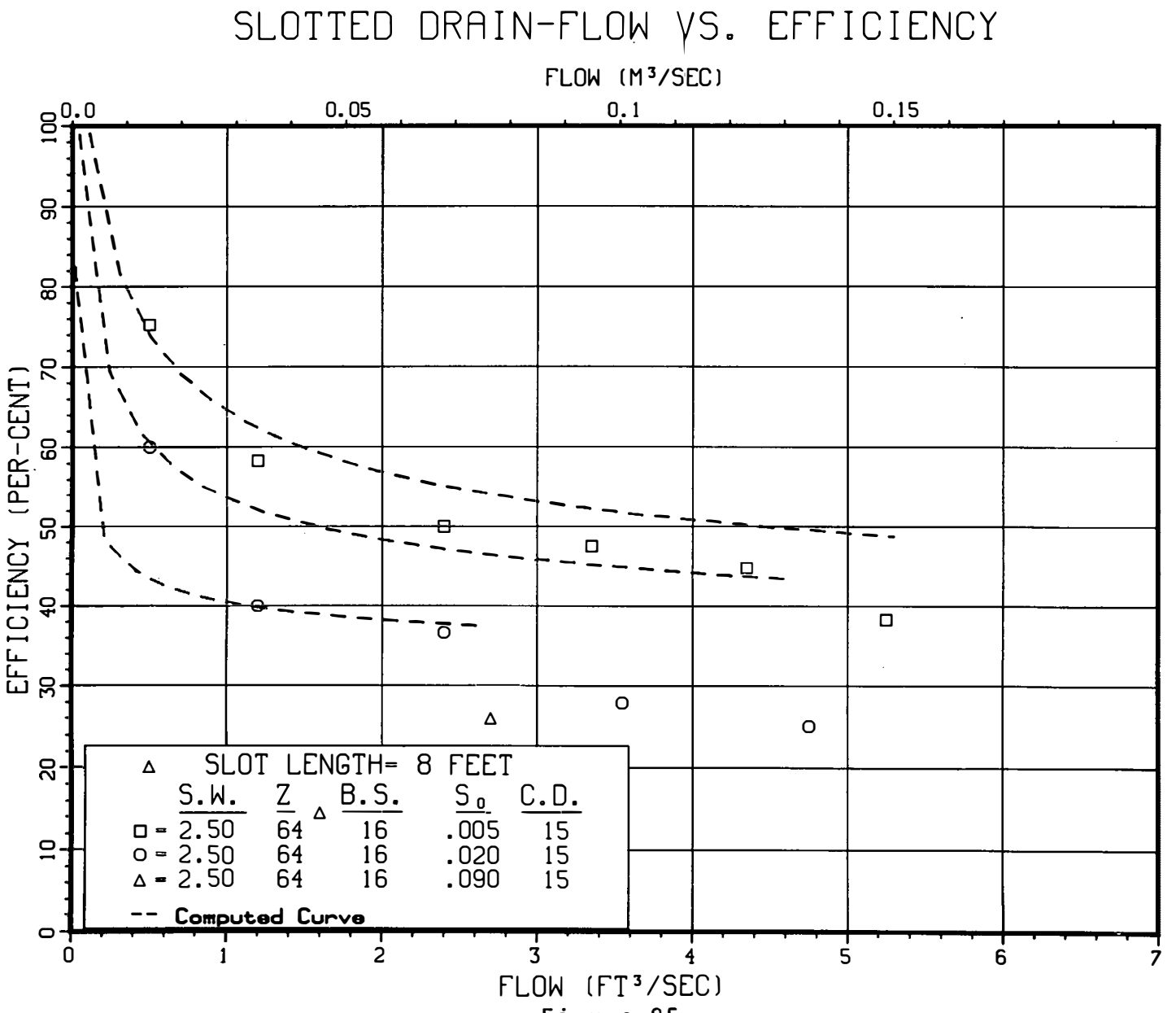

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH= 8 FEET
S.W. Z B.S. S₀ C.D.
□ = 2.50 64 16 .005 15
○ = 2.50 64 16 .020 15
△ = 2.50 64 16 .090 15
-- Computed Curve

Figure 85.

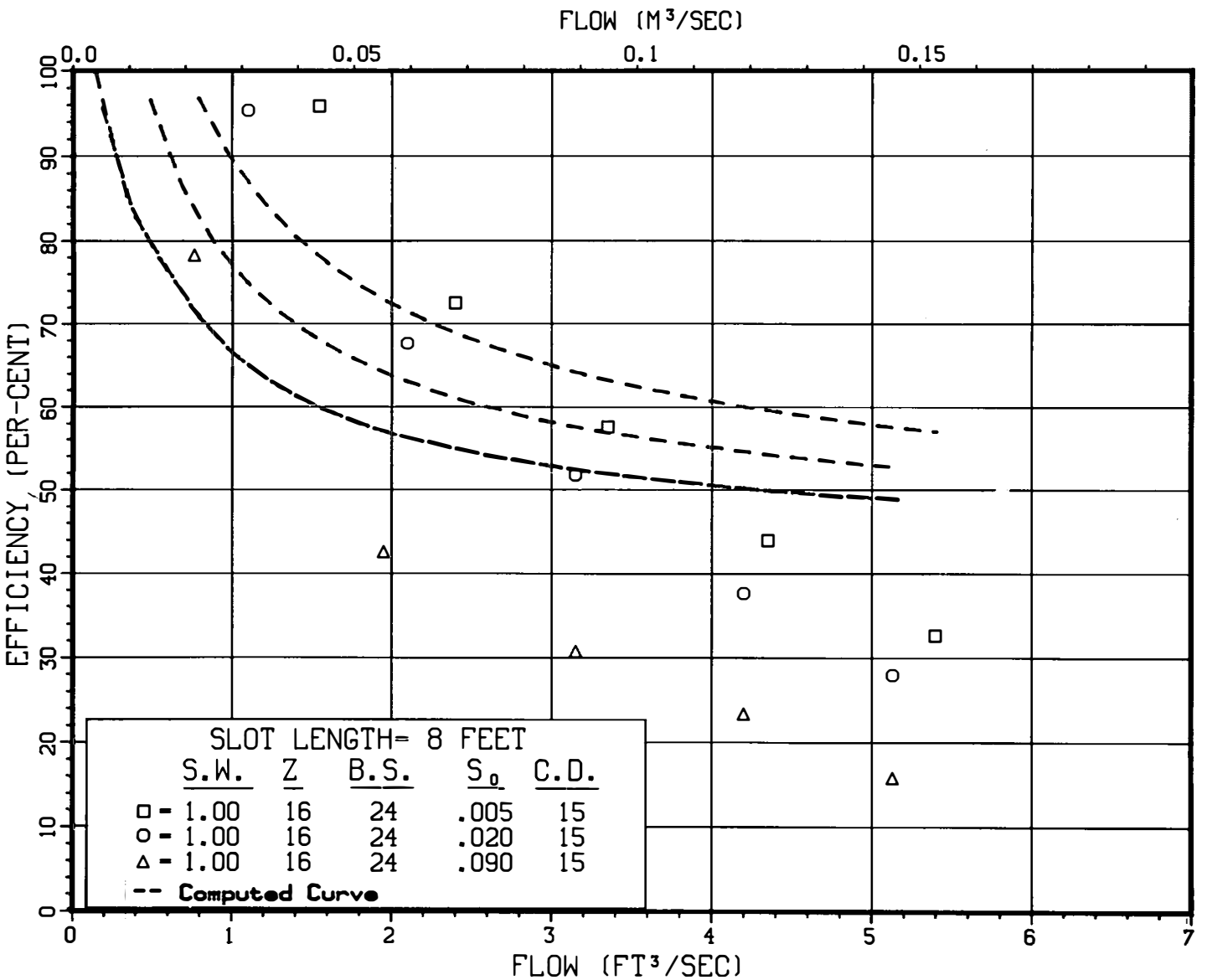

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH= 8 FEET
S.W. Z B.S. S₀ C.D.
□ = 1.00 16 24 .005 15
○ = 1.00 16 24 .020 15
△ = 1.00 16 24 .090 15
-- Computed Curve

Figure 86.

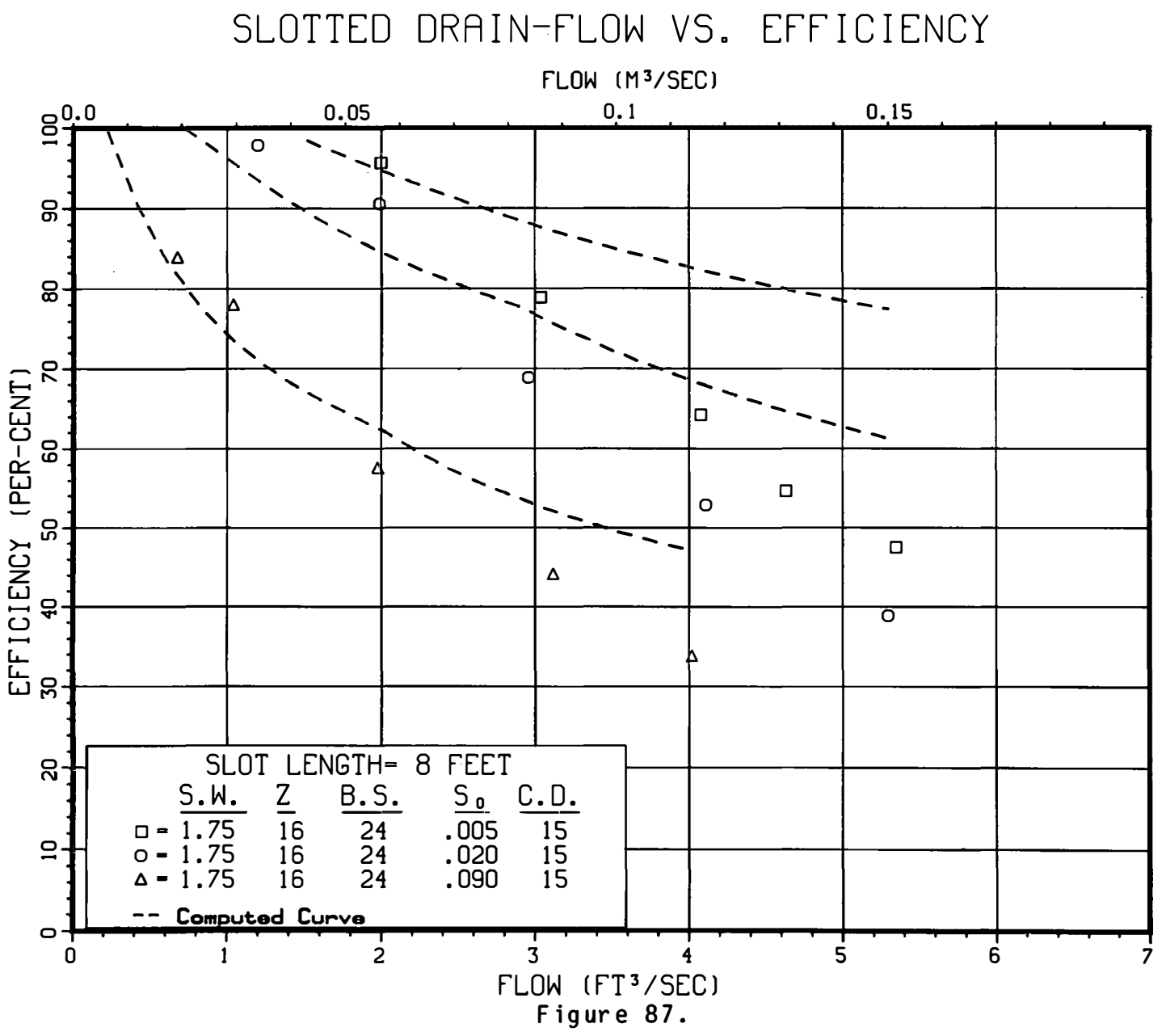

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH= 8 FEET
S.W. Z B.S. S₀ C.D.
□ = 1.75 16 24 .005 15
○ = 1.75 16 24 .020 15
△ = 1.75 16 24 .090 15
-- Computed Curve

Figure 87.

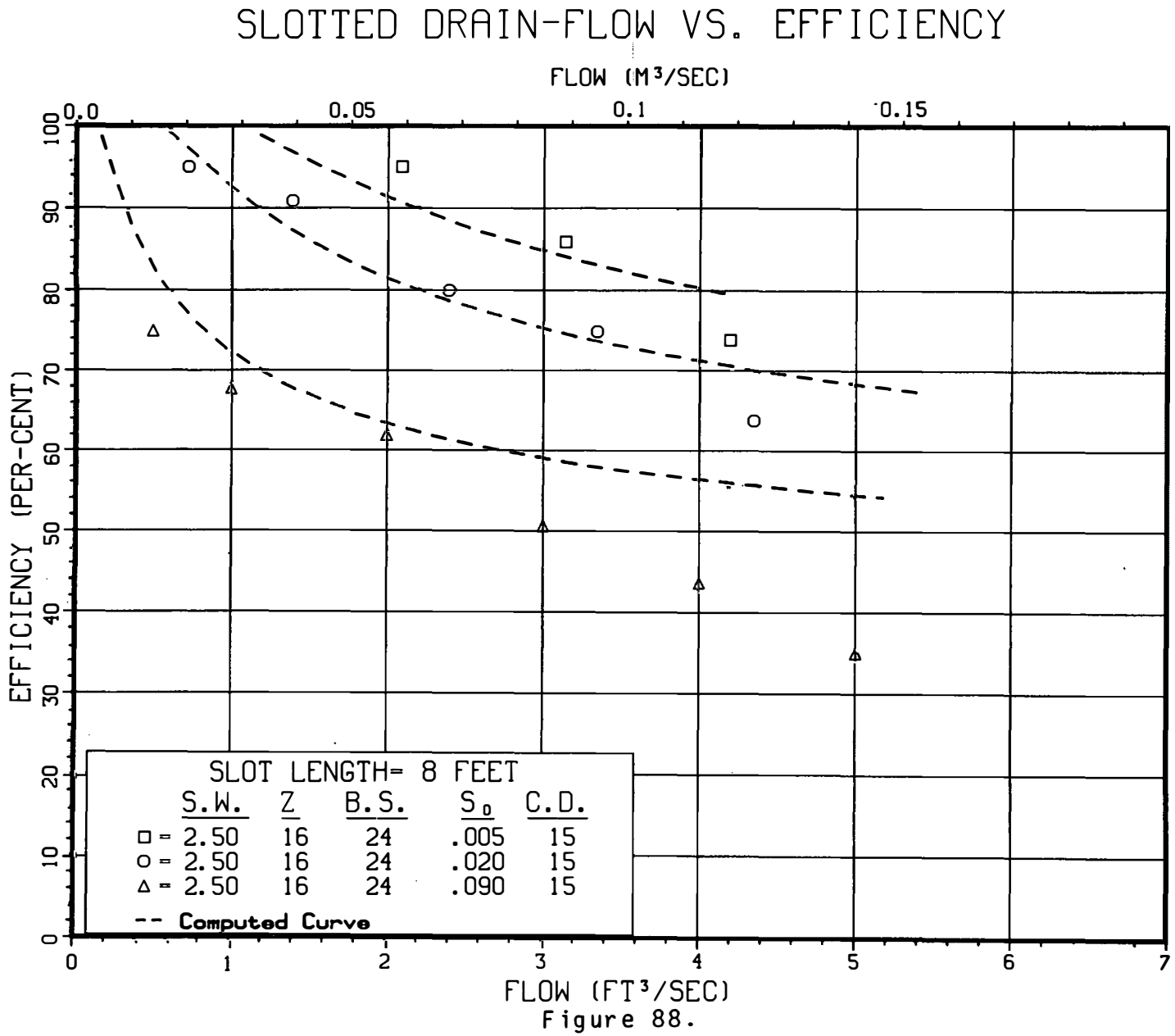

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH= 8 FEET
S.W. Z B.S. S₀ C.D.
□ = 2.50 16 24 .005 15
○ = 2.50 16 24 .020 15
△ = 2.50 16 24 .090 15
-- Computed Curve

Figure 88.

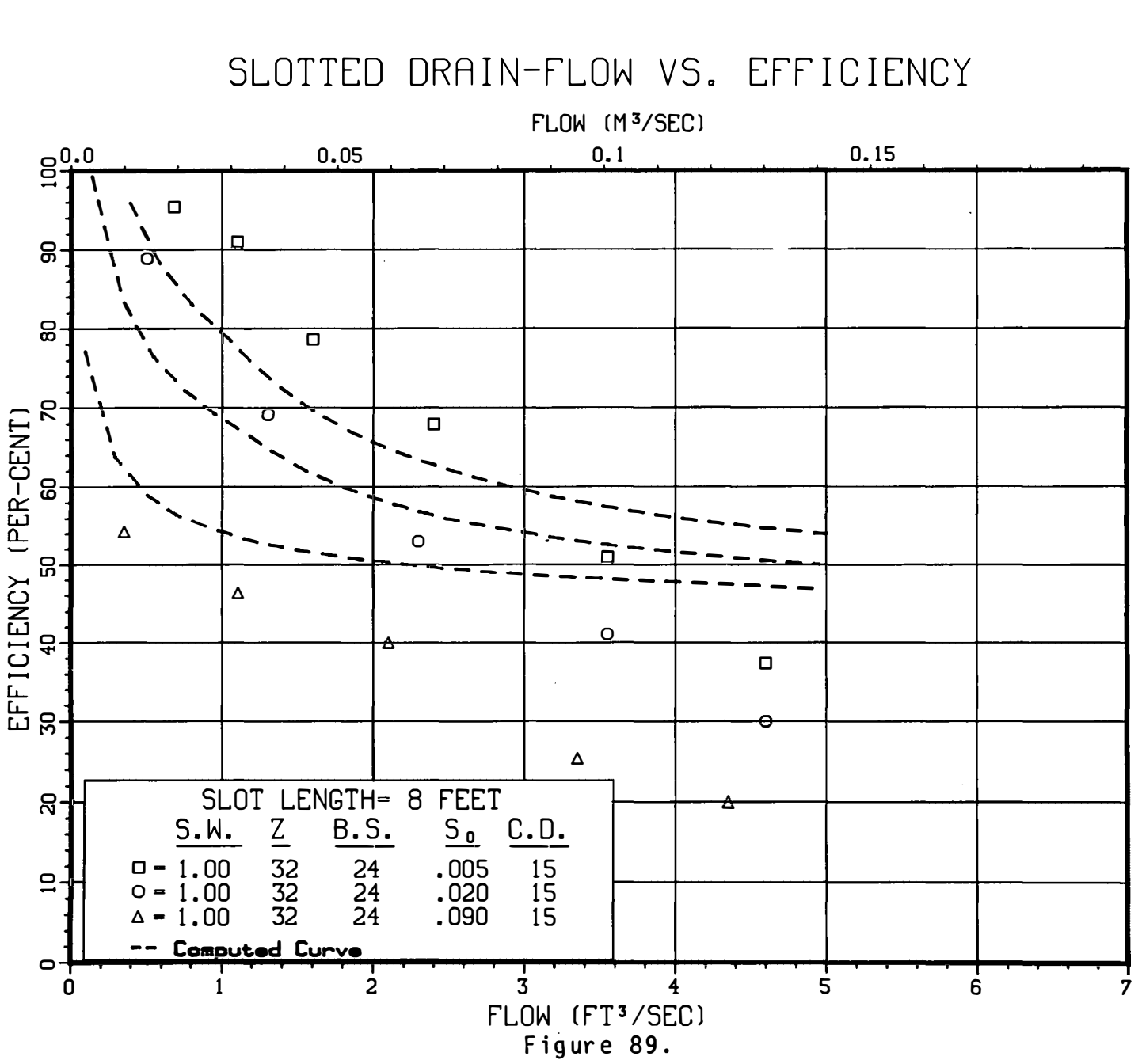

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH= 8 FEET
S.W. Z B.S. S₀ C.D.
□ = 1.00 32 24 .005 15
○ = 1.00 32 24 .020 15
△ = 1.00 32 24 .090 15
-- Computed Curve

Figure 89.

