ENTRANCES TO CONDUITS OF
RECTANGULAR CROSS SECTION

INVESTIGATION OF ENTRANCES FLARED IN THREE DIRECTIONS AND IN ONE DIRECTION

TECHNICAL MEMORANDUM NO. 2-428

Report 2

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U. S. Army Engineer Waterways Experiment Station
CORPS OF ENGINEERS
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PREFACE

Investigation of the shapes of entrances to conduits of rectangular cross section was authorized by the Office, Chief of Engineers, on 6 January 1948, as part of the Civil Works Investigation Program. Tests concerned with entrance shapes flared in four directions constituted the first phase of work to be accomplished under Item CW 802, Conduit Intake Model Tests. This phase was reported in Technical Memorandum No. 2-428, Entrances to Conduits of Rectangular Cross Section, Report No. 1, Investigation of Entrance Flared in Four Directions.

Tests reported herein constitute the second phase of work to be accomplished under CW Item 802.

All tests were conducted at the Waterways Experiment Station under the general direction of and in cooperation with engineers of the Office, Chief of Engineers.

Personnel of the Hydraulics Division, Waterways Experiment Station, who were actively engaged in the study were Messrs. J. H. Ables, Jr., and T. E. Murphy, under the supervision of Mr. F. R. Brown and Mr. E. P. Fortson, Jr. This report was prepared by Mr. T. E. Murphy.

Directors of the Waterways Experiment Station during the second phase of the test program were Col. A. P. Rollins, Jr., CE, and Col. Edmund H. Lang, CE. Technical Director was Mr. J. B. Tiffany.

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SUMMARY

Tests of conduit entrances flared in three directions and in one direction were conducted to develop entrance shapes which would not be damaged by cavitation and yet would be as small as possible in cross section. Pressure measurements were made on a transparent conduit, 0.283 ft wide by 0.500 ft high by 8.64 ft long, connected to a steel pressure headbay tank.

Test results indicate that pressure conditions probably acceptable for most installations can be obtained by the use of elliptical entrance curves with the minor axis equal to one-third the major axis. For entrances flared in three directions, the major axes for the entrance curves should be equal to the dimensions of the conduit proper in the directions concerned. For an entrance in which only the top is flared, the major axis of the entrance curve should be equal to at least 1.5 times the depth of the conduit proper.

At installations where high heads and little back pressure result in hydraulic conditions highly susceptible to cavitation, an entrance formed by a compound elliptical curve is desirable.

ENTRANCES TO CONDUITS OF RECTANGULAR CROSS SECTION

INVESTIGATION OF ENTRANCES FLARED IN THREE DIRECTIONS AND IN ONE DIRECTION

PART I: INTRODUCTION

The Problem

1. Conduit entrances in high dams are subject to cavitation damage unless they are shaped so as to insure that the high velocity jet will not separate from the confining walls of the conduit. For high heads and short flow passages the water in the conduit may be flowing at or near spouting velocity, with a loss at the intake of most of the head available to cause flow. Under these conditions slight misalignments may cause severe negative pressure, and cavitation may occur with its resulting pitting of the adjacent concrete surfaces. The designer, therefore, is particularly interested in providing the proper shape at the intake to avoid cavitation damage. Another consideration in the design of conduit entrances is the desirability of making the dimensions of the entrance as small as possible to economize on the entrance structure and bulkhead closure gates.

2. It would appear that intakes to conduits should be satisfactorily designed if the entrance curves conform to the free jet issuing from a sharp-edged orifice of similar proportions. Such a design is possible if the conduit is circular. However, if the conduit is rectangular, design of the entrance is complicated by the fact that the cross section of the jet issuing from a rectangular orifice is distorted by the effect of flow at the corners.

3. Outlet conduits through concrete gravity dams usually are placed above the bed of the river and the entrance is flared in all four directions. Data on entrances flared in four directions are contained in Report No. 1 of this series.* On the other hand, outlet conduits for earth dams

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* U. S. Army Engineer Waterways Experiment Station, CE, Entrances to Conduits of Rectangular Cross Section, Report No. 1, Investigation of Entrance Flared in Four Directions, Technical Memorandum No. 2-428 (Vicksburg, Mississippi, March 1956).

are usually placed at low elevations in order to provide a means for diverting river flow during construction of the embankment. The invert at the intake frequently is at the same elevation as the floor of the approach channel. Thus the entrance can be flared only on the top and two sides. Also, where multiple gate passages are used, construction economy often dictates little or no flare on the sides, which results in an entrance with only the top flared.

Purpose of Tests

4. The purpose of these tests was to develop conduit entrance shapes flared in three directions and in one direction that would be free of the danger of cavitation and as small as possible in cross section.

Experimental Apparatus

5. All tests were conducted on a model conduit 0.283 ft wide by 0.500 ft high by 8.64 ft long (fig. 1). These dimensions simulate a prototype conduit 5.667 ft wide by 10 ft high by 172.8 ft long to a scale of 1:20. The conduit was constructed of clear plastic with piezometers located at critical points along the center line and corners of the top and sides. A large steel pressure tank was used as a headbay to permit simulation of a large range of head conditions.

Test Procedures

6. All entrances were tested under a range of heads varying from 1.25 to 15 ft. The head was measured between the hydraulic gradient in the pool area and the center line of the conduit. Pressures were measured by means of piezometers.

Presentation of Data

7. Data showing the actual magnitude of pressures at each piezometer are presented in tabular form (tables 1-15) and also are plotted in

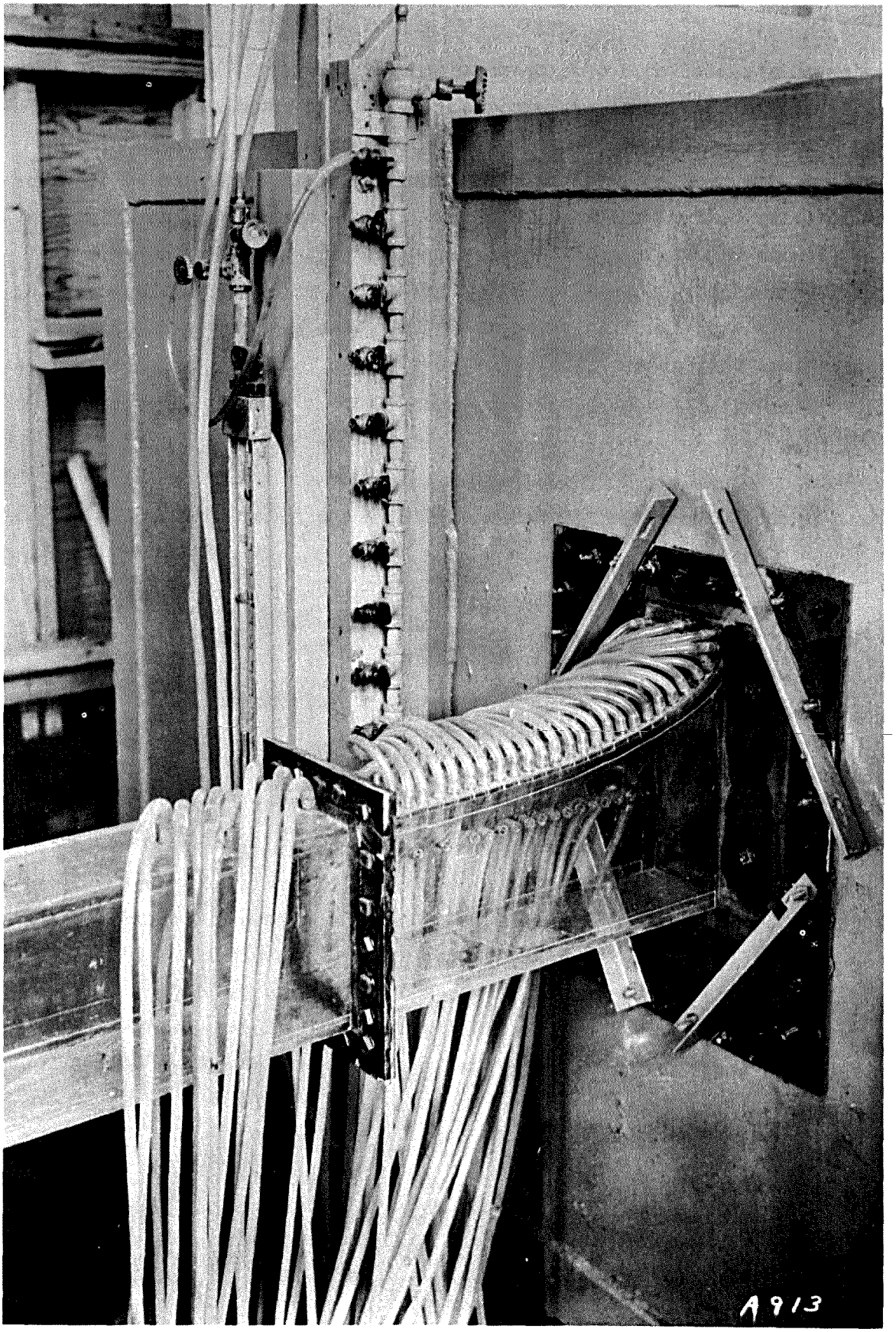

Fig. 1. Model conduit used in tests

various plates in terms of a pressure-drop coefficient. All data in the tables and in the plates are expressed in model dimensions. The pressure-drop coefficient for each piezometer is expressed as a function of the pressure drop from pool to the piezometer in question divided by the average velocity head in the conduit proper. Expression of the data in this form permits computation of the pressure gradient through a conduit entrance, regardless of head, velocity, or length of conduit. The entrance designs involving flare in three directions have been given numerical designations while those involving flare of the top curve only (one direction) have been given alphabetical designations.

PART II: RESULTS OF TESTS

Entrances Flared in Three Directions

Type 1

8. Tests of entrances flared in four directions had revealed reasonably good pressure conditions when the entrance was shaped to an elliptical curve wherein the major axis was equal to the dimension of the conduit in the direction concerned and the minor axis was equal to one-third the major axis. Therefore, initial tests of the entrance flared in three directions were conducted with this flare on the side curves, but with the flare of the top curve doubled to compensate for the lack of flare on the bottom. This design was designated the type 1 entrance wherein the top was shaped to the elliptical curve

$$\frac{X^2}{D^2} + \frac{Y^2}{(2D/3)^2} = 1$$

and the sides were shaped to the curve

$$\frac{X^2}{D^2} + \frac{Y^2}{(D/3)^2} = 1$$

where D is the dimension of the conduit in the direction concerned. Details of the type 1 entrance and locations of piezometers are shown in plate 1. Pressure measurements for seven head conditions are listed in table 1. Plate 2 includes plots of the average pressure-drop coefficients computed from pressure measurements along top center line, top corner, and side center line of the entrance. These data reveal a dip in local pressures both on the top center line and top corner at an L/D* value of 0.7.

Type 2

9. The type 2 entrance utilized the same side curves as the type 1, but the top curve was modified to increase curvature in the upstream portion of the entrance and decrease curvature in the downstream portion of

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* L/D = ratio of distance downstream to dimension of conduit in direction concerned.

the entrance. The top of the entrance conformed to the elliptical curve:

$$\frac{X^2}{D^2} + \frac{Y^2}{(D/3)^2} = 1$$

Details of this entrance together with locations of piezometers are contained in plate 3. Pressure data are presented in table 2, and plots of the average pressure-drop coefficients are shown in plate 2. Pressure conditions were more favorable in the type 2 entrance than in the type 1 entrance. As was expected, pressures near the upstream end of the type 2 entrance were lower than those in the type 1 entrance, but the dip below the average grade line in the downstream portion of the entrance also was less.

Types 3 and 4

10. In the types 3 and 4 entrances the side curves were the same as in the types 1 and 2, and the top curves were of the same shape as the type 2 entrance but were enlarged as follows:

Type 3 $$\frac{X^2}{(2D)^2} + \frac{Y^2}{(2D/3)^2} = 1$$

Type 4 $$\frac{X^2}{(1.5D)^2} + \frac{Y^2}{(1.5D/3)^2} = 1$$

Details of these two entrances are shown in plates 4 and 5, respectively. Pressure data are listed in tables 3 and 4, and average pressure-drop coefficients for the types 3 and 4 entrances are plotted in plate 6. The type 2 coefficients are also plotted in plate 6 to facilitate comparison of the data. These plots show that as the top curve was enlarged, the pressure reduction through the entrance became more gradual; however, minimum pressure in the type 3 entrance (largest top curve) was only slightly more favorable than the minimum pressures in the types 2 and 4.

Type 5

11. The type 5 entrance utilized top and side curves shaped to a compound ellipse as follows:

Upstream portion $$\frac{X^2}{D^2} + \frac{Y^2}{(0.64D)^2} = 1$$

Downstream portion $$\frac{X^2}{D^2} + \frac{Y^2}{(0.32D)^2} = 1$$

Details of the type 5 entrance are shown in plate 7. It was planned that this entrance would result in the satisfactory pressure conditions in the upstream portion which were obtained with the type 1 entrance, and that the added length would result in better pressure conditions in the downstream portion than were obtained with the type 2 entrance. Pressure data are given in table 5. Plots of the average pressure-drop coefficient are presented in plate 8. Pressures in the upstream part of the entrance were as expected; however, pressures in the downstream part showed no improvement over those obtained with the type 2 entrance.

Types 6 and 7

12. The top and side curves for the type 6 entrance were shaped to a compound ellipse which had given best all-round performance for an entrance flared in four directions. (See Report No. 1 of this series.) The upstream portions of the curves followed the equation:

$$\frac{X^2}{D^2} + \frac{Y^2}{(0.32D)^2} = 1$$

while the downstream portions of the curves followed the equation:

$$\frac{X^2}{D^2} + \frac{Y^2}{(0.16D)^2} = 1$$

The type 7 entrance utilized a larger top curve of the same shape, as follows:

Upstream portion $$\frac{X^2}{(2D)^2} + \frac{Y^2}{(0.64D)^2} = 1$$

Downstream portion $$\frac{X^2}{(2D)^2} + \frac{Y^2}{(0.32D)^2} = 1$$

Side curves for the type 7 entrance were the same as those used in the type 6 entrance. Details of the types 6 and 7 entrances are given in plates 9 and 10, respectively. Pressure data for the two entrances are shown in tables 6 and 7, while average pressure-drop coefficients are

plotted in plate 8. Pressure conditions in the type 7 entrance were excellent, with a gradually decreasing gradient and no dip in the grade line. The type 6 entrance also revealed good pressure conditions with only a slight dip below the average grade line.

Entrances Flared in One Direction

Type A

13. With the entrance flared on the top only (one direction), it was felt that the flare of the top curve should be increased to compensate for the lack of flare on the sides and bottom. Initial tests were conducted with the top curve shaped to the elliptical curve.

$$\frac{X^2}{D^2} + \frac{Y^2}{(2D/3)^2} = 1$$

where D is the vertical dimension of the conduit. Details of this entrance and locations of piezometers are given in plate 11. Pressure data are listed in table 8. Plots of average pressure-drop coefficients are contained in plate 12. These data reveal good pressure conditions in the upstream portion of the entrance, but an undesirable dip in local pressures at an L/D value of about 0.7.

Types B, C, and D

14. The types B, C, and D entrances utilized the single ellipse shape found to be generally satisfactory in previous tests of entrances flared in four and three directions. These three entrances differed from each other only in the size of the top entrance curve. Top curves were shaped to the following equations:

Type B $$\frac{X^2}{D^2} + \frac{Y^2}{(D/3)^2} = 1$$

Type C $$\frac{X^2}{(2D)^2} + \frac{Y^2}{(2D/3)^2} = 1$$

Type D $$\frac{X^2}{(1.5D)^2} + \frac{Y^2}{(1.5D/3)^2} = 1$$

Details of the types B, C, and D entrances are shown in plates 13, 14, and 15, respectively. Pressure data for the three entrances are shown in tables 9, 10, and 11, respectively. Average pressure-drop coefficients are plotted in plate 12. The type B entrance was too small and a severe dip in local pressures occurred near the upstream end of the entrance. Pressure conditions in the type C entrance were good with only a slight dip in local pressures near the downstream end of the entrance. The type D entrance resulted in local pressures below the average gradient over a wide zone, but minimum pressure was only about 0.16 times the average velocity head in the conduit proper below the average gradient.

Types E and F

15. The types E and F entrances had their top curves shaped to the following elliptical equations:

$$\text{Type E} \qquad \frac{X^2}{D^2} + \frac{Y^2}{(D/2)^2} = 1$$

$$\text{Type F} \qquad \frac{X^2}{(1.5D)^2} + \frac{Y^2}{(2D/3)^2} = 1$$

Details of these entrances are shown in plates 16 and 17, respectively. Pressure data are contained in tables 12 and 13, and average pressure-drop coefficients are plotted in plate 18. Neither of these entrances resulted in satisfactory pressure conditions.

Types G and H

16. The types G and H entrances had their top curves shaped to compound elliptical equations. The type G entrance, plate 19, was shaped as follows:

$$\text{Upstream portion} \qquad \frac{X^2}{D^2} + \frac{Y^2}{(0.64D)^2} = 1$$

$$\text{Downstream portion} \qquad \frac{X^2}{D^2} + \frac{Y^2}{(0.32D)^2} = 1$$

while the type H entrance, plate 20, was shaped to the equations

Upstream portion $$\frac{X^2}{(2D)^2} + \frac{Y^2}{(0.64D)^2} = 1$$

Downstream portion $$\frac{X^2}{(2D)^2} + \frac{Y^2}{(0.32D)^2} = 1$$

Pressures are listed in tables 14 and 15, and average pressure-drop coefficients are plotted in plate 21. The type G entrance was too small and resulted in a large zone of low pressures. On the other hand, the type H entrance exhibited the best all-round performance of any of the entrance designs tested in which flare was on the top only.

PART III: DISCUSSION

17. Test results reported herein reveal that reasonably good pressure conditions can be obtained in the entrance to a rectangular conduit if the entrance curves are shaped to an ellipse in which the minor axis is equal to one-third the major axis. The required length for the major axis of any particular entrance curve depends upon the dimension of the conduit in the direction concerned and the flare of the other sides. Still better, in fact almost ideal pressure conditions can be obtained by using the ellipse described above for the upstream portion of the entrance, and an ellipse in which the minor axis is equal to only one-sixth the major axis for the downstream portion of the entrance. Use of an entrance formed by this compound ellipse would be required when high heads and little back pressure would result in conditions highly susceptible to cavitation.

18. For an entrance flared in three directions, pressure conditions adequate for most installations can be obtained by use of the type 2 entrance (paragraph 9) in which the top and side curves are shaped to the elliptical curve

$$\frac{X^2}{D^2} + \frac{Y^2}{(D/3)^2} = 1$$

in which D is the dimension of the conduit proper in the direction concerned. Such an entrance will result in local pressures dipping below the average pressure gradient by a maximum of about 0.13 times the average velocity head in the conduit proper. Local pressures will dip a maximum of only about 0.09 times the average velocity head in the conduit proper if the type 6 entrance (paragraph 12) is utilized. This entrance is formed by a compound ellipse with the upstream portion shaped to the equation

$$\frac{X^2}{D^2} + \frac{Y^2}{(0.32D)^2} = 1$$

and the downstream portion shaped to the equation

$$\frac{X^2}{D^2} + \frac{Y^2}{(0.16D)^2} = 1$$

The type 7 entrance (paragraph 12) was formed by a top curve of the same shape but twice the size of the type 6 entrance top curve. Side curves for the type 7 entrance were the same as those used in the type 6 entrance. The type 7 entrance resulted in no dip of local pressures below the average pressure gradient.

19. For entrances flared at the top only, the type D entrance (paragraph 14) is believed to be feasible for most installations. The top curve for this entrance is shaped to the elliptical equation

$$\frac{X^2}{(1.5D)^2} + \frac{Y^2}{(1.5D/3)^2} = 1$$

The maximum dip in local pressures below the average pressure gradient amounted to 0.16 times the average velocity head in the conduit proper. This dip occurred near the upstream end of the entrance, and thus minimum pressures could not be improved by use of a compound ellipse with the above as the upstream portion. The type C entrance (paragraph 14) which had a top curve of the same shape but one-fourth larger than the top curve of the type D entrance resulted in local pressures dipping below the average pressure gradient by a maximum of only 0.07 times the average velocity head in the conduit proper. Pressure corditions in the type H entrance (paragraph 16), which utilized a compound ellipse, were only slightly better than those in the type C entrance.

20. In cases where structural considerations permit some flare to the sides of a conduit entrance but not as much as is desirable from a hydraulic standpoint, it is suggested that the designer use a top entrance curve of the basic shape of the curves used for the types 2 and D entrances but that the size of the curve be adjusted to suit local conditions.

21. All data herein are based on a width-depth ratio of 0.567 which exists for a conduit 5 ft 8 in. wide by 10 ft high. Adaptation of these data to other sizes of conduits leads to the assumption that the profiles of the jets through rectangular-shaped entrances for various ratios of width to depth are similar; the degree of accuracy of this assumption is unknown.

22. It is realized that the designer normally desires to select an entrance with curves of minimum dimensions, but caution should be exercised.

Hydraulic conditions in the entrance section, where boundary turbulence is not fully developed, are such that small surface irregularities can cause cavitation much more readily than can the same size irregularities in the conduit proper. Thus, the conditions for cavitation should not be further enhanced by permitting zones of subatmospheric pressures.

Table 1

Pressure Data, Type 1 Entrance (Flared in Three Directions)

Equation for top flare: $\frac{X^2}{D^2} + \frac{Y^2}{(2D/3)^2} = 1$

Equation for side flares: $\frac{X^2}{D^2} + \frac{Y^2}{(D/3)^2} = 1$

D = 0.500 ft

D = 0.283 ft

Piez No.	Piez Zero	Pressure, ft of Water H,* 1.25 ft Q,* 1.10 cfs	H, 2.50 ft Q, 1.55 cfs	H, 5.00 ft Q, 2.25 cfs	H, 7.50 ft Q, 2.72 cfs	H, 10.00 ft Q, 3.15 cfs	H, 12.50 ft Q, 3.55 cfs	H, 15.00 ft Q, 3.87 cfs
				Top Center Line				
1	0.583	0.65	1.86	4.30	6.73	9.20	11.52	13.80
2	0.491	0.67	1.81	4.13	6.41	8.72	10.85	13.02
3	0.439	0.66	1.69	3.83	5.92	8.09	10.86	13.07
4	0.384	0.53	1.40	3.14	4.88	6.61	8.35	10.10
5	0.349	0.39	1.08	2.43	3.76	5.10	6.45	7.80
6	0.318	0.20	0.67	1.52	3.38	3.18	4.03	4.81
7	0.297	0.05	0.34	0.91	1.44	2.00	2.55	3.04
8	0.279	-0.08	0.05	0.27	0.54	0.76	1.00	1.18
9	0.266	-0.11	-0.03	0.10	0.21	0.36	0.50	0.56
10	0.257	-0.09	0.01	0.18	0.36	0.54	0.72	0.85
11	0.252	-0.05	0.09	0.35	0.62	0.89	1.14	1.35
12	0.250	-0.02	0.15	0.45	0.78	1.11	1.43	1.70
13	0.250	0.01	0.21	0.57	0.98	1.41	1.78	2.13
14	0.250	0.04	0.23	0.63	1.03	1.46	1.86	2.23
15	0.250	0.06	0.30	0.78	1.26	1.76	2.26	2.71
16	0.250	0.09	0.34	0.86	1.36	1.90	2.40	2.91
17	0.250	0.12	0.40	0.96	1.52	2.10	2.67	3.23
18	0.250	0.15	0.44	1.05	1.65	2.28	2.89	3.48
				Top Corner				
19	0.583	0.67	1.90	4.40	6.82	9.63	11.62	14.02
20	0.491	0.69	1.84	4.24	6.50	9.03	10.85	13.23
21	0.439	0.64	1.68	3.84	5.87	8.23	10.09	11.98
22	0.384	0.48	1.31	2.98	4.08	6.33	7.82	9.38
23	0.349	0.34	0.97	2.23	3.48	4.71	5.93	7.13
24	0.318	0.16	0.60	1.47	2.29	3.16	4.03	4.86
25	0.297	0.01	0.24	0.70	1.13	1.56	1.96	2.43
26	0.279	-0.08	0.01	0.29	0.52	0.72	0.93	1.12
27	0.266	-0.11	-0.07	-0.01	0.08	0.17	0.24	0.27
28	0.257	-0.09	-0.04	0.09	0.24	0.39	0.54	0.65
29	0.252	-0.06	0.01	0.19	0.38	0.55	0.71	0.90
30	0.250	-0.05	0.00	0.17	0.36	0.50	0.70	0.90
31	0.250	0.02	0.20	0.60	0.99	1.37	1.76	2.15
32	0.250	0.05	0.23	0.64	1.09	1.53	1.95	2.35
33	0.250	0.06	0.26	0.71	1.13	1.58	2.00	2.41
34	0.250	0.09	0.33	0.87	1.37	1.91	2.44	2.93
35	0.250	0.11	0.39	0.97	1.54	2.10	2.74	3.29
36	0.250	0.14	0.43	1.05	1.66	2.30	2.91	3.48
				Side Center Line				
37	0.000	0.95	1.86	3.81	5.60	7.40	9.20	10.91
38	0.000	0.78	1.51	3.05	4.44	5.86	7.30	8.68
39	0.000	0.72	1.40	2.76	4.05	5.36	6.70	7.95
40	0.000	0.66	1.28	2.47	3.70	4.92	6.14	7.25
41	0.000	0.61	1.16	2.30	3.37	4.50	5.60	6.65
42	0.000	0.55	1.06	2.10	3.05	4.06	5.06	6.00
43	0.000	0.52	0.98	1.93	2.82	3.75	4.70	5.61
44	0.000	0.49	0.92	1.81	2.63	3.51	4.35	5.17
45	0.000	0.46	0.85	1.66	2.46	3.26	4.05	4.83
46	0.000	0.44	0.80	1.54	2.26	3.01	3.73	4.48
47	0.000	0.41	0.77	1.49	2.18	2.91	3.65	4.34
48	0.000	0.40	0.73	1.40	2.10	2.80	3.48	4.18
49	0.000	0.39	0.70	1.35	2.00	2.66	3.34	3.98
50	0.000	0.37	0.68	1.31	1.91	2.55	3.19	3.80
51	0.000	0.37	0.66	1.30	1.90	2.54	3.18	3.80
52	0.000	0.37	0.65	1.31	1.90	2.54	3.18	3.79
53	0.000	0.36	0.65	1.26	1.85	2.48	3.06	3.68
54	0.000	0.36	0.65	1.25	1.82	2.41	2.96	3.56
55	0.000	0.33	0.56	1.10	1.58	2.11	2.61	3.14
56	0.000	0.27	0.46	0.90	1.30	1.73	2.16	2.58
57	0.000	0.21	0.35	0.66	0.97	1.30	1.61	1.95
58	0.000	0.14	0.20	0.36	0.42	0.69	0.85	1.03
59	0.000	0.08	0.10	0.15	0.20	0.24	0.30	0.33
60	0.000	0.00	0.00	0.00	-0.02	-0.02	-0.03	-0.04

Note: Bottom of intake and conduit at same elevation as approach channel.

