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Ribbon and Gliding Type Parachutes Evaluated in the 7 by 10 Foot Transonic Wind Tunnel

Prepared by Naval Ship Research and Development Center,
Aviation and Surface Effects Department, Bethesda, MD 20084

Printed by Sandia Laboratories, Albuquerque, NM 87115, and Livermore, CA 94550, for the United States Energy Research and Development Administration under Contract AT(29-1)-789.

Printed September 1975.

Sandia Laboratories

SF 2900 Q(7-73)

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER TM 16-75-06	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Ribbon and Gliding Type Parachutes Evaluated in the 7 by 10 Foot Transonic Wind Tunnel		5. TYPE OF REPORT & PERIOD COVERED Technical Memorandum 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Jonah Ottensoser		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval Ship Research and Development Center Aviation and Surface Effects Department Bethesda, Maryland 20084		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Sandia Corporation Alburquerque, New Mexico		12. REPORT DATE April 1975 13. NUMBER OF PAGES 70+
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Distribution completely controlled by the Sandia Corporation.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Parachute
Fist Parachute
Gliding Parachute
Transonic Parachute
Parachute Disreefing

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

An experiment has been conducted in the NSRDC 7- x 10-foot transonic tunnel for the Sandia Corporation to evaluate various parachute parameters. The experiment consisted of three main parts: the first phase evaluated the disreefing characteristics of the various parachutes as well as the drag forces before, during and after disreefing; the second phase measured the pressure distribution around the chute as well as the drag forces; and the final phase evaluated the disreefing and drag characteristics of gliding type parachutes. The free stream dynamic pressure varied from 65 to 500 psf.

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S/N 0102-014-6601

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SYMBOLS

CDO	Drag coefficent based on constructed area, $D/(qS_o)$
CDP	Drag coefficient based on actual parachute area $D/(qS_p)$
D	Drag, lbs
D_o	Constructed parachute diameter, 36 in.
D_p	Inflated parachute diameter as measured from 70 mm photos, in.
D_{ACTUAL}	Final value of pressure drag including compensation of chute porosity, $D_{ACTUAL} = D_{TOTAL}$ (1.00 - % Porosity/100), lbs
D_{TOTAL}	Drag as integrated from pressure taps, lbs
D/D_{inf}	Ratio of balance drag at a point in time during disreefing to steady state balance drag after disreefing
D_p/D_o	Ratio of inflated maximum diameter to constructed diameter
FXX	Fist parachute model with XX indicating percent geometric porosity
FGLXX	Fist gliding parachute model with XX indicating percent geometric porosity
LXX	Shroud line length with XX indicating shroud line length in constructed chute diameter
L/D_o	Ratio of shroud line length to constructed diameter
L/R	Ratio of distance from center of chute vent to pressure port to distance from center of vent to skirt with all distances measured along chute surface
P	Pressure, psf or indication of pressure chute configuration in run description
Q,q	Free stream dynamic pressure, psf
RXX	Reefing line length with XX indicating length in inches
r	Maximum radius of chute at point in time during disreefing, in.
r/r_{inf}	Ratio of r to maximum steady state radius after disreefing
S_o	Reference area based on constructed diameter (D_o), ft^2
S_p	Reference area based on actual parachute diameter (D_p) as taken from 70 mm photos, ft^2
t	Time from initiation of disreefing, sec.
t/t_o	Ratio of t to total time taken from initiation of disreefing to steady state condition

V_∞	Free stream velocity, fps
α	Angle between centerline of inflated chute and normal to chute surface at a pressure port location, deg.

Summary

An experiment has been conducted in the NSRDC 7- x 10-foot transonic tunnel for the Sandia Corporation to evaluate various parachute parameters. The experiment consisted of three main parts: the first phase evaluated the disreefing characteristics of the various parachutes as well as the drag forces before, during and after disreefing; the second phase measured the pressure distribution around the chute as well as the drag forces; and the final phase evaluated the disreefing and drag characteristics of gliding type parachutes. The free stream dynamic pressure varied from 65 to 500 psf.

Models

The models evaluated during the first two phases of the experiment were FIST ribbon design parachutes which varied in geometric porosity from 15 to 30 per cent. These models were made of flexible cloth and were symmetric about the parachute centerline (see Figure 1). Reefing lines of various lengths (19, 38, and 57 inches) were threaded through rings sewn to the skirts of the parachutes. Explosive line cutters were attached to these reefing lines and when fired, severed the reefing line and allowed chute inflation at desired tunnel conditions. In addition, each of the models had loops sewn into the shroud lines. By attaching different sets of loops to the attachment ring at the aft end of the ogive-cylinder model, the effect of shroud line length could be evaluated. Shroud line lengths of 1.0, 1.5 and 2.0 times the constructed diameter were tested.

For phase II where pressure measurements were desired, flexible plastic "Strip-a-Tubing" was glued to the radial lines and brought out the vent of the parachutes, run along a metal rod that was supported between the ogive-cylinder model and the main support boom of the tunnel. After entering the boom, the tubes were connected to a scanivalve system containing pressure transducers. Half of the tubes went to the inside surface of the parachutes while the other half went to the outside making a total of 46 tubes. The ends of the tubes were closed off at the model and vee-shaped notches were cut into the tubes at the desired radial stations.

The final phase of the experiment evaluated the disreefing and drag characteristics of gliding type parachutes. These chutes, also constructed of flexible cloth, had porosities of either 35 or 39 per cent and were reefed with lines of either 48.8, 55.7, 56.5 or 62.8 inches in length. These gliding parachutes had "venetian blind" like cloth ribs angled to the chute centerline in the upper quadrant and thus provided the lift necessary to make the chute glide.

Tunnel Installation

The basic tunnel installation for phases I and II is shown in Figure 2a. The ogive-cylinder model was centered in the tunnel and supported by means of three steel cables in front and three steel cables in the rear. In the front, two cables were attached to brackets in the tunnel floor and one went through the ceiling of the tunnel to an eye firmly anchored to upper tunnel structure. In the rear, the opposite arrangement of cables was used.