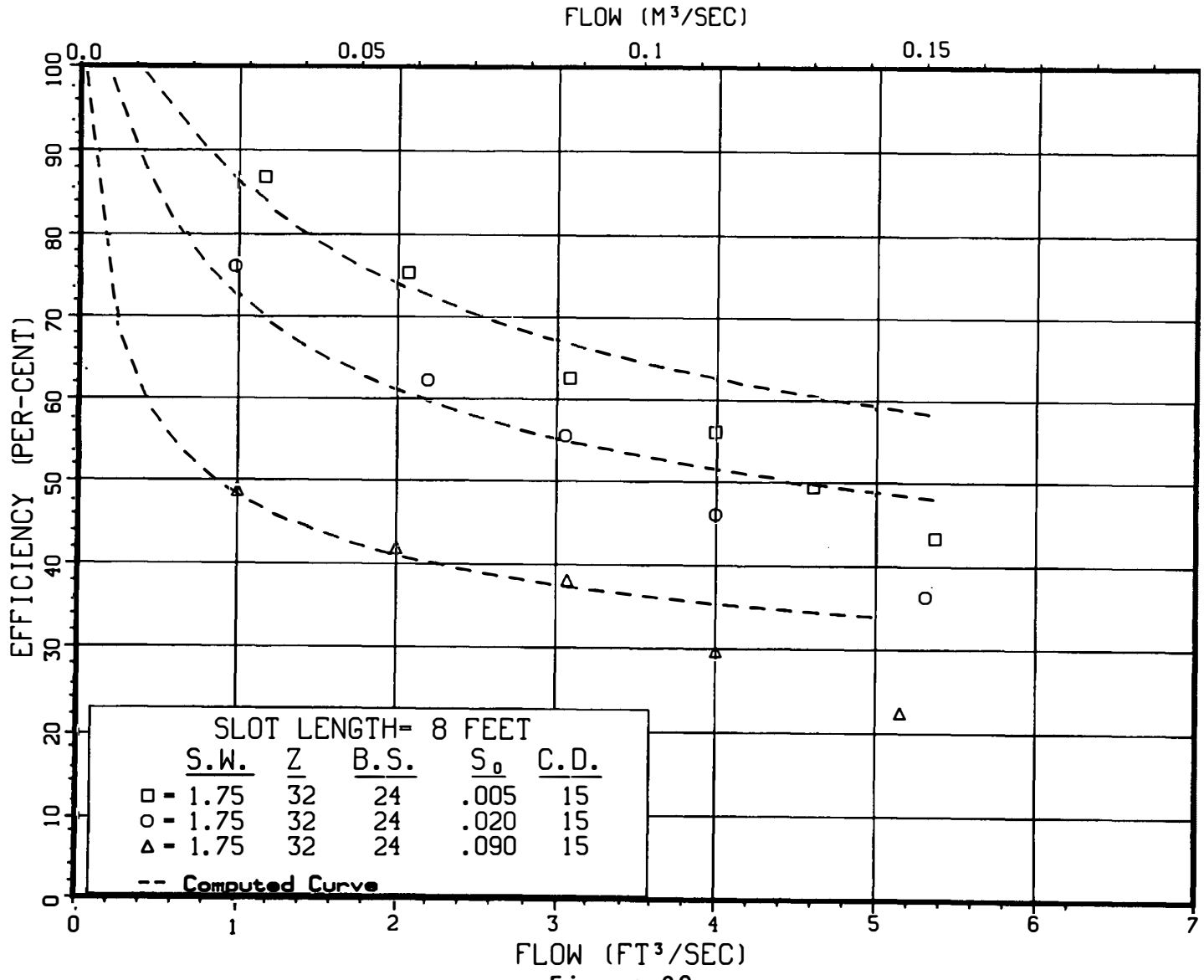

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH= 8 FEET
S.W. Z B.S. S₀ C.D.
□ = 1.75 32 24 .005 15
○ = 1.75 32 24 .020 15
△ = 1.75 32 24 .090 15
-- Computed Curve

Figure 90.

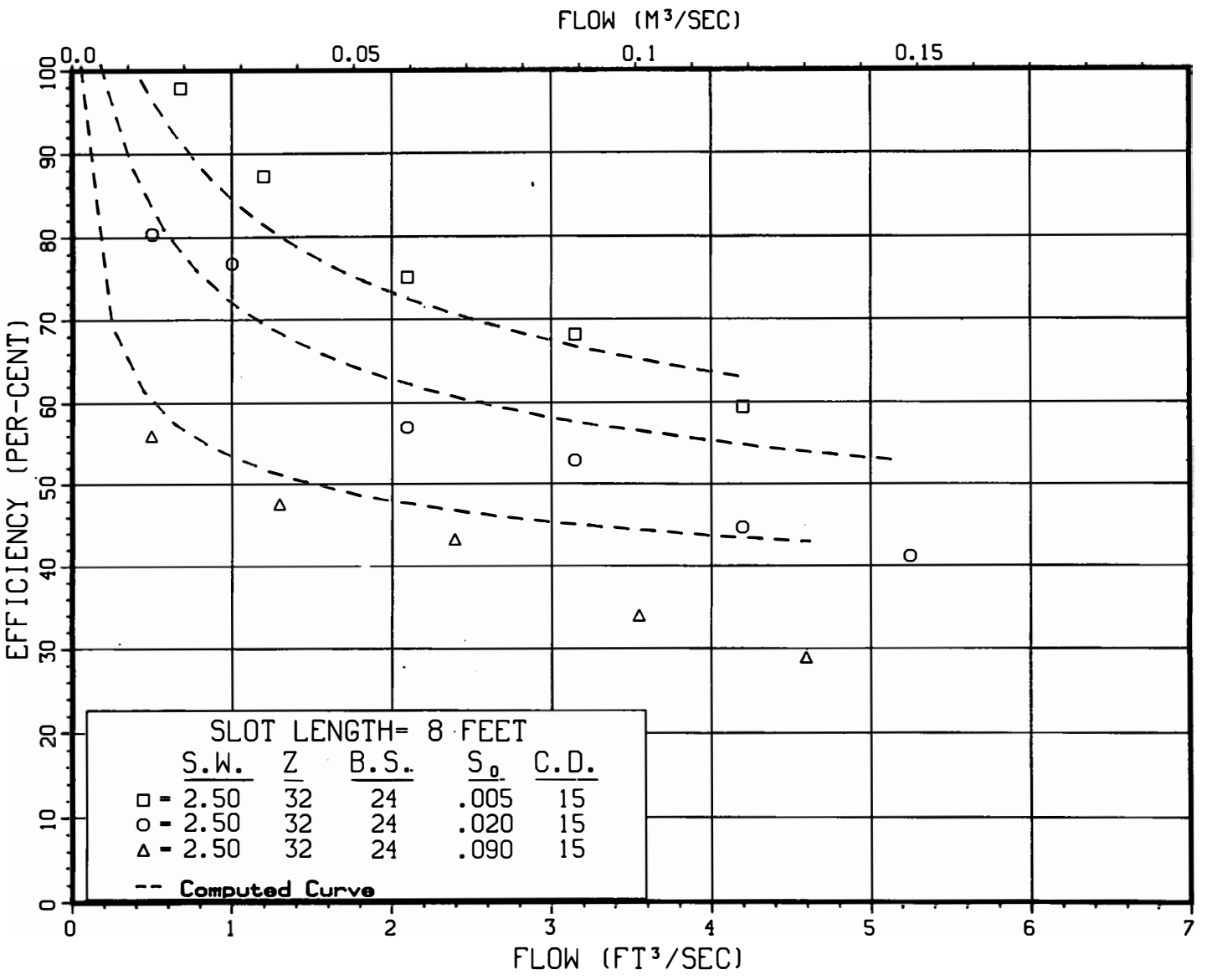

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH= 8 FEET
S.W. Z B.S. S0 C.D.
□ = 2.50 32 24 .005 15
○ = 2.50 32 24 .020 15
△ = 2.50 32 24 .090 15
-- Computed Curve

Figure 91.

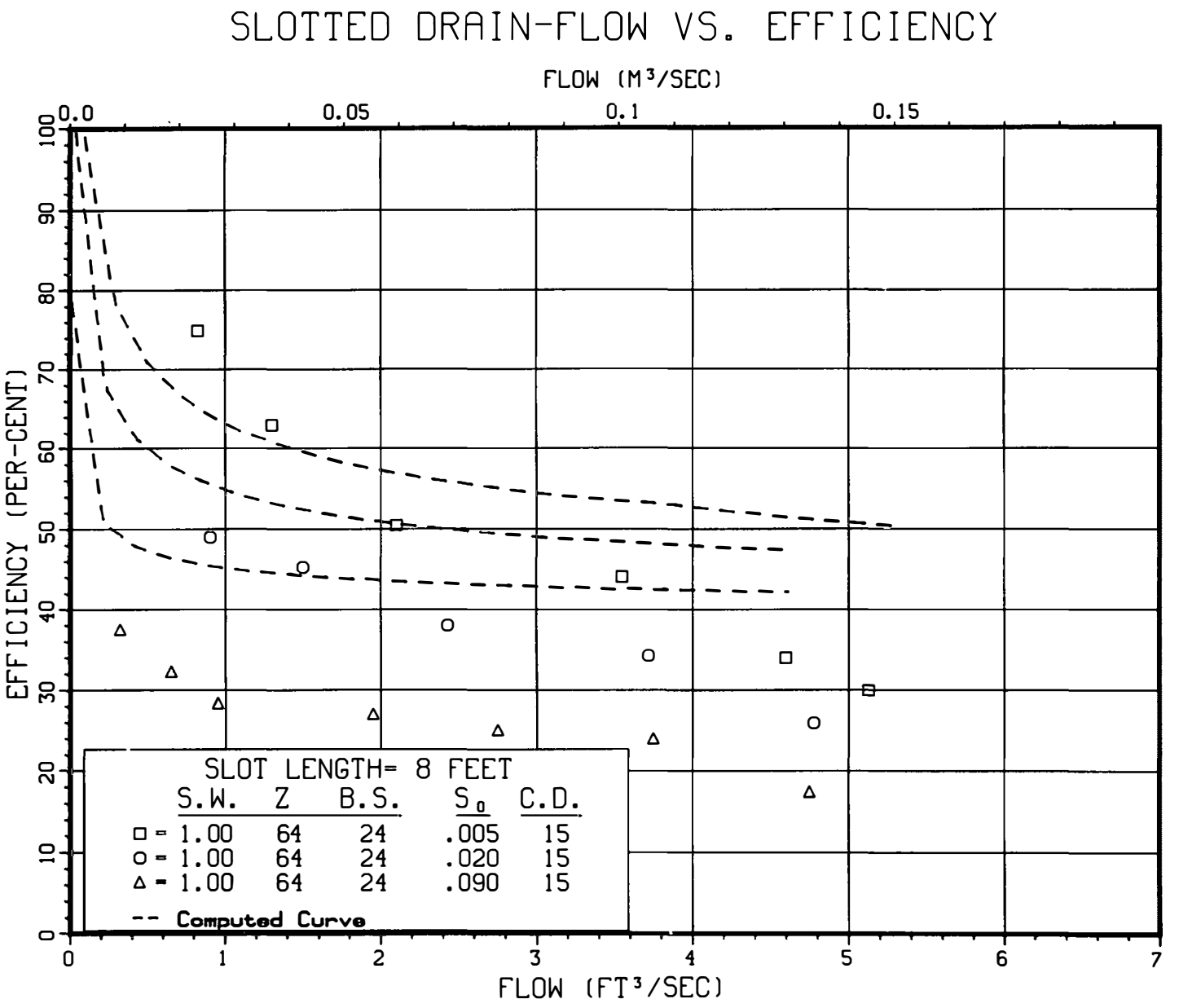

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH= 8 FEET
S.W. Z B.S. S₀ C.D.
□ = 1.00 64 24 .005 15
○ = 1.00 64 24 .020 15
△ = 1.00 64 24 .090 15
-- Computed Curve

Figure 92.

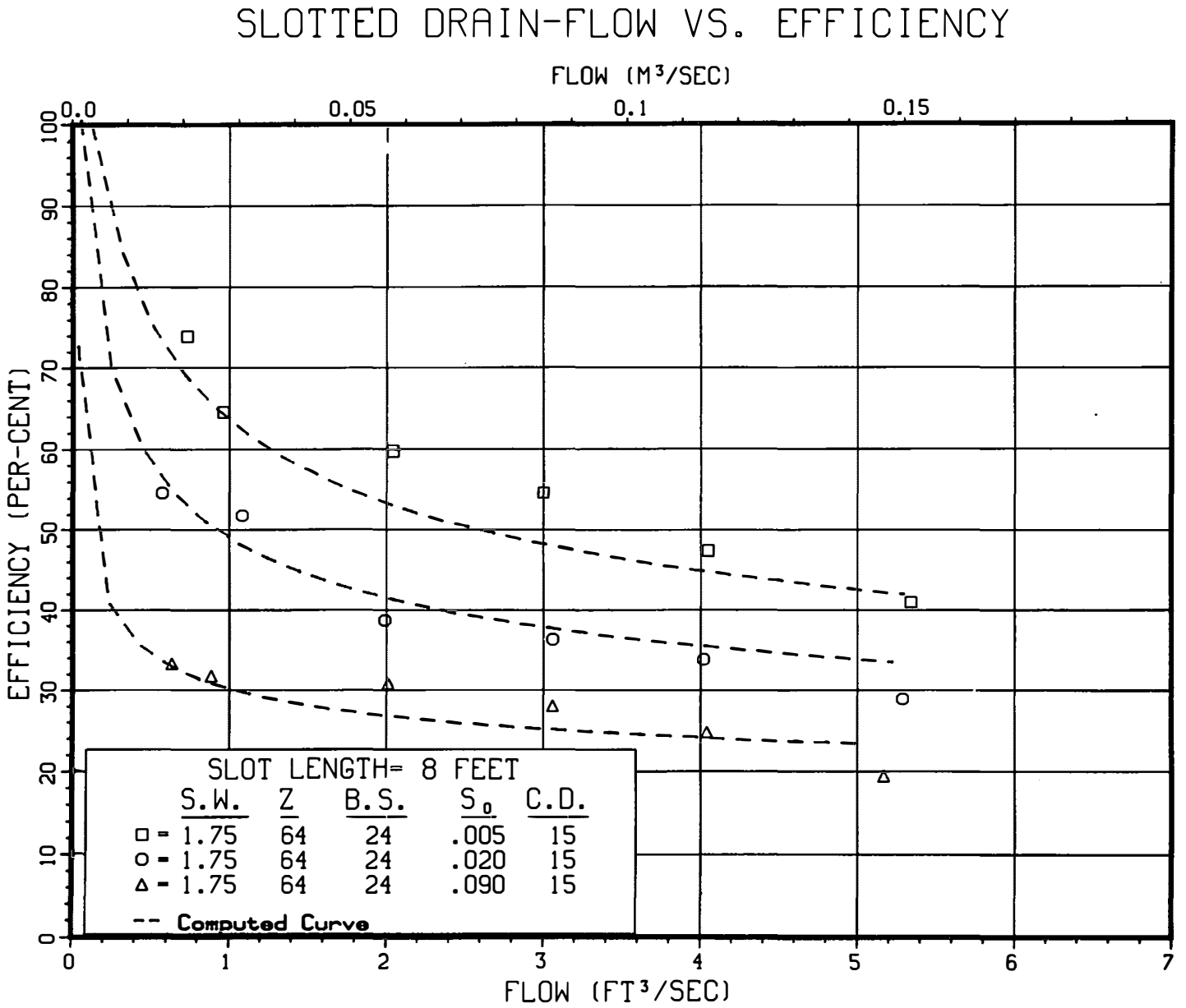

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH= 8 FEET
S.W. Z B.S. S0 C.D.
□ = 1.75 64 24 .005 15
○ = 1.75 64 24 .020 15
△ = 1.75 64 24 .090 15
-- Computed Curve