* H = head in feet of water above conduit center line; Q = discharge.

Table 2

Pressure Data, Type 2 Entrance (Flared in Three Directions)

Equation for top and side flares: $\frac{X^2}{D^2} + \frac{Y^2}{(D/3)^2} = 1$

D = 0.500 ft for top
D = 0.283 ft for sides

Piez No.	Piez Zero	Pressure, ft of Water						
		H,* 1.25 ft Q,* 1.10 cfs	H, 2.50 ft Q, 1.55 cfs	H, 5.00 ft Q, 2.25 cfs	H, 7.50 ft Q, 2.72 cfs	H, 10.00 ft Q, 3.15 cfs	H, 12.50 ft Q, 3.55 cfs	H, 15.00 ft Q, 3.87 cfs
				Top Center Line				
1	0.417	0.71	1.80	3.93	6.15	8.33	10.38	12.58
2	0.370	0.56	1.45	3.24	5.00	6.81	8.55	10.23
3	0.344	0.47	1.20	2.70	4.18	5.66	7.08	8.56
4	0.317	0.38	1.02	2.27	3.53	4.80	6.01	7.06
5	0.298	0.27	0.77	1.77	2.78	3.82	4.77	5.82
6	0.284	0.18	0.56	1.33	2.12	2.92	3.64	4.45
7	0.272	0.07	0.32	0.85	1.38	1.93	2.45	2.98
8	0.264	0.03	0.23	0.64	1.08	1.51	1.91	2.34
9	0.258	-0.01	0.14	0.50	0.89	1.27	1.64	1.99
10	0.253	-0.02	0.12	0.43	0.75	1.07	1.37	1.65
11	0.251	0.01	0.18	0.57	0.93	1.32	1.67	2.00
12	0.250	0.03	0.23	0.69	1.12	1.55	1.95	2.37
13	0.250	0.06	0.29	0.78	1.25	1.72	2.15	2.65
14	0.250	0.08	0.34	0.85	1.35	1.87	2.33	2.85
15	0.250	0.09	0.35	0.88	1.39	1.90	2.39	2.91
16	0.250	0.12	0.39	0.97	1.50	2.08	2.57	3.23
17	0.250	0.12	0.41	0.98	1.54	2.13	2.68	3.22
18	0.250	0.12	0.42	0.99	1.56	2.15	2.68	3.24
				Top Corner				
19	0.417	0.80	2.01	4.41	6.76	9.18	11.48	13.78
20	0.370	0.65	1.61	3.58	5.50	7.38	8.96	11.03
21	0.344	0.43	1.14	2.59	3.99	5.46	6.81	8.21
22	0.317	0.26	0.78	1.81	2.86	3.91	4.86	5.91
23	0.298	0.12	0.47	1.14	1.82	2.52	3.16	3.78
24	0.284	0.05	0.29	0.79	1.28	1.79	1.94	2.72
25	0.272	0.00	0.16	0.55	0.90	1.28	1.61	1.98
26	0.264	-0.02	0.13	0.43	0.76	1.06	1.31	1.63
27	0.258	-0.04	0.11	0.37	0.66	0.91	1.17	1.46
28	0.253	-0.01	0.13	0.43	0.73	1.03	1.31	1.62
29	0.251	0.00	0.15	0.50	0.85	1.15	1.45	1.80
30	0.250	0.03	0.23	0.65	1.08	1.49	1.85	2.28
31	0.250	0.04	0.26	0.71	1.15	1.60	1.99	2.46
32	0.250	0.06	0.31	0.79	1.27	1.75	2.20	2.67
33	0.250	0.08	0.34	0.87	1.38	1.92	2.35	2.90
34	0.250	0.12	0.40	0.97	1.54	2.10	2.67	3.20
35	0.250	0.13	0.41	0.98	1.56	2.13	2.68	3.22
36	0.250	0.13	0.42	1.01	1.60	2.15	2.75	3.28
				Side Center Line				
37	0.000	1.00	1.97	3.93	5.85	7.80	9.68	11.40
38	0.000	0.69	1.35	2.65	3.92	5.22	6.45	7.72
39	0.000	0.63	1.22	2.35	3.47	4.53	5.50	6.55
40	0.000	0.58	1.12	2.15	3.20	4.17	5.12	6.12
41	0.000	0.53	1.00	1.93	2.87	3.72	4.57	5.47
42	0.000	0.48	0.91	1.73	2.54	3.38	4.07	4.88
43	0.000	0.45	0.83	1.60	2.40	3.17	3.87	4.62
44	0.000	0.43	0.79	1.52	2.25	3.03	3.68	4.45
45	0.000	0.40	0.77	1.48	2.21	2.92	3.62	4.32
46	0.000	0.40	0.74	1.42	2.08	2.77	3.45	4.12
47	0.000	0.37	0.71	1.35	2.00	2.67	3.27	3.90
48	0.000	0.37	0.68	1.32	1.96	2.60	3.20	3.82
49	0.000	0.37	0.67	1.28	1.91	2.50	3.12	3.72
50	0.000	0.37	0.65	1.22	1.78	2.33	2.88	3.44
51	0.000	0.37	0.66	1.26	1.83	2.40	3.00	3.58
52	0.000	0.37	0.68	1.28	1.88	2.47	3.08	3.66
53	0.000	0.37	0.67	1.25	1.83	2.40	3.00	3.57
54	0.000	0.37	0.67	1.24	1.81	2.37	2.90	3.45
55	0.000	0.33	0.58	1.08	1.58	2.07	2.40	3.10
56	0.000	0.28	0.48	0.92	1.32	1.75	2.20	2.63
57	0.000	0.22	0.37	0.67	0.97	1.30	1.63	1.97
58	0.000	0.14	0.21	0.40	0.55	0.72	0.87	1.03
59	0.000	0.07	0.09	0.15	0.22	0.25	0.32	0.37
60	0.000	0.02	0.00	0.00	0.00	0.00	-0.04	-0.04

Note: Bottom of intake and conduit at same elevation as approach channel.

* H = head in feet of water above conduit center line; Q = discharge.

Table 3

Pressure Data, Type 3 Entrance (Flared in Three Directions)

Equation for top flare: $\frac{X^2}{(2D)^2} + \frac{Y^2}{(2D/3)^2} = 1$ D = 0.500 ft

Equation for side flares: $\frac{X^2}{D^2} + \frac{Y^2}{(D/3)^2} = 1$ D = 0.283 ft

Piez No.	Piez Zero	Pressure, ft of Water						
		H,* 1.25 ft Q,* 1.12 cfs	H, 2.50 ft Q, 1.58 cfs	H, 5.00 ft Q, 2.30 cfs	H, 7.50 ft Q, 2.77 cfs	H, 10.00 ft Q, 3.20 cfs	H, 12.50 ft Q, 3.57 cfs	H, 15.00 ft Q, 3.96 cfs
				Top Center Line				
1	0.583	0.59	1.71	3.97	6.20	8.53	10.91	13.12
2	0.479	0.57	1.54	3.55	5.55	7.58	9.54	11.77
3	0.438	0.52	1.39	3.23	5.05	6.86	8.70	10.54
4	0.410	0.44	1.19	2.82	4.40	5.98	7.54	9.07
5	0.383	0.35	0.98	2.33	3.65	5.02	6.32	7.65
6	0.362	0.29	0.84	2.02	3.17	3.98	5.15	6.34
7	0.345	0.22	0.69	1.69	2.69	3.68	4.69	5.67
8	0.330	0.15	0.56	1.42	2.27	3.15	3.98	4.86
9	0.317	0.12	0.46	1.18	1.90	2.64	3.36	4.06
10	0.305	0.10	0.40	1.05	1.68	2.34	2.98	3.63
11	0.295	0.07	0.35	0.97	1.57	2.15	2.74	3.31
12	0.285	0.05	0.29	0.82	1.34	1.83	2.36	2.85
13	0.278	0.03	0.24	0.71	1.18	1.62	2.06	2.48
14	0.270	0.02	0.21	0.62	1.02	1.42	1.81	2.21
15	0.265	0.03	0.22	0.62	1.00	1.37	1.73	2.09
16	0.257	0.00	0.18	0.53	0.87	1.18	1.49	1.82
17	0.252	0.01	0.19	0.51	0.81	1.11	1.40	1.68
18	0.251	0.05	0.23	0.69	1.09	1.47	1.83	2.23
				Top Corner				
19	0.583	0.65	1.85	4.25	6.67	9.14	11.67	13.75
20	0.479	0.53	1.45	3.41	5.35	7.25	9.15	11.22
21	0.438	0.44	1.24	2.94	4.59	6.29	7.94	9.59
22	0.410	0.34	0.94	2.38	3.72	4.95	6.37	7.74
23	0.383	0.25	0.77	1.85	2.96	4.02	5.05	6.10
24	0.362	0.21	0.69	1.70	2.72	3.67	4.67	5.62
25	0.345	0.17	0.60	1.53	2.45	3.35	4.24	5.14
26	0.330	0.13	0.46	1.17	1.89	2.58	3.25	3.95
27	0.317	0.10	0.42	1.10	1.78	2.46	3.11	3.79
28	0.305	0.09	0.38	1.01	1.61	2.23	2.74	3.38
29	0.295	0.09	0.36	0.97	1.56	2.16	2.75	3.34
30	0.285	0.07	0.32	0.88	1.42	1.95	2.49	2.97
31	0.278	0.03	0.25	0.69	1.13	1.56	2.00	2.40
32	0.270	0.04	0.25	0.69	1.13	1.56	2.01	2.41
33	0.265	0.02	0.22	0.59	0.98	1.33	1.69	2.02
34	0.257	0.00	0.22	0.59	0.97	1.33	1.69	2.02
35	0.252	0.01	0.20	0.53	0.87	1.17	1.50	1.78
36	0.251	0.03	0.19	0.60	0.96	1.31	1.67	1.98
				Side Center Line				
37	0.000	0.99	1.91	3.80	5.73	7.58	9.48	11.49
38	0.000	0.76	1.43	2.81	4.21	5.63	6.98	8.28
39	0.000	0.75	1.36	2.77	4.10	5.45	6.76	8.08
40	0.000	0.71	1.33	2.66	3.95	5.28	6.56	7.83
41	0.000	0.67	1.26	2.48	3.72	4.94	6.18	7.38
42	0.000	0.62	1.16	2.29	3.41	4.53	5.64	6.76
43	0.000	0.59	1.11	2.19	3.26	4.35	5.39	6.48
44	0.000	0.56	1.05	2.06	3.11	4.11	5.10	6.10
45	0.000	0.54	0.98	1.95	2.92	3.83	4.83	5.79
46	0.000	0.51	0.93	1.85	2.75	3.60	4.53	5.43
47	0.000	0.48	0.87	1.71	2.56	3.38	4.20	5.05
48	0.000	0.48	0.83	1.63	2.48	3.28	4.08	4.90
49	0.000	0.45	0.79	1.55	2.31	3.05	3.78	4.53
50	0.000	0.41	0.75	1.45	2.14	2.84	3.51	4.18
51	0.000	0.39	0.71	1.36	2.00	2.65	3.25	3.88
52	0.000	0.37	0.66	1.26	1.85	2.44	3.03	3.56
53	0.000	0.36	0.64	1.22	1.79	2.33	2.88	3.41
54	0.000	0.35	0.61	1.14	1.66	2.15	2.65	3.08
55	0.000	0.34	0.58	1.11	1.62	2.11	2.61	3.08
56	0.000	0.30	0.50	0.94	1.36	1.78	2.20	2.60
57	0.000	0.23	0.36	0.71	1.03	1.33	1.65	1.98
58	0.000	0.15	0.21	0.38	0.55	0.73	0.88	1.05
59	0.000	0.06	0.07	0.10	0.12	0.16	0.19	0.21
60	0.000	0.01	0.00	-0.01	-0.04	-0.05	-0.07	-0.08

Note: Bottom of intake and conduit at same elevation as approach channel.

* H = head in feet of water above conduit center line; Q = discharge.

Table 4

Pressure Data, Type 4 Entrance (Flared in Three Directions)

Equation for top flare: $\frac{X^2}{(1.5D)^2} + \frac{Y^2}{(1.5D/3)^2} = 1$ Equation for side flares: $\frac{X^2}{D^2} + \frac{Y^2}{(D/3)^2} = 1$

D = 0.500 ft D = 0.283 ft

Piez No.	Piez Zero	Pressure, ft of Water						
		H,* 1.25 ft Q,* 1.12 cfs	H, 2.50 ft Q, 1.58 cfs	H, 5.00 ft Q, 2.25 cfs	H, 7.50 ft Q, 2.75 cfs	H, 10.00 ft Q, 3.20 cfs	H, 12.50 ft Q, 3.58 cfs	H, 15.00 ft Q, 3.95 cfs
				Top Center Line				
1	0.500	0.70	1.85	4.21	6.53	8.83	11.03	12.83
2	0.460	0.62	1.63	3.72	5.75	7.82	9.82	11.63
3	0.410	0.54	1.41	3.21	4.99	6.77	8.57	9.99
4	0.374	0.43	1.17	2.63	4.11	5.56	6.96	8.46
5	0.350	0.30	0.86	2.00	3.11	4.25	5.33	6.48
6	0.330	0.23	0.70	1.66	2.63	3.58	4.49	5.48
7	0.313	0.17	0.54	1.34	2.17	2.92	3.67	4.17
8	0.298	0.03	0.23	0.65	1.08	1.48	1.86	2.23
9	0.288	0.00	0.19	0.59	0.99	1.38	1.72	2.09
10	0.277	-0.02	0.20	0.52	0.92	1.27	1.60	1.94
11	0.270	-0.02	0.17	0.52	0.89	1.24	1.58	1.94
12	0.265	-0.04	0.11	0.39	0.70	0.97	1.22	1.45
13	0.258	-0.05	0.09	0.35	0.64	0.87	1.09	1.29
14	0.253	-0.03	0.11	0.36	0.66	0.89	1.12	1.31
15	0.252	-0.04	0.07	0.29	0.53	0.71	0.88	1.05
16	0.251	0.01	0.23	0.60	1.02	1.40	1.71	2.11
17	0.250	0.03	0.23	0.59	0.98	1.31	1.65	1.96
18	0.250	0.06	0.27	0.68	1.07	1.49	1.88	2.23
				Top Corner				
19	0.500	0.75	1.96	4.40	6.83	9.23	11.36	13.85
20	0.460	0.67	1.76	3.97	6.15	8.37	10.22	12.43
21	0.410	0.49	1.34	3.05	4.75	6.44	8.12	9.82
22	0.374	0.34	0.98	2.28	3.58	4.89	6.16	7.44
23	0.350	0.22	0.70	1.70	2.70	3.70	5.66	5.68
24	0.330	0.15	0.50	1.28	2.15	2.90	3.60	4.40
25	0.313	0.07	0.34	0.90	1.50	2.07	2.59	3.05
26	0.298	0.00	0.21	0.65	1.15	1.61	2.01	2.41
27	0.288	-0.03	0.13	0.45	0.81	1.15	1.42	1.67
28	0.277	-0.03	0.13	0.45	0.79	1.13	1.43	1.68
29	0.270	-0.03	0.11	0.39	0.69	0.99	1.24	1.44
30	0.265	-0.05	0.07	0.30	0.55	0.77	0.95	1.07
31	0.258	-0.06	0.03	0.22	0.40	0.59	0.77	0.90
32	0.253	-0.03	0.08	0.34	0.58	0.81	1.06	1.21
33	0.252	0.00	0.16	0.49	0.83	1.16	1.48	1.74
34	0.251	0.03	0.23	0.60	1.01	1.36	1.71	2.05
35	0.250	0.05	0.27	0.71	1.16	1.57	1.98	2.38
36	0.250	0.05	0.23	0.66	1.07	1.45	1.81	2.19
				Side Center Line				
37	0.000	1.01	1.97	3.93	5.85	7.80	9.78	11.32
38	0.000	0.73	1.38	2.73	4.10	5.38	6.80	8.00
39	0.000	0.68	1.28	2.54	3.78	5.00	6.23	7.36
40	0.000	0.64	1.20	2.39	3.56	4.73	5.90	6.93
41	0.000	0.58	1.10	2.14	3.19	4.20	5.21	6.21
42	0.000	----	----	----	----	----	----	----
43	0.000	0.54	1.02	1.95	2.83	3.73	4.69	5.68
44	0.000	0.48	0.91	1.78	2.65	3.52	4.35	5.16
45	0.000	0.48	0.84	1.63	2.43	3.23	4.00	4.71
46	0.000	0.43	0.77	1.50	2.24	2.95	3.63	4.36
47	0.000	0.40	0.70	1.33	1.97	2.58	3.21	3.81
48	0.000	0.38	0.66	1.28	1.90	2.48	3.10	3.65
49	0.000	0.36	0.65	1.25	1.85	2.44	3.01	3.58
50	0.000	0.34	0.59	1.08	1.62	2.11	2.58	3.03
51	0.000	0.36	0.65	1.24	1.83	2.40	2.98	3.48
52	0.000	0.35	0.64	1.20	1.81	2.36	2.95	3.43
53	0.000	0.35	0.63	1.19	1.75	2.30	2.85	3.33
54	0.000	0.34	0.61	1.14	1.68	2.21	2.73	3.24
55	0.000	0.32	0.55	1.03	1.51	1.98	2.48	2.93
56	0.000	0.28	0.48	0.90	1.19	1.58	2.06	2.53
57	0.000	0.21	0.35	0.66	0.98	1.26	1.58	1.85
58	0.000	0.14	0.20	0.35	0.50	0.65	0.81	0.96
59	0.000	0.06	0.06	0.06	0.10	0.11	0.12	0.11
60	0.000	0.01	-0.01	-0.04	-0.05	-0.08	-0.10	-0.14

Note: Bottom of intake and conduit at same elevation as approach channel.

* H = head in feet of water above conduit center line; Q = discharge.

Table 5

Pressure Data, Type 5 Entrance (Flared in Three Directions)

Equation for top and side flares combines portions of equations

$$\frac{X^2}{D^2} + \frac{Y^2}{(0.64D)^2} = 1 \quad \text{and} \quad \frac{X^2}{D^2} + \frac{Y^2}{(0.32D)^2} = 1$$

D = 0.500 ft for top
D = 0.283 ft for sides

Piez No.	Piez Zero	Pressure, ft of Water						
		H,* 1.25 ft Q,* 1.08 cfs	H, 2.50 ft Q, 1.57 cfs	H, 5.00 ft Q, 2.23 cfs	H, 7.50 ft Q, 2.77 cfs	H, 10.00 ft Q, 3.18 cfs	H, 12.50 ft Q, 3.60 cfs	H, 15.00 ft Q, 3.97 cfs
				Top Center Line				
1	0.572	0.65	1.86	4.33	6.78	9.26	11.67	14.29
2	0.473	0.70	1.81	4.10	6.41	8.70	10.95	13.30
3	0.432	0.67	1.75	3.85	5.97	8.09	10.23	12.48
4	0.403	0.64	1.62	3.63	5.64	7.69	9.63	11.95
5	0.378	0.55	1.49	3.37	5.24	7.07	8.89	10.88
6	0.359	0.51	1.24	2.89	4.51	6.08	7.71	9.29
7	0.341	0.44	1.14	2.56	4.02	5.42	6.88	8.39
8	0.315	0.24	0.71	1.66	2.63	3.57	4.47	5.46
9	0.297	0.13	0.47	1.18	1.86	2.56	3.27	3.95
10	0.283	0.05	0.25	0.70	1.16	1.60	2.91	2.59
11	0.272	-0.03	0.13	0.43	0.75	1.04	1.40	1.70
12	0.264	-0.02	0.12	0.39	0.71	1.00	1.38	1.57
13	0.258	-0.01	0.14	0.44	0.78	1.07	1.37	1.69
14	0.254	-0.03	0.08	0.31	0.57	0.80	1.03	1.25
15	0.251	-0.01	0.13	0.43	0.75	1.04	1.30	1.60
16	0.250	0.02	0.22	0.63	1.03	1.43	1.77	2.18
17	0.250	0.06	0.27	0.74	1.19	1.60	2.03	2.49
18	0.250	0.07	0.31	0.78	1.27	1.72	2.21	2.63
19	0.250	0.08	0.33	0.82	1.33	1.79	2.27	2.79
20	0.250	0.09	0.35	0.84	1.35	1.83	2.32	2.82
21	0.250	0.08	0.34	0.83	1.34	1.82	2.29	2.81
22	0.250	0.07	0.32	0.75	1.29	1.76	2.22	2.72
				Top Corner				
23	0.572	0.67	1.86	4.35	6.88	9.35	11.84	14.29
24	0.473	0.75	1.91	4.33	6.71	9.08	11.50	13.96
25	0.432	0.71	1.79	4.07	6.32	8.50	10.72	13.12
26	0.403	0.68	1.69	3.80	5.88	8.00	10.07	12.39
27	0.378	0.61	1.52	3.40	5.30	7.15	9.07	11.21
28	0.359	0.51	1.32	2.91	4.50	6.04	7.62	9.24
29	0.341	0.40	1.06	2.40	3.74	5.06	6.43	7.87
30	0.315	0.17	0.56	1.34	2.11	2.88	3.69	4.52
31	0.297	0.05	0.28	0.77	1.27	1.75	2.25	2.78
32	0.283	-0.04	0.10	0.39	0.67	0.95	1.24	1.53
33	0.272	-0.05	0.06	0.28	0.50	0.75	0.96	1.19
34	0.264	-0.03	0.11	0.41	0.68	0.94	1.21	1.47
35	0.258	-0.04	0.07	0.29	0.51	0.72	0.93	1.16
36	0.254	-0.02	0.10	0.38	0.67	0.93	1.13	1.46
37	0.251	-0.01	0.15	0.45	0.74	1.02	1.27	1.60
38	0.250	0.03	0.22	0.60	1.00	1.35	1.71	2.10
39	0.250	0.05	0.28	0.75	1.20	1.66	2.07	2.53
40	0.250	0.07	0.31	0.79	1.27	1.71	2.15	2.62
41	0.250	0.08	0.33	0.85	1.36	1.83	2.31	2.78
42	0.250	0.09	0.33	0.85	1.35	1.82	2.39	2.77
43	0.250	0.08	0.31	0.77	1.22	1.63	2.05	2.48
44	0.250	0.07	0.29	0.76	1.22	1.64	2.08	2.50
				Side Center Line				
45	0.000	1.19	2.32	4.72	7.05	9.36	11.70	14.21
46	0.000	1.01	1.95	3.87	5.77	7.70	9.70	11.70
47	0.000	0.94	1.81	3.56	5.31	7.03	8.83	11.28
48	0.000	0.78	1.48	2.93	4.37	5.75	7.18	8.75
49	0.000	0.65	1.22	2.40	3.55	4.68	5.85	6.98
50	0.000	0.58	1.07	2.07	3.08	4.03	5.01	6.00
51	0.000	0.51	0.92	1.78	2.62	3.44	4.30	5.17
52	0.000	0.46	0.82	1.58	2.33	3.08	3.88	4.61
53	0.000	0.42	0.78	1.48	2.18	2.88	3.62	4.32
54	0.000	0.40	0.77	1.47	2.17	2.88	3.60	4.32
55	0.000	0.40	0.73	1.40	2.04	2.77	3.45	4.13
56	0.000	0.37	0.71	1.33	1.96	2.63	3.27	3.90
57	0.000	0.42	0.67	1.27	1.87	2.51	3.12	3.77
58	0.000	0.42	0.67	1.27	1.90	2.53	3.14	3.78
59	0.000	0.40	0.60	1.23	1.83	2.40	2.98	3.55
60	0.000	0.40	0.60	1.24	1.84	2.42	3.02	3.59
61	0.000	0.40	0.59	1.22	1.80	2.35	2.92	3.47
62	0.000	0.35	0.61	1.18	1.65	2.21	2.80	3.37
63	0.000	0.35	0.62	1.20	1.67	2.21	2.83	3.39
64	0.000	0.35	0.63	1.22	1.67	2.23	2.83	3.39
65	0.000	0.34	0.60	1.13	1.56	2.10	2.67	3.23
66	0.000	0.29	0.50	0.96	1.30	1.77	2.27	2.74
67	0.000	0.23	0.38	0.71	0.97	1.31	1.70	2.08
68	0.000	0.15	0.23	0.43	0.62	0.76	1.03	1.22
69	0.000	0.08	0.08	0.11	0.17	0.15	0.28	0.33
70	0.000	0.02	0.00	0.00	0.00	0.02	0.02	0.03

Note: Bottom of intake and conduit at same elevation as approach channel.
* H = head in feet of water above conduit center line; Q = discharge.