Data from a previous subsonic test were used to estimate the required cable tension to hold the ogive-cylinder body in place during disreefing and full deployment. Knowing the cable tension required and using the relationship

$$\text{Period of Vibration} = \frac{1}{2 \times \text{Cable length}} \cdot \sqrt{\frac{\text{Cable tension}}{\text{Cable density}}},$$

a strobe light focused on the cables permitted adjustment of the cable tension, by means of turnbuckles, to the required amount.

The aft end of the ogive-cylinder model contained a one component strain gage gimbaled balance. The loops in the shroud lines of the various parachutes were attached to a ring that was connected to the gimbal. The purpose of the gimbal arrangement was to allow $\pm 10^0$ movement in pitch and yaw while still reading the full load along the axis of the parachute. The electric leads from the balance, as well as the leads for the explosive line cutters, were taped to the support cables and run out of the tunnel.

For phase II, where pressure measurements were required, a rod was connected at one end to the center of the ogive-cylinder model, concentric with the gimbaled balance, while the other end was attached to an adapter that connected to the tunnel support system. Pressure tubes running from the parachute model, out the parachute vent, were loosely taped to this rod and fed through the adapter to a scanivalve set up.

For phase III the ogive-cylinder body was supported at an angle of 20^0 to the horizontal to permit interference free balance data to be taken for a trim angle of 25^0. Figure 2b shows this test arrangement.

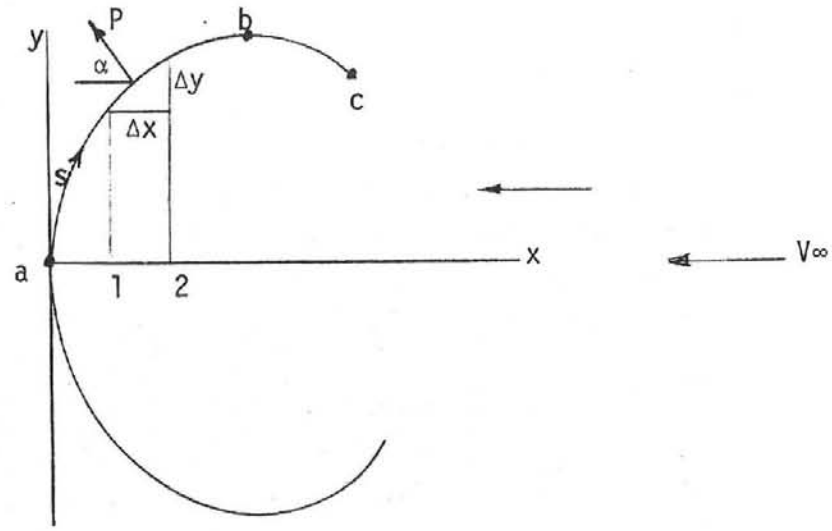
Data

Data taken during this test fell into three basic catagories: balance, pressure, and photographic. A one component gimbaled strain gage balance was rigidly connected to the aft end of the ogive-cylinder body. The ends of the parachute shroud lines were connected to a ring which in turn was fastened to the balance. The analog signal from the balance, along with the free stream tunnel conditions, were fed in the beckman computer and digitized onto magnetic tape. The data on the magnetic tape were then reduced to the desired coefficient form on a XDS 930 computer.

The balance data were also recorded in a different form during parachute disreefing. Because disreefing took place so rapidly, the Beckman data system was too slow to record the force/time history during this process. Instead, the balance signal was split, part going to the Beckman for standard recording and the other part going to a FM recording system. The FM tape was then reduced on a separate computer and plotted for each disreefing run.

Pressure data from the 23 pressure taps inside the parachute surface and the pressure data from the 23 taps outside the model were fed to separate scanivalves that were "ganged" together to read the same port number of each scanivalve simultaneously. These pressure taps surveyed the inside and outside pressure distribution from vent to skirt and were integrated to yield drag.

The following assumptions and steps were taken to integrate for drag:



$$\text{Drag (D)} = \int_0^{\ell} 2\pi\bar{y}\bar{P} \cos\alpha \, ds$$

where ℓ = length along arc s

$$\bar{y} = (y_1 + y_2)/2 \text{ and } \bar{P} = (P_1 + P_2)/2$$

$$\text{but } \cos\alpha = \Delta y/(\Delta x^2 + \Delta y^2) = \Delta y/ds$$

$$\text{therefore } D = \int_0^{y_f} 2\,\bar{y}\bar{P}\, dy$$

where y_f = y component of ℓ.

$$\text{Furthermore } \pi(y_2^{\,2} - y_1^{\,2}) = \pi(y_2 + y_1)\,(y_2 - y_1) = \pi(2\bar{y})dy$$

$$\text{therefore } D = \pi\sum_{i=1}^{n} (y_{i+1}^{\,2} - y_i^{\,2})\bar{P}$$

where n = number of pressure ports.

The total drag is obtained by summing with the above equation in parts over the surface curvature depending on the direction of the surface normal. Thus using points a, b and c as indicated in Sketch 1, the total drag would be

$$D_{Total} = \text{Drag (outside - inside) point a to b} + \text{Drag (inside - outside) point b to c.}$$

However, this total drag calculation assumes that the parachute canopy is solid whereas in fact it is porous.

$$\text{Therefore } D_{Actual} = D_{Total}\ (1.00 - \%\ \text{porosity}/100)$$

An additional correction was made for the drag of the shroud lines with the assumption of a form drag coefficient of 1.10 and a friction drag coefficient of 0.005.

Photographic data were taken in three basic forms. The simplest photographic coverage consisted of 24 fps color movies required for documentary purposes. In addition, high speed, 500 fps, color movies were taken during each disreefing process. This high speed film was analyzed one frame at a time to determine the geometry of the parachute as a function of time during the disreefing process.

Finally, 70 mm black and white still photographs were taken perpendicular to the profile of the parachute for every configuration at each dynamic pressure run for that configuration. For phase II these still photographs, as shown in Figure 3, were used to measure the vertical distance from the centerline to each pressure port as required for the pressure drag integration described above. For all phases these photographs were used to measure the inflated parachute diameter.

Data Presentation

Table 1 contains the entire schedule including pertinent tunnel conditions. In addition, Table 1 contains balance and pressure drag

(in pounds) as well as the inflated chute diameter for every point tested where applicable. Figure 4 through 12 contain all the data requested by the Sandia Corporation. Furthermore, Appendix A contains the complete set of pressure plots.