**Figure 93.**

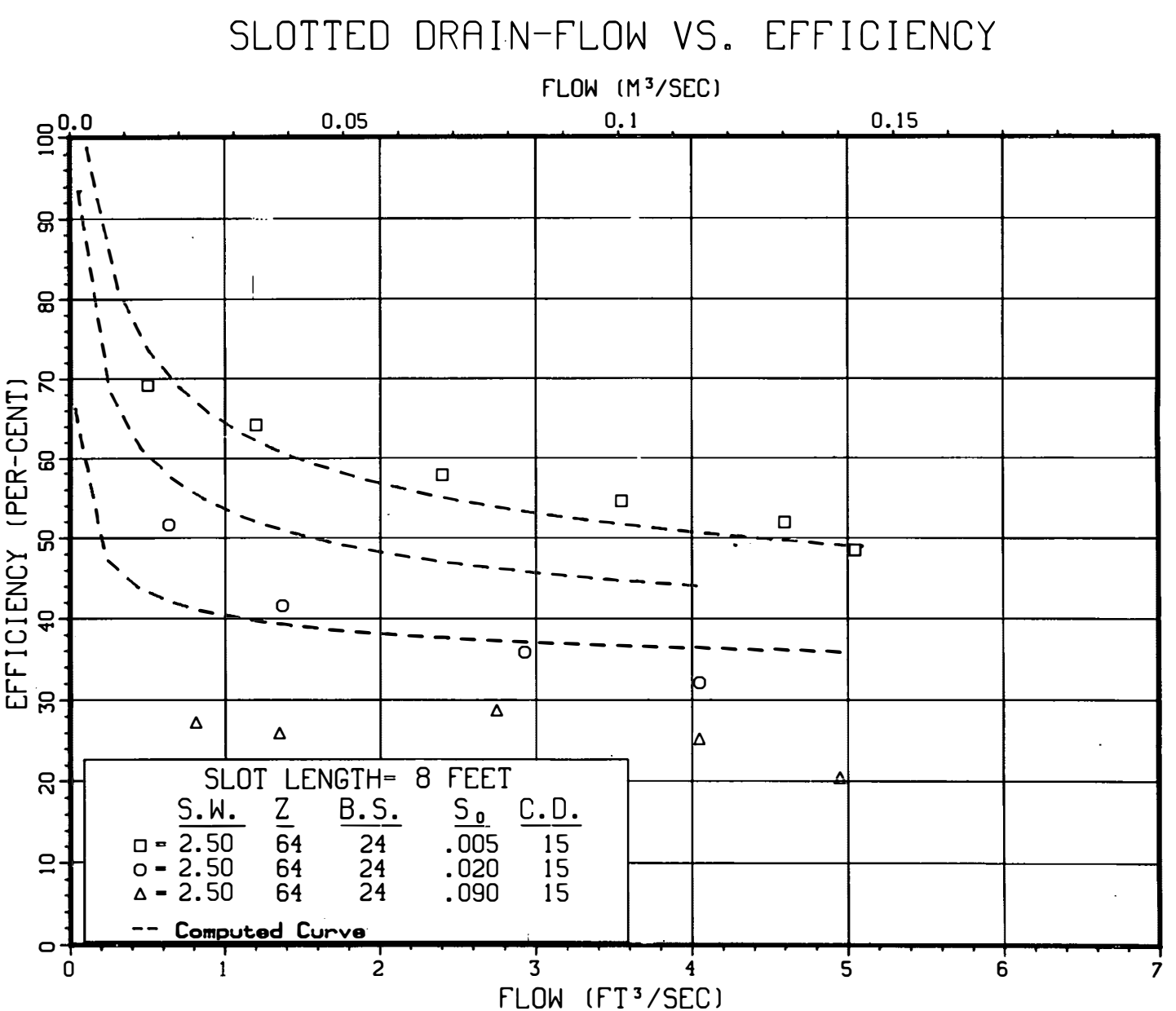

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH= 8 FEET
S.W. Z B.S. S₀ C.D.
□ = 2.50 64 24 .005 15
○ = 2.50 64 24 .020 15
△ = 2.50 64 24 .090 15
-- Computed Curve

Figure 94.

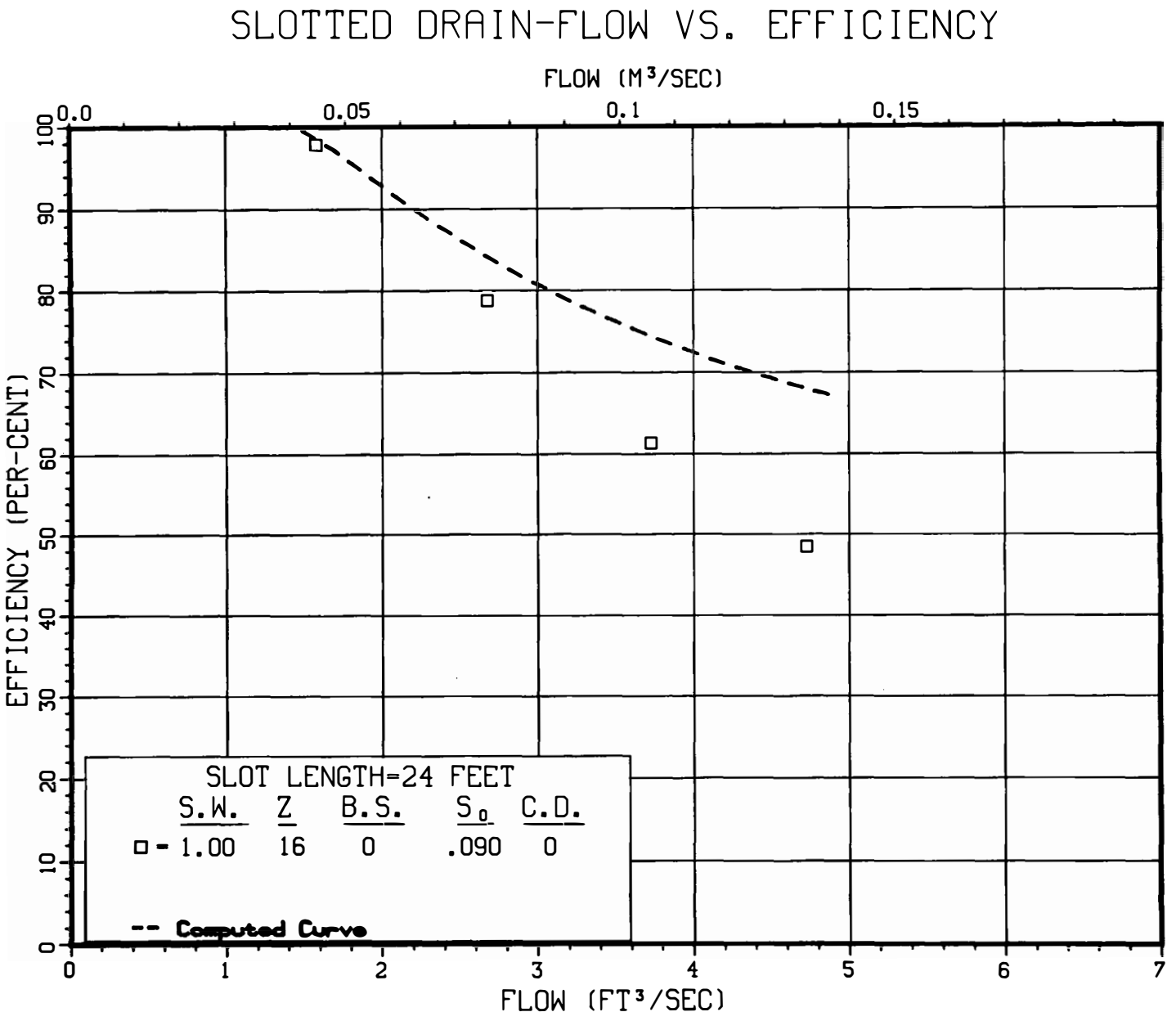

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH=24 FEET
S.W. Z B.S. S₀ C.D.
□ - 1.00 16 0 .090 0
-- Computed Curve

Figure 95.

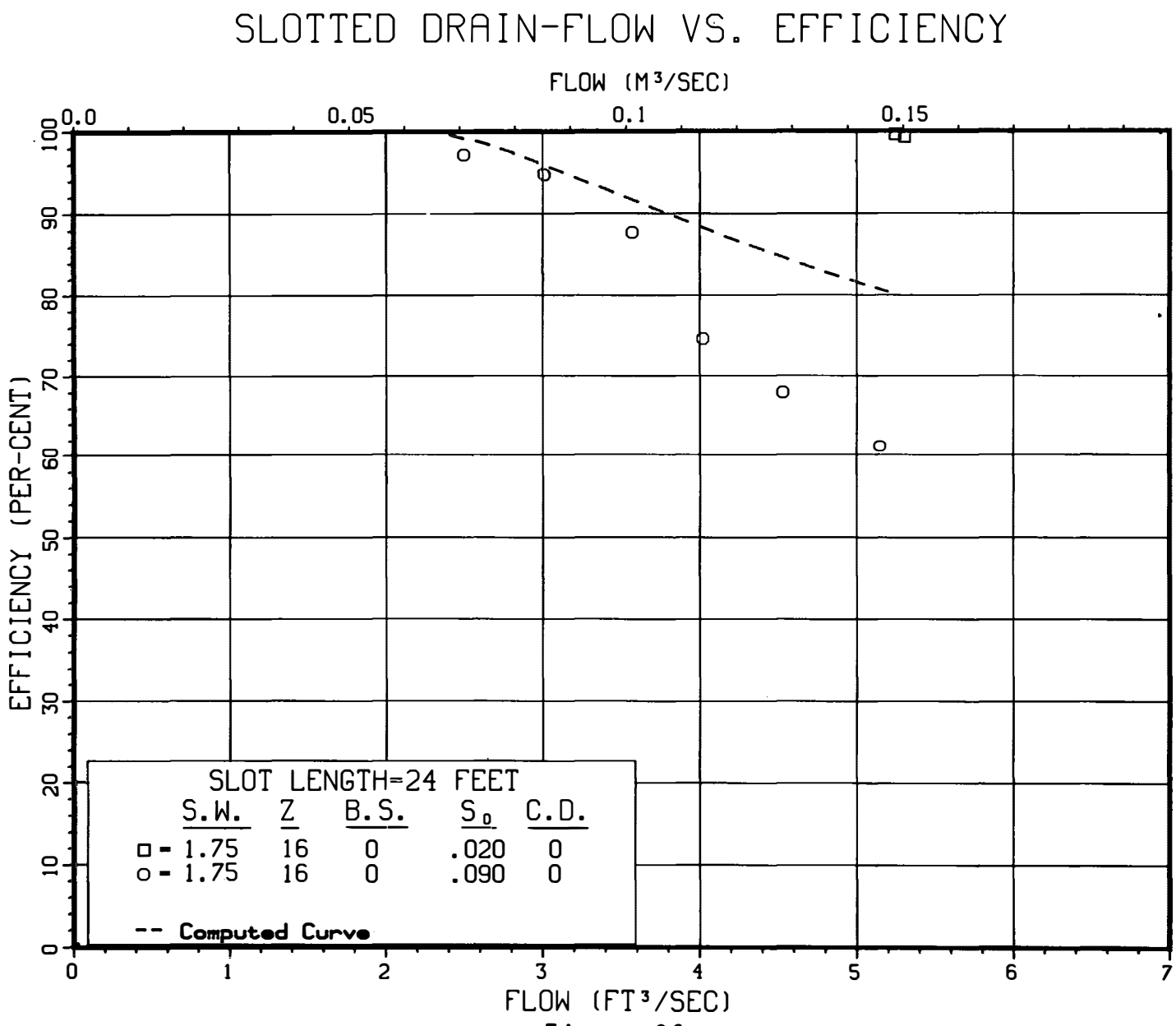

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
SLOT LENGTH=24 FEET
S.W. Z B.S. S₀ C.D.
□ - 1.75 16 0 .020 0
○ - 1.75 16 0 .090 0
-- Computed Curve
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)

Figure 96.

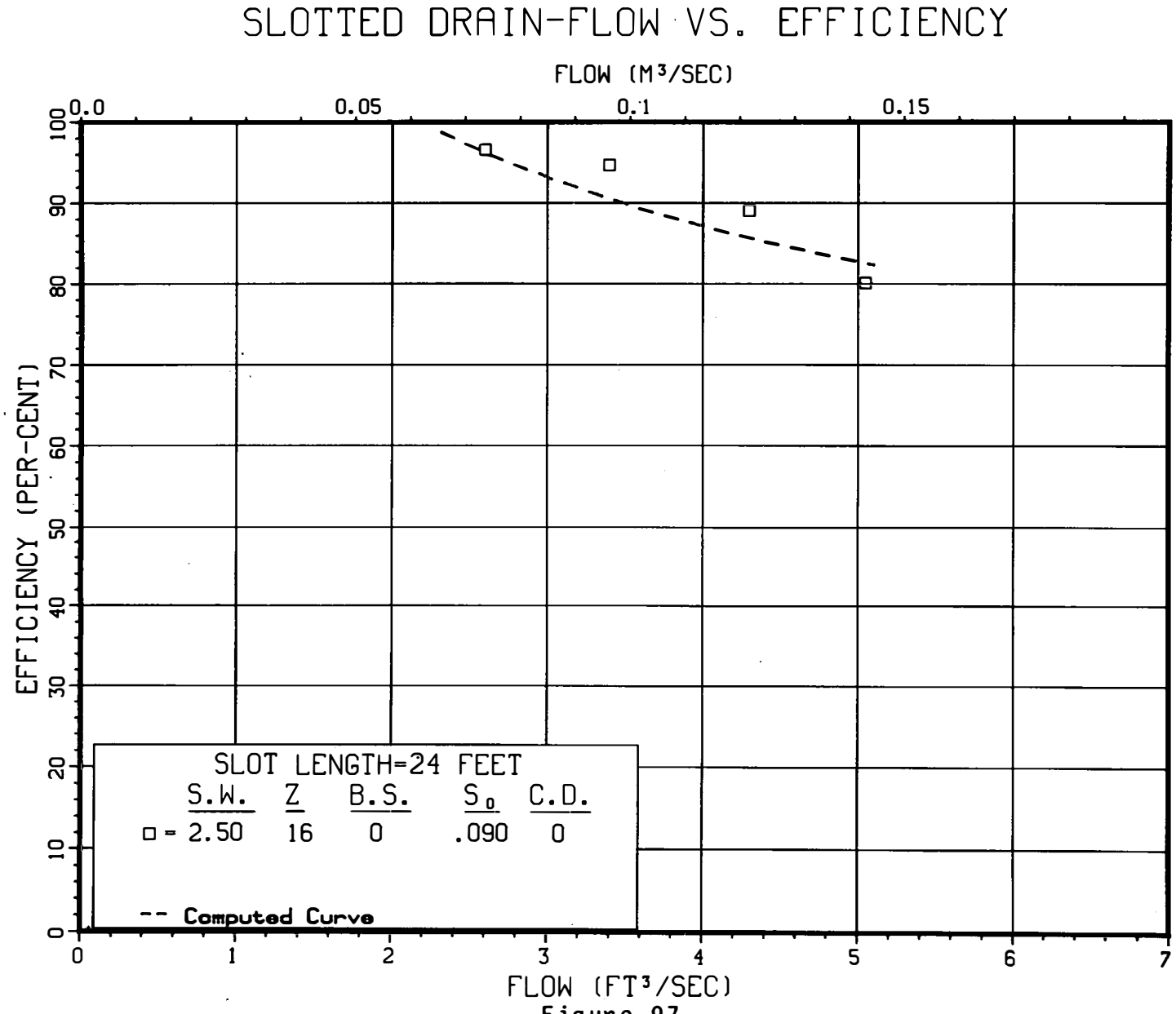

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH=24 FEET
S.W. Z B.S. S₀ C.D.
□ = 2.50 16 0 .090 0
-- Computed Curve

**Figure 97.**

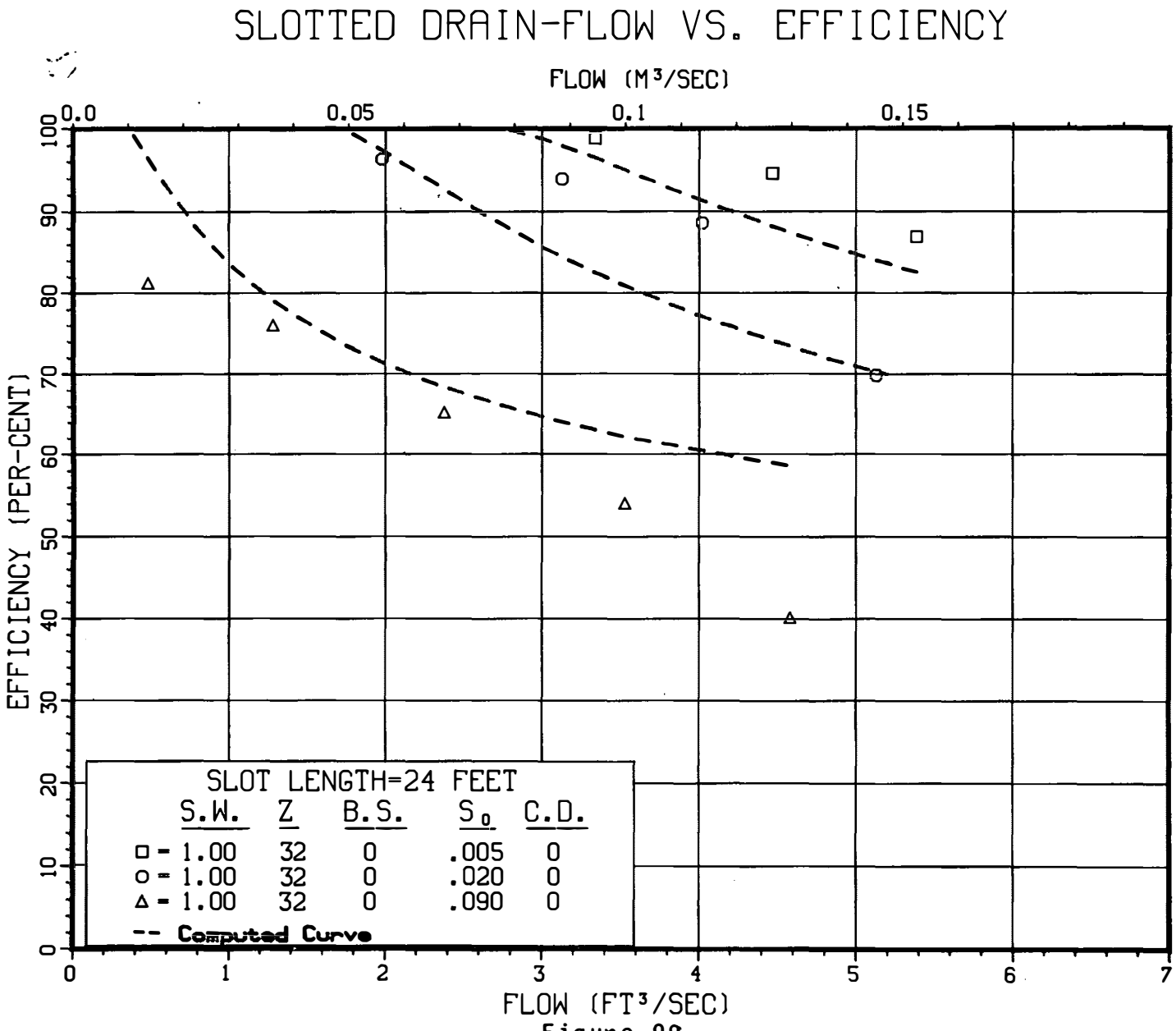

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH=24 FEET
S.W. Z B.S. S₀ C.D.
□ = 1.00 32 0 .005 0
○ = 1.00 32 0 .020 0
△ = 1.00 32 0 .090 0
-- Computed Curve

Figure 98.