Table 6

Pressure Data, Type 6 Entrance (Flared in Three Directions)

Equation for top and side flares combines portions of equations

$$\frac{X^2}{D^2} + \frac{Y^2}{(0.32D)^2} = 1 \quad \text{and} \quad \frac{X^2}{D^2} + \frac{Y^2}{(0.16D)^2} = 1$$

D = 0.500 ft for top
D = 0.283 ft for sides

Piez No.	Piez Zero	Pressure, ft of Water H,* 1.25 ft Q,* 1.08 cfs	H, 2.50 ft Q, 1.58 cfs	H, 5.00 ft Q, 2.22 cfs	H, 7.50 ft Q, 2.74 cfs	H, 10.00 ft Q, 3.17 cfs	H, 12.50 ft Q, 3.57 cfs	H, 15.00 ft Q, 3.97 cfs
				Top Center Line				
1	0.410	0.76	1.83	4.10	6.33	8.63	10.87	13.36
2	0.360	0.47	1.21	2.75	4.26	5.80	7.26	8.91
3	0.340	0.44	1.13	2.56	3.84	5.38	6.71	8.24
4	0.326	0.39	1.03	2.31	3.60	4.90	6.10	7.47
5	0.314	0.35	0.92	2.07	3.17	4.33	5.43	6.64
6	0.302	0.31	0.82	1.87	2.88	3.97	4.98	6.14
7	0.294	0.25	0.69	1.59	2.49	3.43	4.31	5.34
8	0.280	0.15	0.48	1.16	1.81	2.51	3.16	3.89
9	0.272	0.08	0.28	0.74	1.17	1.64	2.11	2.63
10	0.266	0.08	0.29	0.75	1.21	1.70	2.15	2.70
11	0.260	0.03	0.23	0.64	1.06	1.49	1.89	2.32
12	0.256	0.02	0.22	0.61	0.99	1.39	1.75	2.17
13	0.254	0.04	0.24	0.66	1.06	1.48	1.83	2.27
14	0.252	0.05	0.27	0.72	1.14	1.59	2.00	2.47
15	0.251	0.06	0.28	0.76	1.18	1.64	2.07	2.54
16	0.250	0.07	0.31	0.80	1.24	1.72	2.15	2.66
17	0.250	0.08	0.32	0.81	1.25	1.73	2.17	2.69
18	0.250	0.08	0.33	0.82	1.29	1.78	2.22	2.73
19	0.250	0.09	0.35	0.84	1.32	1.82	2.28	2.81
20	0.250	0.12	0.38	0.93	1.43	1.96	2.47	3.06
21	0.250	0.09	0.35	0.87	1.33	1.83	2.29	2.82
22	0.250	0.11	0.37	0.91	1.39	1.94	2.41	2.99
				Top Corner				
23	0.410	0.81	1.99	4.41	6.79	9.14	11.55	14.04
24	0.360	0.56	1.39	3.15	4.87	6.59	8.21	10.17
25	0.340	0.39	1.00	2.37	3.64	4.92	6.19	7.66
26	0.326	0.31	0.75	2.00	3.14	4.24	5.29	6.57
27	0.314	0.26	0.71	1.75	2.69	3.54	4.44	5.46
28	0.302	0.19	0.57	1.42	2.22	3.06	3.78	4.74
29	0.294	0.13	0.46	1.17	1.83	2.55	3.18	3.92
30	0.280	0.05	0.28	0.76	1.23	1.72	2.14	2.65
31	0.272	0.00	0.16	0.52	0.85	1.21	1.51	1.89
32	0.266	0.00	0.15	0.51	0.86	1.22	1.55	1.92
33	0.260	0.01	0.17	0.48	0.81	1.13	1.46	1.81
34	0.256	0.01	0.16	0.51	0.85	1.18	1.50	1.87
35	0.254	0.03	0.21	0.61	0.99	1.38	1.72	2.13
36	0.252	0.05	0.25	0.68	1.11	1.52	1.92	2.37
37	0.251	0.06	0.26	0.70	1.12	1.53	1.93	2.38
38	0.250	0.08	0.32	0.82	1.31	1.78	2.22	2.76
39	0.250	0.08	0.33	0.82	1.31	1.78	2.22	2.76
40	0.250	0.08	0.33	0.82	1.31	1.78	2.22	2.77
41	0.250	0.10	0.34	0.86	1.36	1.85	2.30	2.87
42	0.250	0.12	0.37	0.93	1.45	1.97	2.47	3.04
43	0.250	0.12	0.37	0.92	1.44	1.95	2.45	3.01
44	0.250	0.13	0.38	0.93	1.45	2.00	2.47	3.06
				Side Center Line				
45	0.000	0.85	1.65	3.32	4.59	6.55	8.05	9.75
46	0.000	0.63	1.17	2.33	3.42	4.53	5.50	6.72
47	0.000	0.58	1.08	2.13	3.12	4.14	5.05	6.20
48	0.000	0.59	1.09	2.16	3.21	4.25	5.23	6.40
49	0.000	0.53	0.97	1.92	2.84	3.78	4.63	5.68
50	0.000	0.48	0.87	1.72	2.56	3.36	4.15	5.06
51	0.000	0.46	0.83	1.60	2.40	3.19	3.92	4.75
52	0.000	0.46	0.82	1.58	2.36	3.11	3.82	4.65
53	0.000	0.43	0.73	1.38	2.03	2.67	3.29	4.01
54	0.000	0.40	0.69	1.34	1.98	2.62	3.22	3.92
55	0.000	0.40	0.72	1.38	2.02	2.66	3.28	4.00
56	0.000	0.40	0.71	1.37	2.01	2.64	3.26	3.96
57	0.000	0.38	0.68	1.33	1.94	2.54	3.15	3.82
58	0.000	0.40	0.68	1.31	1.97	2.49	3.07	3.84
59	0.000	0.38	0.64	1.21	1.84	2.28	2.79	3.58
60	0.000	0.37	0.64	1.22	1.77	2.31	2.85	3.45
61	0.000	0.37	0.64	1.20	1.74	2.27	2.78	3.38
62	0.000	0.34	0.62	1.16	1.70	2.22	2.72	3.28
63	0.000	0.33	0.59	1.11	1.64	2.16	2.65	3.21
64	0.000	0.28	0.50	0.93	1.37	1.82	2.21	2.69
65	0.000	0.23	0.38	0.69	1.03	1.33	1.65	1.98
66	0.000	0.16	0.23	0.42	0.61	0.80	0.93	1.22
67	0.000	0.08	0.08	0.12	0.16	0.21	0.25	0.31
68	0.000	0.02	0.01	0.00	0.00	0.00	0.02	0.02

Note: Bottom of intake and conduit at same elevation as approach channel.
* H = head in feet of water above conduit center line; Q = discharge.

Table 7

Pressure Data, Type 7 Entrance (Flared in Three Directions)

Equation for top flare combines portions of equations $\frac{X^2}{(2D)^2} + \frac{Y^2}{(0.64D)^2} = 1$ and $\frac{X^2}{(2D)^2} + \frac{Y^2}{(0.32D)^2} = 1$

Equation for side flare combines portions of equations $\frac{X^2}{D^2} + \frac{Y^2}{(0.32D)^2} = 1$ and $\frac{X^2}{D^2} + \frac{Y^2}{(0.16D)^2} = 1$

D = 0.500 ft | D = 0.283 ft

Piez No.	Piez Zero	Pressure, ft of Water						
		H,* 1.25 ft Q,* 1.12 cfs	H, 2.50 ft Q, 1.60 cfs	H, 5.00 ft Q, 2.25 cfs	H, 7.50 ft Q, 2.82 cfs	H, 10.00 ft Q, 3.20 cfs	H, 12.50 ft Q, 3.60 cfs	H, 15.00 ft Q, 3.95 cfs
		Top Center Line						
1	0.570	0.65	1.83	4.21	6.68	9.03	11.43	13.98
2	0.500	0.62	1.67	3.88	6.08	8.27	10.34	12.61
3	0.469	0.58	1.57	3.62	5.68	7.69	9.65	11.77
4	0.447	0.53	1.45	3.34	5.27	7.16	8.98	10.83
5	0.429	0.50	1.35	3.13	4.94	6.70	8.44	10.25
6	0.413	0.47	1.27	2.75	4.63	6.25	7.91	9.56
7	0.400	0.43	1.16	2.70	4.25	5.78	7.28	8.81
8	0.377	0.38	1.04	2.46	3.87	5.26	6.86	8.05
9	0.359	0.34	0.96	2.26	3.56	4.84	6.10	7.41
10	0.341	0.28	0.79	1.91	3.01	4.08	5.16	6.35
11	0.326	0.20	0.64	1.58	2.52	3.47	4.39	5.38
12	0.314	0.16	0.55	1.35	2.16	2.99	3.76	4.59
13	0.304	0.13	0.48	1.21	1.96	2.70	3.39	3.99
14	0.295	0.10	0.42	1.08	1.77	2.44	3.10	3.77
15	0.288	0.08	0.37	0.99	1.62	2.24	2.84	3.44
16	0.279	0.07	0.33	0.87	1.45	2.00	2.53	3.08
17	0.274	0.05	0.31	0.83	1.36	1.89	2.39	2.91
18	0.270	0.05	0.28	0.75	1.23	1.77	2.13	2.60
19	0.266	0.05	0.26	0.70	1.16	1.67	2.03	2.46
20	0.262	0.06	0.29	0.76	1.24	1.70	2.19	2.66
21	0.259	0.06	0.27	0.71	1.15	1.64	2.01	2.46
22	0.257	0.06	0.28	0.72	1.17	1.60	2.02	2.46
23	0.255	0.06	0.28	0.75	1.21	1.67	2.10	2.56
24	0.254	0.07	0.29	0.76	1.22	1.67	2.11	2.57
25	0.253	0.07	0.29	0.75	1.21	1.66	2.12	2.56
26	0.252	0.08	0.30	0.78	1.24	1.72	2.15	2.63
27	0.251	0.09	0.32	0.80	1.28	1.75	2.22	2.70
28	0.250	0.09	0.32	0.81	1.29	1.77	2.23	2.72
29	0.250	0.10	0.34	0.84	1.30	1.84	2.31	2.82
		Top Corner						
30	0.570	0.67	1.83	4.29	6.75	9.16	11.51	14.28
31	0.500	0.66	1.72	4.01	6.31	8.53	10.72	13.03
32	0.469	0.60	1.60	3.67	5.77	7.79	9.83	11.94
33	0.447	0.51	1.41	3.26	5.12	6.95	8.72	10.63
34	0.429	0.44	1.23	2.89	4.54	6.19	7.77	9.45
35	0.413	0.38	1.09	2.55	4.02	5.50	6.89	8.34
36	0.400	0.35	1.00	2.34	3.72	5.12	6.36	7.76
37	0.377	0.31	0.90	2.11	3.40	4.62	5.77	7.04
38	0.359	0.27	0.81	1.92	3.04	4.18	5.28	6.39
39	0.341	0.24	0.73	1.78	2.83	3.89	4.89	5.99
40	0.326	0.17	0.59	1.45	2.35	3.20	4.04	4.93
41	0.314	0.13	0.46	1.17	1.88	2.57	3.29	3.94
42	0.304	0.12	0.45	1.15	1.84	2.55	3.22	3.90
43	0.295	0.07	0.35	0.92	1.47	2.03	2.55	3.15
44	0.288	0.08	0.37	0.98	1.61	2.22	2.83	3.45
45	0.279	0.08	0.63	0.90	1.49	2.07	2.60	3.19
46	0.274	0.07	0.58	0.84	1.38	1.91	2.40	2.93
47	0.270	0.05	0.54	0.73	1.21	1.70	2.11	2.60
48	0.266	0.05	0.54	0.76	1.24	1.74	2.20	2.66

(Continued)

Note: Bottom of intake and conduit at same elevation as approach channel.

* H = head in feet of water above conduit center line; Q = discharge.

Table 7 (Concluded)

Piez No.	Piez Zero	Pressure, ft of Water H, 1.25 ft Q, 1.12 cfs	H, 2.50 ft Q, 1.60 cfs	H, 5.00 ft Q, 2.25 cfs	H, 7.50 ft Q, 2.82 cfs	H, 10.00 ft Q, 3.20 cfs	H, 12.50 ft Q, 3.60 cfs	H, 15.00 ft Q, 3.95 cfs
				Top Corner (Continued)				
49	0.262	0.06	0.53	0.76	1.24	1.74	2.14	2.63
50	0.259	0.04	0.50	0.69	1.11	1.56	1.98	2.39
51	0.257	0.05	0.52	0.72	1.15	1.60	2.01	2.44
52	0.255	0.06	0.52	0.71	1.14	1.61	2.02	2.45
53	0.254	0.08	0.55	0.78	1.24	1.70	2.15	2.63
54	0.253	0.08	0.57	0.82	1.30	1.80	2.27	2.73
55	0.252	0.08	0.57	0.83	1.31	1.82	2.28	2.76
56	0.251	0.09	0.59	0.85	1.34	1.85	2.32	2.81
57	0.250	0.09	0.58	0.84	1.43	1.83	2.30	2.79
58	0.250	0.09	0.58	0.85	1.35	1.87	2.34	2.86
				Side Center Line				
59	0.000	1.00	1.93	3.88	5.83	7.72	9.63	11.45
60	0.000	0.80	1.57	3.02	4.63	5.97	7.45	9.00
61	0.000	0.71	1.33	2.63	3.96	5.23	6.51	7.80
62	0.000	0.74	1.41	2.79	4.17	5.63	8.08	8.42
63	0.000	0.67	1.25	2.48	3.73	5.09	6.28	7.49
64	0.000	0.65	1.21	2.40	3.55	4.86	6.02	7.28
65	0.000	0.63	1.17	2.27	3.38	4.53	5.63	6.73
66	0.000	0.60	1.11	2.19	3.24	4.43	5.41	6.51
67	0.000	0.58	1.06	2.09	3.12	4.32	5.25	6.34
68	0.000	0.53	0.98	1.92	2.83	3.83	4.70	5.63
69	0.000	0.50	0.93	1.83	2.72	3.72	4.56	5.47
70	0.000	0.48	0.87	1.68	2.49	3.45	4.22	5.02
71	0.000	0.46	0.83	1.65	2.44	3.40	4.16	4.97
72	0.000	0.43	0.74	1.56	2.31	3.17	3.88	4.65
73	0.000	0.42	0.76	1.50	2.22	3.06	3.77	4.43
74	0.000	0.40	0.72	1.40	2.08	2.74	3.37	4.05
75	0.000	0.38	0.68	1.32	1.95	2.57	3.18	3.80
76	0.000	0.36	0.64	1.23	1.81	2.37	2.94	3.51
77	0.000	0.35	0.63	1.18	1.74	2.27	2.82	3.38
78	0.000	0.34	0.59	1.12	1.64	2.11	2.67	3.15
79	0.000	0.33	0.58	1.11	1.62	2.11	2.60	3.11
				Top Center Line				
80	0.250	0.05	0.26	0.70	1.05	1.52	1.91	2.32
81	0.250	0.08	0.30	0.79	1.25	1.72	2.15	2.63
82	0.250	0.08	0.30	0.79	1.27	1.75	2.21	2.70
83	0.250	0.08	0.31	0.79	1.26	1.72	2.14	2.63
84	0.250	0.08	0.31	0.81	1.30	1.80	2.24	2.73
85	0.250	0.08	0.30	0.78	1.26	1.73	2.20	2.61
86	0.250	0.08	0.31	0.81	1.32	1.81	2.25	2.75
87	0.250	0.08	0.31	0.80	1.30	1.78	2.23	2.73
88	0.250	0.07	0.30	0.78	1.26	1.73	2.20	2.70
89	0.250	0.06	0.29	0.75	1.19	1.65	2.08	2.52
				Side Center Line				
90	0.000	0.34	0.57	1.07	1.58	2.10	2.54	3.02
91	0.000	0.30	0.49	0.92	1.37	1.79	2.19	2.64
92	0.000	0.23	0.37	0.64	1.02	1.31	1.63	1.96
93	0.000	0.16	0.24	0.44	0.64	0.83	1.04	1.27
94	0.000	0.08	0.08	0.13	0.17	0.23	0.28	0.30
95	0.000	0.03	0.00	0.00	0.00	-0.01	0.00	0.02

Table 8

Pressure Data, Type A Entrance (Flared in One Direction)

Equation for top flare: $\frac{X^2}{D^2} + \frac{Y^2}{(2D/3)^2} = 1$ D = 0.500 ft

Piez No.	Piez Zero	Pressure, ft of Water H,* 1.25 ft Q,* 1.05 cfs	H, 2.50 ft Q, 1.53 cfs	H, 5.00 ft Q, 2.17 cfs	H, 7.50 ft Q, 2.68 cfs	H, 10.00 ft Q, 3.08 cfs	H, 12.50 ft Q, 3.48 cfs	H, 15.00 ft Q, 3.82 cfs
				Top Center Line				
1	0.583	0.47	1.33	2.89	4.69	6.54	8.49	10.59
2	0.491	0.24	0.67	1.76	2.86	3.89	4.75	5.41
3	0.439	0.15	0.50	1.31	2.15	2.99	3.72	4.39
4	0.384	0.09	0.35	0.94	1.50	2.25	2.85	3.51
5	0.349	0.01	0.21	0.64	1.10	1.60	2.03	2.60
6	0.318	-0.08	0.04	0.27	0.52	0.79	1.03	1.38
7	0.297	-0.14	-0.04	0.17	0.37	0.56	0.75	0.94
8	0.279	-0.13	-0.08	0.07	0.19	0.33	0.47	0.60
9	0.266	-0.19	-0.20	-0.21	-0.23	-0.27	-0.29	-0.31
10	0.257	-0.16	-0.15	-0.14	-0.13	-0.11	-0.11	-0.02
11	0.252	-0.13	-0.10	-0.05	-0.01	0.04	0.06	0.12
12	0.250	-0.06	0.06	0.29	0.50	0.70	0.91	1.14
13	0.250	0.00	0.18	0.54	0.87	1.21	1.52	1.84
14	0.250	0.05	0.25	0.66	1.07	1.47	1.86	2.22
15	0.250	0.08	0.32	0.81	1.30	1.79	2.27	2.72
16	0.250	0.08	0.32	0.80	1.29	1.76	2.24	2.67
17	0.250	0.10	0.35	0.88	1.40	1.92	2.42	2.90
18	0.250	0.11	0.36	0.90	1.44	1.96	2.46	2.94
				Top Corner				
19	0.583	0.43	1.20	3.03	4.78	6.49	8.14	9.72
20	0.491	0.22	0.70	1.82	2.94	3.96	5.03	6.26
21	0.439	0.17	0.62	1.57	2.52	3.58	4.56	5.85
22	0.384	0.10	0.40	1.04	1.72	2.43	3.11	3.93
23	0.349	0.03	0.25	0.69	1.20	1.67	2.14	2.82
24	0.318	-0.10	-0.01	0.15	0.30	0.48	0.65	0.92
25	0.297	-0.09	0.02	0.17	0.27	0.52	0.69	1.01
26	0.279	-0.13	-0.05	0.05	0.17	0.29	0.39	0.61
27	0.266	-0.17	-0.13	-0.08	-0.04	-0.01	0.05	0.12
28	0.257	-0.22	-0.24	-0.34	-0.45	-0.60	-0.72	-0.79
29	0.252	-0.10	-0.01	0.13	0.29	0.46	0.59	0.80
30	0.250	-0.06	0.07	0.29	0.51	0.73	0.90	1.15
31	0.250	-0.01	0.17	0.50	0.81	1.12	1.42	1.75
32	0.250	0.04	0.26	0.70	1.14	1.57	2.00	2.44
33	0.250	0.04	0.28	0.74	1.17	1.60	2.07	2.48
34	0.250	0.07	0.33	0.83	1.34	1.82	2.30	2.80
35	0.250	0.10	0.37	0.84	1.45	2.00	2.52	3.10
36	0.250	0.08	0.36	0.80	1.42	1.94	2.47	2.96
				Side Center Line				
55	0.000	0.32	0.58	1.09	1.61	2.12	2.60	3.10
56	0.000	0.27	0.47	0.90	1.35	1.76	2.17	2.57
57	0.000	0.21	0.36	0.69	1.02	1.33	1.65	1.94
58	0.000	0.13	0.21	0.40	0.59	0.79	0.94	1.11
59	0.000	0.05	0.06	0.09	0.13	0.18	0.21	0.24
60	0.000	0.00	0.01	0.02	0.03	0.05	0.07	0.09

Note: Bottom of intake and conduit at same elevation as approach channel.

* H = head in feet of water above conduit center line; Q = discharge.

Table 9

Pressure Data, Type B Entrance (Flared in One Direction)

Equation for top flare: $\frac{X^2}{D^2} + \frac{Y^2}{(D/3)^2} = 1$ D = 0.500 ft

Piez No.	Piez Zero	Pressure, ft of Water H,* 1.25 ft Q,* 1.05 cfs	H, 2.50 ft Q, 1.53 cfs	H, 5.00 ft Q, 2.18 cfs	H, 7.50 ft Q, 2.68 cfs	H, 10.00 ft Q, 3.12 cfs	H, 12.50 ft Q, 3.48 cfs	H, 15.00 ft Q, 3.83 cfs
				Top Center Line				
1	0.471	0.03	0.08	0.58	1.08	1.35	1.65	2.08
2	0.370	-0.38	-0.82	-1.23	-1.68	-2.31	-2.85	-3.50
3	0.344	-0.28	-0.53	-0.65	-0.84	-1.20	-1.45	-1.72
4	0.317	-0.22	-0.34	-0.38	-0.47	-0.65	-0.78	-0.93
5	0.298	-0.18	-0.23	-0.20	-0.20	-0.28	-0.31	-0.39
6	0.284	-0.15	-0.16	-0.12	-0.10	-0.15	-0.18	-0.18
7	0.272	-0.10	-0.03	0.13	0.26	0.25	0.33	0.41
8	0.264	-0.09	-0.06	0.04	0.14	0.18	0.25	0.30
9	0.258	-0.08	-0.03	0.11	0.23	0.31	0.43	0.53
10	0.253	-0.04	0.05	0.26	0.47	0.64	0.82	0.98
11	0.251	-0.01	0.13	0.40	0.69	0.94	1.19	1.44
12	0.250	0.03	0.20	0.54	0.88	1.20	1.52	1.86
13	0.250	0.06	0.28	0.69	1.11	1.51	1.90	2.30
14	0.250	0.09	0.33	0.76	1.21	1.65	2.08	2.53
15	0.250	0.09	0.34	0.81	1.30	1.76	2.22	2.70
16	0.250	0.09	0.35	0.84	1.34	1.82	2.29	2.73
17	0.250	0.09	0.35	0.84	1.34	1.82	2.29	2.73
18	0.250	0.10	0.37	0.88	1.39	1.90	2.39	2.88
				Top Corner				
19	0.471	-0.24	-0.40	0.15	0.37	0.35	0.52	0.70
20	0.370	-0.38	-0.83	-1.00	-1.40	-2.12	-2.42	-2.85
21	0.344	-0.15	-0.25	-0.23	-0.24	-0.27	-0.32	-0.39
22	0.317	-0.13	-0.22	-0.23	-0.22	-0.24	-0.29	-0.35
23	0.298	-0.11	-0.14	-0.09	-0.02	0.00	0.05	0.01
24	0.284	-0.08	-0.08	0.01	0.11	0.17	0.25	0.30
25	0.272	-0.06	-0.00	0.14	0.31	0.42	0.56	0.67
26	0.264	-0.05	0.02	0.21	0.36	0.51	0.66	0.79
27	0.258	-0.06	0.01	0.16	0.32	0.43	0.56	0.68
28	0.253	-0.02	0.09	0.31	0.55	0.75	0.96	1.16
29	0.251	-0.01	0.90	0.38	0.65	0.86	1.12	1.50
30	0.250	0.04	0.23	0.61	1.00	1.39	1.76	2.15
31	0.250	0.05	0.27	0.67	1.09	1.48	1.88	2.32
32	0.250	0.10	0.34	0.82	1.35	1.82	2.32	2.82
33	0.250	0.10	0.35	0.86	1.39	1.89	2.39	2.92
34	0.250	0.10	0.36	0.87	1.41	1.92	2.43	2.95
35	0.250	0.10	0.36	0.86	1.39	1.89	2.39	2.92
36	0.250	0.10	0.36	0.87	1.41	1.89	2.39	2.92
				Side Center Line				
55	0.000	0.33	0.57	1.08	1.59	2.07	2.55	3.05
56	0.000	0.28	0.47	0.91	1.34	1.73	2.15	2.56
57	0.000	0.22	0.37	0.69	1.00	1.29	1.58	1.89
58	0.000	0.14	0.22	0.39	0.58	0.74	0.91	1.09
59	0.000	0.06	0.06	0.09	0.13	0.14	0.16	0.19
60	0.000	0.00	0.00	-0.01	-0.03	-0.08	-0.10	-0.12

Note: Bottom of intake and conduit at same elevation as approach channel.

* H = head in feet of water above conduit center line; Q = discharge.