TABLE 1 - Schedule and Drag Data

Configuration	Run No.	Point No.	Dynamic Pressure (psf)	Mach No.	Reefed (R) or Disreefed (D)	Inflated Diameter (in.)	Balance Drag (lbs)	Pressure Drag (lbs)
F30/L1.0/R57	1	1	301.2	.453	R	*	551.2	-
F30/L1.0/R38	2	2	299.2	.452	R	14.97	350.5	-
		3	298.8	.451	D	19.22	581.2	-
F30/L1.0/R19	3	4	299.4	.452	R	8.47	91.4	-
		5	301.3	.453	D	19.48	607.5	-
		6	101.1	.263	D	19.87	208.7	-
		7	196.6	.366	D	19.60	397.1	-
		8	401.0	.523	D	19.57	817.5	-
		9	500.0	.584	D	19.44	1013.8	-
F15/L1.0/R57	4	10	75.1	.226	R	*	202.3	-
		11	301.8	.453	R	22.53	873.1	-
		12	300.7	.452	D	26.32	1169.7	-
F15/L1.0/R38	5	13	76.5	.228	R	*	130.6	-
		14	301.7	.453	R	17.80	528.9	-
		15	302.3	.453	D	26.57	1178.0	-

* No photograph available

TABLE 1 - Continued

Configuration	Run No.	Point No.	Dynamic Pressure (psf)	Mach No.	Reefed (R) or Disreefed (D)	Inflated Diameter (in.)	Balance Drag (lbs)	Pressure Drag (lbs)
F15/L1.o/R19	6	16	74.5	.225	R	*	36.8	-
		17	301.5	.453	R	9.81	124.9	-
		18	299.9	.452	D	*	1174.2	-
		19	74.5	.225	D	25.89	281.8	-
		20	200.5	.370	D	26.19	771.3	-
		21	401.0	.523	D	26.54	1595.0	-
F25/L1.0/R57	7	22	74.8	.226	R	*	190.0	-
		23	297.9	.451	R	21.42	768.1	-
		24	297.7	.450	D	22.88	883.7	-
F25/L1.0/R38	8	25	74.9	.226	R	*	111.6	-
		26	303.9	.455	R	16.38	455.5	-
		27	299.3	.452	D	23.13	895.7	-
F25/L1.0/R19	9	28	75.9	.227	R	*	32.5	-
		29	302.3	.454	R	9.24	101.8	-
		30	300.6	.453	D	23.13	909.6	-
		31	75.8	.227	D	23.40	228.7	-
		32	198.4	.368	D	23.18	598.9	-
		33	401.8	.523	D	23.13	1220.2	-
		34	498.4	.583	D	23.09	1516.1	-

* No photographs available

TABLE 1 - Continued

Configuration	Run No.	Point No.	Dynamic Pressure (psf)	Mach No.	Reefed (R) or Disreefed (D)	Inflated Diameter (in.)	Balance Drag (lbs)	Pressure Drag (lbs)
F20/L1.0/R57	10	35	75.8	.227	R	*	197.5	-
		36	299.2	.451	R	22.24	818.9	-
		37	298.7	.451	D	24.86	1018.8	-
F20/L1.0/R38	11	38	76.5	.228	R	*	117.0	-
		39	301.1	.453	R	16.86	471.0	-
		40	299.6	.452	D	25.20	1036.1	-
F20/L1.0/R19	12	41	75.1	.226	R	*	33.3	-
		42	302.8	.454	R	9.12	111.7	-
		43	299.1	.451	D	24.98	1033.0	-
		44	75.1	.226	D	24.98	255.8	-
		45	198.4	.368	D	24.77	682.4	-
		46	399.9	.522	D	24.98	1384.4	-
		47	498.4	.583	D	24.81	1719.5	-
F25/L1.5/R38	13	48	74.6	.225	R	*	106.8	-
		49	300.4	.452	R	17.11	444.5	-
		50	299.2	.451	D	26.89	1132.0	-
		51	75.8	.227	D	26.89	281.5	-
		52	199.6	.369	D	26.89	748.0	-
		53	400.1	.522	D	27.12	1541.2	-

* No photograph available

TABLE 1 - Continued

Configuration	Run No.	Point No.	Dynamic Pressure (psf)	Mach No.	Reefed (R) or Disreefed (D)	Inflated Diameter (in.)	Balance Drag (lbs)	Pressure Drag (lbs)
F15/L1.5/R38	14	55	74.5	.224	R	*	128.1	-
		57	304.6	.453	R	18.06	540.3	-
		58	302.1	.451	D	*	1380.3	-
		59	75.2	.225	D	28.21	333.6	-
		60	203.8	.370	D	28.44	911.8	-
		61	401.9	.520	D	*	1885.3	-
F20/L1.5/R38	15	62	73.8	.223	R	*	115.9	-
		63	301.3	.450	R	17.88	482.2	-
		64	304.0	.452	D	27.80	1268.2	-
		65	73.8	.223	D	27.35	301.5	-
		66	201.6	.368	D	27.62	826.8	-
		67	401.4	.520	D	27.80	1707.3	-
F30/L1.5/R38	16	68	76.9	.228	R	*	102.2	-
		69	302.0	.451	R	16.93	401.1	-
		70	303.0	.452	D	25.25	980.4	-
		71	76.6	.227	D	25.39	248.1	-
		72	199.3	.366	D	25.21	641.0	-
		73	403.7	.521	D	25.48	1321.5	-
		74	504.6	.583	D	25.48	1649.1	-