# SLOTTED DRAIN-FLOW VS. EFFICIENCY

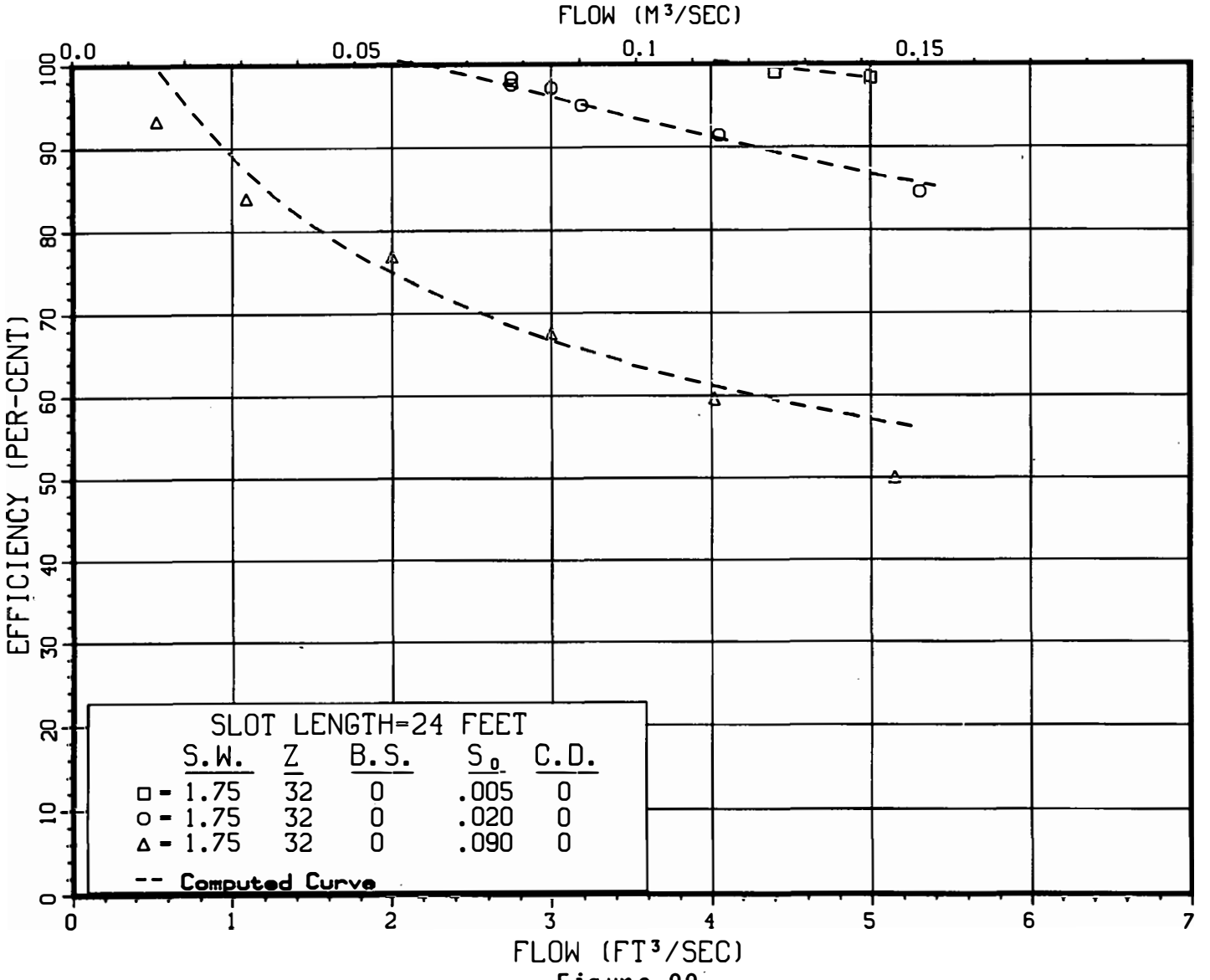



Figure 99.

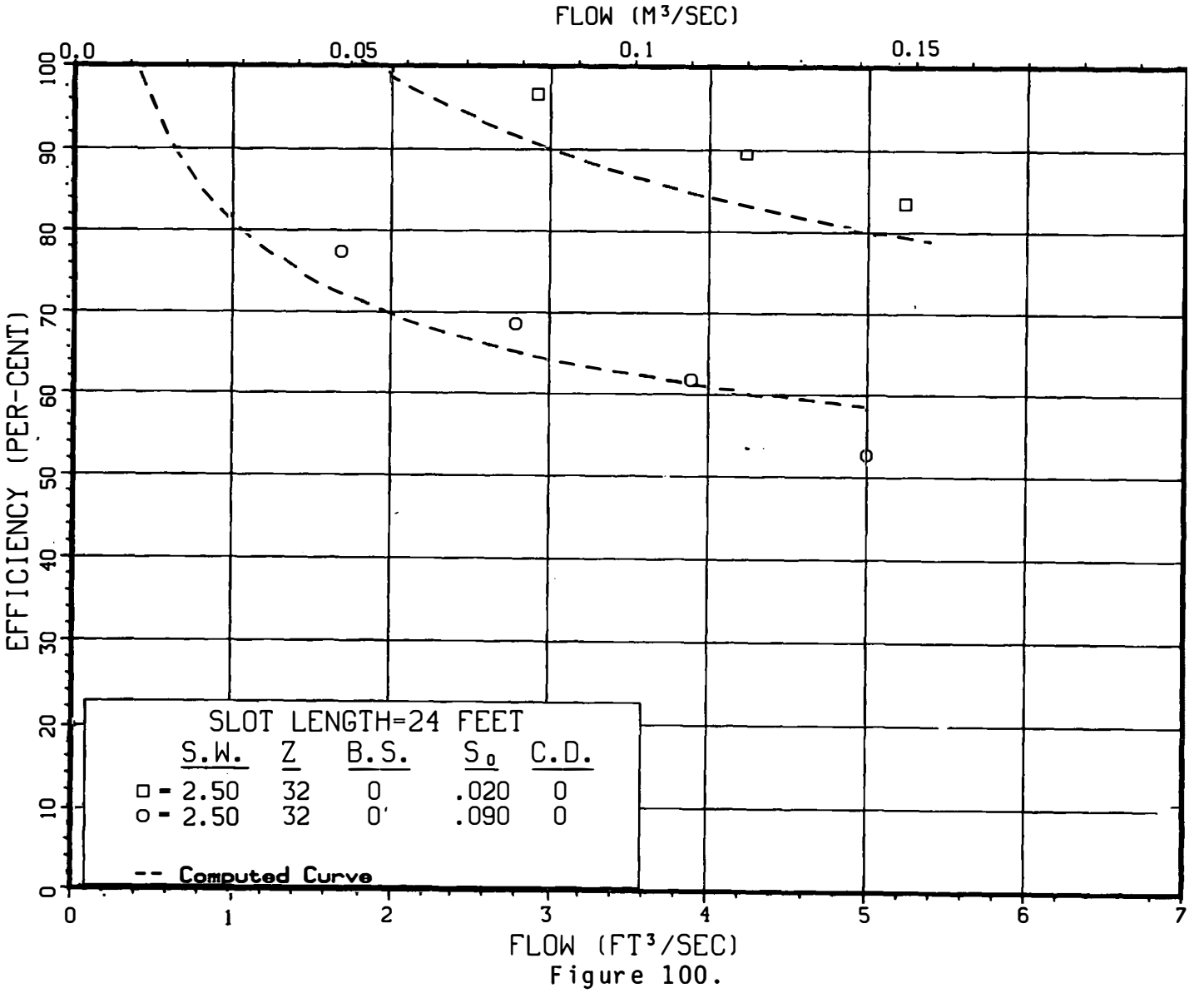

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
SLOT LENGTH=24 FEET
S.W. Z B.S. S₀ C.D.
□ = 2.50 32 0 .020 0
o = 2.50 32 0' .090 0
-- Computed Curve
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)

Figure 100.

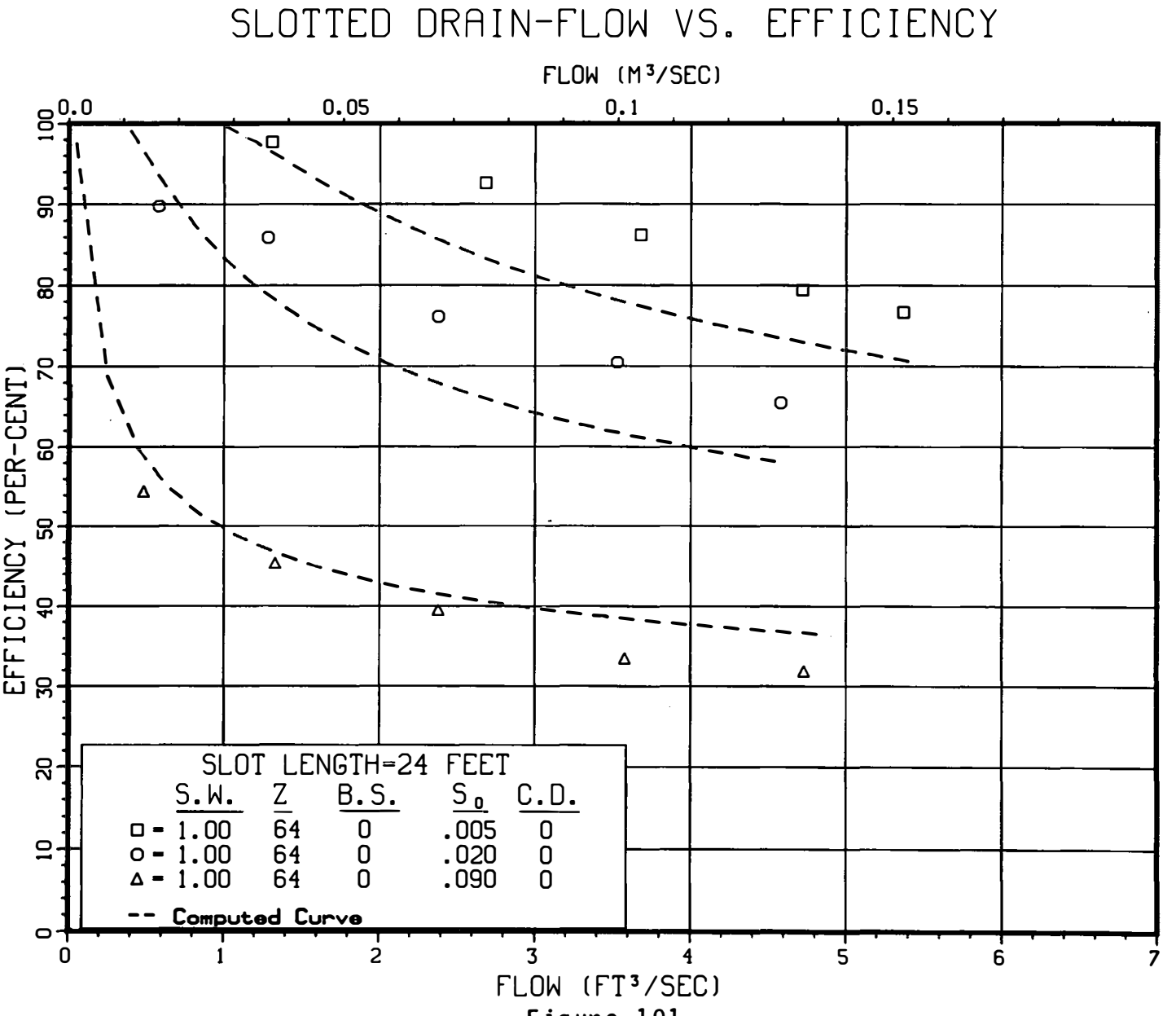

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH=24 FEET
S.W. Z B.S. S0 C.D.
□ - 1.00 64 0 .005 0
○ - 1.00 64 0 .020 0
△ - 1.00 64 0 .090 0
-- Computed Curve

Figure 101.

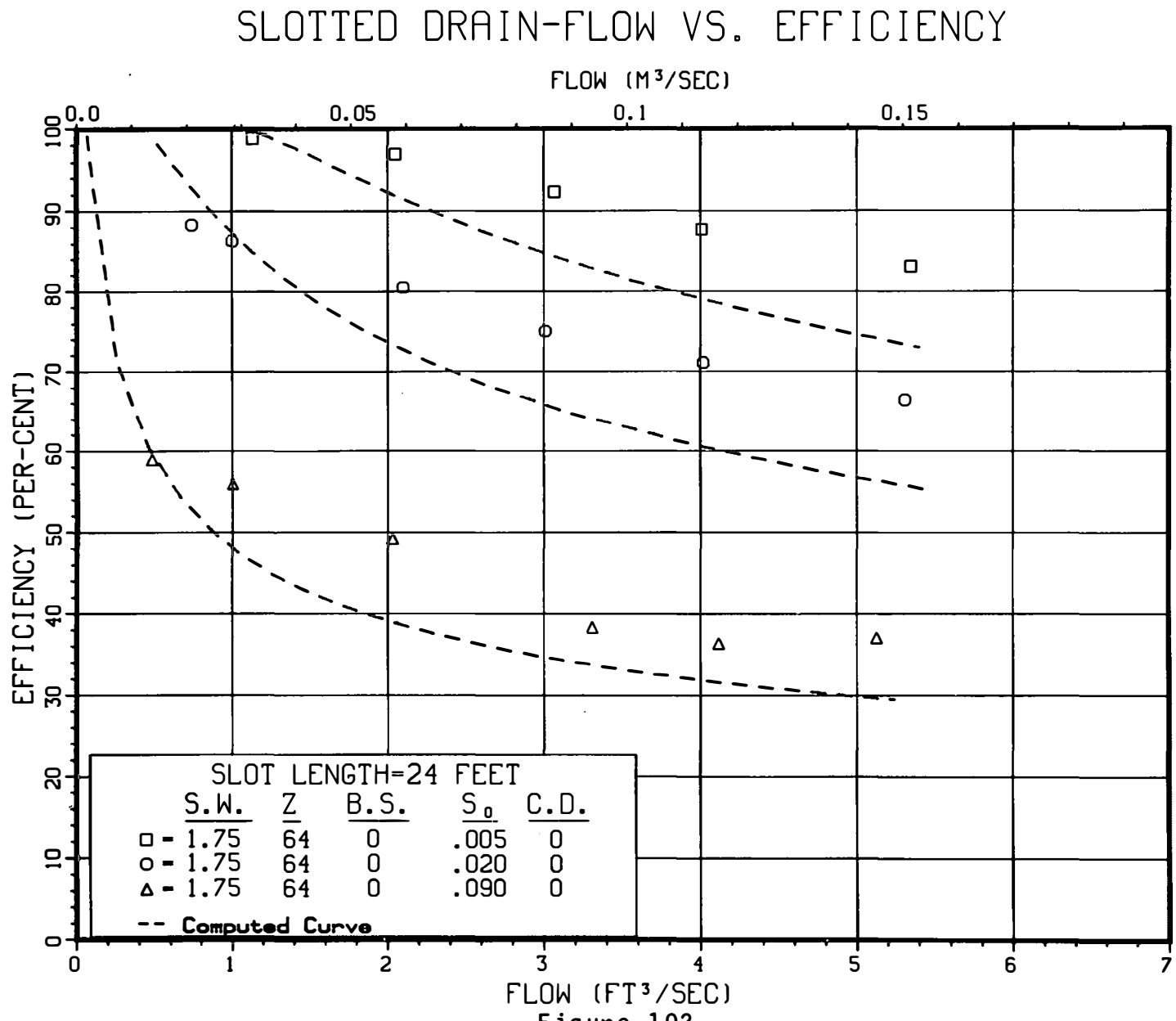

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH=24 FEET
S.W. Z B.S. S₀ C.D.
□ - 1.75 64 0 .005 0
○ - 1.75 64 0 .020 0
△ - 1.75 64 0 .090 0
-- Computed Curve

Figure 102.