Table 10

Pressure Data, Type C Entrance (Flared in One Direction)

Equation for top flare: $\frac{X^2}{2D^2} + \frac{Y^2}{(2D/3)^2} = 1$ D = 0.500 ft

Piez No.	Piez Zero	Pressure, in ft of Water H,* 1.25 ft Q,* 1.11 cfs	H, 2.50 ft Q, 1.58 cfs	H, 5.00 ft Q, 2.22 cfs	H, 7.50 ft Q, 2.75 cfs	H, 10.00 ft Q, 3.17 cfs	H, 12.50 ft Q, 3.57 cfs	H, 15.00 ft Q, 3.90 cfs
				Top Center Line				
1	0.583	0.19	1.02	2.57	4.20	5.75	7.26	8.94
2	0.479	-0.21	0.24	0.89	1.60	2.31	3.00	3.75
3	0.438	-0.04	0.40	1.23	2.08	2.93	3.78	4.65
4	0.410	-0.03	0.42	1.24	2.07	2.91	3.75	4.60
5	0.383	-0.01	0.39	1.18	2.00	2.80	3.60	4.40
6	0.362	0.01	0.36	1.09	1.85	2.58	3.31	4.06
7	0.345	-0.01	0.33	1.01	1.73	2.43	3.14	3.82
8	0.330	0.00	0.33	0.99	1.67	2.35	3.04	3.71
9	0.317	0.02	0.36	1.04	1.76	2.47	3.18	3.87
10	0.305	0.01	0.31	0.92	1.57	2.22	2.78	3.50
11	0.295	-0.02	0.22	0.76	1.33	1.88	2.45	2.96
12	0.285	-0.02	0.21	0.74	1.29	1.82	2.37	2.88
13	0.278	-0.01	0.22	0.75	1.29	1.83	2.38	2.89
14	0.270	0.00	0.23	0.75	1.27	1.81	2.34	2.85
15	0.265	-0.03	0.20	0.68	1.18	1.68	2.17	2.63
16	0.257	-0.02	0.20	0.67	1.12	1.80	2.07	2.53
17	0.252	-0.01	0.21	0.68	1.14	1.62	2.08	2.54
18	0.251	0.00	0.23	0.72	1.22	1.72	2.18	2.65
				Top Corner				
19	0.583	0.05	0.84	1.99	3.25	4.49	5.89	7.22
20	0.479	-0.11	0.36	1.09	1.92	2.72	3.59	4.39
21	0.438	-0.01	0.48	1.32	2.23	3.11	3.92	4.73
22	0.410	0.00	0.45	1.26	2.11	2.97	3.82	4.71
23	0.383	0.02	0.44	1.22	2.05	3.23	3.74	4.59
24	0.362	0.01	0.40	1.14	1.92	3.06	3.50	4.27
25	0.345	0.00	0.36	1.05	1.79	2.86	3.25	3.97
26	0.330	0.00	0.33	1.00	1.69	2.70	3.07	3.73
27	0.317	0.00	0.32	0.95	1.61	2.59	2.94	3.60
28	0.305	0.00	0.32	0.94	1.62	2.57	2.92	3.56
29	0.295	0.00	0.31	0.88	1.50	2.43	2.77	3.35
30	0.285	-0.01	0.27	0.81	1.39	2.24	2.55	3.12
31	0.278	-0.01	0.25	0.78	1.34	2.17	2.45	3.02
32	0.270	0.00	0.27	0.80	1.36	2.18	2.49	3.05
33	0.265	-0.15	0.23	0.75	1.28	2.07	2.33	2.85
34	0.257	-0.03	0.20	0.71	1.20	1.97	2.21	2.70
35	0.252	-0.02	0.22	0.69	1.16	1.90	2.11	2.58
36	0.251	-0.03	0.20	0.63	1.07	1.75	1.93	2.45
				Side Center Line				
55	0.000	0.23	0.48	0.96	1.45	1.95	2.40	2.90
56	0.000	0.19	0.40	0.80	1.22	1.63	2.04	2.46
57	0.000	0.12	0.27	0.58	0.88	1.20	1.50	1.82
58	0.000	0.04	0.12	0.27	0.40	0.58	0.74	0.90
59	0.000	-0.03	-0.03	-0.02	0.00	0.03	0.05	0.07
60	0.000	-0.08	-0.09	-0.12	-0.15	-0.17	-0.18	-0.22

Note: Bottom of intake and conduit at same elevation as approach channel.

* H = head in feet of water above conduit center line; Q = discharge.

Table 11

Pressure Data, Type D Entrance (Flared in One Direction)

Equation for top flare: $\frac{X^2}{(1.5D)^2} + \frac{Y^2}{(1.5D/3)^2} = 1$ D = 0.500 ft

Piez No.	Piez Zero	Pressure, in ft of Water						
		H,* 1.25 ft Q,* 1.12 cfs	H, 2.50 ft Q, 1.58 cfs	H, 5.00 ft Q, 2.15 cfs	H, 7.50 ft Q, 2.68 cfs	H, 10.00 ft Q, 3.11 cfs	H, 12.50 ft Q, 3.53 cfs	H, 15.00 ft Q, 3.87 cfs
				Top Center Line				
1	0.500	-0.03	0.37	1.14	1.94	2.75	3.50	4.37
2	0.460	-0.07	0.31	1.03	1.76	2.49	3.19	3.96
3	0.410	-0.22	-0.08	0.14	0.39	0.68	0.89	1.16
4	0.374	-0.13	0.03	0.42	0.80	1.18	1.52	1.90
5	0.350	-0.05	0.18	0.64	1.07	1.56	1.99	1.45
6	0.330	0.00	0.23	0.71	1.19	1.70	2.17	2.67
7	0.313	0.03	0.25	0.73	1.21	1.73	2.18	2.68
8	0.298	0.04	0.25	0.71	1.19	1.66	2.12	2.59
9	0.288	0.02	0.23	0.66	1.11	1.56	2.00	2.45
10	0.277	0.02	0.22	0.64	1.06	1.52	1.93	2.37
11	0.270	0.01	0.18	0.56	0.95	1.33	1.68	2.10
12	0.265	0.00	0.17	0.54	0.91	1.28	1.64	2.04
13	0.258	0.03	0.18	0.57	0.95	1.34	1.68	2.09
14	0.253	0.04	0.19	0.57	0.95	1.34	1.66	2.07
15	0.252	0.05	0.22	0.62	1.00	1.40	1.79	2.19
16	0.251	0.22	0.24	0.65	1.05	1.49	1.85	2.29
17	0.250	0.05	0.26	0.70	1.14	1.59	1.99	2.44
18	0.250	0.09	0.32	0.80	1.29	1.79	2.22	2.75
				Top Corner				
19	0.500	-0.03	0.34	1.02	1.74	2.42	3.12	3.92
20	0.460	-0.04	0.28	0.84	1.38	2.01	2.51	3.26
21	0.410	-0.16	0.11	0.49	0.99	1.44	1.88	2.35
22	0.374	-0.08	0.14	0.52	1.02	1.47	1.87	2.35
23	0.350	-0.02	0.21	0.68	1.16	1.67	2.12	2.64
24	0.330	0.01	0.25	0.74	1.23	1.76	2.21	2.79
25	0.313	0.03	0.28	0.78	1.28	1.81	2.28	2.83
26	0.298	0.03	0.27	0.75	1.24	1.74	2.20	2.72
27	0.288	0.03	0.24	0.69	1.13	1.60	2.02	2.53
28	0.277	0.02	0.21	0.64	1.04	1.49	1.91	2.34
29	0.270	0.02	0.20	0.60	0.99	1.42	1.77	2.20
30	0.265	0.02	0.21	0.63	1.02	1.44	1.84	2.26
31	0.258	0.04	0.22	0.63	1.03	1.45	1.83	2.26
32	0.253	0.06	0.24	0.66	1.09	1.50	1.89	2.35
33	0.252	0.05	0.25	0.67	1.11	1.52	1.91	2.39
34	0.251	0.05	0.26	0.70	1.14	1.59	2.00	2.49
35	0.250	0.08	0.29	0.75	1.22	1.69	2.14	2.62
36	0.250	0.10	0.33	0.84	1.34	1.85	2.34	2.85
				Side Center Line				
55	0.000	0.33	0.57	1.07	1.57	2.07	2.55	3.07
56	0.000	0.29	0.49	0.92	1.34	1.79	2.19	2.65
57	0.000	0.22	0.35	0.69	0.99	1.32	1.62	1.97
58	0.000	0.13	0.20	0.39	0.55	0.75	0.92	1.12
59	0.000	0.05	0.05	0.10	0.13	0.17	0.20	0.24
60	0.000	0.00	-0.01	-0.03	-0.05	-0.05	-0.06	-0.07

Note: Bottom of intake and conduit at same elevation as approach channel.

* H = head in feet of water above conduit center line; Q = discharge.

Table 12

Pressure Data, Type E Entrance (Flared in One Direction)

Equation for top flare: D = 0.500 ft

$$\frac{X^2}{D^2} + \frac{Y^2}{(D/2)^2} = 1$$

Piez No.	Piez Zero	Pressure, ft of Water H,* 1.25 ft Q,* 1.07 cfs	H, 2.50 ft Q, 1.54 cfs	H, 5.00 ft Q, 2.19 cfs	H, 7.50 ft Q, 2.70 cfs	H, 10.00 ft Q, 3.12 cfs	H, 12.50 ft Q, 3.48 cfs	H, 15.00 ft Q, 3.85 cfs
				Top Center Line				
1	0.500	0.43	1.04	2.49	3.90	5.32	6.44	7.97
2	0.450	0.12	0.32	0.96	1.57	2.25	2.80	3.34
3	0.415	0.08	0.20	0.73	1.20	1.69	2.15	2.63
4	0.391	-0.11	-0.15	-0.02	0.10	0.20	0.36	0.38
5	0.368	-0.12	-0.14	-0.02	0.14	0.28	0.43	0.51
6	0.350	-0.12	-0.11	0.03	0.14	0.24	0.33	0.41
7	0.322	-0.11	-0.08	0.08	0.23	0.37	0.50	0.62
8	0.299	-0.13	-0.10	0.01	0.14	0.24	0.34	0.42
9	0.283	-0.16	-0.17	-0.14	-0.12	-0.12	-0.09	-0.09
10	0.270	-0.16	-0.16	-0.14	-0.12	-0.13	-0.11	-0.11
11	0.261	-0.14	-0.13	-0.12	-0.08	-0.05	-0.03	-0.01
12	0.255	-0.12	-0.09	-0.02	0.07	0.14	0.20	0.25
13	0.252	-0.06	0.00	0.18	0.34	0.50	0.67	0.78
14	0.250	0.00	0.11	0.39	0.66	0.94	1.21	1.45
15	0.250	0.04	0.21	0.55	0.91	1.26	1.59	1.95
16	0.250	0.06	0.25	0.68	1.09	1.50	1.91	2.27
17	0.250	0.08	0.29	0.76	1.21	1.66	2.10	2.53
18	0.250	0.09	0.31	0.80	1.28	1.75	2.22	2.63
19	0.250	0.09	0.31	0.80	1.29	1.76	2.24	2.65
20	0.250	0.09	0.32	0.82	1.31	1.79	2.26	2.70
21	0.250	0.09	0.30	0.79	1.28	1.74	2.19	2.62
22	0.250	0.07	0.28	0.74	1.21	1.65	2.02	2.49
				Top Corner				
23	0.500	0.35	0.99	2.41	3.82	5.20	6.44	7.92
24	0.450	0.10	0.34	1.10	1.84	2.60	3.35	4.15
25	0.415	0.05	0.22	0.77	1.34	1.86	2.36	2.91
26	0.391	-0.08	-0.05	0.20	0.51	1.86	1.18	1.48
27	0.368	-0.09	-0.08	0.12	0.32	0.53	0.68	0.80
28	0.350	-0.05	0.00	0.28	0.54	0.87	1.12	1.37
29	0.322	-0.07	-0.05	0.15	0.32	0.48	0.65	0.82
30	0.299	-0.10	-0.09	0.02	0.17	0.23	0.34	0.44
31	0.283	-0.13	-0.14	-0.09	-0.04	0.01	0.10	0.15
32	0.270	-0.14	-0.15	-0.13	-0.10	-0.07	-0.05	-0.05
33	0.261	-0.14	-0.14	-0.12	-0.10	-0.08	-0.07	-0.08
34	0.255	-0.09	-0.04	0.09	0.22	0.37	0.50	0.62
35	0.252	-0.05	0.03	0.22	0.38	0.60	0.78	0.95
36	0.250	-0.01	0.12	0.41	0.69	0.98	1.28	1.55
37	0.250	0.04	0.21	0.62	0.99	1.38	1.78	2.18
38	0.250	0.06	0.27	0.74	1.19	1.64	2.10	2.54
39	0.250	0.07	0.29	0.76	1.21	1.66	2.14	2.57
40	0.250	0.09	0.33	0.84	1.33	1.83	2.34	2.82
41	0.250	0.09	0.33	0.84	1.33	1.83	2.34	2.80
42	0.250	0.09	0.32	0.82	1.30	1.79	2.27	2.74
43	0.250	0.07	0.30	0.79	1.27	1.74	2.22	2.64
44	0.250	0.05	0.28	0.72	1.16	1.58	2.01	2.42
				Side Center Line				
45	0.000	0.32	0.57	1.06	1.56	2.06	2.52	2.97
46	0.000	0.28	0.48	0.89	1.30	1.72	2.11	2.47
47	0.000	0.22	0.35	0.64	0.98	1.29	1.58	1.80
48	0.000	0.15	0.22	0.39	0.56	0.74	0.91	1.05
49	0.000	0.09	0.10	0.15	0.22	0.29	0.36	0.40
50	0.000	0.03	0.03	0.04	0.05	0.07	0.09	0.09

Note: Bottom of intake and conduit at same elevation as approach channel.
* H = head in feet of water above conduit center line; Q = discharge.

Table 13

Pressure Data, Type F Entrance (Flared in One Direction)

Equation for top flare:

$$\frac{X^2}{(1.5D)^2} + \frac{Y^2}{(2D/3)^2} = 1$$

D = 0.500 ft

Piez No.	Piez Zero	Pressure, ft of Water H,* 1.25 ft Q,* 1.06 cfs	H, 2.50 ft Q, 1.55 cfs	H, 5.00 ft Q, 2.19 cfs	H, 7.50 ft Q, 2.70 cfs	H, 10.00 ft Q, 3.13 cfs	H, 12.50 ft Q, 3.52 cfs	H, 15.00 ft Q, 3.86 cfs
				Top Center Line				
1	0.581	0.48	1.23	3.05	4.80	6.53	8.27	10.10
2	0.520	0.20	0.56	1.54	2.56	3.51	4.51	5.56
3	0.494	0.17	0.46	1.41	2.29	3.16	4.02	4.94
4	0.462	0.11	0.40	1.20	2.02	2.72	3.50	4.27
5	0.437	0.07	0.35	1.07	1.76	2.49	3.12	3.82
6	0.415	0.08	0.36	1.04	1.73	2.39	3.04	3.72
7	0.381	0.09	0.36	1.02	1.68	2.35	3.03	3.67
8	0.356	0.07	0.35	0.96	1.58	2.22	2.84	3.54
9	0.333	0.05	0.30	0.82	1.39	1.95	2.53	3.08
10	0.314	0.04	0.27	0.74	1.23	1.72	2.25	2.75
11	0.299	0.01	0.21	0.60	1.05	1.48	1.93	2.35
12	0.286	-0.01	0.19	0.52	0.90	1.25	1.64	2.04
13	0.276	-0.02	0.14	0.45	0.77	1.10	1.42	1.78
14	0.266	-0.02	0.10	0.38	0.66	0.93	1.26	1.54
15	0.259	-0.03	0.09	0.34	0.59	0.84	1.14	1.40
16	0.255	-0.02	0.08	0.32	0.57	0.80	1.05	1.33
17	0.253	-0.04	0.06	0.25	0.54	0.75	1.00	1.23
18	0.251	-0.01	0.20	0.52	0.86	1.20	1.55	1.90
19	0.250	0.05	0.23	0.65	1.04	1.45	1.86	2.28
20	0.250	0.06	0.26	0.70	1.12	1.55	2.01	2.46
21	0.250	0.07	0.28	0.73	1.16	1.59	2.06	2.54
22	0.250	0.09	0.33	0.83	1.35	1.83	2.33	2.85
				Top Corner				
23	0.581	0.38	1.13	2.78	4.50	6.12	7.78	9.40
24	0.520	0.19	0.59	1.61	2.68	3.74	4.80	5.84
25	0.494	0.16	0.52	1.52	2.49	3.42	4.43	5.34
26	0.462	0.14	0.45	1.30	2.14	2.97	3.79	4.59
27	0.437	0.09	0.36	1.08	1.82	2.52	3.35	4.12
28	0.415	0.12	0.40	1.16	1.90	2.63	3.35	4.05
29	0.381	0.13	0.38	1.08	1.78	2.48	3.36	4.04
30	0.356	0.09	0.35	0.99	1.64	2.29	3.00	3.70
31	0.333	0.08	0.32	0.88	1.46	2.05	2.70	3.33
32	0.314	0.02	0.22	0.65	1.11	1.61	2.12	2.58
33	0.299	0.03	0.24	0.71	1.19	1.69	2.18	2.66
34	0.286	0.01	0.21	0.62	1.02	1.46	1.87	2.29
35	0.276	-0.02	0.14	0.45	0.78	1.08	1.40	1.70
36	0.266	-0.04	0.10	0.37	0.65	0.93	1.19	1.47
37	0.259	-0.04	0.09	0.35	0.60	0.86	1.09	1.34
38	0.255	-0.02	0.11	0.39	0.69	0.98	1.24	1.53
39	0.253	-0.01	0.12	0.39	0.69	0.98	1.23	1.52
40	0.251	0.01	0.18	0.53	0.88	1.23	1.56	1.92
41	0.250	0.04	0.25	0.65	1.08	1.46	1.86	2.30
42	0.250	0.06	0.28	0.74	1.21	1.64	2.08	2.53
43	0.250	0.06	0.28	0.74	1.21	1.64	2.09	2.53
44	0.250	0.12	0.37	0.94	1.51	2.05	2.60	3.11
				Side Center Line				
63	0.000	0.33	0.56	1.05	1.54	2.01	2.51	3.00
64	0.000	0.28	0.48	0.86	1.27	1.66	2.07	2.48
65	0.000	0.22	0.34	0.61	0.90	1.20	1.50	1.80
66	0.000	0.15	0.22	0.38	0.55	0.72	0.90	1.06
67	0.000	0.08	0.10	0.15	0.21	0.28	0.34	0.40
68	0.000	0.03	0.02	0.02	0.03	0.04	0.06	0.07

Note: Bottom of intake and conduit at same elevation as approach channel.

* H = head in feet of water above conduit center line; Q = discharge.

Table 14

Pressure Data, Type G Entrance (Flared in One Direction)

Equation for top flare combines portions of equations

$$\frac{X^2}{D^2} + \frac{Y^2}{(0.64D)^2} = 1 \text{ and } \frac{X^2}{D^2} + \frac{Y^2}{(0.32D)^2} = 1$$

D = 0.500 ft

Piez No.	Piez Zero	Pressure, ft of Water H,* 1.25 ft Q,* 1.06 cfs	H, 2.50 ft Q, 1.57 cfs	H, 5.00 ft Q, 2.22 cfs	H, 7.50 ft Q, 2.73 cfs	H, 10.00 ft Q, 3.15 cfs	H, 12.50 ft Q, 3.53 cfs	H, 15.00 ft Q, 3.90 cfs
				Top Center Line				
1	0.572	0.51	1.36	3.21	4.98	6.76	8.56	10.33
2	0.473	0.21	0.55	1.43	2.40	3.27	4.03	4.93
3	0.432	0.06	0.26	0.87	1.44	1.97	2.43	2.90
4	0.403	0.02	0.18	0.68	1.20	1.62	2.15	2.45
5	0.378	0.00	0.12	0.57	0.96	1.34	1.67	2.04
6	0.359	-0.06	0.04	0.37	0.72	1.01	1.32	1.59
7	0.341	-0.09	-0.05	0.16	0.36	0.49	0.66	0.86
8	0.315	-0.17	-0.17	-0.11	-0.04	-0.02	0.01	0.05
9	0.297	-0.15	-0.15	-0.08	-0.02	0.00	0.04	0.08
10	0.283	-0.11	-0.10	0.00	-0.08	0.12	0.20	0.30
11	0.272	-0.13	-0.12	-0.06	0.00	0.03	0.05	0.06
12	0.264	-0.08	-0.04	0.11	0.27	0.39	0.51	0.64
13	0.258	-0.03	0.05	0.28	0.51	0.71	0.92	1.14
14	0.254	-0.04	0.04	0.25	0.49	0.68	0.87	1.08
15	0.251	-0.03	0.04	0.24	0.48	0.66	0.81	1.02
16	0.250	0.02	0.16	0.47	0.83	1.10	1.43	1.70
17	0.250	0.03	0.19	0.57	0.95	1.30	1.66	2.01
18	0.250	0.06	0.24	0.66	1.10	1.51	1.90	2.29
19	0.250	0.04	0.22	0.61	1.00	1.40	1.77	2.15
20	0.250	0.07	0.27	0.71	1.16	1.59	1.99	2.40
21	0.250	0.07	0.27	0.71	1.17	1.60	1.98	2.43
22	0.250	0.05	0.24	0.66	1.11	1.52	1.89	2.31
				Top Corner				
23	0.572	0.41	1.20	2.96	5.25	6.30	8.05	9.83
24	0.473	0.23	0.66	1.73	2.80	3.81	4.95	5.88
25	0.432	0.07	0.33	1.00	1.57	2.19	2.84	3.65
26	0.403	0.05	0.25	0.77	1.35	1.88	2.40	2.95
27	0.378	0.00	0.18	0.65	1.02	1.46	1.87	2.40
28	0.359	-0.03	0.10	0.39	0.74	1.01	1.34	1.67
29	0.341	-0.09	-0.01	0.23	0.40	0.58	0.81	1.11
30	0.315	-0.15	-0.15	-0.10	-0.09	-0.08	-0.03	0.08
31	0.297	-0.14	-0.14	-0.11	-0.10	-0.10	-0.07	0.03
32	0.283	-0.13	-0.11	-0.04	-0.01	0.03	0.10	0.21
33	0.272	-0.10	-0.08	0.03	0.13	0.20	0.33	0.47
34	0.264	-0.07	0.01	0.17	0.32	0.46	0.64	0.82
35	0.258	-0.08	0.00	0.14	0.28	0.39	0.53	0.67
36	0.254	-0.05	0.04	0.23	0.43	0.60	0.79	0.98
37	0.251	-0.03	0.09	0.34	0.60	0.83	1.09	1.33
38	0.250	0.00	0.17	0.49	0.83	1.14	1.37	1.83
39	0.250	0.03	0.22	0.61	0.98	1.36	1.67	2.13
40	0.250	0.04	0.24	0.66	1.06	1.47	1.86	2.29
41	0.250	0.05	0.27	0.72	1.15	1.57	2.02	2.48
42	0.250	0.04	0.26	0.69	1.10	1.50	1.94	2.38
43	0.250	0.06	0.29	0.75	1.21	1.66	2.08	2.57
44	0.250	0.05	0.28	0.73	1.16	1.53	2.03	2.47
				Side Center Line				
45	0.000	0.71	1.35	2.60	4.23	5.52	6.68	7.53
46	0.000	0.73	1.43	2.80	4.17	5.54	6.90	8.30
47	0.000	0.70	1.36	2.67	3.95	5.23	6.52	7.83
48	0.000	0.64	1.23	2.44	3.62	4.77	5.95	7.13
49	0.000	0.58	1.12	2.21	3.25	4.28	5.36	6.40
50	0.000	0.54	1.02	1.96	2.92	3.87	4.80	5.77
51	0.000	0.51	0.94	1.83	2.72	3.67	4.48	5.38
52	0.000	0.47	0.85	1.65	2.44	3.21	3.97	4.78
53	0.000	0.43	0.78	1.52	2.23	2.93	3.62	4.37
54	0.000	0.40	0.74	1.43	2.10	2.76	3.43	4.10
55	0.000	0.40	0.71	1.36	2.11	2.63	3.25	3.91
56	0.000	0.38	0.68	1.28	1.91	2.50	3.08	3.72
57	0.000	0.36	0.64	1.21	1.79	2.34	2.90	3.46
58	0.000	0.35	0.62	1.19	1.75	2.30	2.84	3.39
59	0.000	0.34	0.61	1.16	1.69	2.20	2.74	3.25
60	0.000	0.33	0.58	1.10	1.59	2.07	2.55	3.03
61	0.000	0.34	0.61	1.15	1.67	2.17	2.69	3.17
62	0.000	0.32	0.54	1.03	1.47	1.89	2.32	2.75
63	0.000	0.32	0.56	1.06	1.56	2.03	2.47	2.97
64	0.000	0.32	0.56	1.05	1.56	2.04	2.55	3.03
65	0.000	0.28	0.47	0.88	1.32	1.73	2.15	2.56
66	0.000	0.22	0.35	0.67	0.97	1.25	1.57	1.87
67	0.000	0.15	0.22	0.40	0.58	0.78	0.97	1.18
68	0.000	0.07	0.08	0.11	0.15	0.20	0.24	0.30
69	0.000	0.02	0.00	0.00	0.01	0.02	0.03	0.04

Note: Bottom of intake and conduit at same elevation as approach channel.

* H = head in feet of water above conduit center line; Q = discharge.