* No photograph available

TABLE 1 - Continued

Configuration	Run No.	Point No.	Dynamic Pressure (psf)	Mach No.	Reefed (R) or Disreefed (D)	Inflated Diameter (in.)	Balance Drag (lbs)	Pressure Drag (lbs)
F15/L2.0/R38	17	75	77.2	.228	R	*	131.9	-
		76	302.8	.452	R	18.66	539.9	-
		77	303.3	.452	D	28.98	1498.4	-
		78	75.8	.226	D	28.48	360.6	-
		79	201.8	.369	D	28.71	970	-
F20/L2.0/R38	18	80	77.2	.228	R	*	123.2	-
		81	303.4	.452	R	18.34	491.0	-
		82	300.4	.450	D	28.39	1338.2	-
		83	76.5	.227	D	27.94	323.5	-
		84	202.6	.370	D	28.30	888.9	-
		85	404.8	.522	D	28.48	1861.6	-
F25/L2.0/R38	19	86	76.5	.227	R	*	115.5	-
		87	305.4	.454	R	17.84	463.3	-
		88	302.4	.452	D	27.80	1245.1	-
		89	76.5	.227	D	27.71	306.1	-
		90	203.0	.370	D	27.71	829.6	-
		91	405.0	.523	D	27.94	1710.0	-

* No photographs available

TABLE 1 - Continued

Configuration	Run No.	Point No.	Dynamic Pressure (psf)	Mach No.	Reefed (R) or Disreefed (D)	Inflated Diameter (in.)	Balance Drag (lbs)	Pressure Drag (lbs)
F30/L2.0/R38	20	92	77.2	.228	R	*	104.0	-
		93	305.4	.454	R	16.84	406.0	-
		94	302.5	.452	D	26.94	1069.0	-
		95	77.2	.228	D	26.66	265.7	-
		96	202.2	.369	D	*	705.4	-
		97	406.2	.523	D	26.98	1451.5	-
		98	503.1	.582	D	27.03	1824.5	-
F30/L1.0	21	99	75.2	.225	D	*	181.1	-
		100	203.0	.370	D	18.75	338.5	-
		101	304.4	.453	D	19.38	541.8	-
		102	410.2	.526	D	20.07	789.1	-
		103	503.1	.581	D	*	978.4	-
F25/PL1.0/R19	22	105	75.7	.226	R	*	36.3	*
		106	207.3	.373	R	*	97.5	*
		107	307.7	.455	R	*	141.8	*
		108	407.3	.523	R	10.12	187.0	*
		109	508.2	.584	R	9.90	231.2	*

* No photographs available

TABLE 1 - Continued

Configuration	Run No.	Point No.	Dynamic Pressure (psf)	Mach No.	Reefed (R) or Disreefed (D)	Inflated Diameter (in.)	Balance Drag (lbs)	Pressure Drag (lbs)
F25/PL1.0/R38	23	110	72.4	.221	R	17.70	111.0	123.3
		112	206.2	.372	R	17.83	323.3	314.5
		114	303.8	.452	R	18.14	489.7	482.0
		115	410.0	.525	R	18.37	674.9	646.8
		116	507.7	.584	R	18.55	869.1	904.7
F25/PL1.0/R57	24	117	75.4	.225	R	22.67	194.7	197.4
		118	202.9	.369	R	23.03	535.5	538.5
F25/PL1.0	25	119	79.0	.231	D	26.07	264.6	260.0
		120	202.2	.369	D	26.30	699.0	757.6
		122	303.3	.452	D	26.21	1068.0	1122.0
		123	405.6	.522	D	26.43	1450.8	1500.5
		124	506.4	.584	D	26.70	1827.8	1924.2
		125	79.1	.231	D	26.16	263.6	268.4
F25/PL1.5	26	126	75.2	.225	D	27.02	305.7	317.3
		127	202.9	.369	D	27.37	848.2	897.1
		128	300.3	.449	D	27.54	1291.9	1383.5

TABLE 1 - Continued

Configuration	Run No.	Point No.	Dynamic Pressure (psf)	Mach No.	Reefed (R) or Disreefed (D)	Inflated Diameter (in.)	Balance Drag (lbs)	Pressure Drag (lbs)
F25/PL2.0	27	129	75.1	.225	D	27.41	325.4	341.1
		130	202.8	.369	D	28.07	911.3	998.2
		131	300.0	.449	D	28.16	1385.9	1511.0
F20/PL2.0	28	132	75.1	.225	D	27.59	333.6	379.7
		133	203.7	.370	D	28.16	953.1	1118.7
		134	304.5	.452	D	28.51	1481.5	1772.4
F20/PL1.5	29	135	74.6	.224	D	27.46	317.2	351.9
		136	202.2	.369	D	27.94	894.4	1029.8
		137	304.2	.452	D	28.16	1385.0	1569.6
		138	385.7	.509	D	28.51	1797.1	2132.6
F20/PL1.0	30	139	75.8	.226	D	26.62	282.7	304.7
		140	203.9	.370	D	26.88	787.4	892.2
		141	303.1	.451	D	26.97	1203.0	1361.9
		142	399.3	.518	D	27.27	1617.0	1849.4

TABLE 1 - Continued

Configuration	Run No.	Point No.	Dynamic Pressure (psf)	Mach No.	Reefed (R) or Disreefed (D)	Inflated Diameter (in.)	Balance Drag (lbs)	Pressure Drag (lbs)
F20/PL1.o/R57	31	143	73.8	.223	R	23.06	196.2	194.7
		144	205.4	.371	R	23.14	563.8	567.1
		145	303.9	.452	R	23.36	859.7	902.4
		146	406.3	.522	R	23.36	1184.7	1226.5
F20/PL1.0/R38	32	148	78.6	.230	R	18.14	131.0	128.0
		149	204.1	.370	R	17.92	341.5	329.9
		150	306.0	.453	R	18.05	519.4	518.7
		151	407.1	.523	R	18.27	704.2	693.4
F20/PL1.0/R19	33	152	75.4	.225	R	11.31	39.5	*
		153	202.1	.368	R	10.70	108.5	*
		154	304.5	.452	R	10.70	157.4	*
		155	406.8	.523	R	10.96	206.8	*
		156	507.3	.584	R	10.92	254.1	*
F15/PL2.0	34	157	75.8	.226	D	*	356.7	*
		158	205.9	.372	D	*	1034.1	*
		159	308.4	.455	D	*	1617.3	*