# SLOTTED DRAIN-FLOW VS. EFFICIENCY

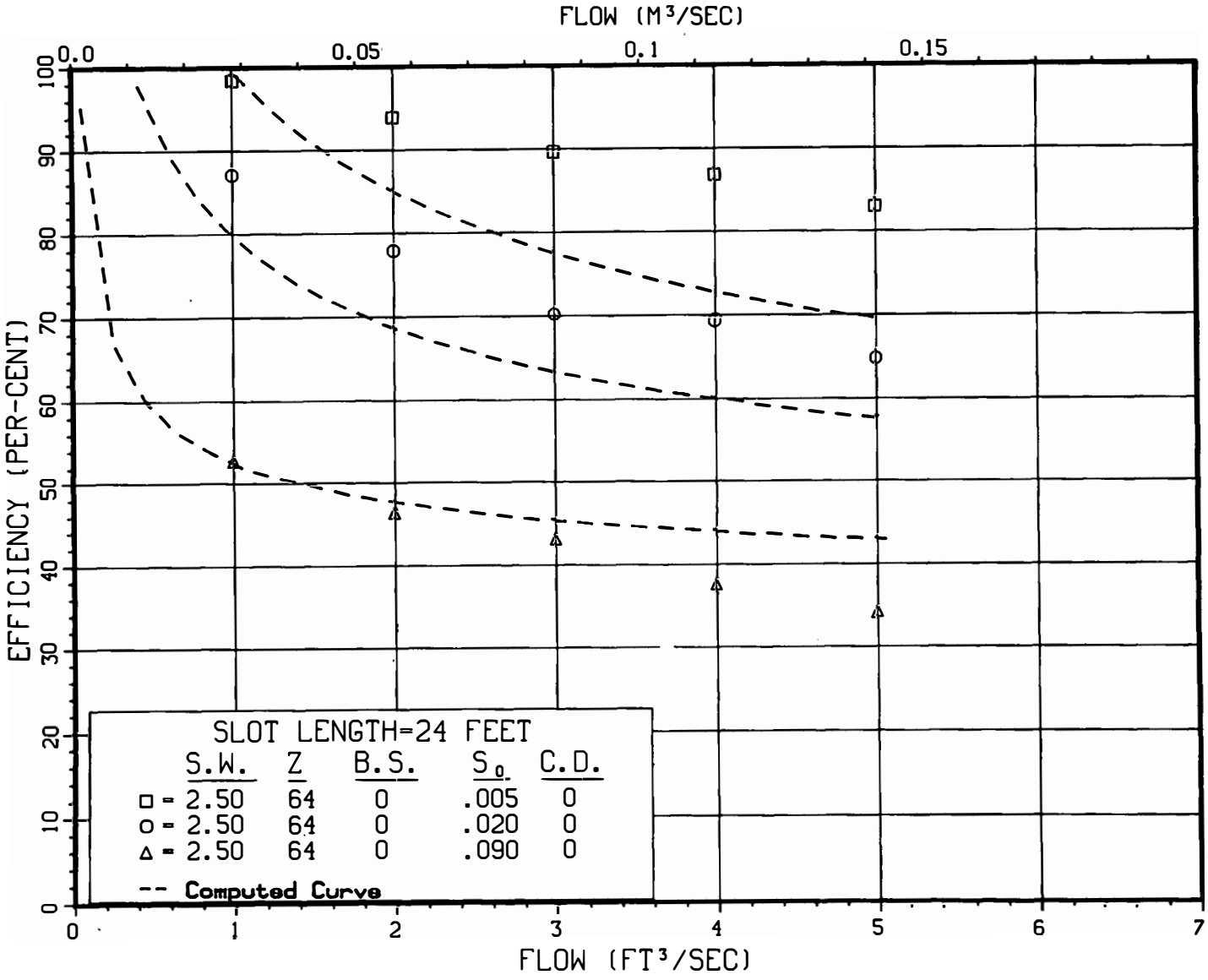



Figure 103.

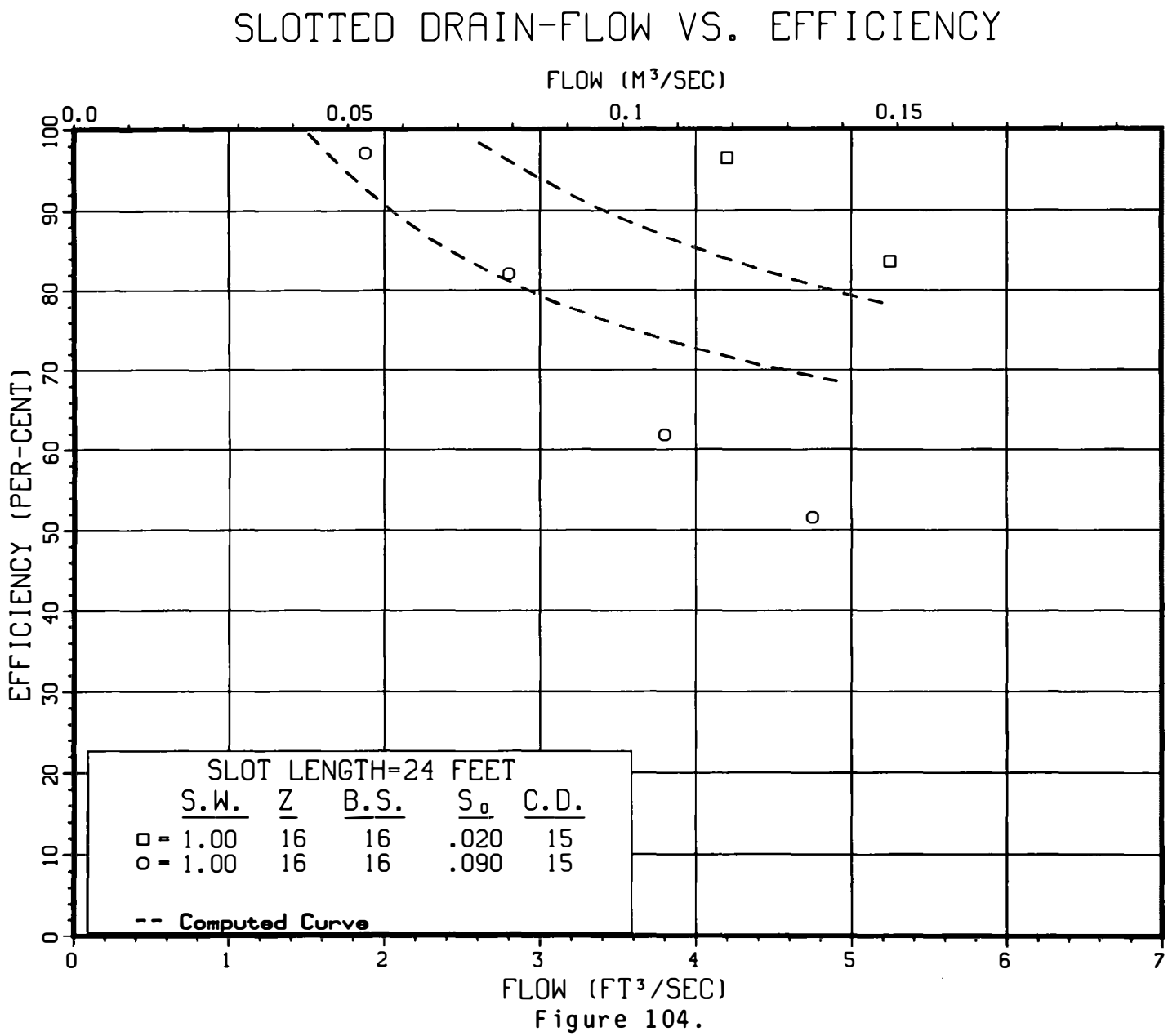

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
SLOT LENGTH=24 FEET
S.W. Z B.S. S0 C.D.
□ = 1.00 16 16 .020 15
o = 1.00 16 16 .090 15
-- Computed Curve
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)

Figure 104.

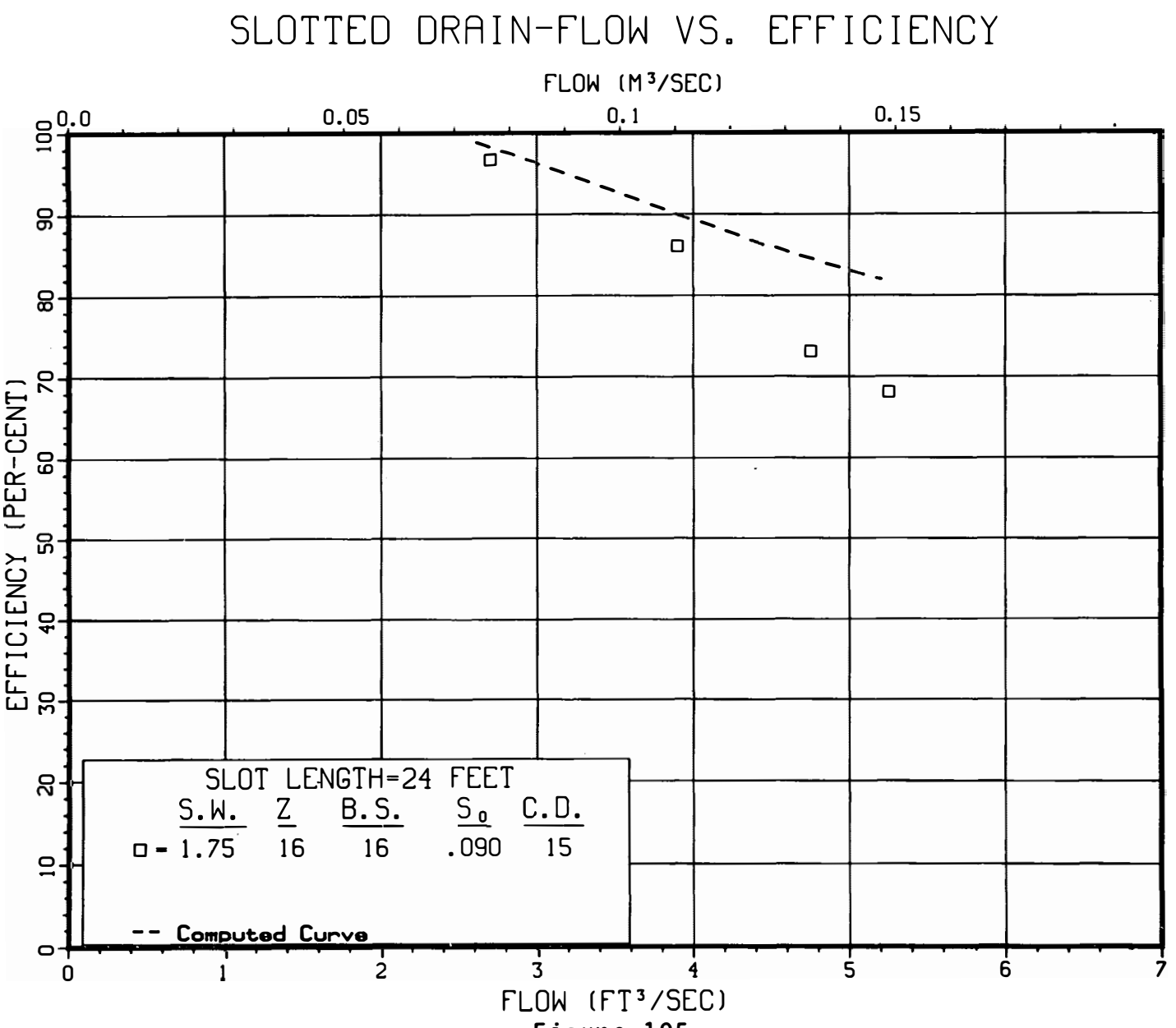

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
100
90
80
70
60
50
40
30
20
10
0
SLOT LENGTH=24 FEET
S.W. Z B.S. S₀ C.D.
□ - 1.75 16 16 .090 15
-- Computed Curve
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)

**Figure 105.**

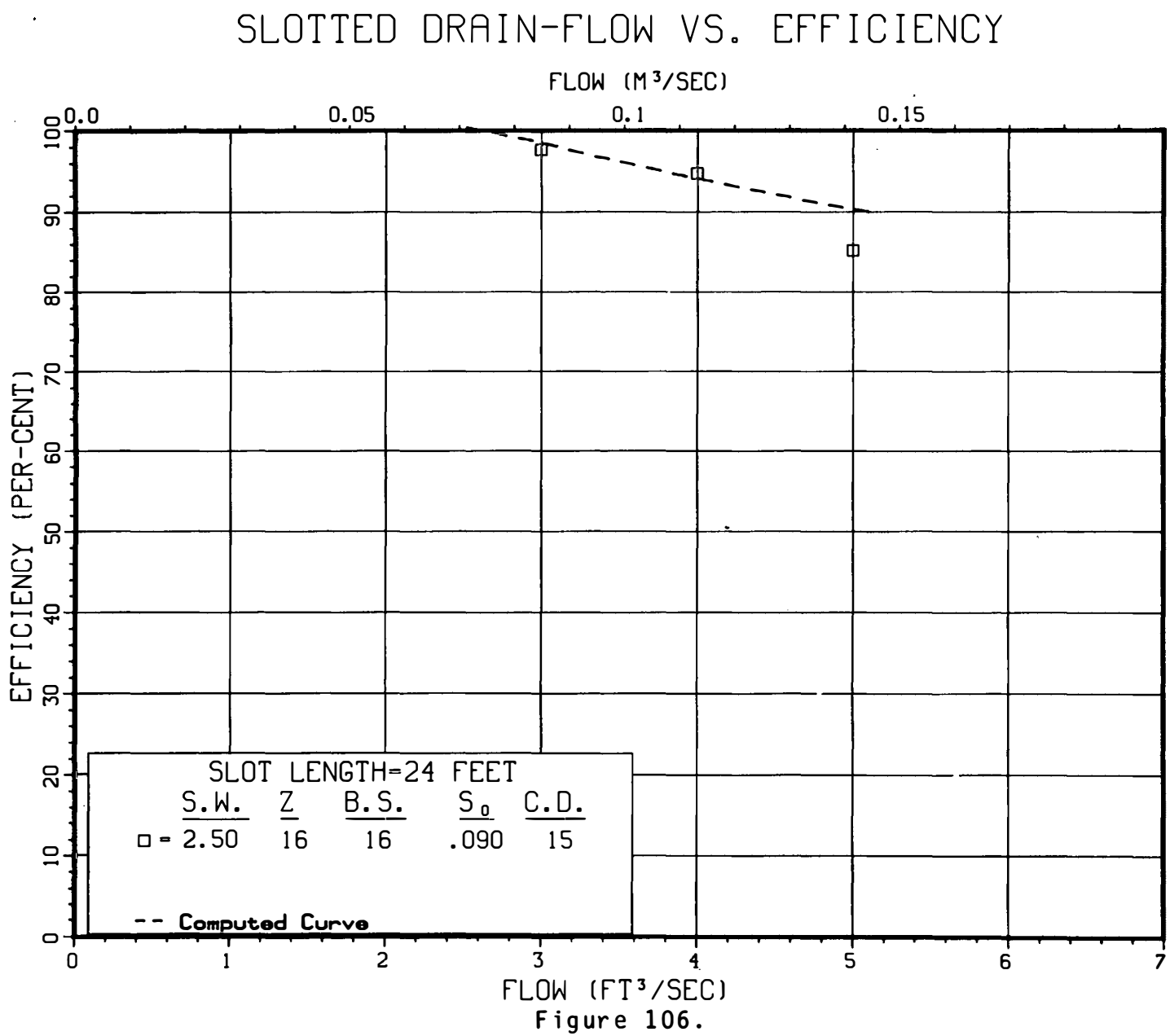

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
100
90
80
70
60
50
40
30
20
10
0
SLOT LENGTH=24 FEET
S.W. Z B.S. S₀ C.D.
□ = 2.50 16 16 .090 15
-- Computed Curve
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)

Figure 106.

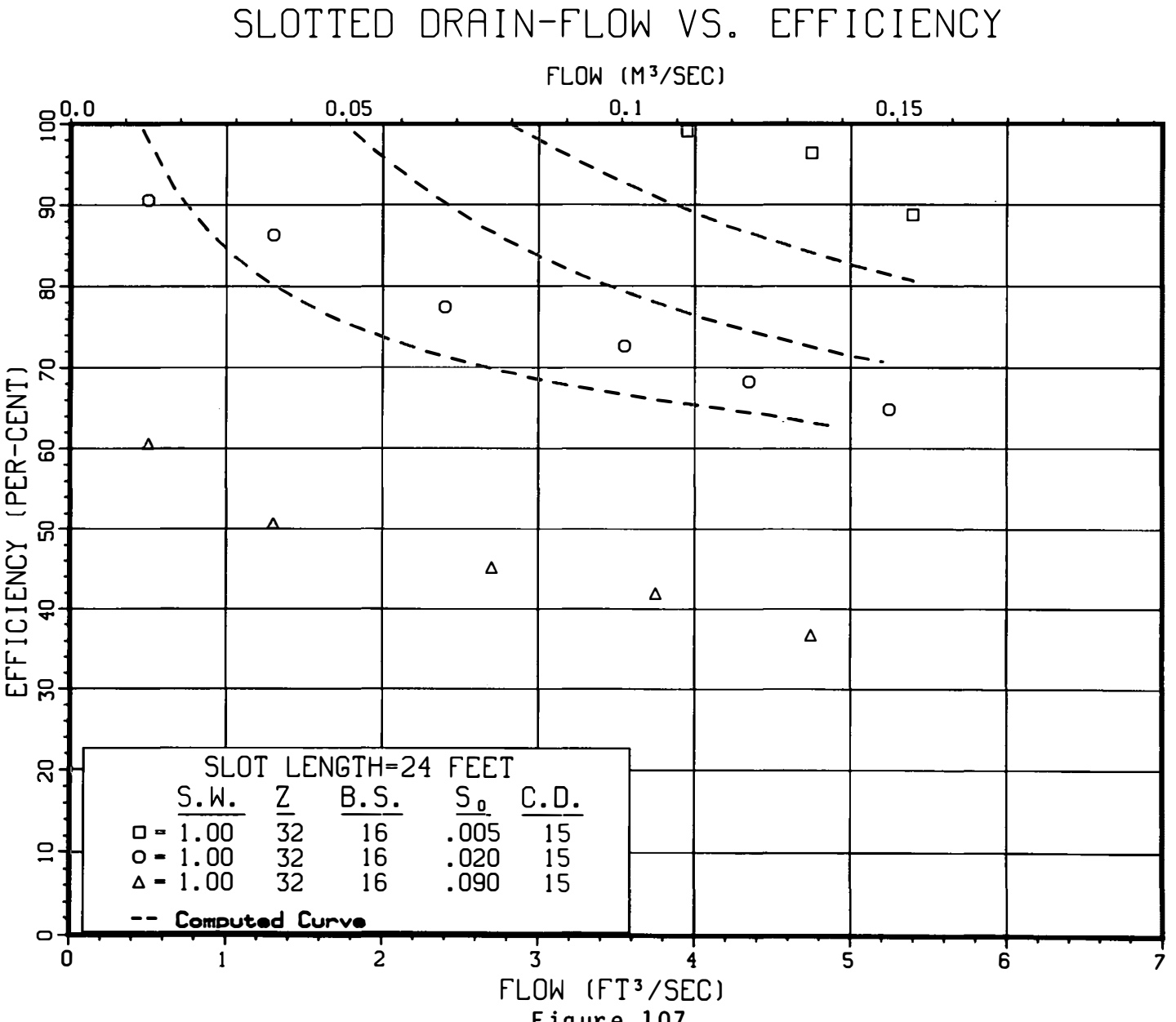

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH=24 FEET
S.W. Z B.S. S₀ C.D.
□ = 1.00 32 16 .005 15
o = 1.00 32 16 .020 15
Δ = 1.00 32 16 .090 15
-- Computed Curve

Figure 107.