Table 15

Pressure Data, Type H Entrance (Flared in One Direction)

Equation for top flare combines portions of equations $\frac{X^2}{(2D)^2} + \frac{Y^2}{(0.64D)^2} = 1$ and $\frac{X^2}{(2D)^2} + \frac{Y^2}{(0.32D)^2} = 1$

D = 0.500 ft

Piez No.	Piez Zero	Pressure, ft of Water						
		H,* 1.25 ft Q,* 1.10 cfs	H, 2.50 ft Q, 1.58 cfs	H, 5.00 ft Q, 2.22 cfs	H, 7.50 ft Q, 2.73 cfs	H, 10.00 ft Q, 3.13 cfs	H, 12.50 ft Q, 3.55 cfs	H, 15.00 ft Q, 3.92 cfs
				Top Center Line				
1	0.570	0.45	1.15	2.76	4.26	5.76	7.28	8.78
2	0.500	0.14	0.45	1.35	2.18	2.95	3.58	4.41
3	0.469	0.05	0.27	0.98	1.67	2.31	2.87	3.53
4	0.447	-0.01	0.16	0.70	1.32	1.81	2.30	2.85
5	0.429	-0.02	0.15	0.68	1.27	1.72	2.27	2.82
6	0.413	-0.01	0.19	0.76	1.36	1.83	2.36	2.91
7	0.400	0.00	0.23	0.82	1.43	1.90	2.53	3.13
8	0.377	0.04	0.30	0.93	1.58	2.17	2.77	3.42
9	0.359	0.08	0.37	1.05	1.74	2.36	2.99	3.69
10	0.341	0.09	0.38	1.03	1.66	2.26	2.96	3.66
11	0.326	0.09	0.39	1.04	1.72	2.35	2.97	3.67
12	0.314	0.09	0.39	1.03	1.66	2.27	2.94	3.59
13	0.304	0.10	0.40	1.03	1.65	2.25	2.90	3.56
14	0.295	0.21	0.35	0.90	1.43	1.99	2.54	3.13
15	0.288	0.12	0.35	0.92	1.48	2.04	2.59	3.18
16	0.279	0.13	0.32	0.85	1.40	1.90	2.42	2.95
17	0.274	0.11	0.31	0.84	1.35	1.87	2.40	2.91
18	0.270	0.13	0.35	0.88	1.42	1.95	2.48	3.01
19	0.266	0.08	0.29	0.76	1.23	1.69	2.17	2.63
20	0.262	0.02	0.34	0.86	1.38	1.87	2.37	2.89
21	0.259	0.10	0.34	0.85	1.39	1.91	2.38	2.91
22	0.257	0.10	0.23	0.84	1.36	1.86	2.36	2.87
23	0.255	0.05	0.27	0.69	1.11	1.51	1.96	2.35
24	0.254	0.05	0.24	0.66	0.98	1.43	1.81	2.22
25	0.253	0.09	0.32	0.82	1.31	1.79	2.26	2.73
26	0.252	0.09	0.31	0.79	1.27	1.73	2.17	2.62
27	0.251	0.09	0.31	0.78	1.26	1.72	2.15	2.61
28	0.250	0.09	0.30	0.77	1.25	1.70	2.13	2.60
29	0.250	0.09	0.30	0.77	1.25	1.70	2.13	2.60
				Top Corner				
30	0.570	0.38	1.25	2.94	4.41	5.90	7.47	8.86
31	0.500	0.16	0.64	1.68	2.70	3.72	4.70	5.66
32	0.469	0.07	0.42	1.22	1.99	2.79	3.59	4.48
33	0.447	-0.01	0.20	0.73	1.26	1.81	2.83	2.89
34	0.429	-0.01	0.18	0.68	1.14	1.66	2.69	2.63
35	0.413	0.02	0.28	0.88	1.47	2.06	2.63	3.28
36	0.400	0.04	0.32	0.94	1.54	2.15	2.75	3.42
37	0.377	0.05	0.36	0.99	1.58	2.19	2.80	3.49
38	0.359	0.06	0.38	1.02	1.63	2.23	2.82	3.54
39	0.341	0.08	0.41	1.06	1.70	2.35	3.01	3.71
40	0.326	0.07	0.34	0.92	1.46	2.06	2.67	3.31
41	0.314	0.09	0.38	1.01	1.57	2.22	2.82	3.47
42	0.304	0.10	0.42	1.06	1.66	2.33	2.92	3.63
43	0.295	0.03	0.26	0.70	1.14	1.61	2.00	2.49
44	0.288	0.11	0.39	1.00	1.59	2.21	2.83	3.46
45	0.279	0.09	0.36	0.92	1.44	2.00	2.55	3.13
46	0.274	0.09	0.36	0.92	1.44	2.00	2.54	3.11
47	0.270	0.08	0.25	0.88	1.39	1.91	2.42	2.96

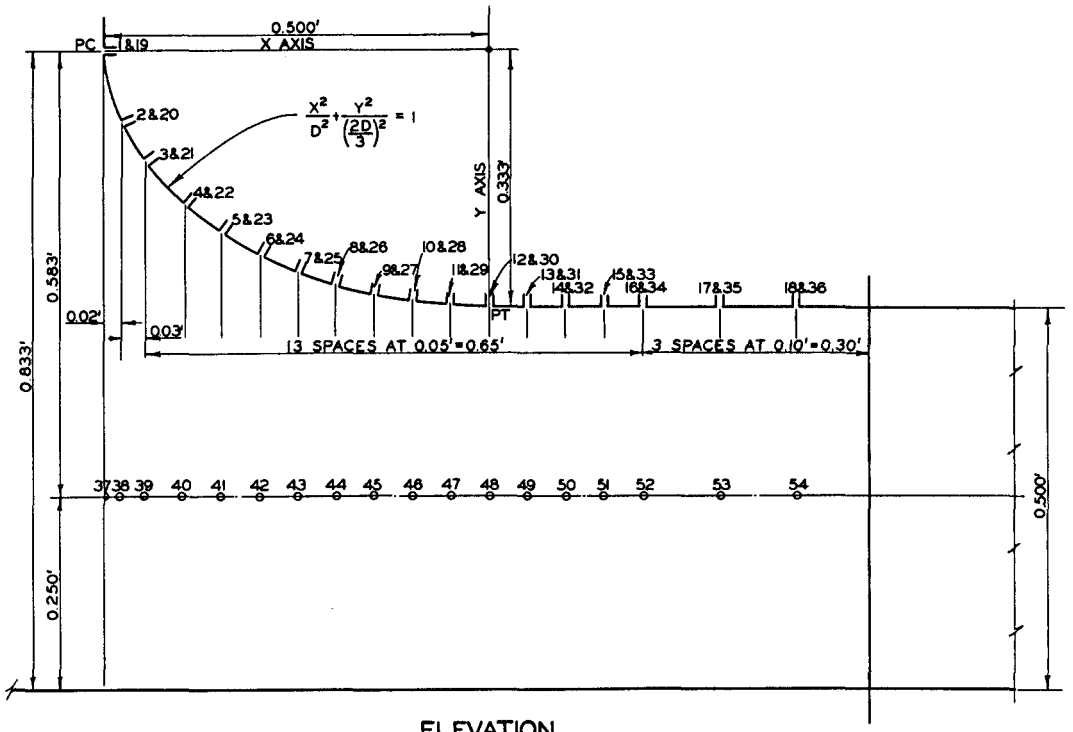
(Continued)

Note: Bottom of intake and conduit at the same elevation as approach channel.

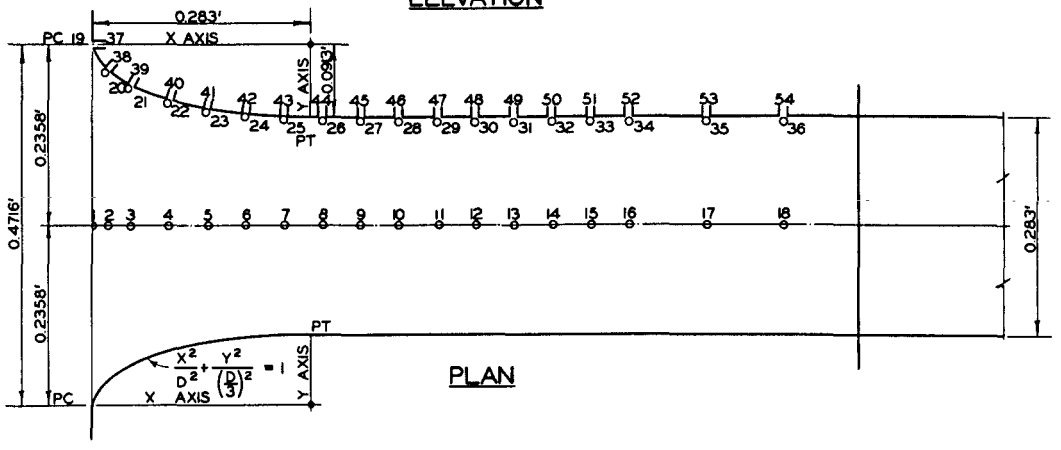
* H = head in feet of water above conduit center line; Q = discharge.

Table 15 (Concluded)

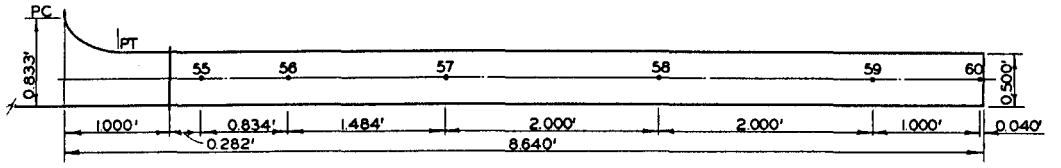
Piez No.	Piez Zero	Pressure, ft of Water H, 1.25 ft Q, 1.10 cfs	H, 2.50 ft Q, 1.58 cfs	H, 5.00 ft Q, 2.22 cfs	H, 7.50 ft Q, 2.73 cfs	H, 10.00 ft Q, 3.13 cfs	H, 12.50 ft Q, 3.55 cfs	H, 15.00 ft Q, 3.92 cfs
				Top Corner (Continued)				
48	0.266	0.08	0.25	0.88	1.39	1.92	2.43	2.97
49	0.262	0.10	0.37	0.92	1.47	2.03	2.57	3.14
50	0.259	0.10	0.36	0.90	1.43	1.98	2.49	3.03
51	0.257	0.10	0.36	0.90	1.42	1.96	2.48	3.01
52	0.255	0.11	0.36	0.88	1.41	1.92	2.45	2.97
53	0.254	0.10	0.35	0.87	1.39	1.91	2.42	2.93
54	0.253	0.08	0.32	0.81	1.29	1.78	2.24	2.70
55	0.252	0.08	0.32	0.79	1.28	1.75	2.19	2.65
56	0.251	0.08	0.32	0.80	1.29	1.77	2.23	2.70
57	0.250	0.07	0.30	0.77	1.22	1.68	2.12	2.54
58	0.250	0.00	0.30	0.66	1.03	1.41	1.77	2.13
				Side Center Line				
59	0.000	----	----	----	----	----	----	----
60	0.000	0.82	1.60	3.18	4.73	6.27	7.75	9.35
61	0.000	0.79	1.55	3.07	4.55	6.05	7.52	9.03
62	0.000	0.77	1.48	2.93	4.32	5.80	7.23	8.63
63	0.000	0.73	1.41	2.77	4.11	5.47	6.80	8.15
64	0.000	0.70	1.33	2.57	3.86	5.11	6.35	7.60
65	0.000	0.66	1.25	2.43	3.63	4.83	6.02	7.22
66	0.000	0.62	1.17	2.26	3.37	4.43	5.52	6.63
67	0.000	0.59	1.11	2.20	3.23	4.27	5.32	6.40
68	0.000	0.57	1.07	2.06	3.06	4.08	5.05	6.12
69	0.000	0.52	0.98	1.91	2.81	3.73	4.68	5.64
70	0.000	0.50	0.94	1.82	2.69	3.56	4.40	5.38
71	0.000	0.48	0.89	1.72	2.54	3.36	4.19	5.00
72	0.000	0.46	0.85	1.63	2.39	3.18	3.96	4.74
73	0.000	0.43	0.81	1.56	2.30	3.04	3.78	4.50
74	0.000	0.42	0.77	1.45	2.13	2.81	3.48	4.18
75	0.000	0.41	0.73	1.38	2.03	2.67	3.34	4.00
76	0.000	0.38	0.68	1.30	1.90	2.49	3.09	3.73
77	0.000	0.36	0.64	1.20	1.75	2.31	2.86	3.43
78	0.000	0.36	0.62	1.16	1.65	2.19	2.70	3.26
79	0.000	0.36	0.62	1.15	1.67	2.18	2.64	3.25
				Top Center Line				
80	0.250	0.05	0.27	0.71	1.18	1.62	1.97	2.35
81	0.250	0.08	0.31	0.79	1.25	1.71	2.16	2.53
82	0.250	0.08	0.31	0.78	1.24	1.69	2.15	2.65
83	0.250	0.08	0.31	0.78	1.23	1.68	2.12	2.60
84	0.250	0.08	0.31	0.78	1.28	1.71	2.18	2.68
85	0.250	0.08	0.31	0.78	1.23	1.67	2.12	2.61
86	0.250	0.08	0.31	0.78	1.27	1.72	2.18	2.67
87	0.250	0.08	0.31	0.78	1.25	1.70	2.17	2.64
88	0.250	0.08	0.30	0.77	1.23	1.68	2.12	2.61
89	0.250	0.08	0.28	0.73	1.18	1.62	2.05	2.51
				Side Center Line				
90	0.000	0.33	0.57	1.07	1.55	2.05	2.51	3.04
91	0.000	0.30	0.52	0.92	1.32	1.75	2.16	2.59
92	0.000	0.26	0.38	0.70	1.05	1.33	1.65	1.98
93	0.000	0.17	0.27	0.43	0.65	0.87	1.05	1.27
94	0.000	0.10	0.12	0.14	0.18	0.24	0.29	0.29
95	0.000	0.04	0.03	0.02	0.02	0.03	0.04	0.05



ELEVATION



PLAN



ELEVATION OF CONDUIT

NOTE: BOTTOM OF INTAKE AND CONDUIT AT SAME ELEVATION AS APPROACH CHANNEL.
DISTANCES SHOWN IN FEET.

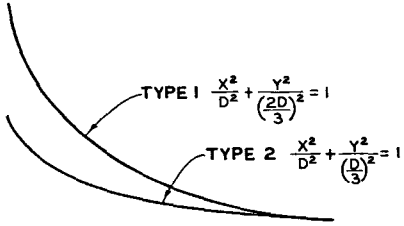
PIEZOMETER LOCATIONS

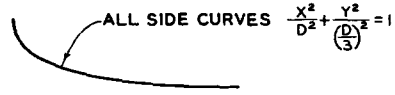
TYPE 1

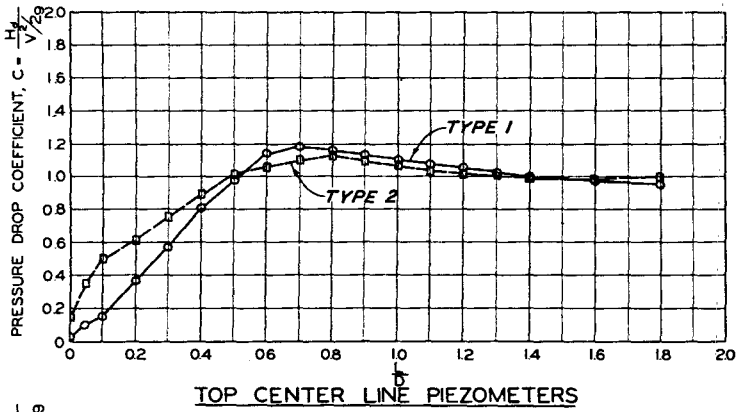
PLATE 1

PLATE 2

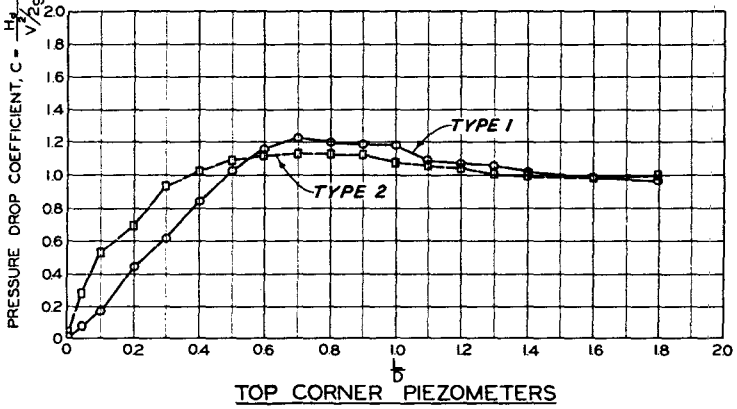
D = 0.500 FT FOR TOP CURVES
D = 0.283 FT FOR SIDE CURVES



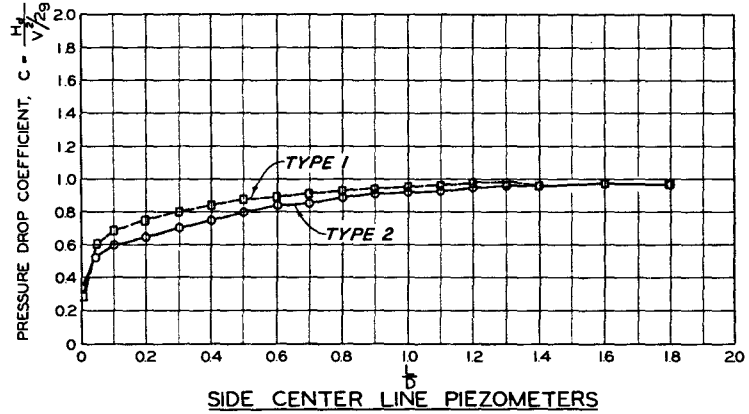




TOP CENTER LINE PIEZOMETERS



TOP CORNER PIEZOMETERS



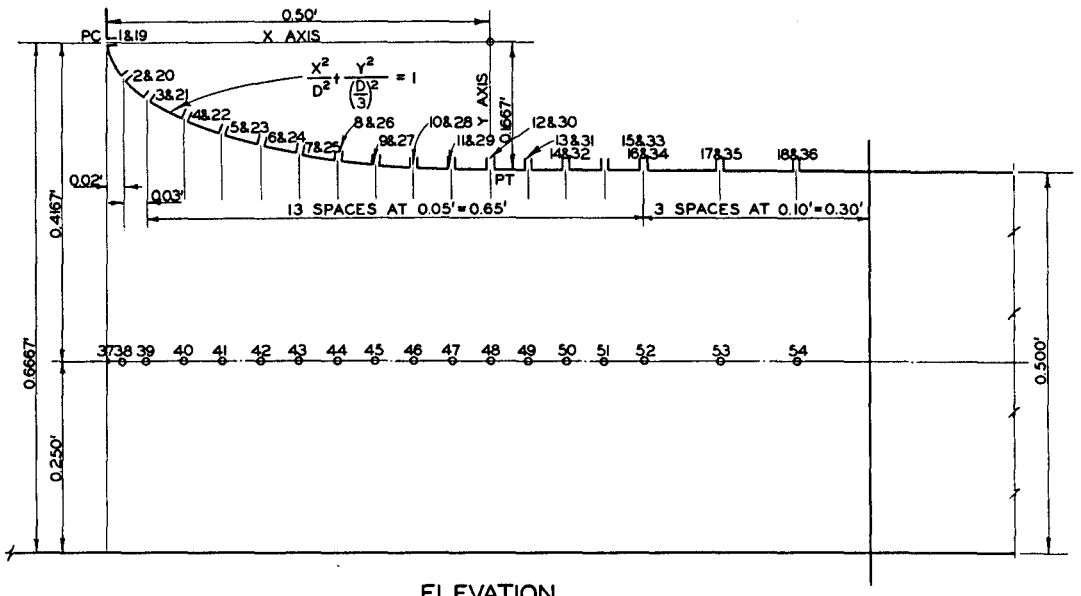
SIDE CENTER LINE PIEZOMETERS

NOTE: H_d = PRESSURE DROP FROM POOL TO PIEZOMETER
V = AVERAGE VELOCITY IN CONDUIT PROPER
$\frac{L}{D}$ = RATIO OF DISTANCE DOWNSTREAM TO DIMENSION OF CONDUIT IN DIRECTION CONCERNED
FLOOR OF INTAKE AND CONDUIT AT ELEVATION OF APPROACH CHANNEL.

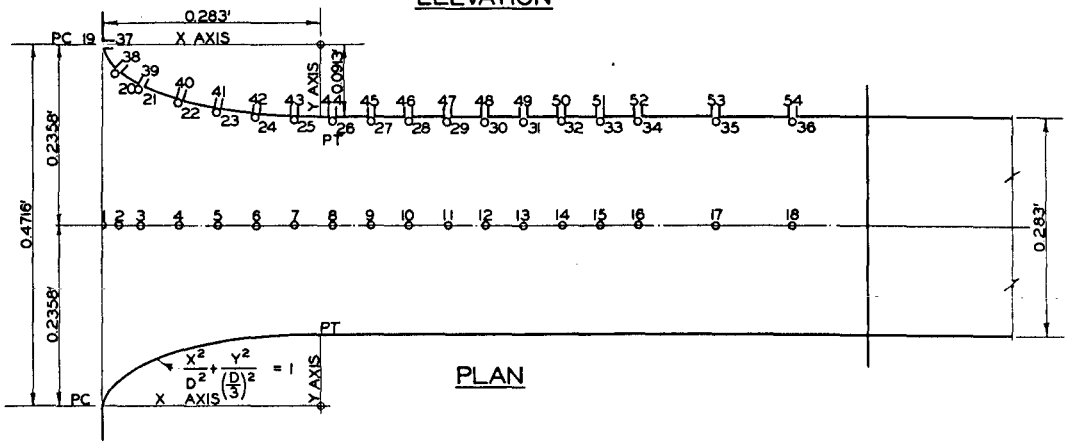
PRESSURE DATA

TYPES 1 AND 2 ENTRANCE CURVES

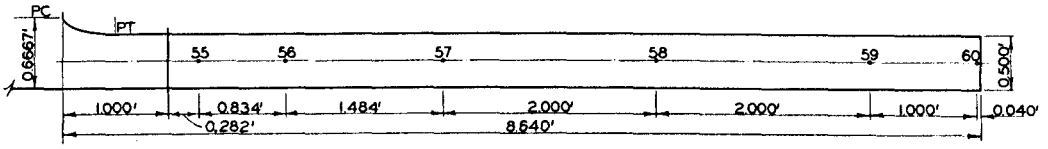
FLARED IN 3 DIRECTIONS



ELEVATION



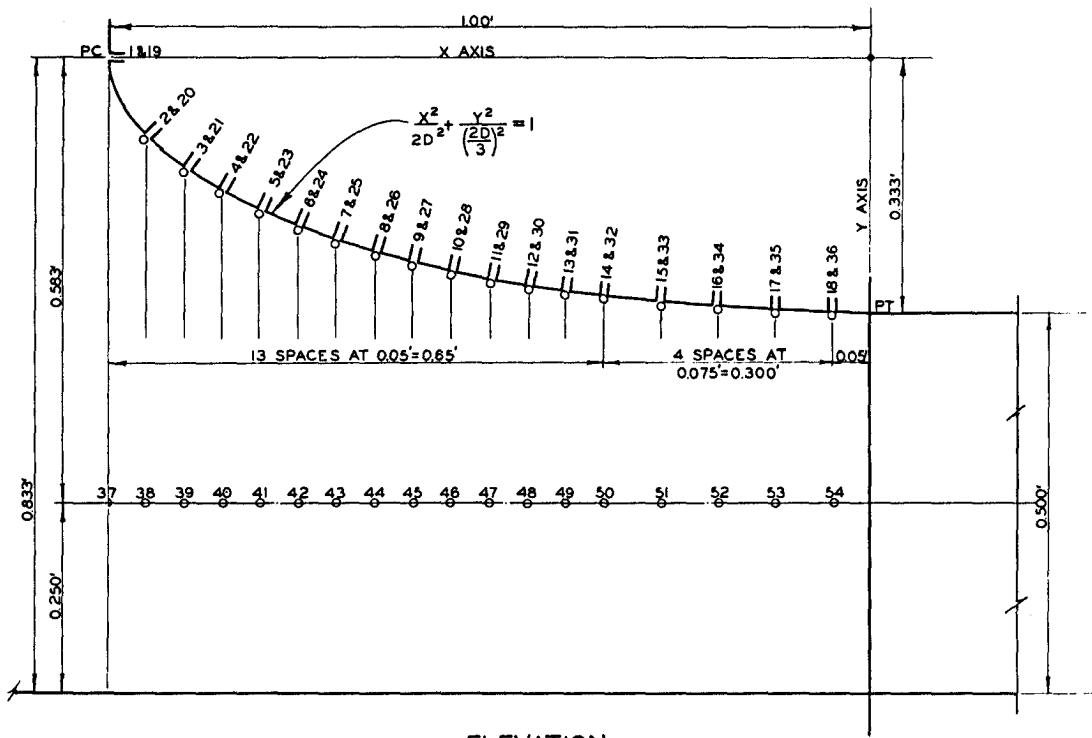
PLAN



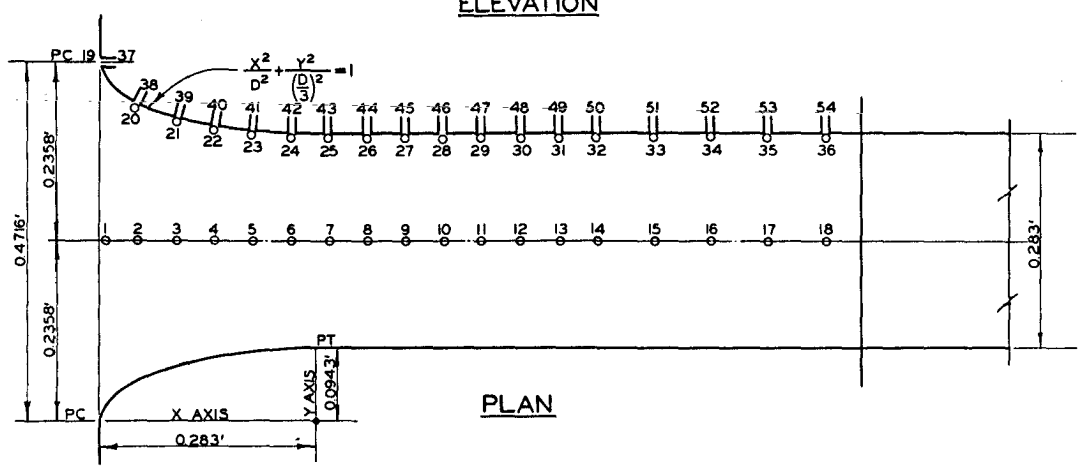
ELEVATION OF CONDUIT

NOTE: BOTTOM OF INTAKE AND CONDUIT AT SAME ELEVATION AS APPROACH CHANNEL.
DISTANCES SHOWN IN FEET.