* No photographs available

TABLE 1 - Continued

Configuration	Run No.	Point No.	Dynamic Pressure (psf)	Mach No.	Reefed (R) or Disreefed (D)	Inflated Diameter (in.)	Balance Drag (lbs)	Pressure Drag (lbs)
F15/PL2.0 (re-run of 34 for photos)	35	160	76.2	.226	D	28.09	367.3	411.1
		161	203.3	.370	D	28.40	1035.0	1173.9
		162	305.7	.453	D	28.93	1622.1	1851.3
F15/PL1.5	36	163	76.9	.227	D	27.28	342.1	348.9
		164	205.0	.371	D	28.16	961.8	1084.0
		165	302.1	.451	D	28.38	1462.8	1658.9
F15/PL1.0	37	166	77.2	.228	D	26.93	300.2	294.8
F15/PL1.0/R57	38	167	78.8	.230	R	23.10	205.9	190.0
		168	205.4	.372	R	23.66	569.1	582.8
		169	306.8	.455	R	23.66	874.6	846.6
F15/PL1.0/R38	39	170	80.7	.233	R	18.62	136.4	132.4
		171	205.2	.372	R	18.49	357.4	344.6
		172	302.9	.452	R	18.66	543.0	530.3
F15/PL1.0/R19	40	174	80.0	.232	R	11.75	45.2	*
		175	204.4	.371	R	11.31	106.7	*
		176	300.1	.450	R	11.31	155.9	*

* No photograph available

TABLE 1 - Continued

Configuration	Run No.	Point No.	Dynamic Pressure (psf)	Mach No.	Reefed (R) or Disreefed (D)	Inflated Diameter (in.)	Balance Drag (lbs)	Pressure Drag (lbs)
F30/PL2.0	41	177	73.8	.223	D	27.21	245.6	308.4
		178	200.4	.367	D	27.74	822.7	937.6
		179	302.4	.451	D	27.78	1270.3	1427.8
		180	405.5	.522	D	28.14	1743.3	2046.7
F30/PL1.5	42	182	74.0	.223	D	27.06	276.6	306.8
		183	199.8	.367	D	27.41	765.0	863.3
		184	304.4	.453	D	27.50	1190.2	1356.9
		185	406.0	.523	D	*	1617.8	*
F30/PL1.0	43	186	75.8	.226	D	25.27	235.6	249.8
		187	201.9	.369	D	25.19	622.9	679.8
		188	304.8	.453	D	25.05	946.4	1013.7
		189	406.7	.523	D	25.05	1268.4	1365.4
		190	506.0	.584	D	25.05	1582.9	1701.8
F30/PL1.0/R57	44	191	76.3	.227	R	21.72	181.6	189.0
		192	204.3	.371	R	21.99	492.7	511.9
		193	305.7	.454	R	22.16	748.0	786.7
		194	407.3	.524	R	22.16	1008.5	1063.3
		195	506.9	.584	R	22.12	1266.6	1328.0

* No photographs available

TABLE 1 - Continued

Configuration	Run No.	Point No.	Dynamic Pressure (psf)	Mach No.	Reefed (R) or Disreefed (D)	Inflated Diameter (in.)	Balance Drag (lbs)	Pressure Drag (lbs)
F30/PL1.0/R38	45	196	75.4	.225	R	16.86	107.5	93.9
		197	205.1	.372	R	17.30	286.8	287.8
		198	306.6	.455	R	17.21	434.6	443.3
		199	407.7	.524	R	17.43	588.3	579.3
F30/PL1.0/R19	46	200	75.8	.226	R	10.34	30.2	*
		201	206.9	.373	R	9.77	80.7	*
		202	306.8	.455	R	9.72	117.1	*
		203	412.6	.528	R	9.77	155.8	*
F25/PL2.0	47	204	73.8	.223	D	27.46	312.3	342.5
		205	201.8	.369	D	28.47	894.9	1038.6
		206	302.6	.452	D	28.69	1385.4	1630.5
F25/PL1.5	48	208	77.1	.228	D	27.50	313.0	343.3
		209	202.5	.370	D	27.90	846.4	938.8
		210	301.5	.451	D	27.98	1293.2	1465.3
F25/PL1.0	49	211	77.2	.228	D	26.50	268.4	262.6
		212	204.2	.372	D	26.50	728.4	750.5
		213	302.2	.453	D	26.54	1099.7	1174.7
		214	404.2	.523	D	27.24	1492.0	1578.2

* No photographs available

TABLE 1 - Continued

Configuration	Run No.	Point No.	Dynamic Pressure (psf)	Mach No.	Reefed (R) or Disreefed (D)	Inflated Diameter (in.)	Balance Drag (lbs)	Pressure Drag (lbs)
F25/PL1.0/R57	50	215	77.9	.230	R	23.21	202.7	215.3
		216	206.8	.374	R	23.43	553.8	567.0
		217	303.1	.453	R	23.30	824.7	835.0
		218	404.7	.523	R	23.91	1124.8	1154.7
		219	504.5	.584	R	23.56	1431.4	1489.6
F25/PL1.0/R38	51	220	75.7	.231	R	18.13	125.9	132.3
		221	201.8	.389	R	18.35	336.1	346.1
		222	300.6	.489	R	18.40	509.3	542.9
		223	400.9	.585	R	18.66	691.5	729.5
		224	512.8	.691	R	18.66	903.3	966.7
		225	602.5	.780	R	18.44	1086.9	1121.3
FGL35/L1.0/R55.7	52	226	64.7	.210	R	22.34	188.4	-
		227	201.2	.371	R	22.30	659.2	-
		228	303.8	.456	R	23.21	1083.2	-
		229	400.7	.523	D	25.53	1951.5	-
		230	305.6	.457	D	25.62	1458.1	-
		231	201.4	.371	D	25.66	940.4	-
		232	69.6	.218	D	25.34	320.2	-