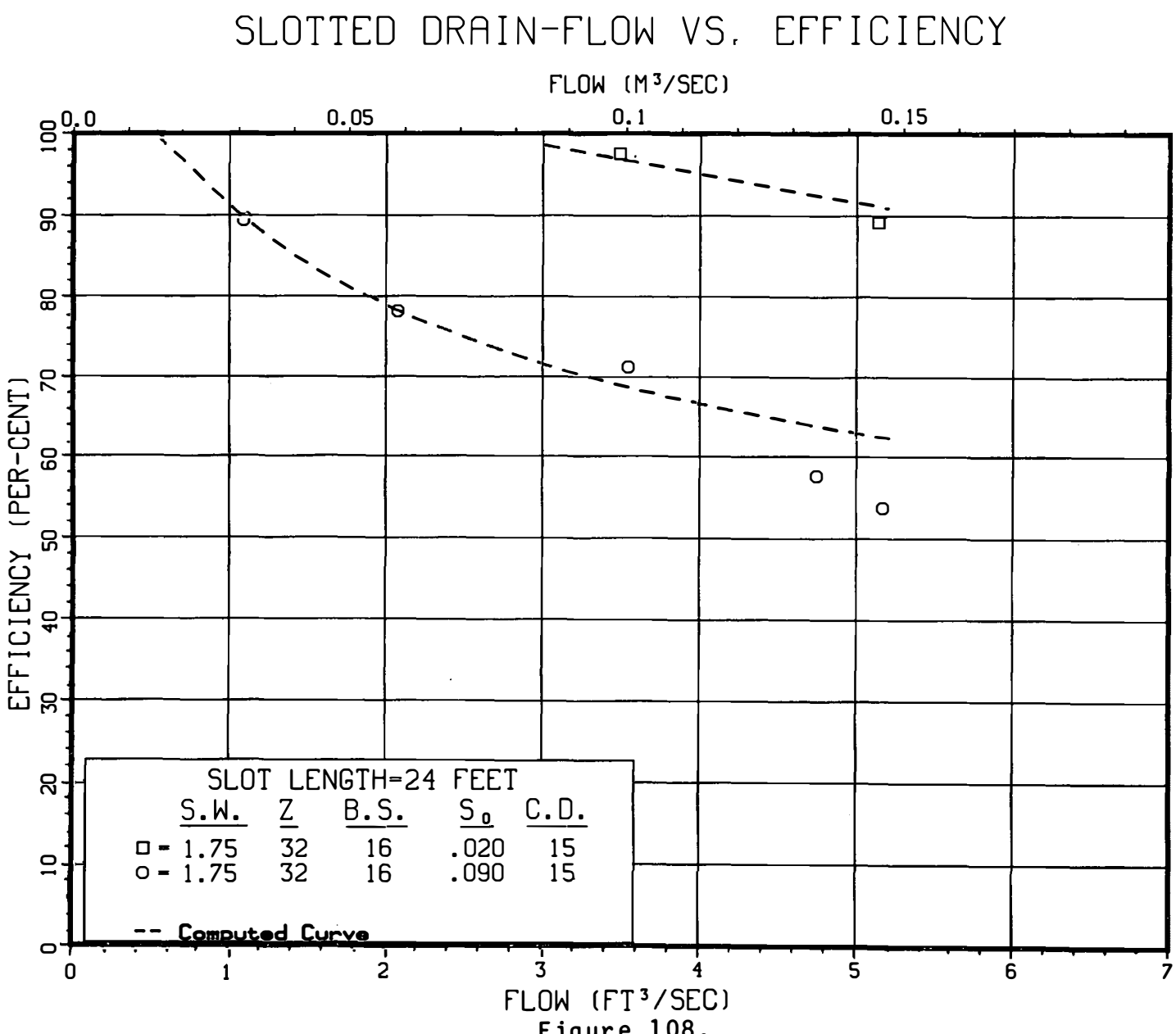

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
100
90
80
70
60
50
40
30
20
10
0
SLOT LENGTH=24 FEET
S.W. Z B.S. S₀ C.D.
□ - 1.75 32 16 .020 15
o - 1.75 32 16 .090 15
-- Computed Curve
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)

Figure 108.

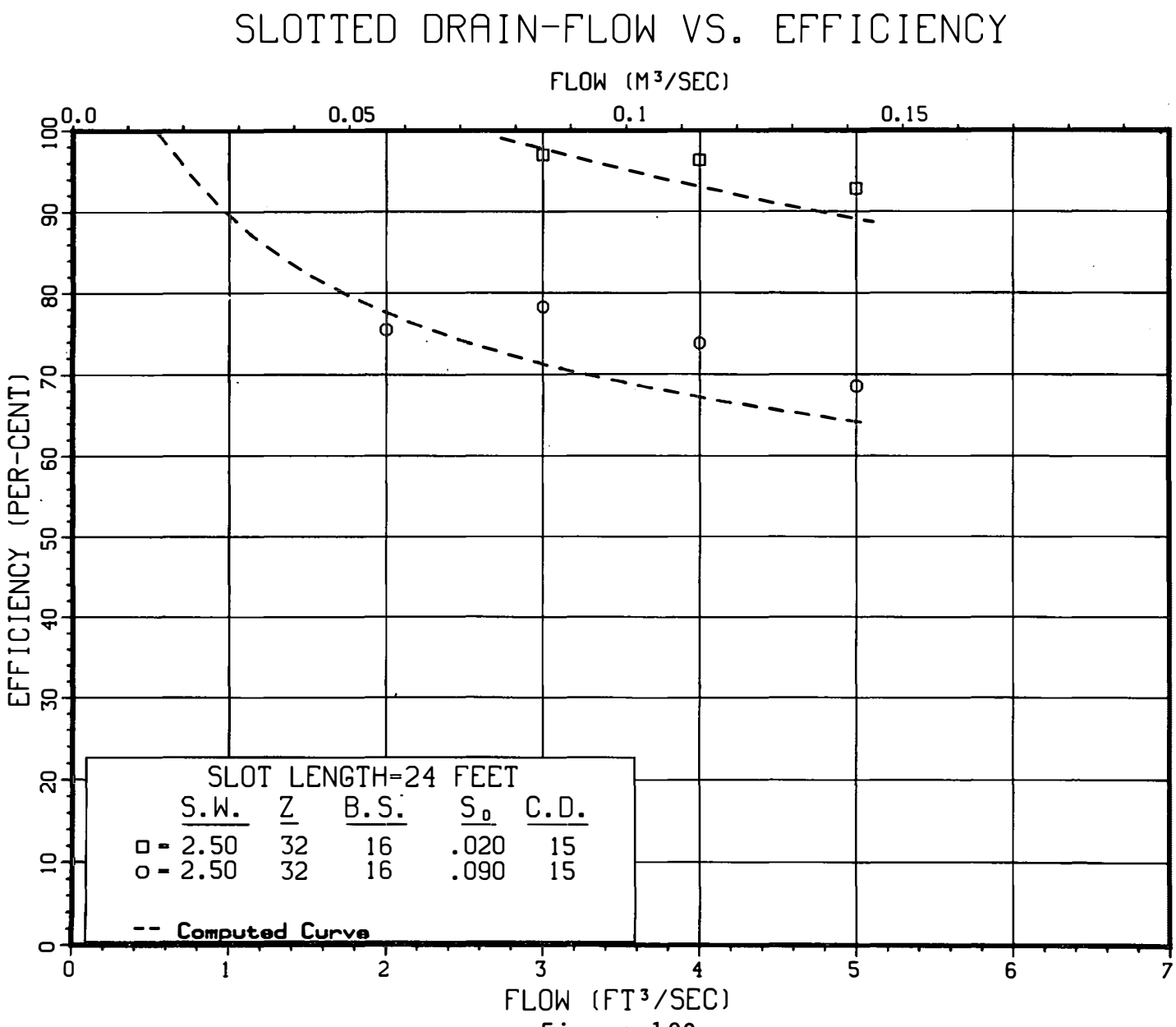

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
SLOT LENGTH=24 FEET
S.W. Z B.S. S₀ C.D.
□ - 2.50 32 16 .020 15
o - 2.50 32 16 .090 15
-- Computed Curve
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)

Figure 109.

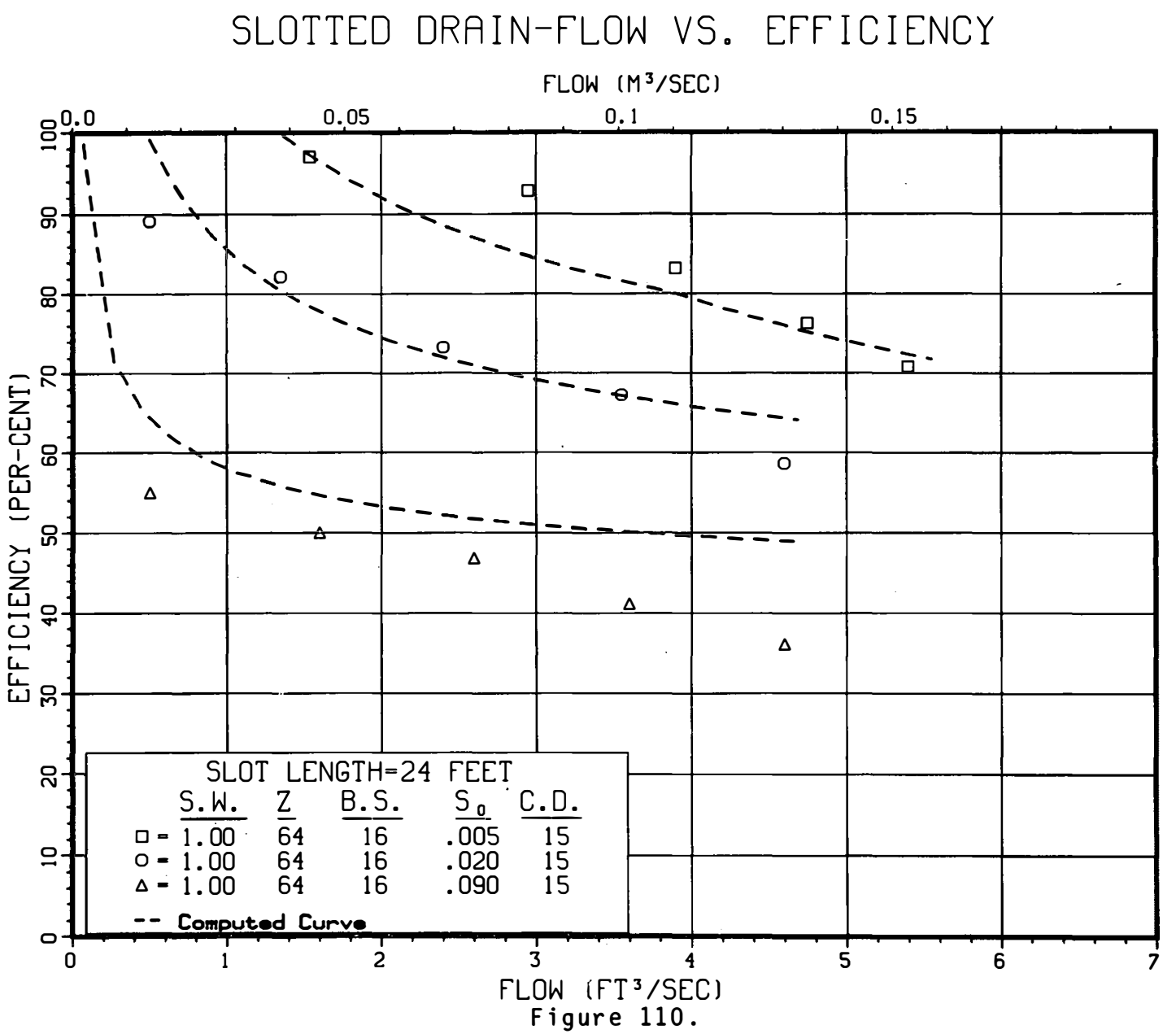

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH=24 FEET
S.W. Z B.S. S₀ C.D.
□ = 1.00 64 16 .005 15
○ = 1.00 64 16 .020 15
△ = 1.00 64 16 .090 15
-- Computed Curve

Figure 110.

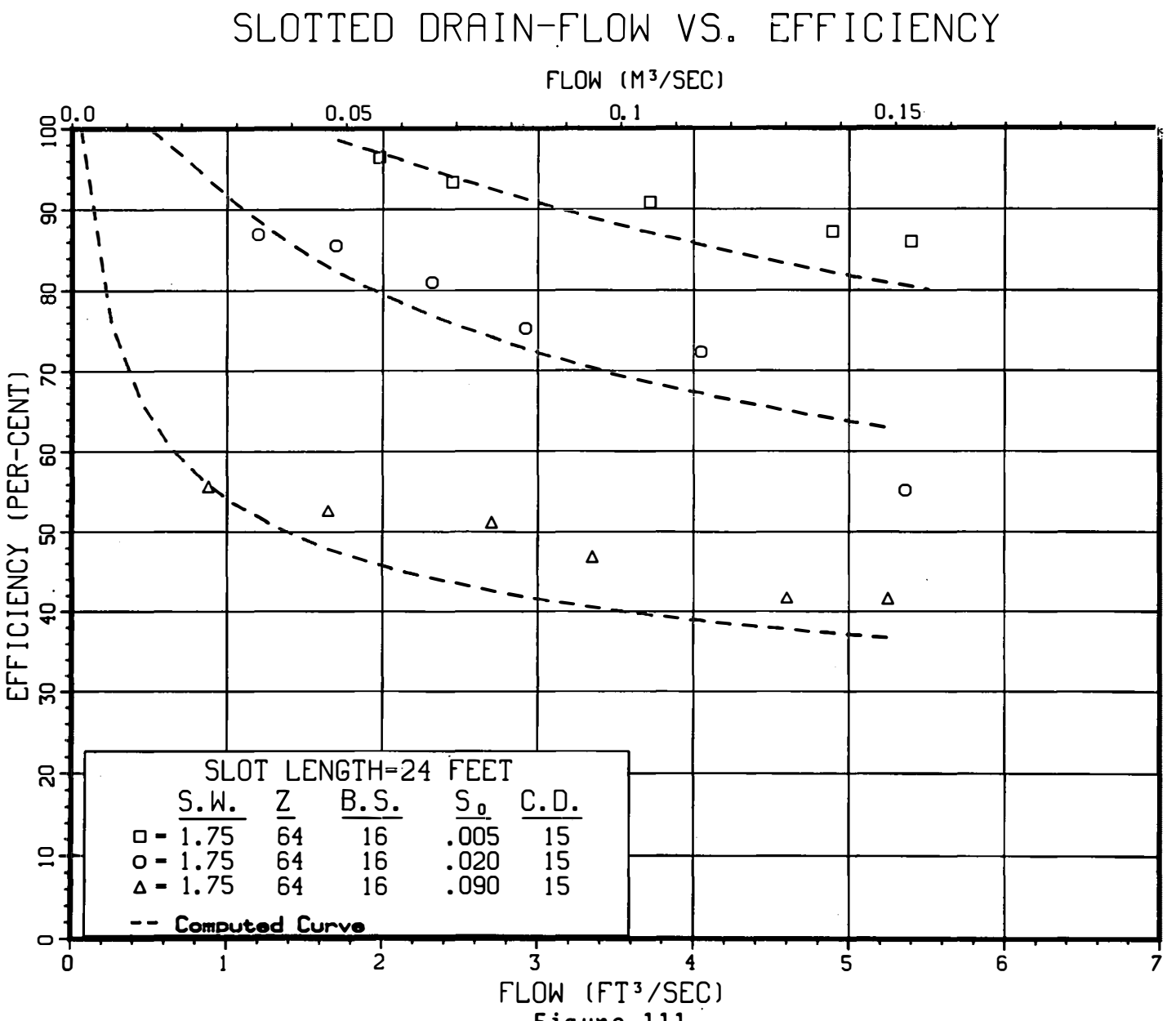

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH=24 FEET
S.W. Z B.S. S₀ C.D.
□ - 1.75 64 16 .005 15
o - 1.75 64 16 .020 15
Δ - 1.75 64 16 .090 15
-- Computed Curve

**Figure 111.**

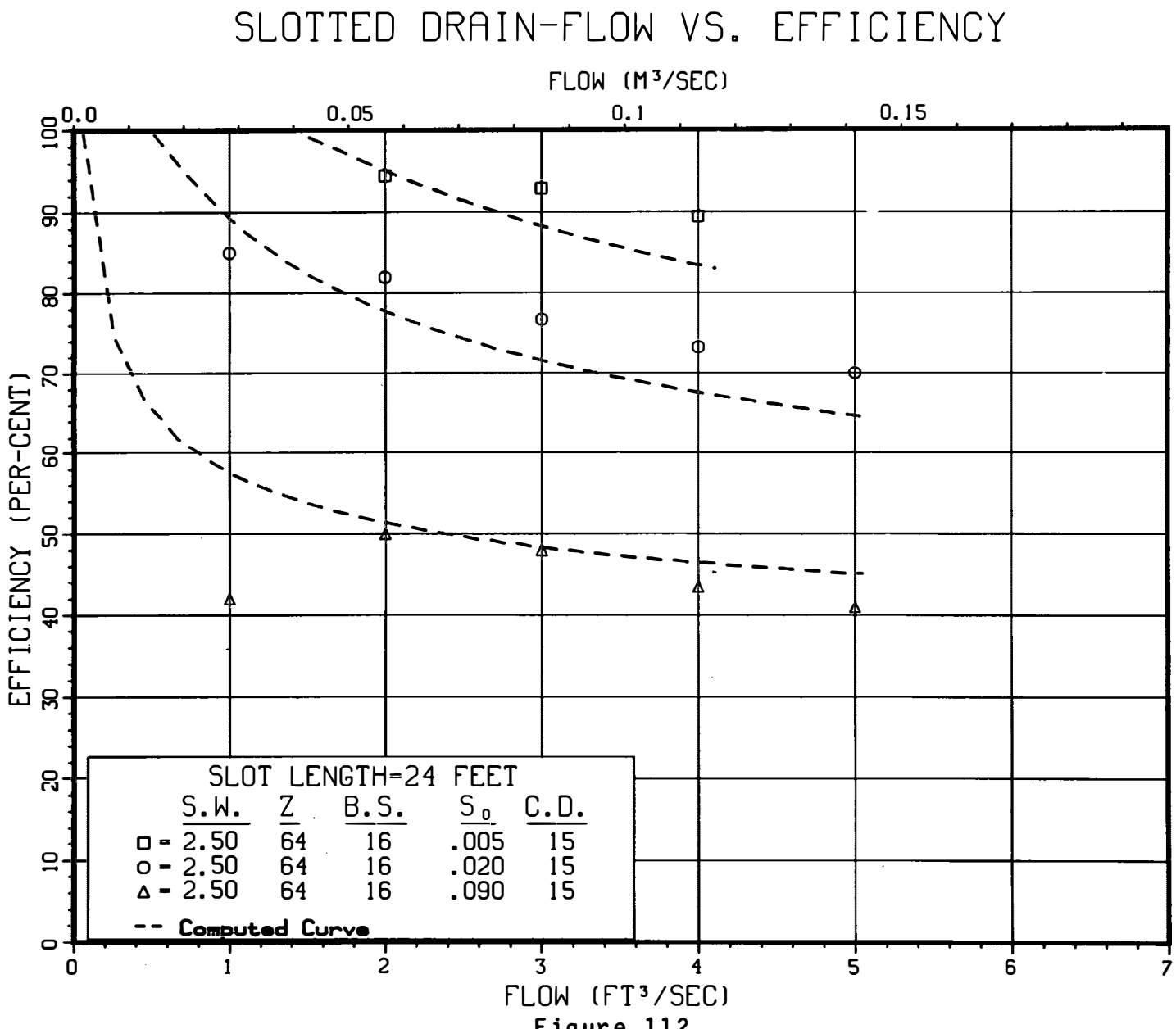

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH=24 FEET
S.W. Z B.S. S0 C.D.
□ = 2.50 64 16 .005 15
o = 2.50 64 16 .020 15
Δ = 2.50 64 16 .090 15
-- Computed Curve

Figure 112.