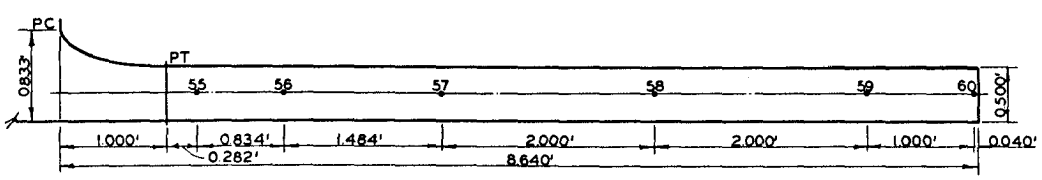
PIEZOMETER LOCATIONS
TYPE 2



ELEVATION



PLAN

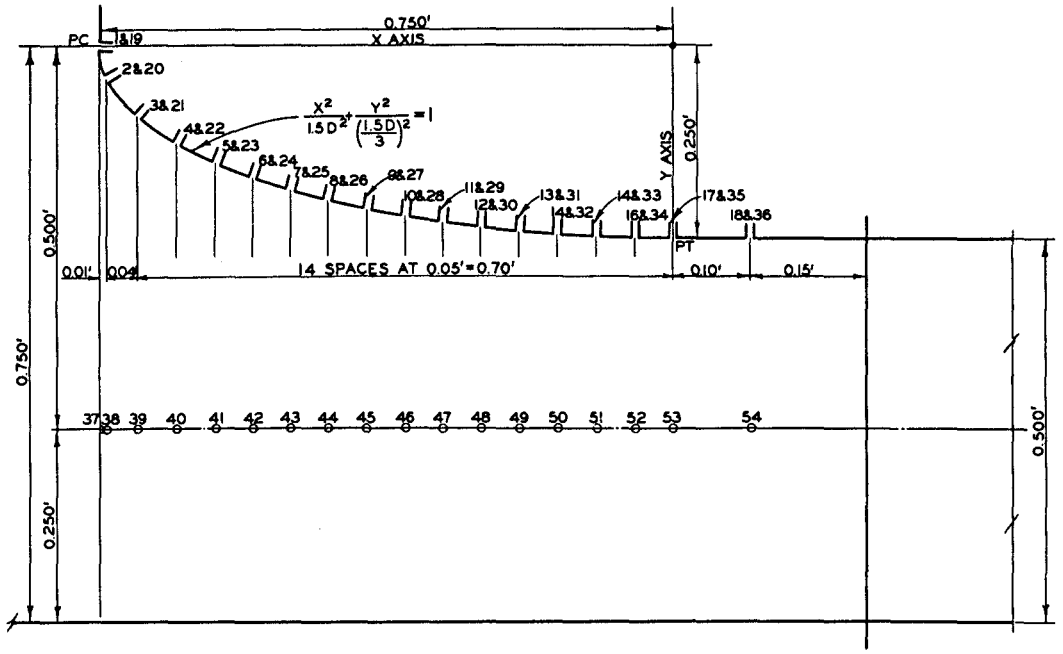


ELEVATION OF CONDUIT

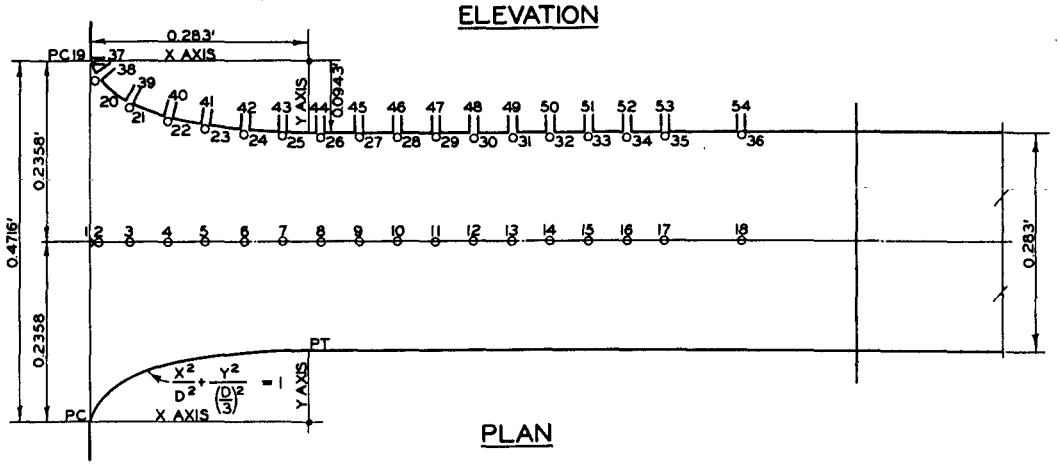
NOTE: BOTTOM OF INTAKE AND CONDUIT AT SAME ELEVATION AS APPROACH CHANNEL.
DISTANCES SHOWN IN FEET.

PIEZOMETER LOCATIONS
TYPE 3

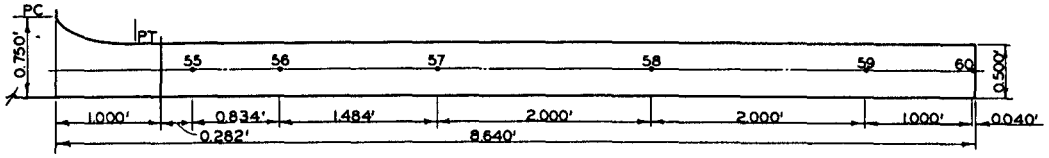
PLATE 4



ELEVATION



PLAN



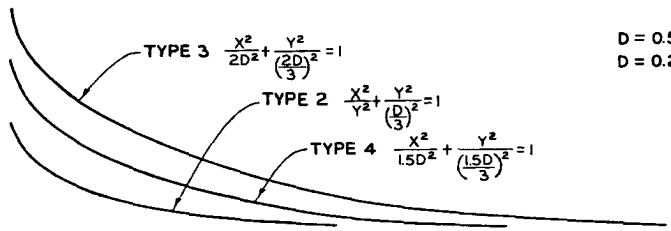
ELEVATION OF CONDUIT

NOTE: BOTTOM OF INTAKE AND CONDUIT AT SAME ELEVATION AS APPROACH CHANNEL.
DISTANCES SHOWN IN FEET.

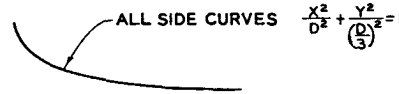
PIEZOMETER LOCATIONS

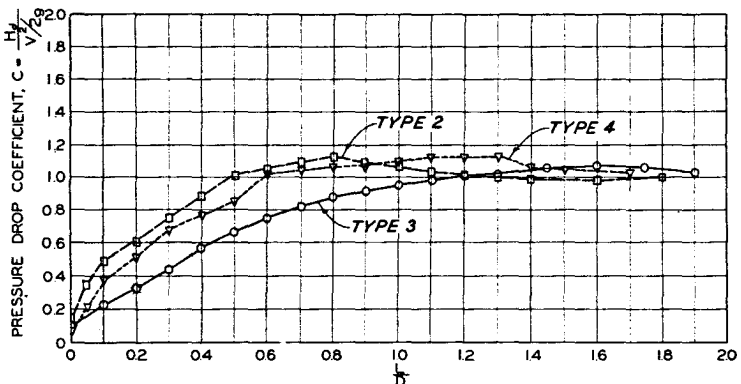
TYPE 4

PLATE 6

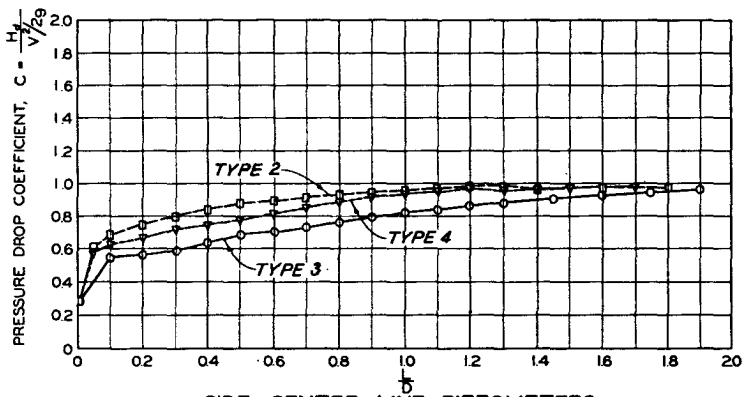


D = 0.500 FT FOR TOP CURVES
D = 0.283 FT FOR SIDE CURVES

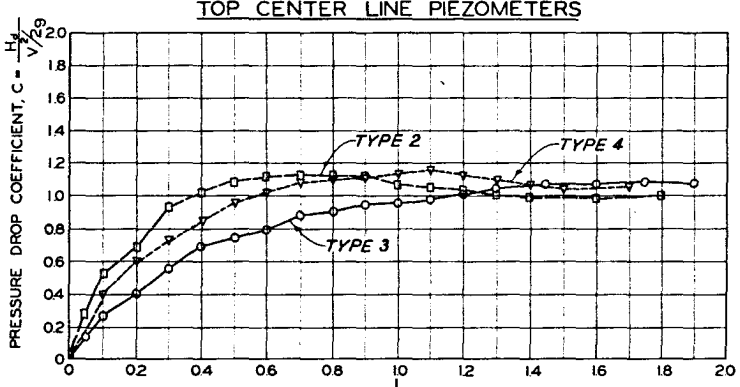




TOP CENTER LINE PIEZOMETERS



SIDE CENTER LINE PIEZOMETERS

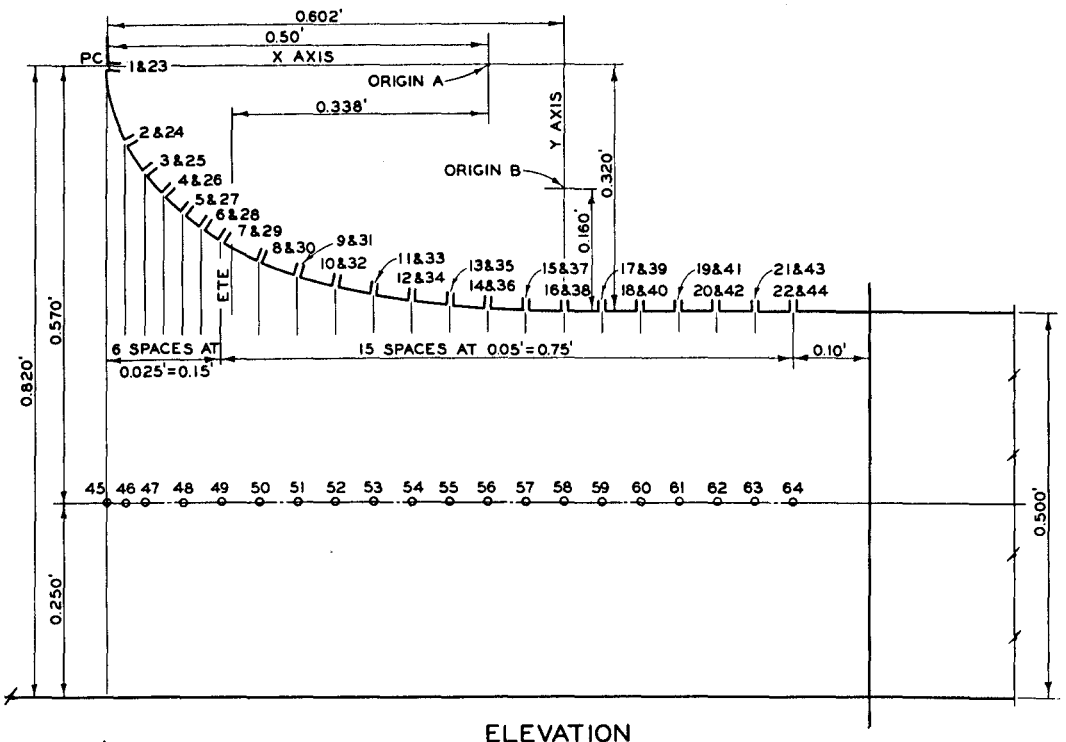


TOP CORNER PIEZOMETERS

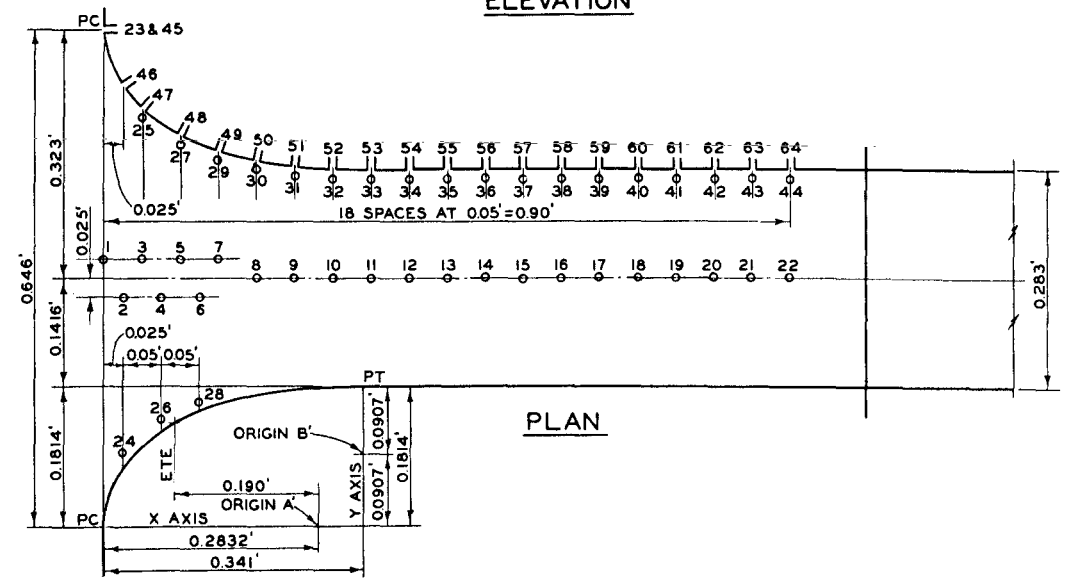
NOTE: H_s = PRESSURE DROP FROM POOL TO PIEZOMETER
V = AVERAGE VELOCITY IN CONDUIT PROPER
$\frac{L}{D}$ = RATIO OF DISTANCE DOWNSTREAM TO DIMENSION OF CONDUIT IN DIRECTION CONCERNED
FLOOR OF INTAKE AND CONDUIT AT ELEVATION OF APPROACH CHANNEL.

PRESSURE DATA

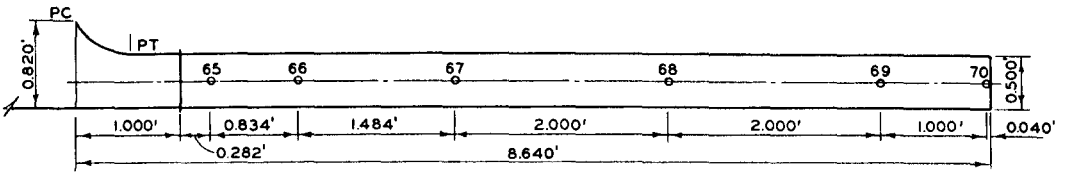
TYPES 2-4
ENTRANCE CURVES
FLARED IN 3 DIRECTIONS



ELEVATION



PLAN



ELEVATION OF CONDUIT

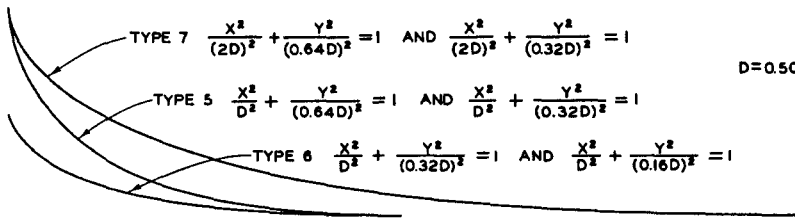
NOTE: DISTANCES SHOWN IN FEET.

EQUATION WITH ORIGIN A & A' $\frac{X^2}{D^2}+\frac{Y^2}{(0.64D)^2}=1$

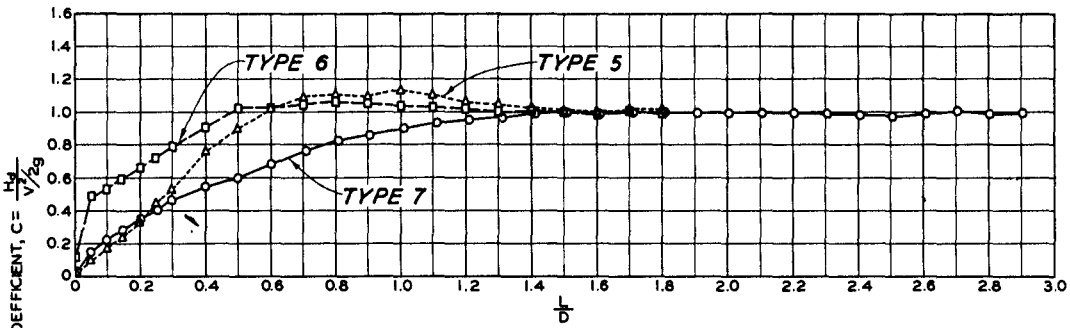
EQUATION WITH ORIGIN B & B' $\frac{X^2}{D^2}+\frac{Y^2}{(0.32D)^2}=1$

PIEZOMETER LOCATIONS
TYPE 5

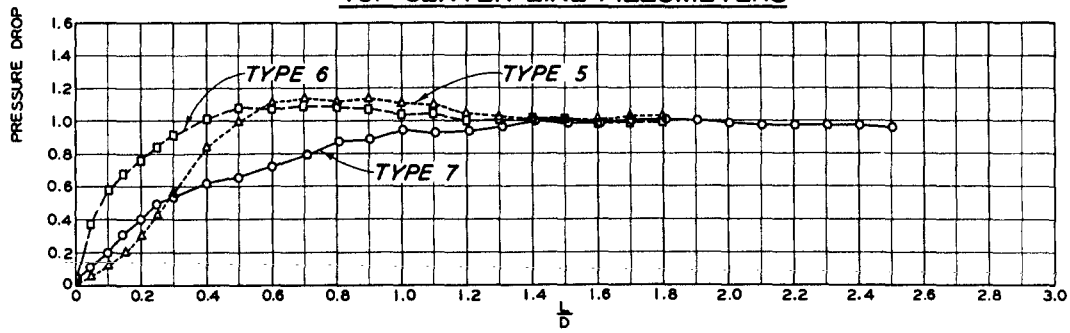
PLATE 7



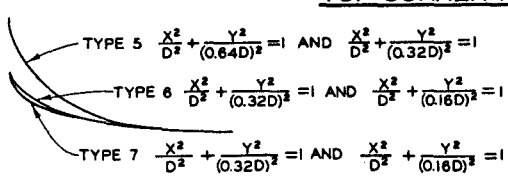
D=0.500 FT FOR TOP CURVES



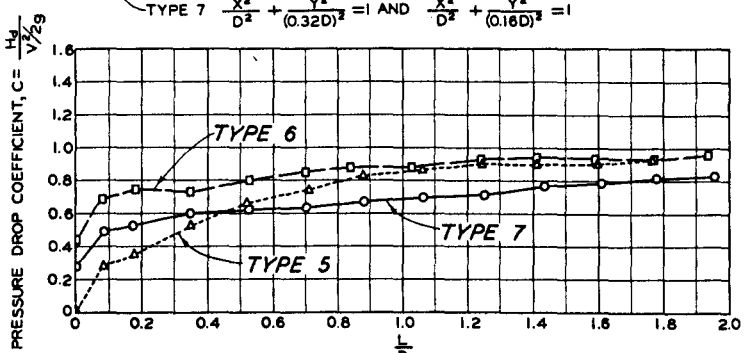
TOP CENTER LINE PIEZOMETERS



TOP CORNER PIEZOMETERS



D = 0.283 FT FOR SIDE CURVES



SIDE CENTER LINE PIEZOMETERS

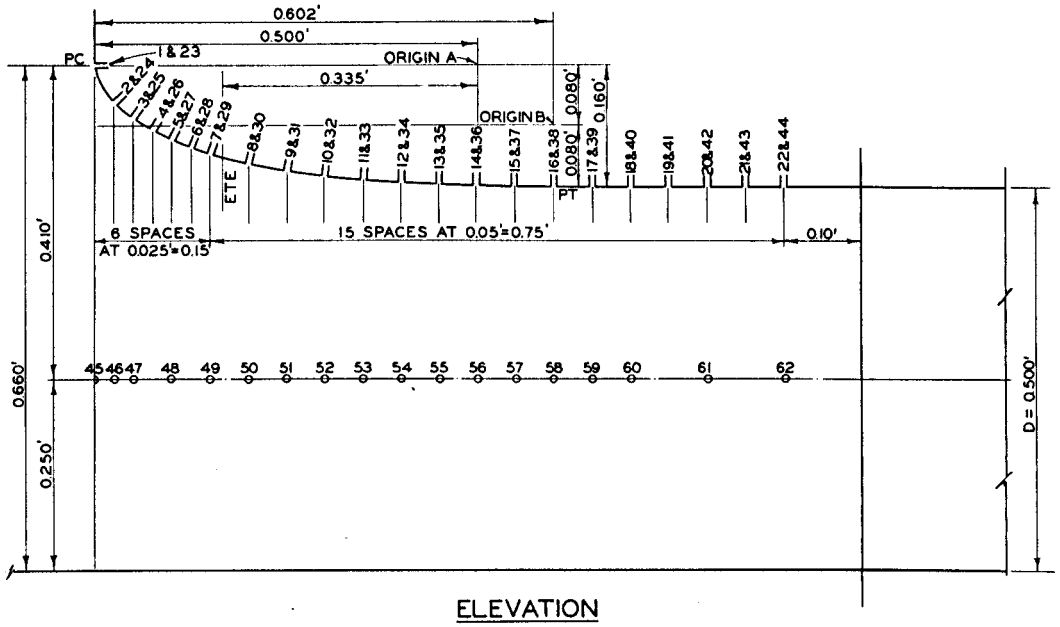
NOTE: H_d = PRESSURE DROP FROM POOL TO PIEZOMETER
V = AVERAGE VELOCITY IN CONDUIT PROPER
$\frac{L}{D}$ = RATIO OF DISTANCE DOWNSTREAM TO DIMENSION OF CONDUIT IN DIRECTION CONCERNED
FLOOR OF INTAKE AND CONDUIT AT ELEVATION OF APPROACH CHANNEL.

PRESSURE DATA

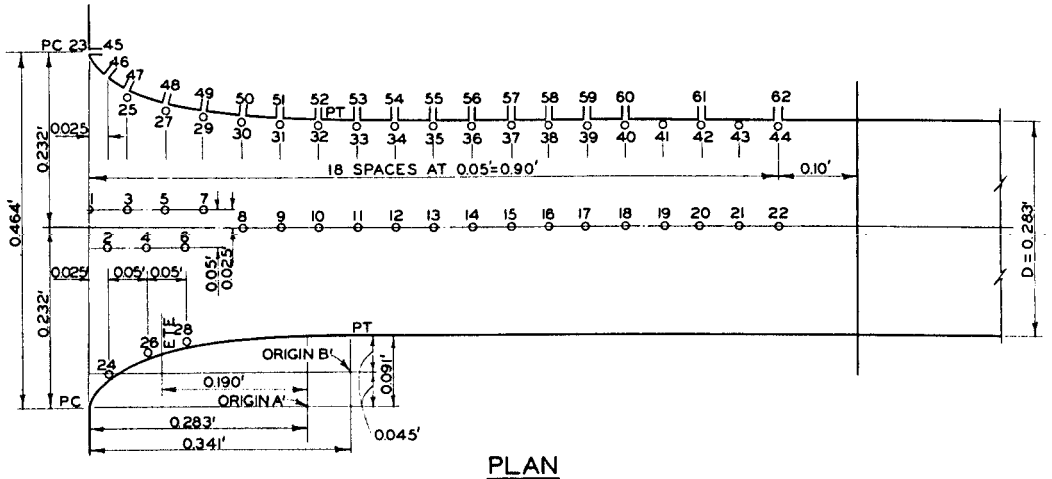
TYPES 5, 6 AND 7 ENTRANCE CURVES

FLARED IN 3 DIRECTIONS

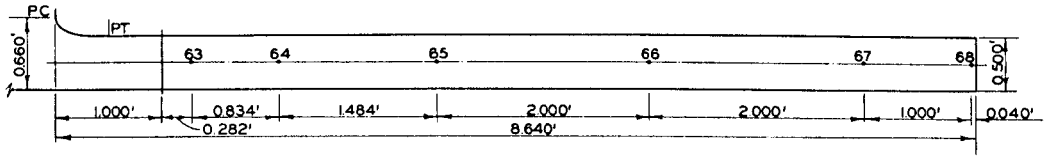
PLATE 8



ELEVATION



PLAN



ELEVATION OF CONDUIT

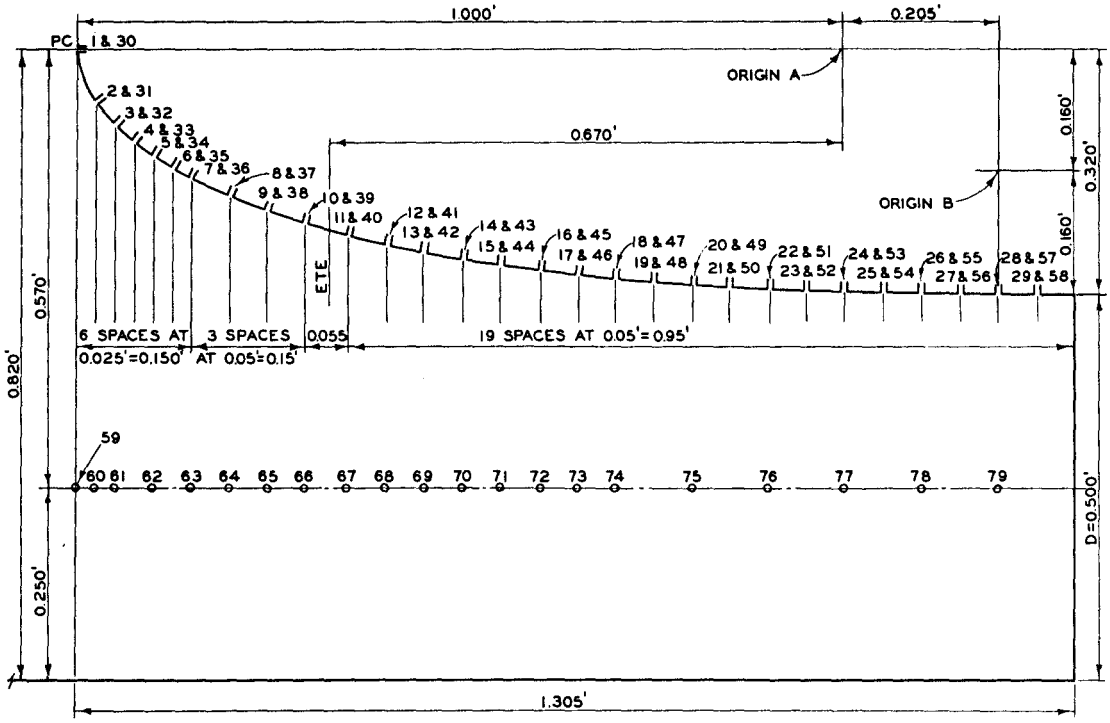
NOTE: DISTANCES SHOWN IN FEET.