TABLE 1 - Continued

Configuration	Run No.	Point No.	Dynamic Pressure (psf)	Mach No.	Reefed (R) or Disreefed (D)	Inflated Diameter (in.)	Balance Drag (lbs)	Pressure Drag (lbs)
FGL35/L1.0/R48.8	53	233	67.6	.215	R**	20.20	174.0	-
		234	202.2	.372	R**	20.25	548.2	-
		235	301.1	.454	R**	21.07	857.7	-
		236	299.3	.452	D	25.89	1412.9	-
FGL39.1/L1.0/R48.8 (shroud line loose -did not disreef)	54	237	68.2	.216	R**	20.98	155.3	-
		238	203.3	.373	R**	21.74	507.2	-
FGL39.1/L1.0/R48.8 (re-run of 54)	55	239	66.8	.214	R**	21.20	156.5	-
		240	202.1	.372	R**	22.20	501.6	-
		241	297.9	.451	R**	27.75	781.9	-
		242	291.0	.446	D	*	1433.8	-
		243	201.6	.371	D	*	981.7	-
		244	65.2	.211	D	*	305.3	-
FGL39.1/L1.0/R55.7	56	245	67.6	.215	R	21.93	208.5	-
		246	199.2	.369	R	22.80	684.9	-
		247	201.2	.371	D	25.71	963.8	-
		248	299.9	.453	D	25.43	1478.3	-

* No photograph available

** Mid-gore reefing

TABLE 1 - Continued

Configuration	Run No.	Point No.	Dynamic Pressure (psf)	Mach No.	Reefed (R) or Disreefed (D)	Inflated Diameter (in.)	Balance Drag (lbs)	Pressure Drag (lbs)
FGL39.1/L1.0/R56.5	57	249	64.5	.210	R**	*	185.7	-
		250	202.0	.372	R**	*	609.2	-
		251	198.5	.369	D	24.75	951.1	-
FGL39.1/L1.0/R62.8	58	252	66.2	.213	R**	22.66	222.2	-
		253	199.7	.370	R**	23.25	699.6	-
		254	197.4	.368	D	25.12	938.9	-
FGL35/L1.0/R48.8 (chute yawed)	59	255	66.9	.214	R**	*	173.3	-
		256	200.7	.371	R**	*	552.6	-
		257	197.1	.367	D	*	932.6	-
FGL35/L1.0/R48.8 (re-run of 59)	60	258	69.6	.218	R**	*	191.9	-
		259	198.3	.369	R**	*	585.6	-
		260	200.2	.370	D	25.71	970.7	-
FGL35/L1.0/R55.7	61	261	63.4	.209	R	*	207.5	-
		262	201.5	.372	R	*	742.4	-
		263	200.0	.370	D	25.25	975.9	-

* No photograph available

** Mid-gore reefing

TABLE 1 - Concluded

Configuration	Run No.	Point No.	Dynamic Pressure (psf)	Mach No.	Reefed (R) or Disreefed (D)	Inflated Diameter (in.)	Balance Drag (lbs)	Pressure Drag (lbs)
FGL39.2/L1.0	62	264	63.8	.209	D	24.02	291.0	-
		265	199.1	.369	D	24.84	935.4	-
		266	294.2	.449	D	25.03	1418.8	-
		267	394.0	.520	D	25.39	1953.0	-