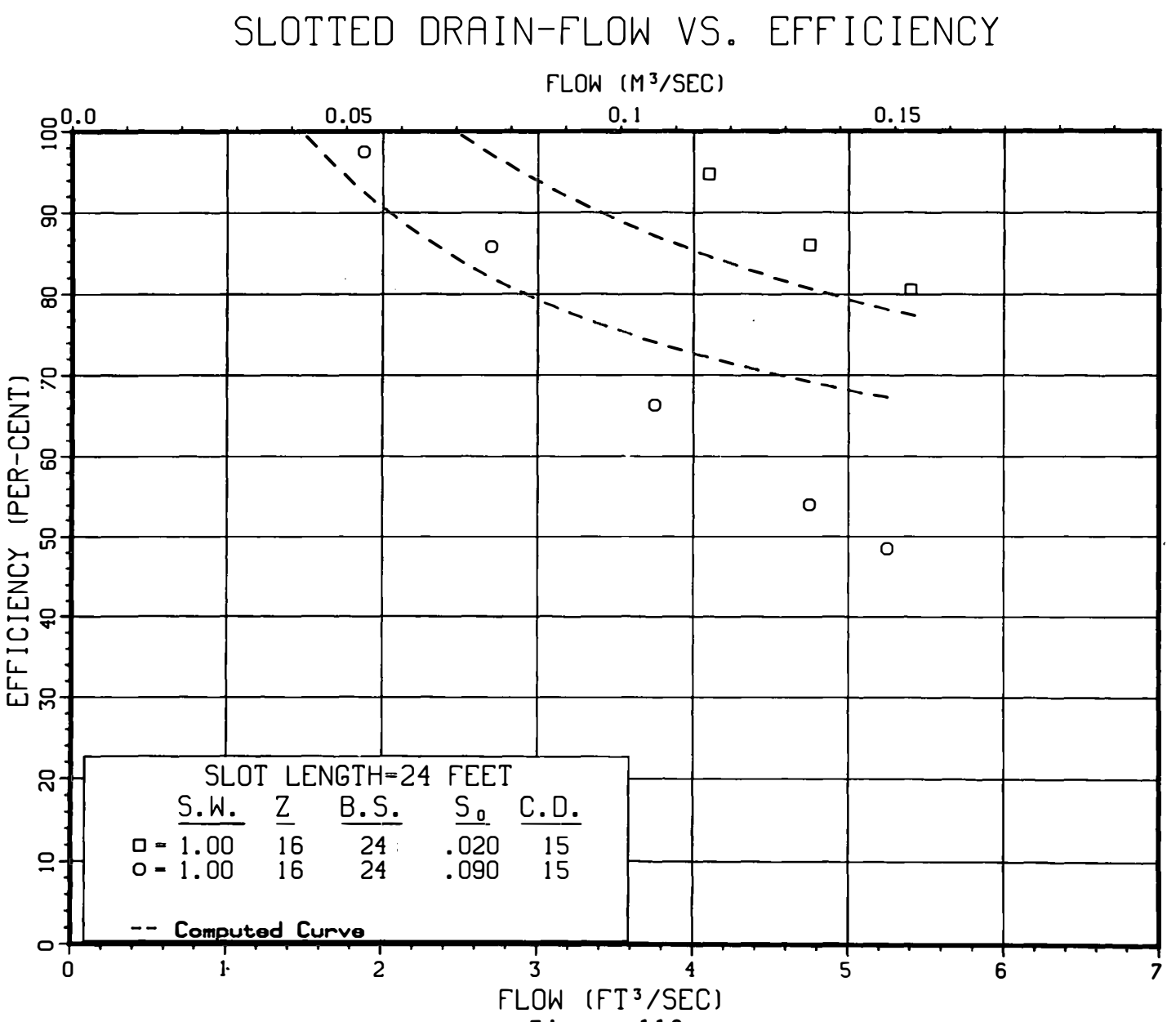

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH=24 FEET
S.W. Z B.S. S₀ C.D.
□ = 1.00 16 24 .020 15
o = 1.00 16 24 .090 15
-- Computed Curve

Figure 113.

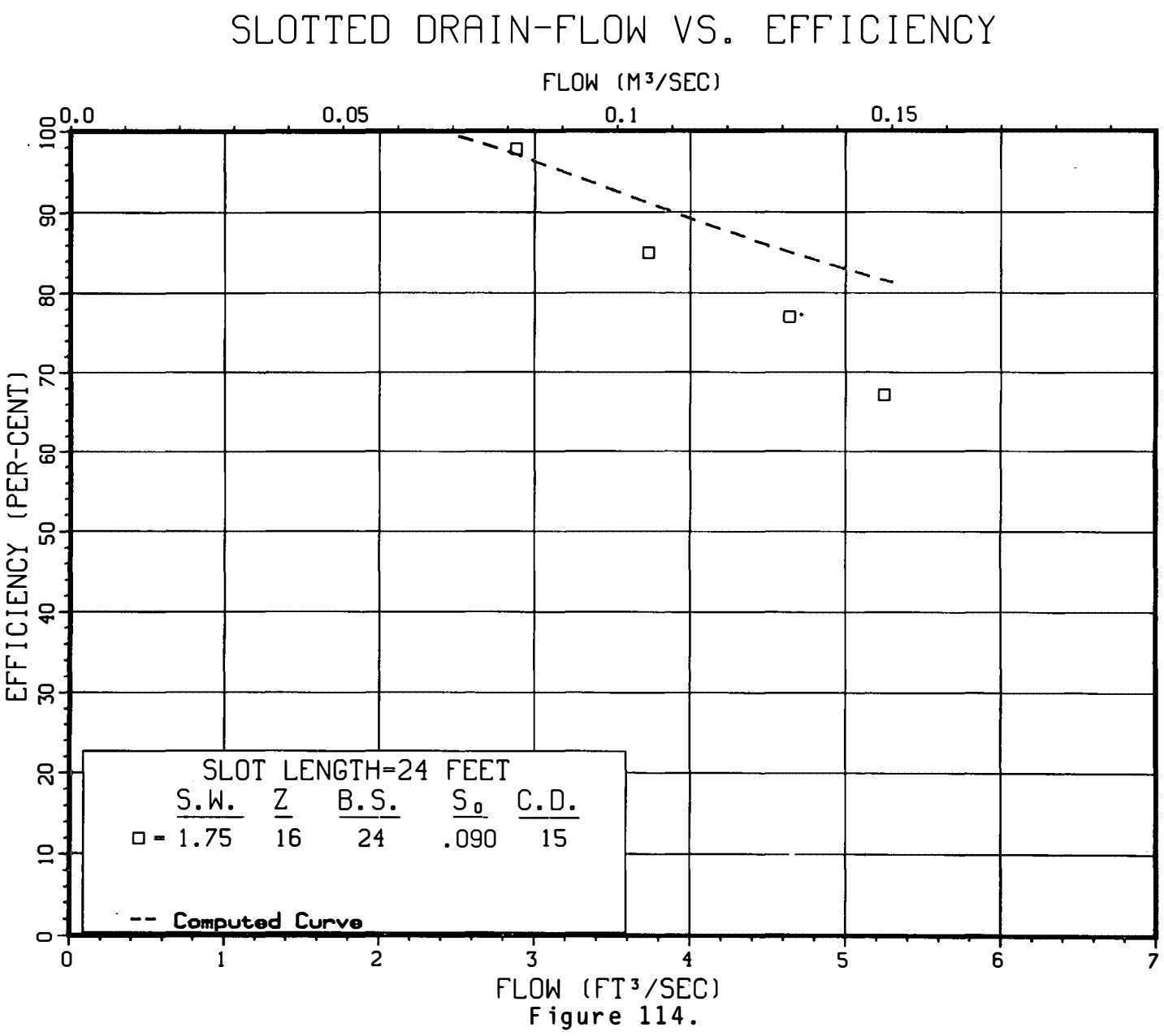

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
SLOT LENGTH=24 FEET
S.W. Z B.S. S₀ C.D.
□ = 1.75 16 24 .090 15
-- Computed Curve
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)

Figure 114.

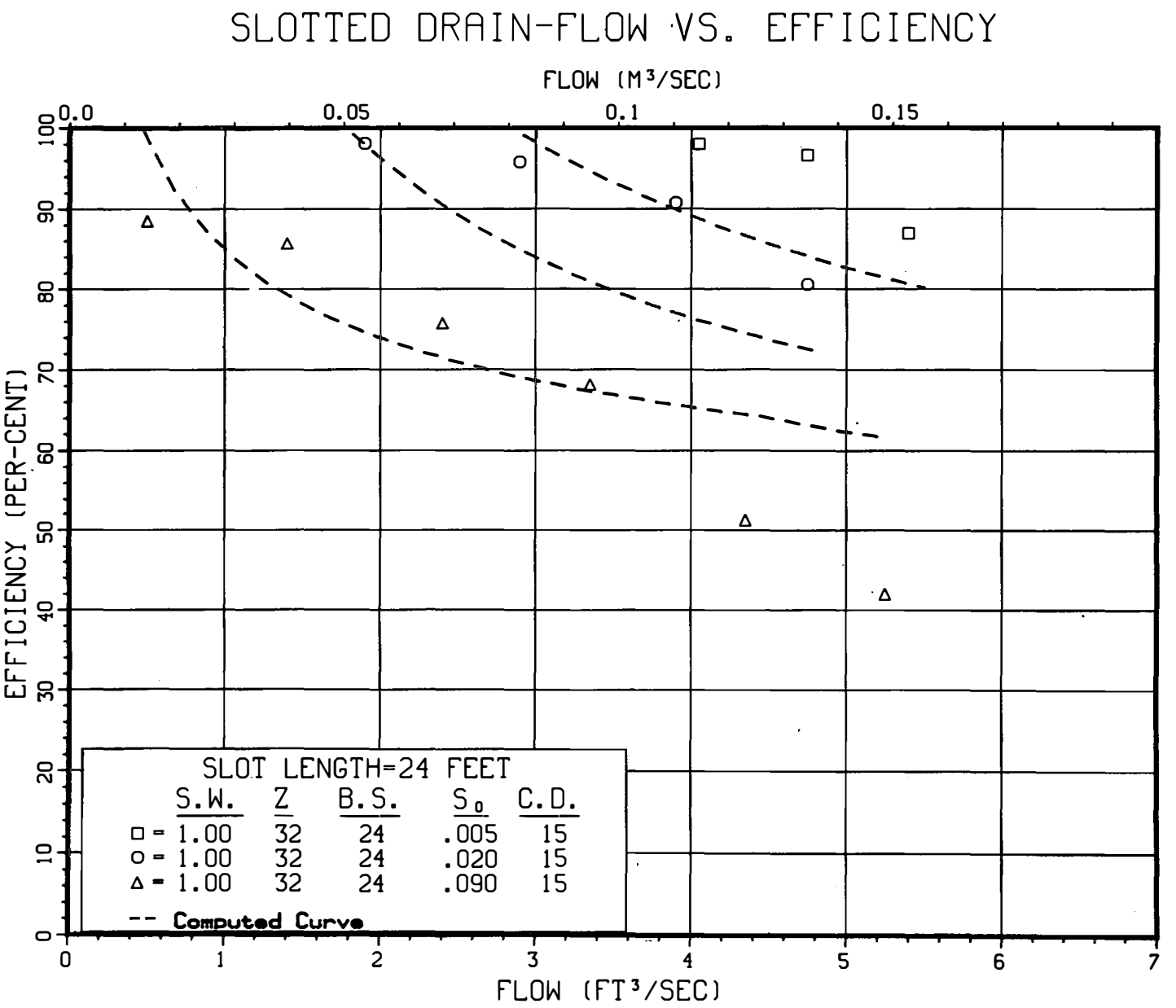

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH=24 FEET
S.W. Z B.S. S₀ C.D.
□ = 1.00 32 24 .005 15
○ = 1.00 32 24 .020 15
△ = 1.00 32 24 .090 15
-- Computed Curve

Figure 115.

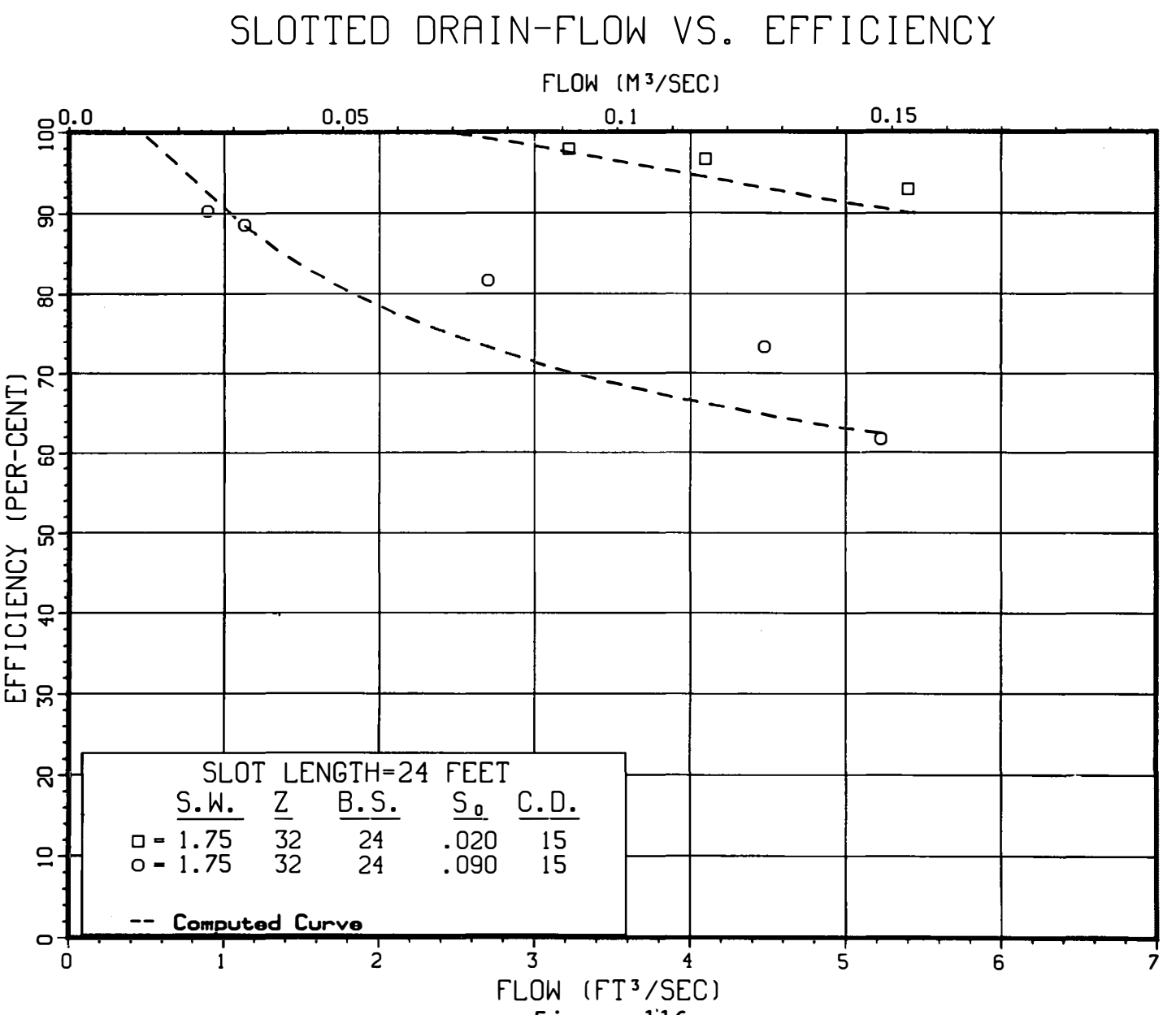

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH=24 FEET
S.W. Z B.S. S₀ C.D.
□ = 1.75 32 24 .020 15
o = 1.75 32 24 .090 15
-- Computed Curve

Figure 116.