EQUATION WITH ORIGIN A & A' $\frac{X^2}{D^2}+\frac{Y^2}{(0.32D)^2}=1$

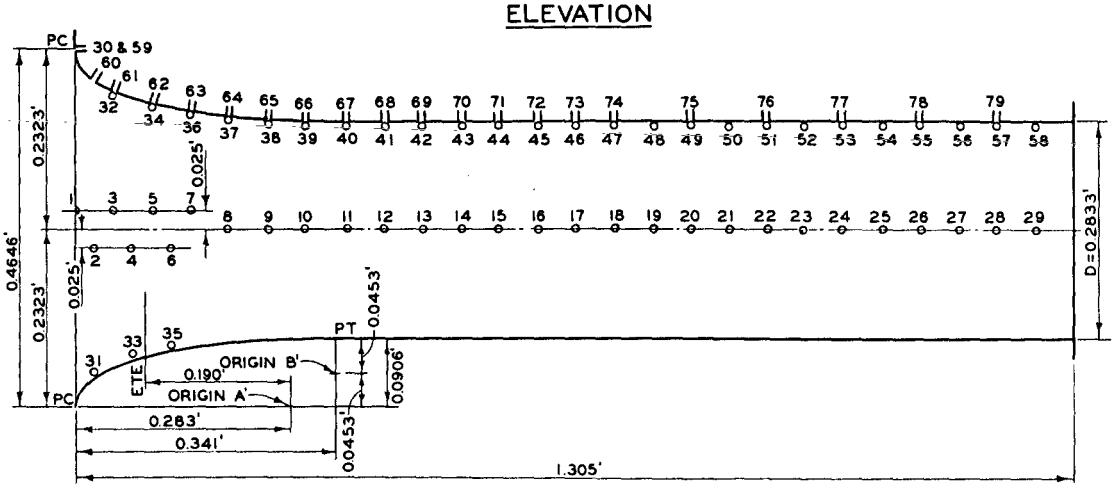
EQUATION WITH ORIGIN B & B' $\frac{X^2}{D^2}+\frac{Y^2}{(0.16D)^2}=1$

PIEZOMETER LOCATIONS

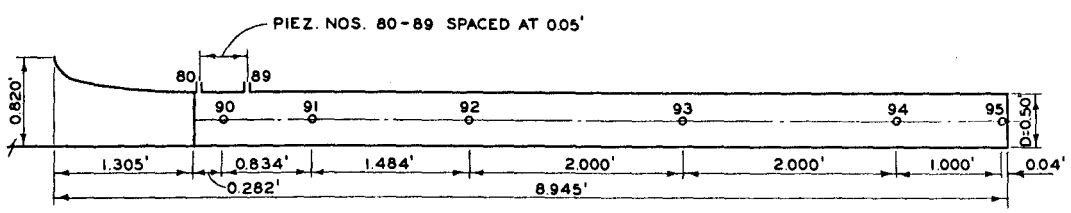
TYPE 6



ELEVATION



PLAN



ELEVATION OF CONDUIT

NOTE: DISTANCES SHOWN IN FEET.

EQUATION WITH ORIGIN A $\frac{X^2}{(2D)^2}+\frac{Y^2}{(0.64D)^2}=1$

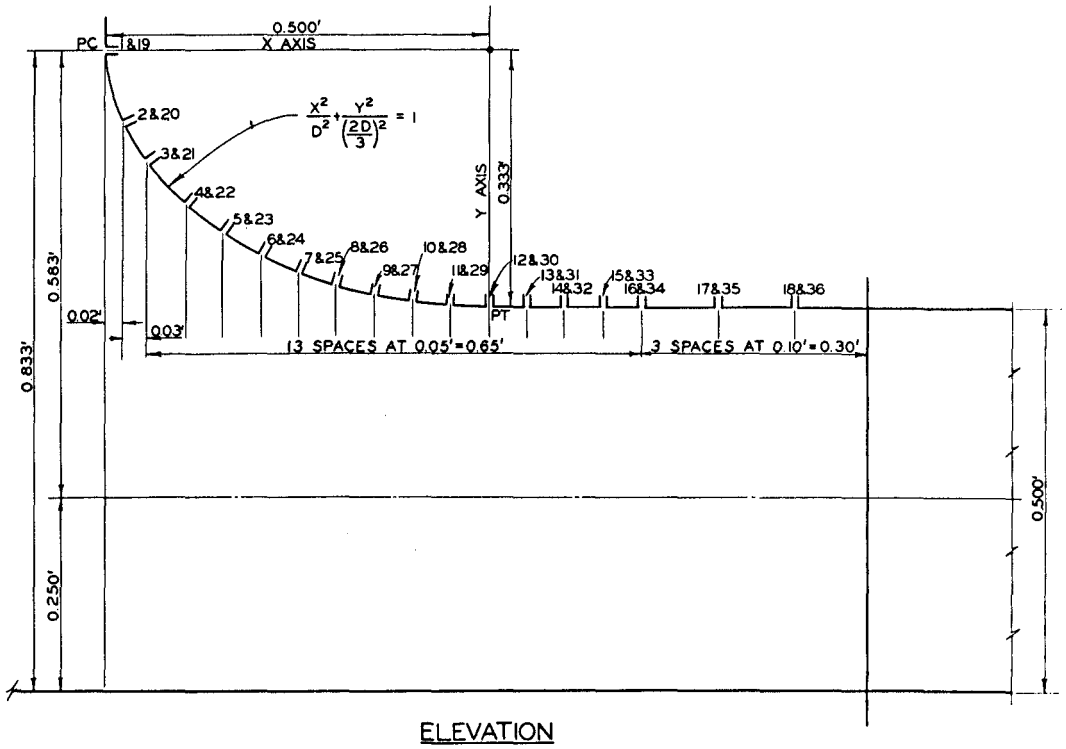
EQUATION WITH ORIGIN B $\frac{X^2}{(2D)^2}+\frac{Y^2}{(0.32D)^2}=1$

EQUATION WITH ORIGIN A' $\frac{X^2}{D^2}+\frac{Y^2}{(0.32D)^2}=1$

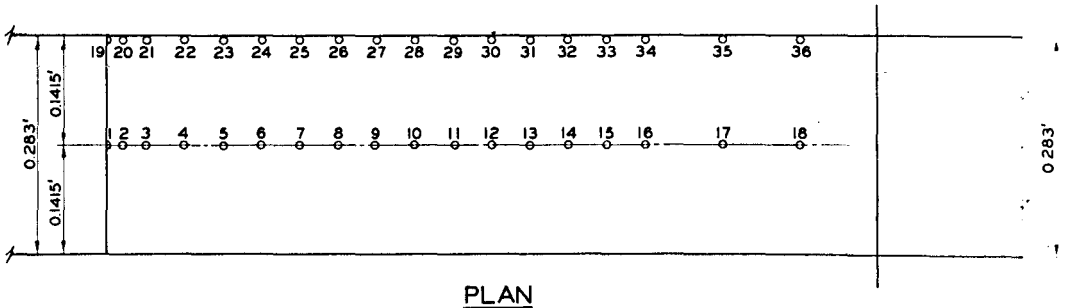
EQUATION WITH ORIGIN B' $\frac{X^2}{D^2}+\frac{Y^2}{(0.16D)^2}=1$

PIEZOMETER LOCATIONS
TYPE 7

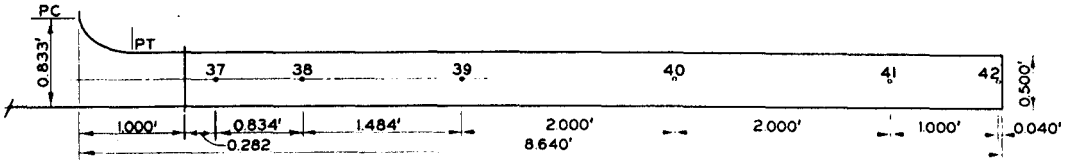
PLATE 10



ELEVATION



PLAN

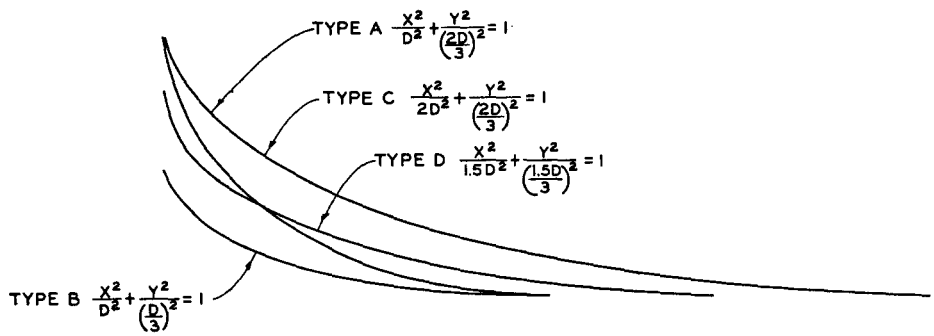


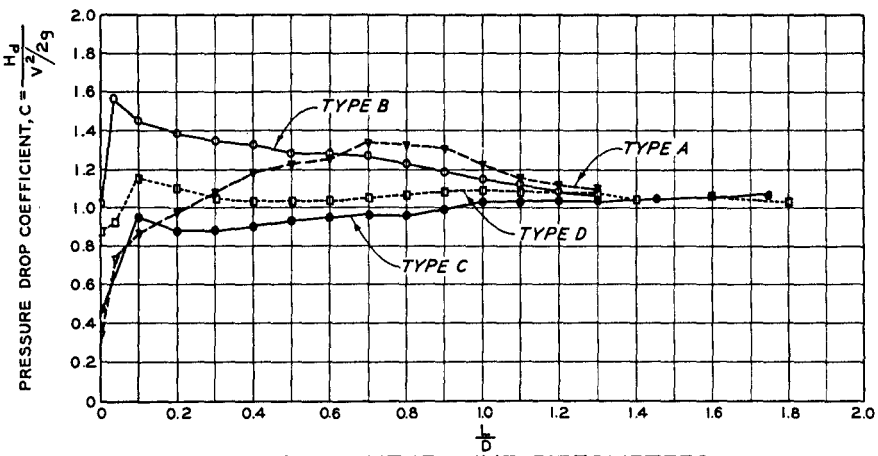
ELEVATION OF CONDUIT

NOTE: BOTTOM OF INTAKE AND CONDUIT AT SAME ELEVATION AS APPROACH CHANNEL.
DISTANCES SHOWN IN FEET.

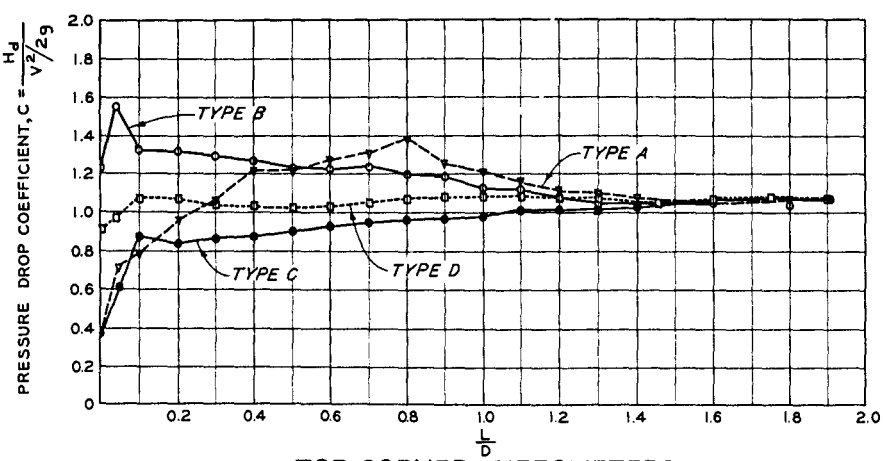
PIEZOMETER LOCATIONS
TYPE A

PLATE 11





TOP CENTER LINE PIEZOMETERS



TOP CORNER PIEZOMETERS

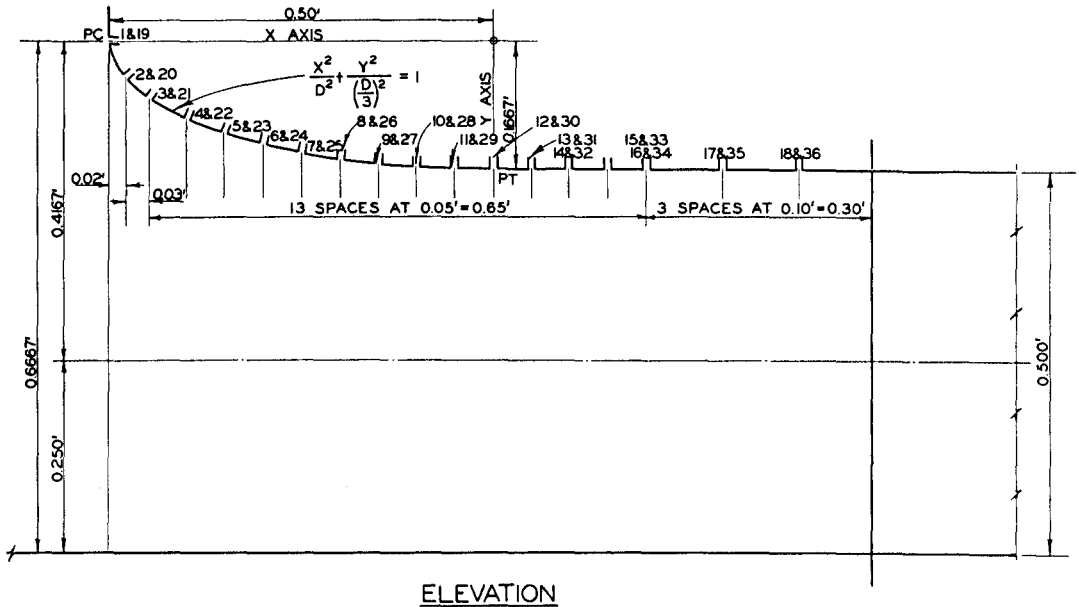
NOTE: H_d = PRESSURE DROP FROM POOL TO PIEZOMETER
V = AVERAGE VELOCITY IN CONDUIT PROPER
$\frac{L}{D}$ = RATIO OF DISTANCE DOWNSTREAM TO DIMENSION OF CONDUIT IN DIRECTION CONCERNED (D = 0.500)
FLOOR OF INTAKE AND CONDUIT AT ELEVATION OF APPROACH CHANNEL.

PRESSURE DATA

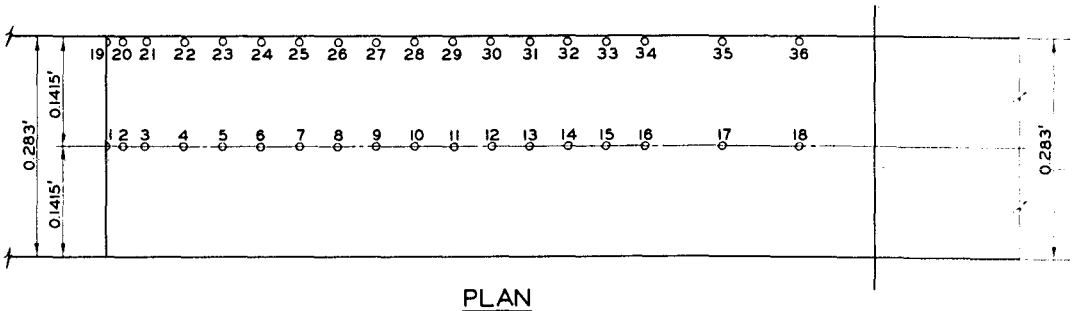
TYPES A,B,C, AND D ENTRANCE CURVES

FLARE ON TOP ONLY

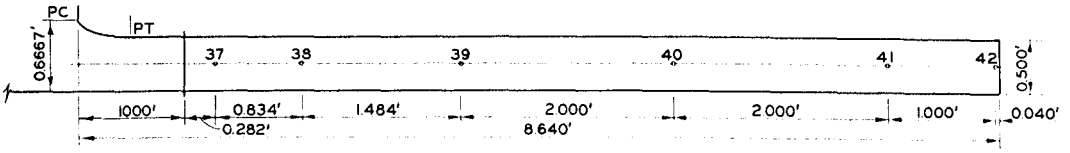
PLATE 12



ELEVATION



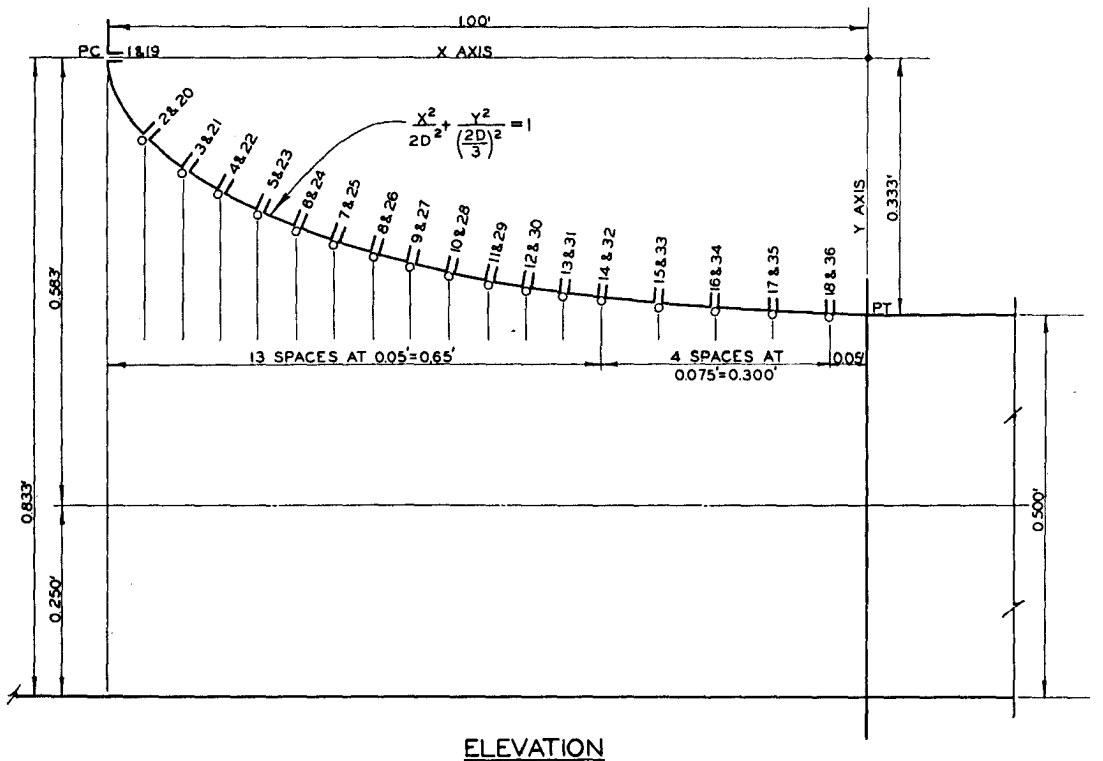
PLAN



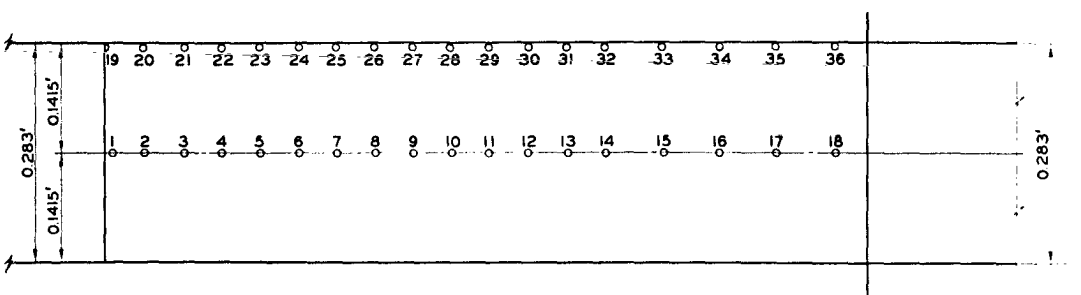
ELEVATION OF CONDUIT

NOTE: BOTTOM OF INTAKE AND CONDUIT AT SAME ELEVATION AS APPROACH CHANNEL.
DISTANCES SHOWN IN FEET.

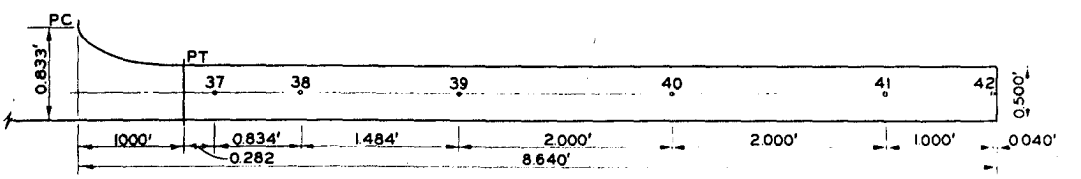
PIEZOMETER LOCATIONS
TYPE B



ELEVATION



PLAN

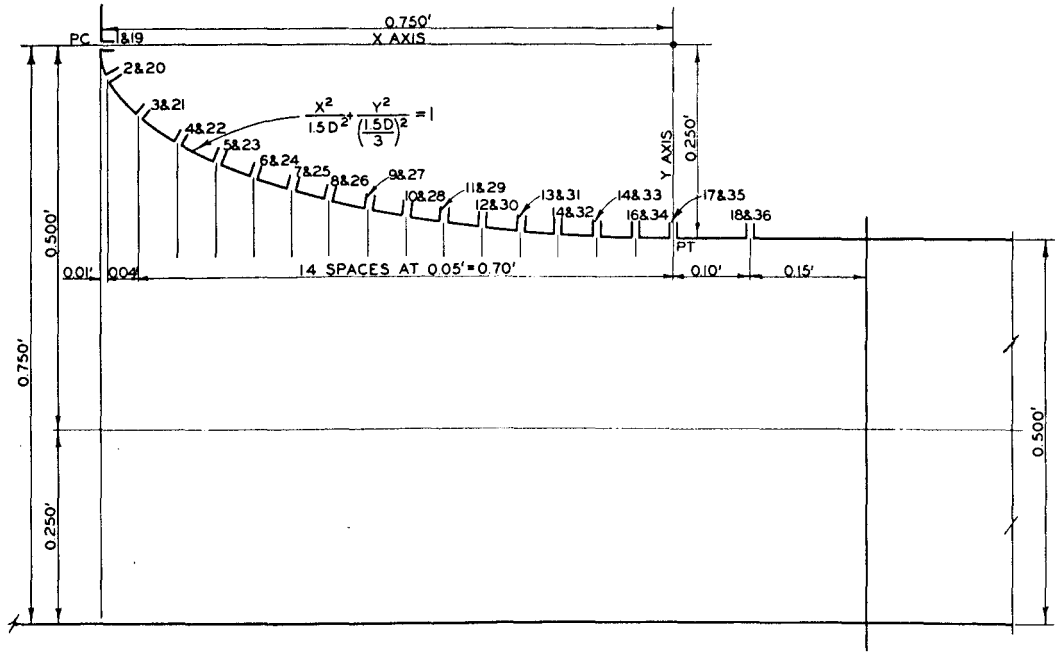


ELEVATION OF CONDUIT

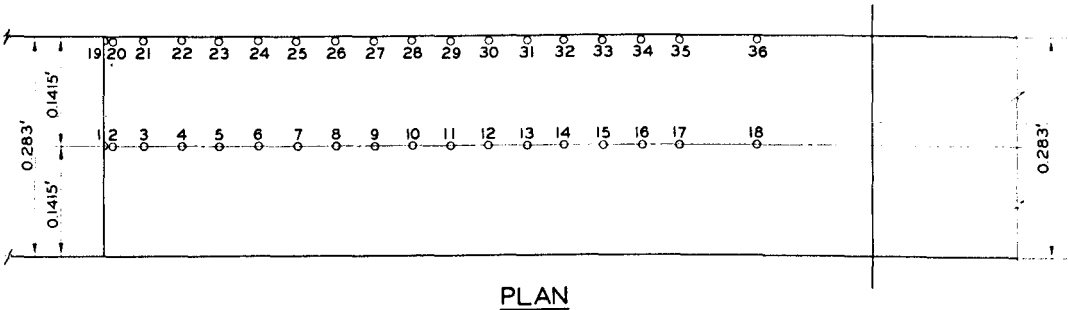
NOTE: BOTTOM OF INTAKE AND CONDUIT AT SAME ELEVATION AS APPROACH CHANNEL.
DISTANCES SHOWN IN FEET.