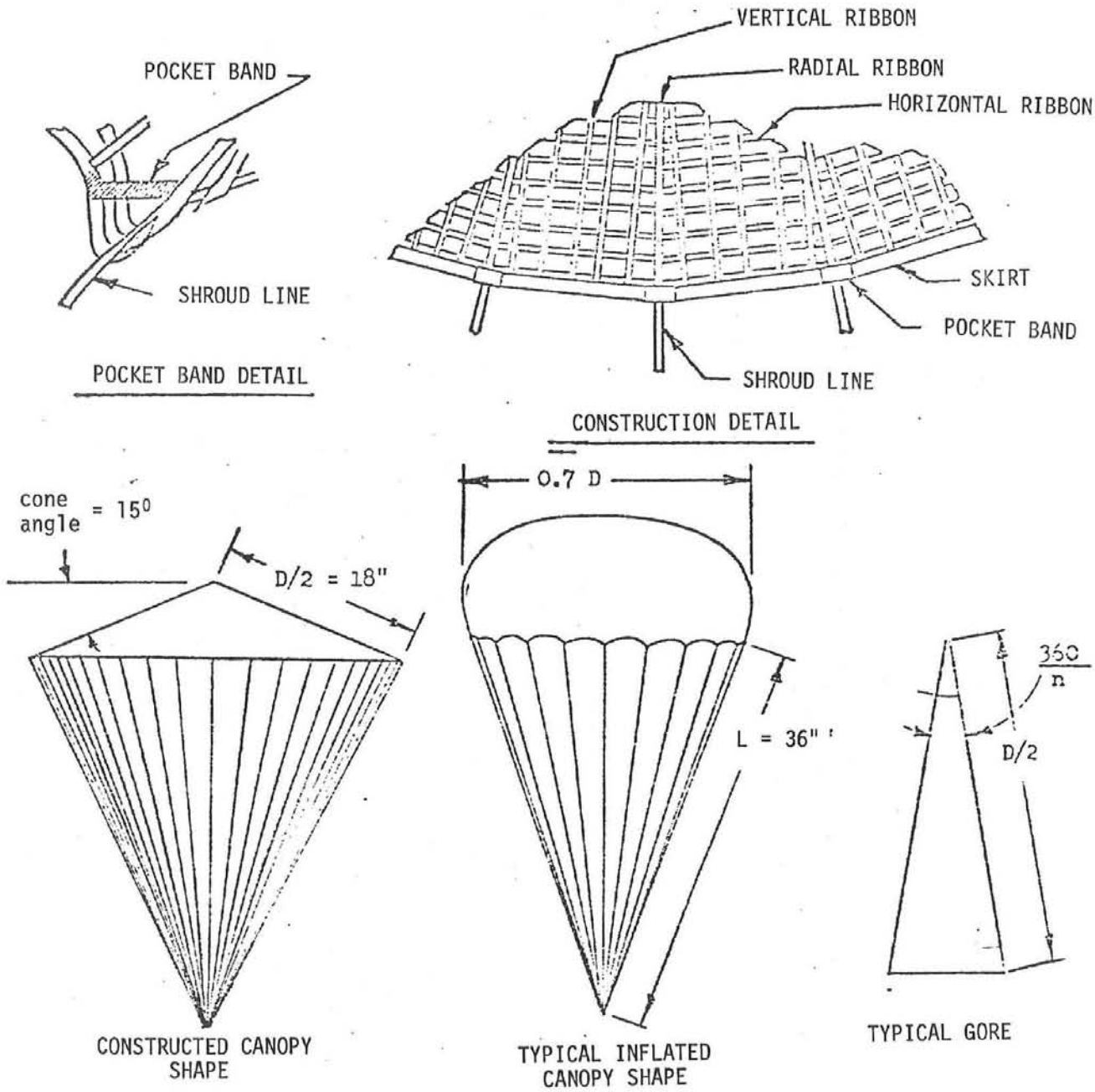


FIGURE 1. FIST Ribbon Canopy

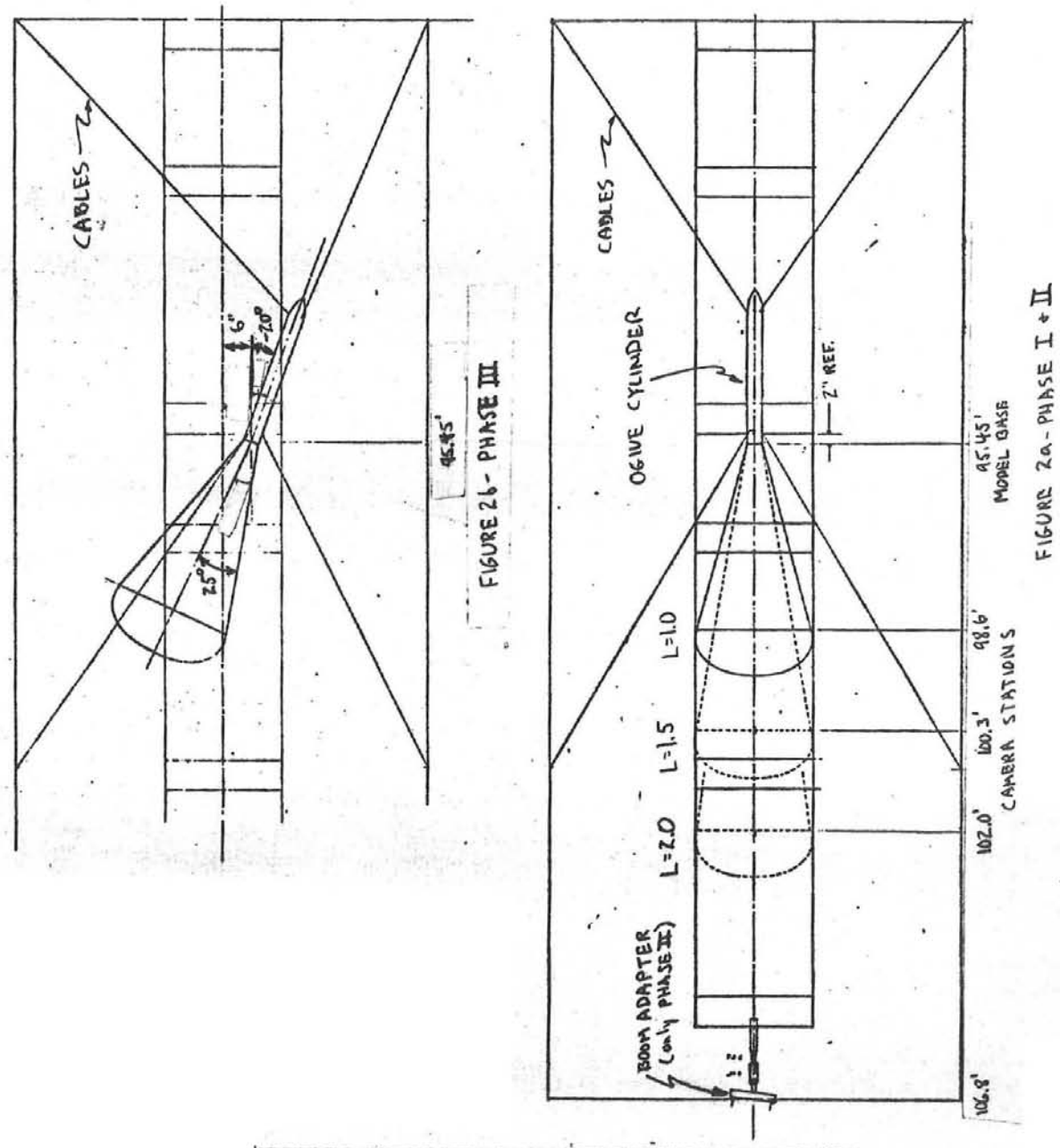


Figure 2 - Tunnel Installation

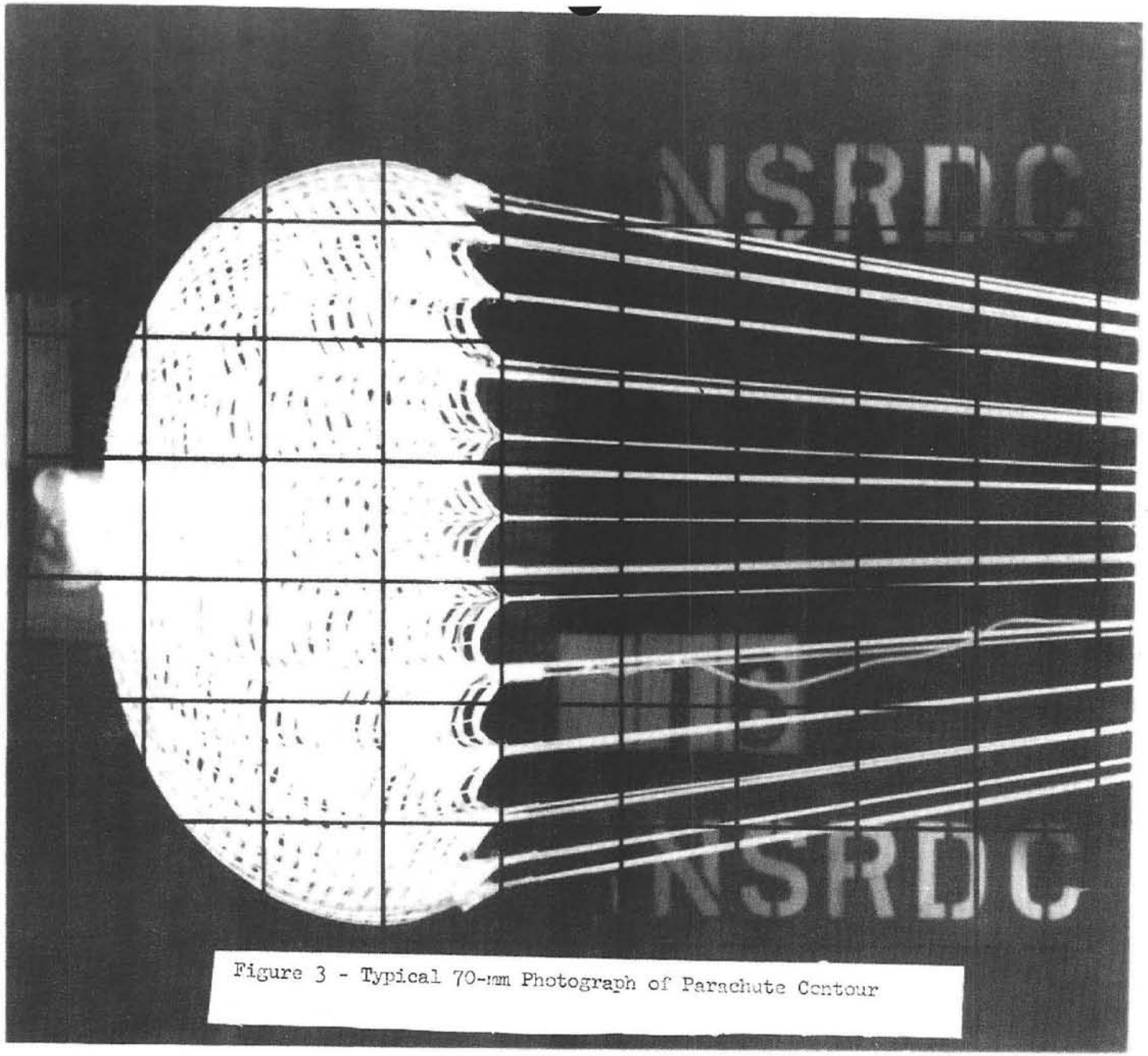