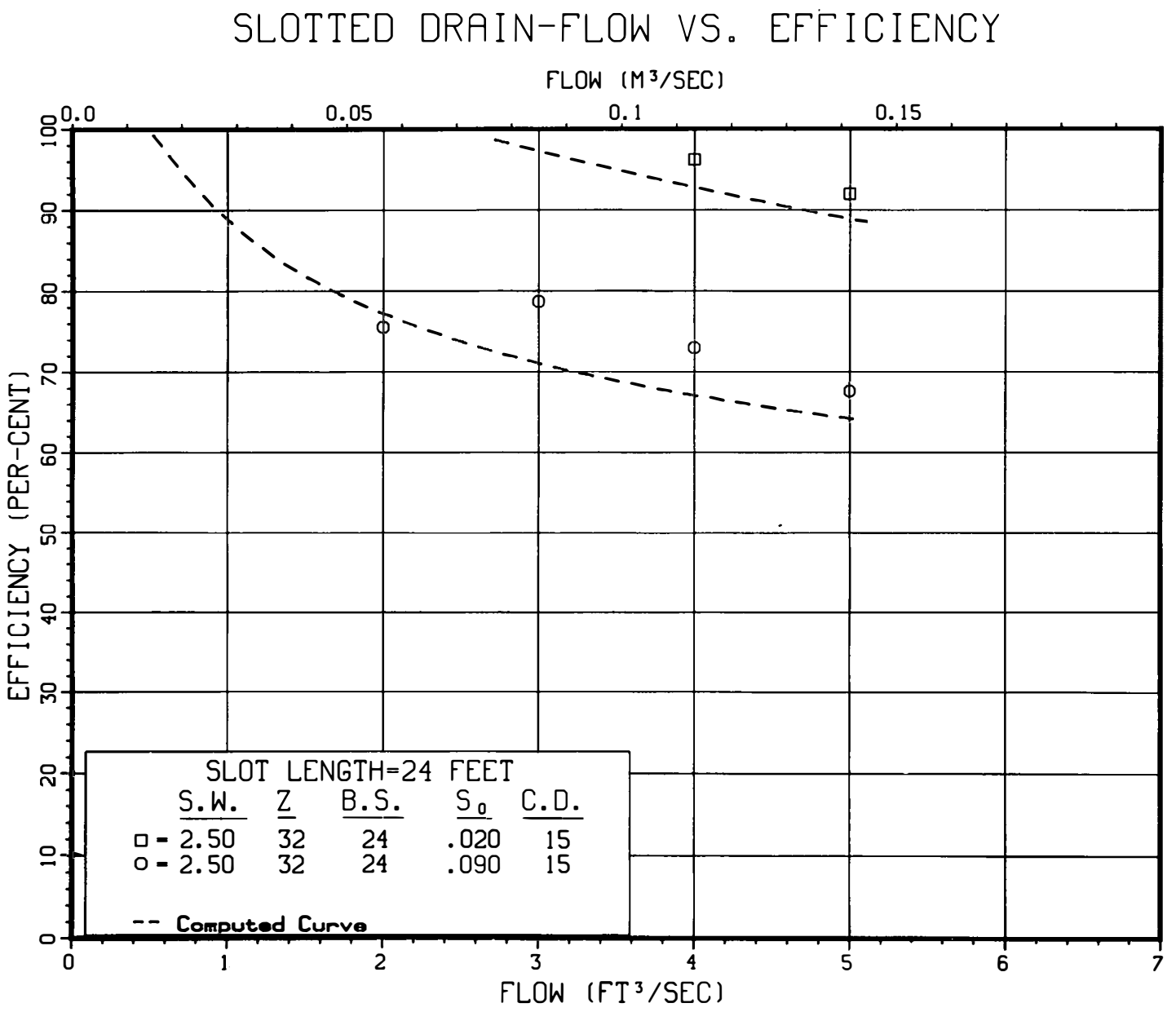

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
SLOT LENGTH=24 FEET
S.W. Z B.S. S₀ C.D.
□ = 2.50 32 24 .020 15
o = 2.50 32 24 .090 15
-- Computed Curve
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)

Figure 1i7.

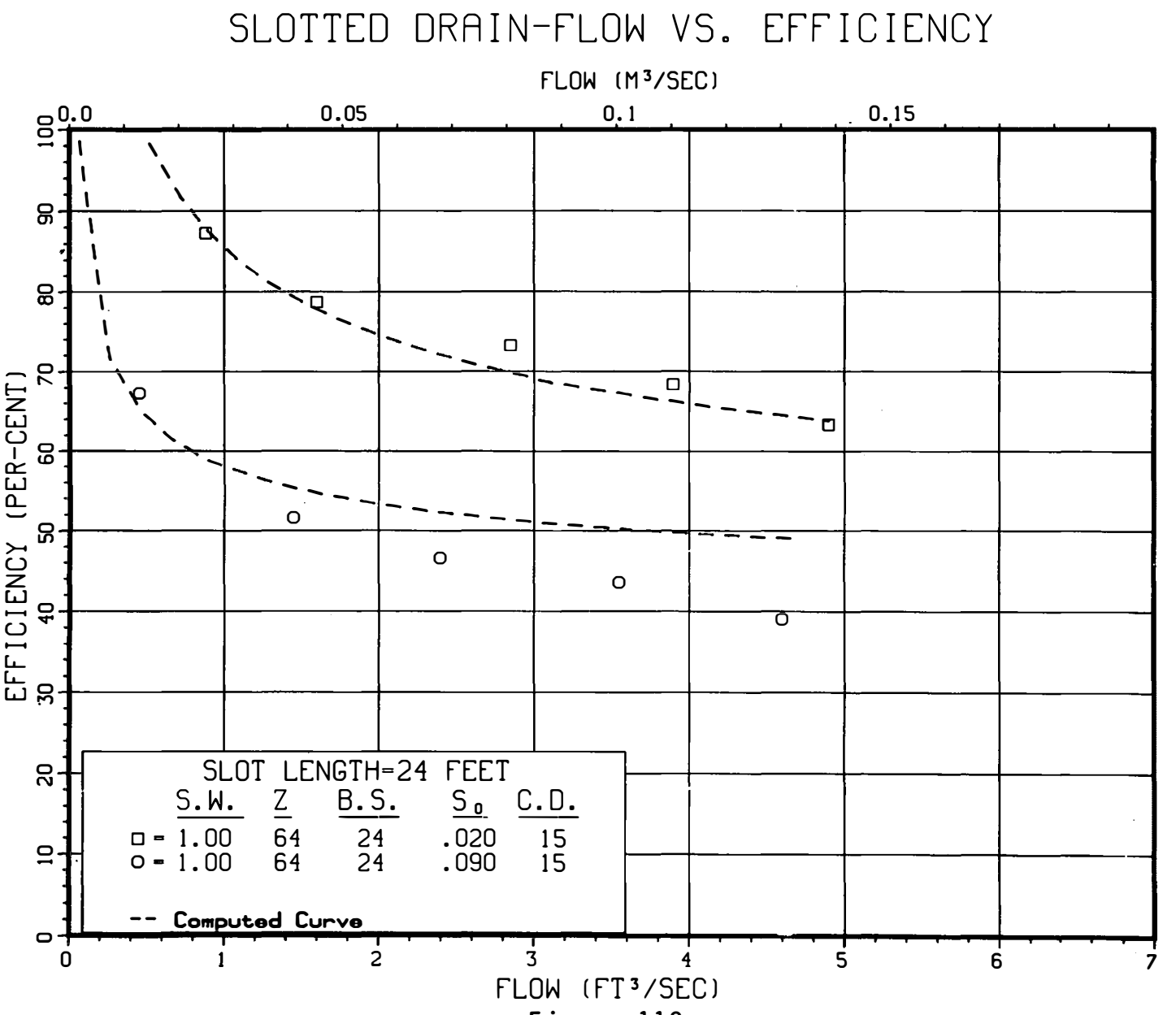

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH=24 FEET
S.W. Z B.S. S₀ C.D.
□ = 1.00 64 24 .020 15
o = 1.00 64 24 .090 15
-- Computed Curve

Figure 118.

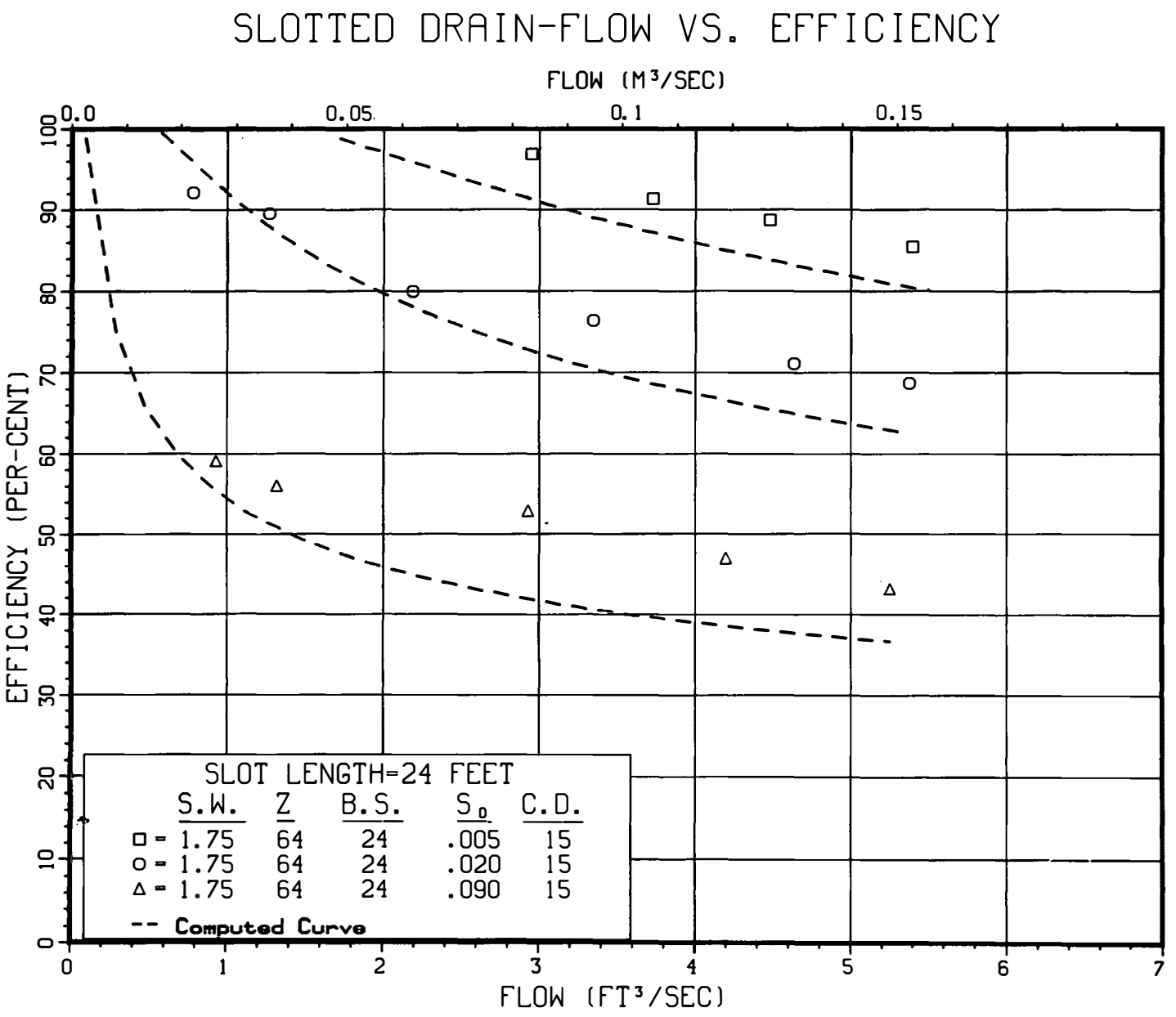

SLOTTED DRAIN-FLOW VS. EFFICIENCY
FLOW (M³/SEC)
0.0
0.05
0.1
0.15
EFFICIENCY (PER-CENT)
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4
5
6
7
FLOW (FT³/SEC)
SLOT LENGTH=24 FEET
S.W. Z B.S. S0 C.D.
□ = 1.75 64 24 .005 15
○ = 1.75 64 24 .020 15
△ = 1.75 64 24 .090 15
-- Computed Curve

**Figure 119.**

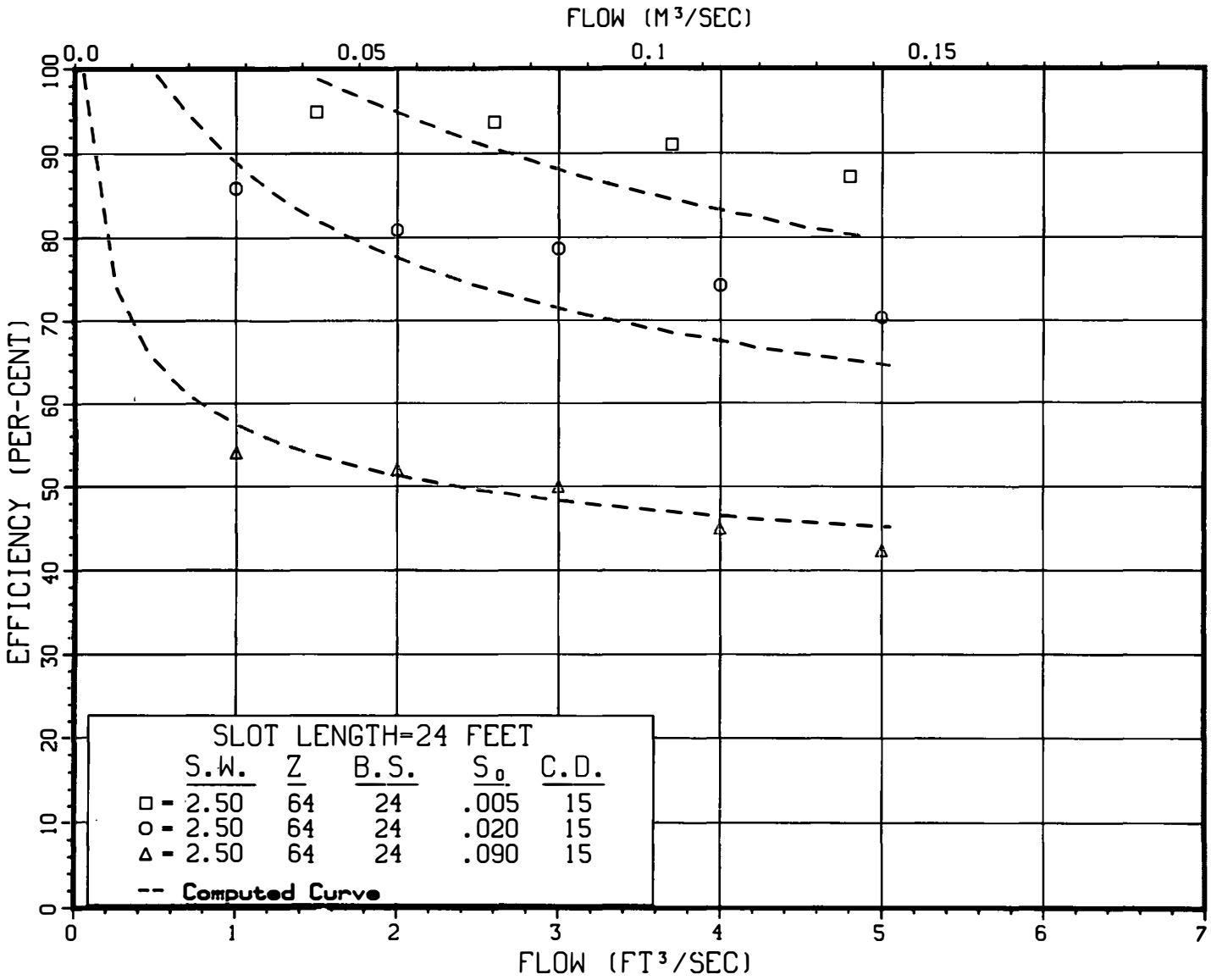



Figure 120.



*U.S. GOVERNMENT PRINTING OFFICE: 1981-0-724-998/1012

## FEDERALLY COORDINATED PROGRAM (FCP) OF HIGHWAY RESEARCH AND DEVELOPMENT

The Offices of Research and Development (R&D) of the Federal Highway Administration (FHWA) are responsible for a broad program of staff and contract research and development and a Federal-aid program, conducted by or through the State highway transportation agencies, that includes the Highway Planning and Research (HP&R) program and the National Cooperative Highway Research Program (NCHRP) managed by the Transportation Research Board. The FCP is a carefully selected group of projects that uses research and development resources to obtain timely solutions to urgent national highway engineering problems.*

The diagonal double stripe on the cover of this report represents a highway and is color-coded to identify the FCP category that the report falls under. A red stripe is used for category 1, dark blue for category 2, light blue for category 3, brown for category 4, gray for category 5, green for categories 6 and 7, and an orange stripe identifies category 0.

### *FCP Category Descriptions*

**1. Improved Highway Design and Operation for Safety**

Safety R&D addresses problems associated with the responsibilities of the FHWA under the Highway Safety Act and includes investigation of appropriate design standards, roadside hardware, signing, and physical and scientific data for the formulation of improved safety regulations.

**2. Reduction of Traffic Congestion, and Improved Operational Efficiency**

Traffic R&D is concerned with increasing the operational efficiency of existing highways by advancing technology, by improving designs for existing as well as new facilities, and by balancing the demand-capacity relationship through traffic management techniques such as bus and carpool preferential treatment, motorist information, and rerouting of traffic.

**3. Environmental Considerations in Highway Design, Location, Construction, and Operation**

Environmental R&D is directed toward identifying and evaluating highway elements that affect the quality of the human environment. The goals are reduction of adverse highway and traffic impacts, and protection and enhancement of the environment.

**4. Improved Materials Utilization and Durability**

Materials R&D is concerned with expanding the knowledge and technology of materials properties, using available natural materials, improving structural foundation materials, recycling highway materials, converting industrial wastes into useful highway products, developing extender or substitute materials for those in short supply, and developing more rapid and reliable testing procedures. The goals are lower highway construction costs and extended maintenance-free operation.

**5. Improved Design to Reduce Costs, Extend Life Expectancy, and Insure Structural Safety**

Structural R&D is concerned with furthering the latest technological advances in structural and hydraulic designs, fabrication processes, and construction techniques to provide safe, efficient highways at reasonable costs.

**6. Improved Technology for Highway Construction**

This category is concerned with the research, development, and implementation of highway construction technology to increase productivity, reduce energy consumption, conserve dwindling resources, and reduce costs while improving the quality and methods of construction.

**7. Improved Technology for Highway Maintenance**

This category addresses problems in preserving the Nation's highways and includes activities in physical maintenance, traffic services, management, and equipment. The goal is to maximize operational efficiency and safety to the traveling public while conserving resources.

**0. Other New Studies**

This category, not included in the seven-volume official statement of the FCP, is concerned with HP&R and NCHRP studies not specifically related to FCP projects. These studies involve R&D support of other FHWA program office research.

* The complete seven-volume official statement of the FCP is available from the National Technical Information Service, Springfield, Va. 22161. Single copies of the introductory volume are available without charge from Program Analysis (HRD-3), Offices of Research and Development, Federal Highway Administration, Washington, D.C. 20590.

DEPARTMENT OF TRANSPORTATION
UNITED STATES OF AMERICA