PIEZOMETER LOCATIONS
TYPE C

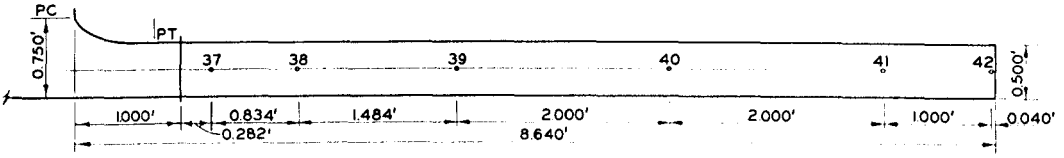
PLATE 14



ELEVATION



PLAN

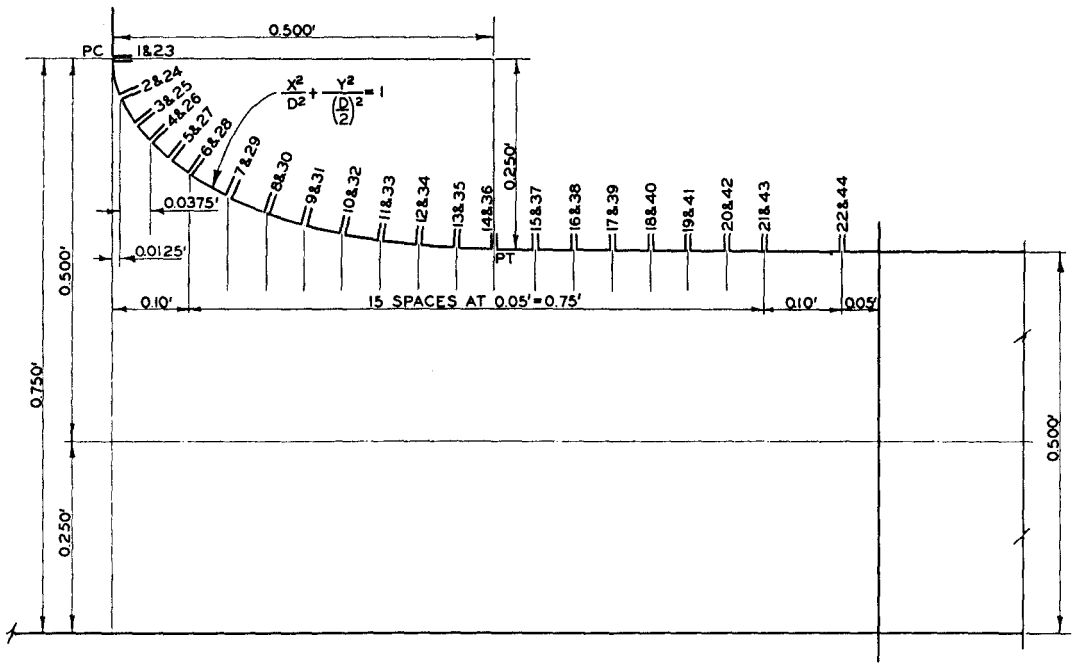


ELEVATION OF CONDUIT

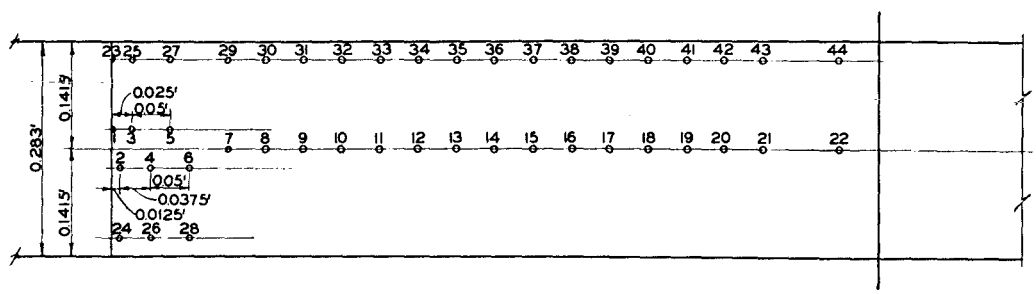
NOTE: BOTTOM OF INTAKE AND CONDUIT AT SAME ELEVATION AS APPROACH CHANNEL.
DISTANCES SHOWN IN FEET.

PIEZOMETER LOCATIONS
TYPE D

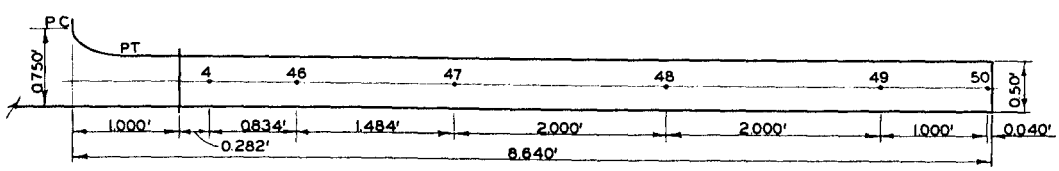
PLATE 15



ELEVATION



PLAN

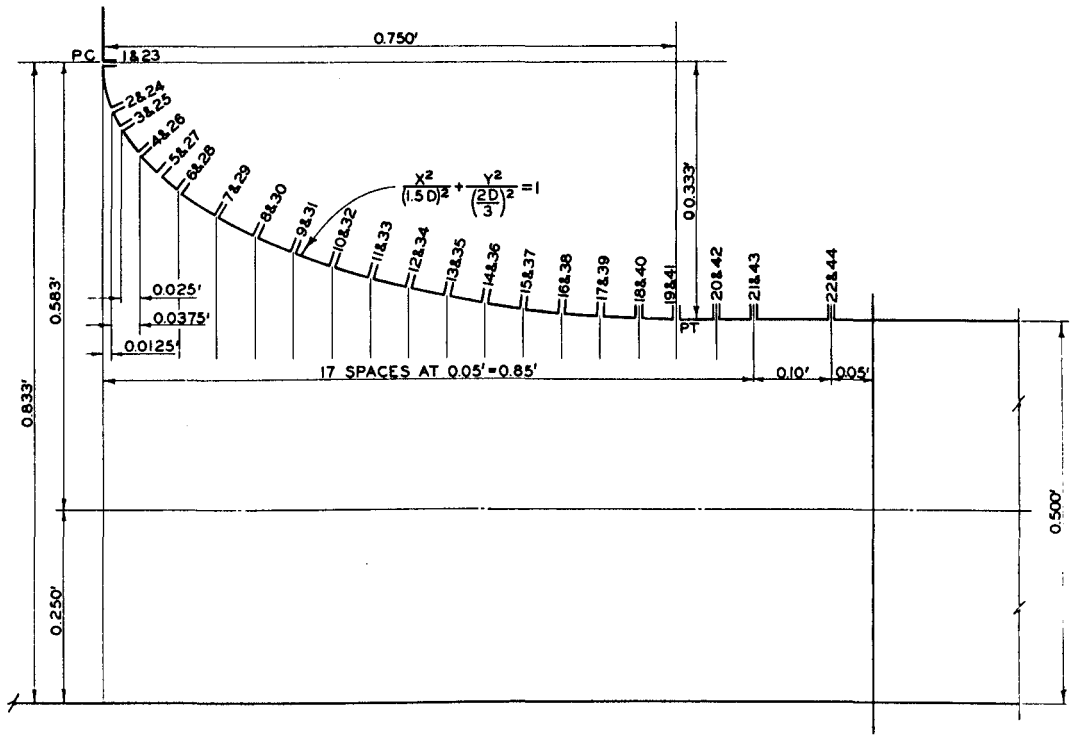


ELEVATION OF CONDUIT

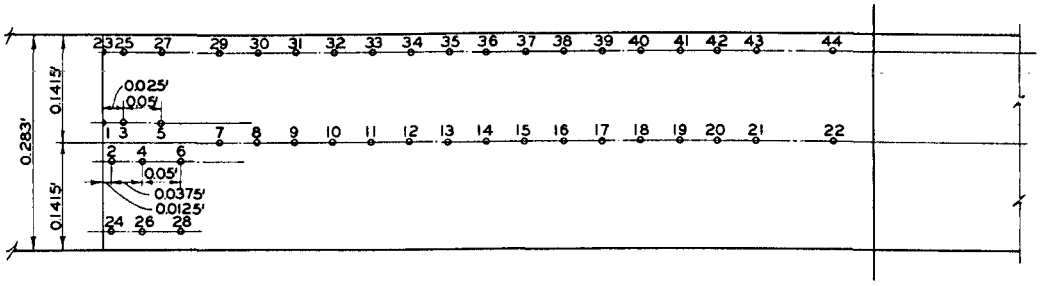
NOTE: BOTTOM OF INTAKE AND CONDUIT AT SAME ELEVATION AS APPROACH CHANNEL.
DISTANCES SHOWN IN FEET.

PIEZOMETER LOCATIONS
TYPE E

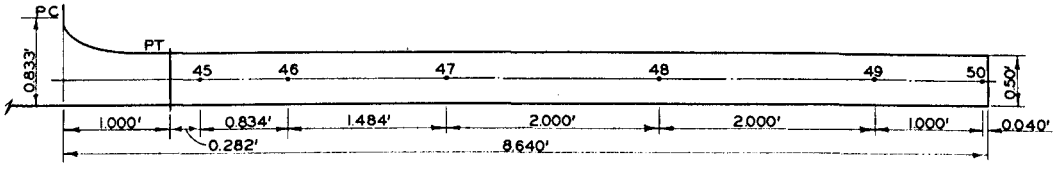
PLATE 16



ELEVATION



PLAN

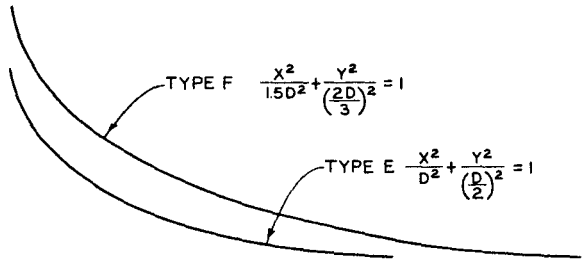


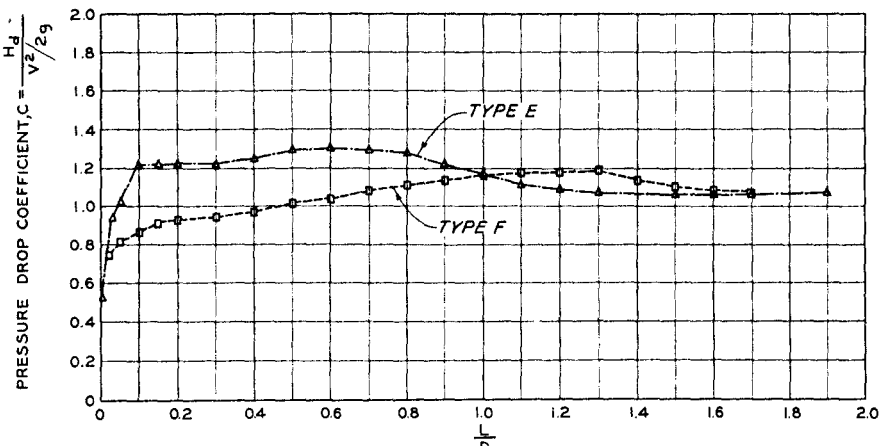
ELEVATION OF CONDUIT

NOTE: BOTTOM OF INTAKE AND CONDUIT AT SAME ELEVATION AS APPROACH CHANNEL.
DISTANCES SHOWN IN FEET.

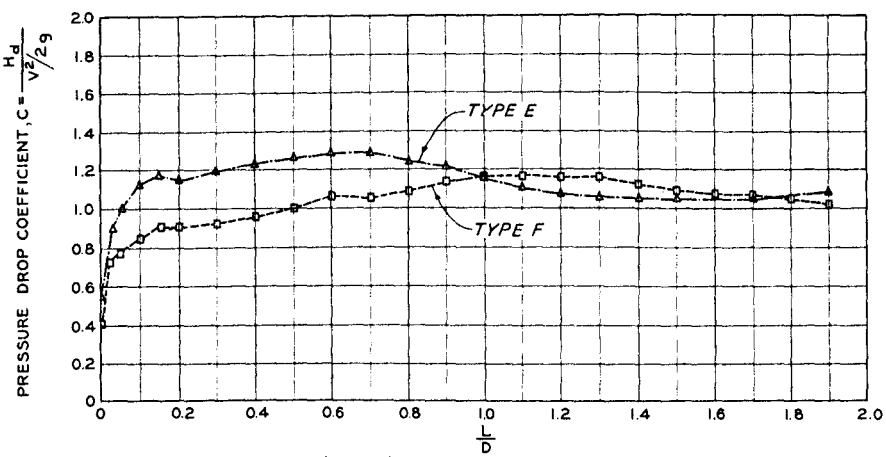
PIEZOMETER LOCATIONS
TYPE F

PLATE 17





TOP CENTER LINE PIEZOMETERS



TOP CORNER PIEZOMETERS

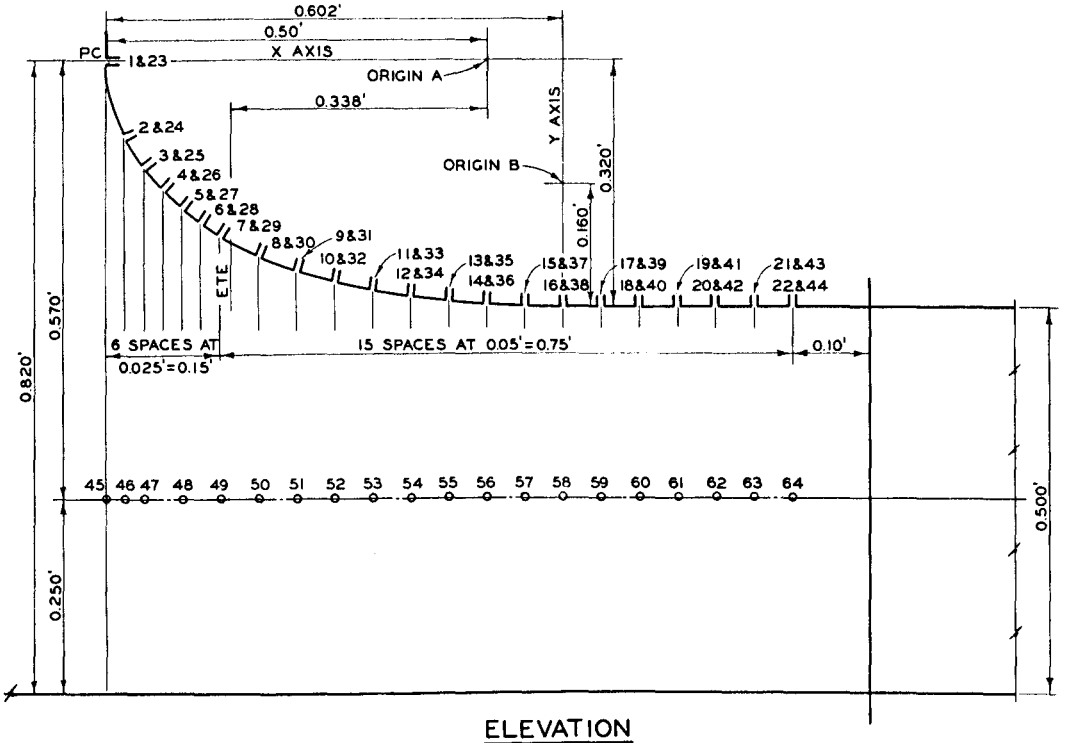
NOTE: H_d = PRESSURE DROP FROM POOL TO PIEZOMETER
V = AVERAGE VELOCITY IN CONDUIT PROPER
$\frac{L}{D}$ = RATIO OF DISTANCE DOWNSTREAM TO DIMENSION OF CONDUIT IN DIRECTION CONCERNED (D = 0.500)
FLOOR OF INTAKE AND CONDUIT AT ELEVATION OF APPROACH CHANNEL.

PRESSURE DATA

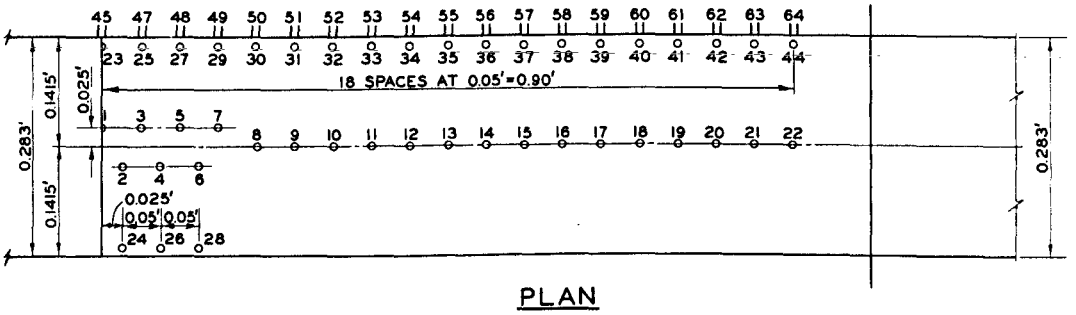
TYPES E AND F ENTRANCE CURVES

FLARE ON TOP ONLY

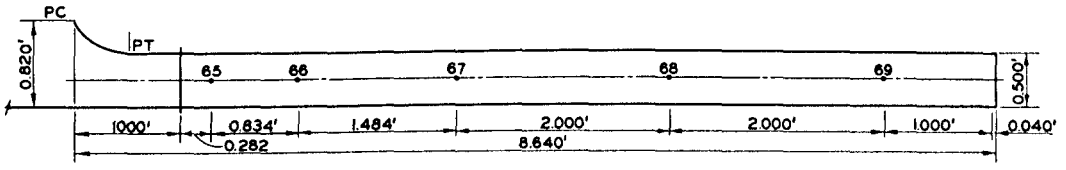
PLATE 18



ELEVATION



PLAN



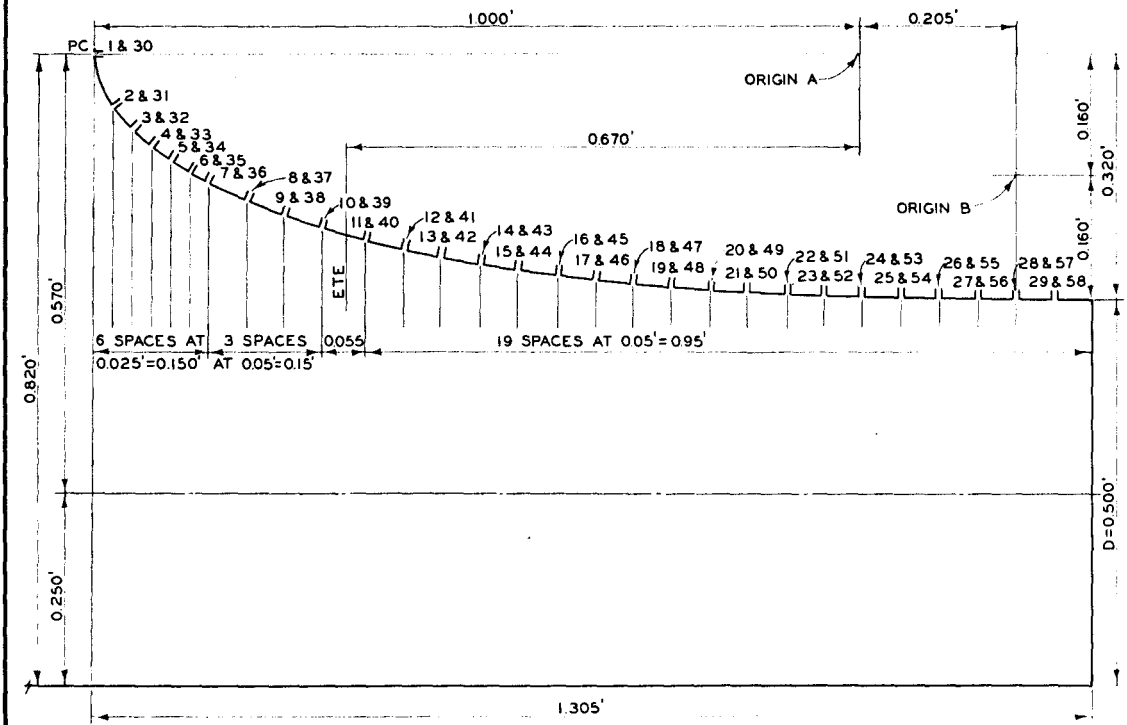
ELEVATION OF CONDUIT

NOTE: DISTANCES SHOWN IN FEET.

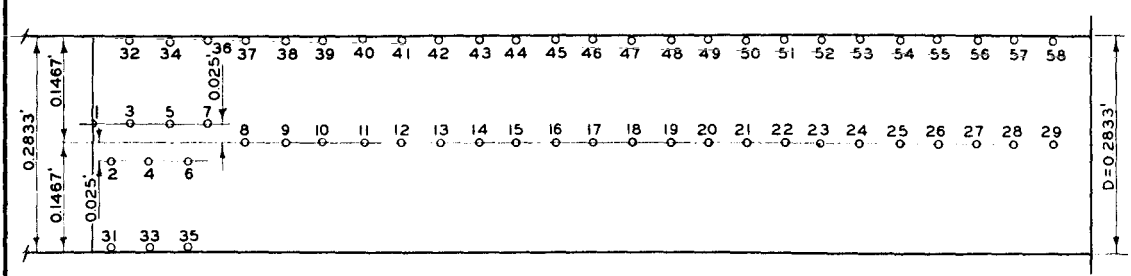
EQUATION WITH ORIGIN A & A' $\frac{X^2}{D^2}+\frac{Y^2}{(0.64D)^2}=1$

EQUATION WITH ORIGIN B & B' $\frac{X^2}{D^2}+\frac{Y^2}{(0.32D)^2}=1$

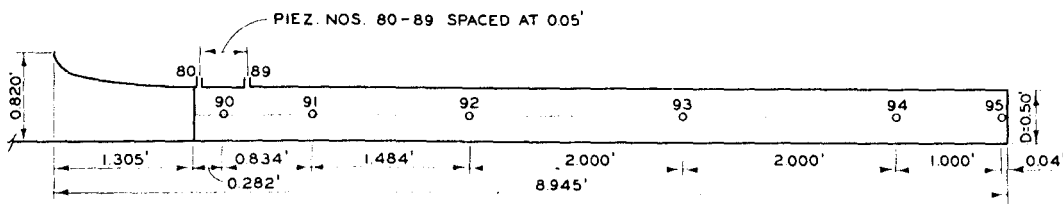
PIEZOMETER LOCATIONS
TYPE G



ELEVATION



PLAN



ELEVATION OF CONDUIT

NOTE: DISTANCES SHOWN IN FEET.

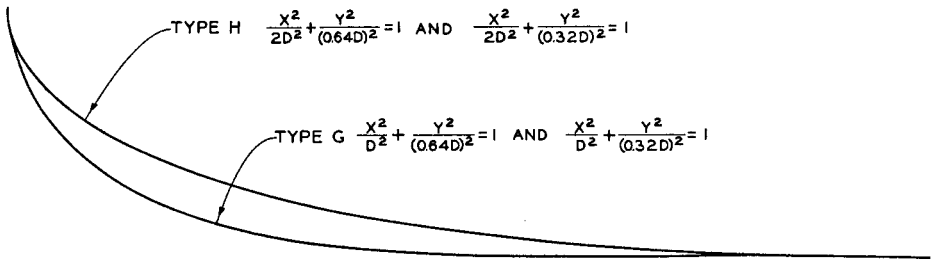
EQUATION WITH ORIGIN A $\frac{X^2}{(2D)^2}+\frac{Y^2}{(0.64D)^2}=1$

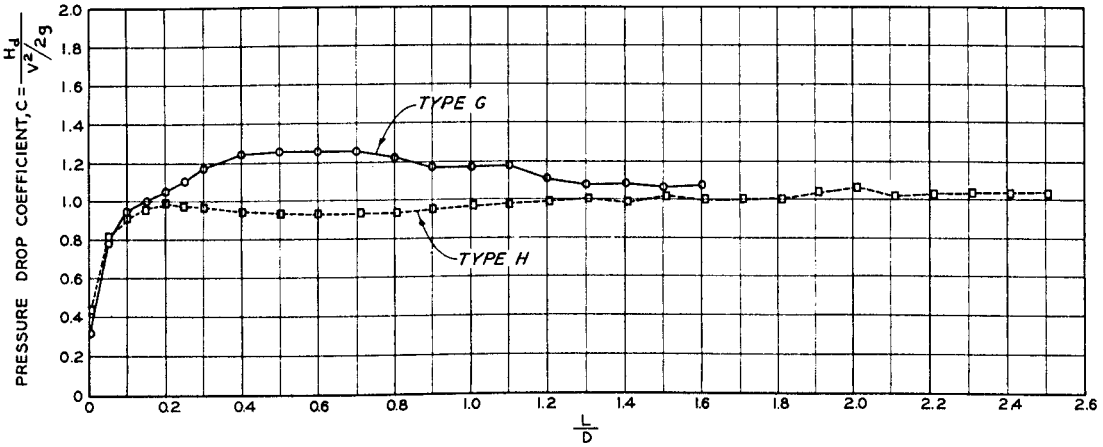
EQUATION WITH ORIGIN B $\frac{X^2}{(2D)^2}+\frac{Y^2}{(0.32D)^2}=1$

PIEZOMETER LOCATIONS

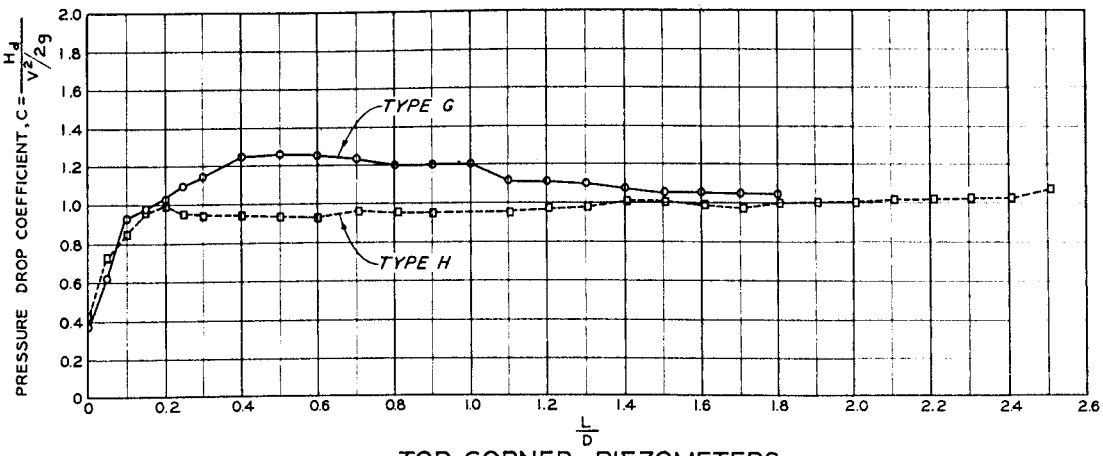
TYPE H

PLATE 20





TOP CENTER LINE PIEZOMETERS



TOP CORNER PIEZOMETERS

NOTE: H_d = PRESSURE DROP FROM POOL TO PIEZOMETER
V = AVERAGE VELOCITY IN CONDUIT PROPER
$\frac{L}{D}$ = RATIO OF DISTANCE DOWNSTREAM TO DIMENSION OF CONDUIT IN DIRECTION CONCERNED (D = 0.500)
FLOOR OF INTAKE AND CONDUIT AT ELEVATION OF APPROACH CHANNEL.

PRESSURE DATA

TYPES G AND H ENTRANCE CURVES

FLARE ON TOP ONLY