Figure 3 - Typical 70-mm Photograph of Parachute Contour

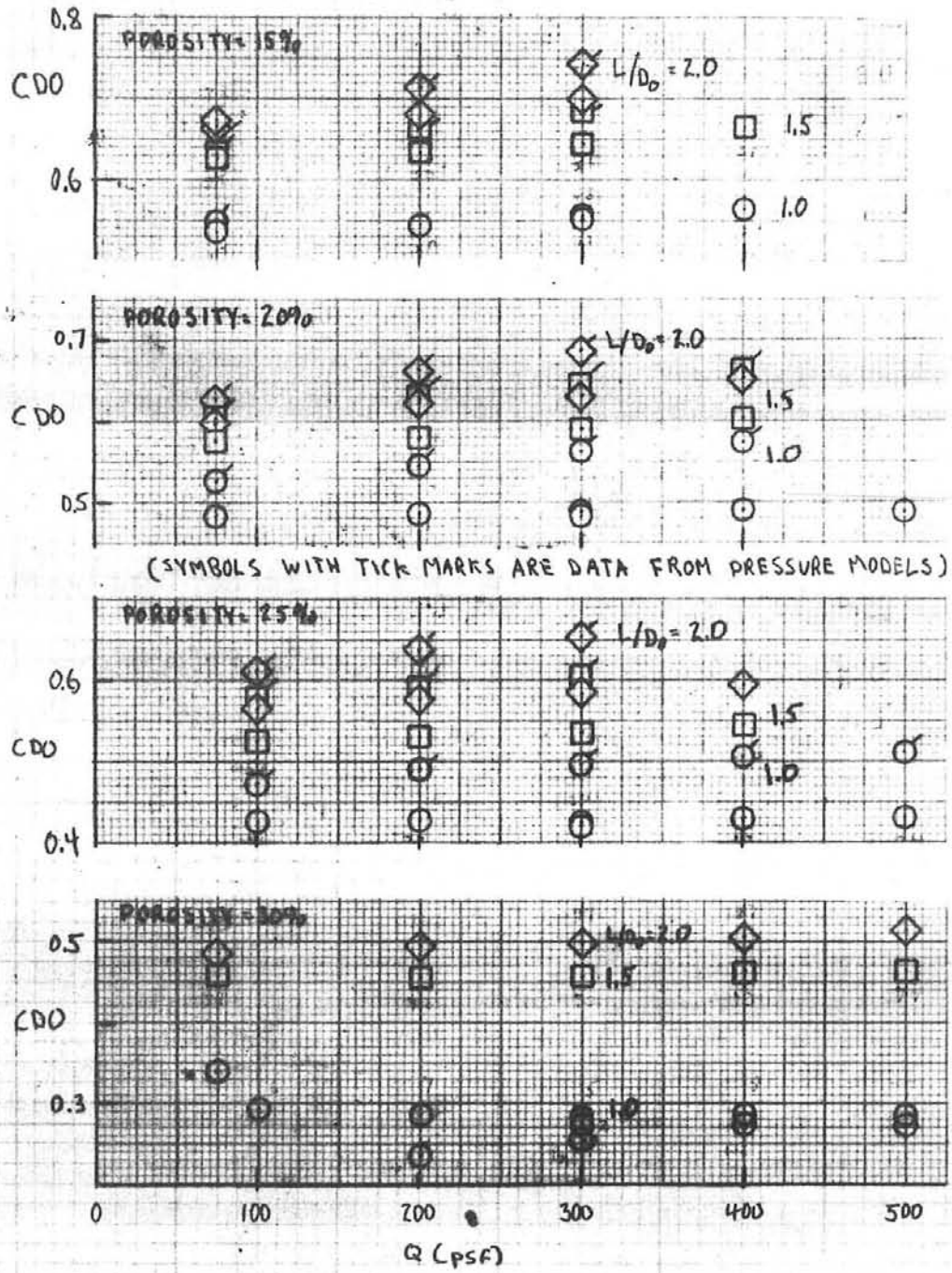


Figure 4 - Plot of CDO versus Dynamic Pressure (Q) for Fully Disreefed Parachutes with L/D_o as Parameter

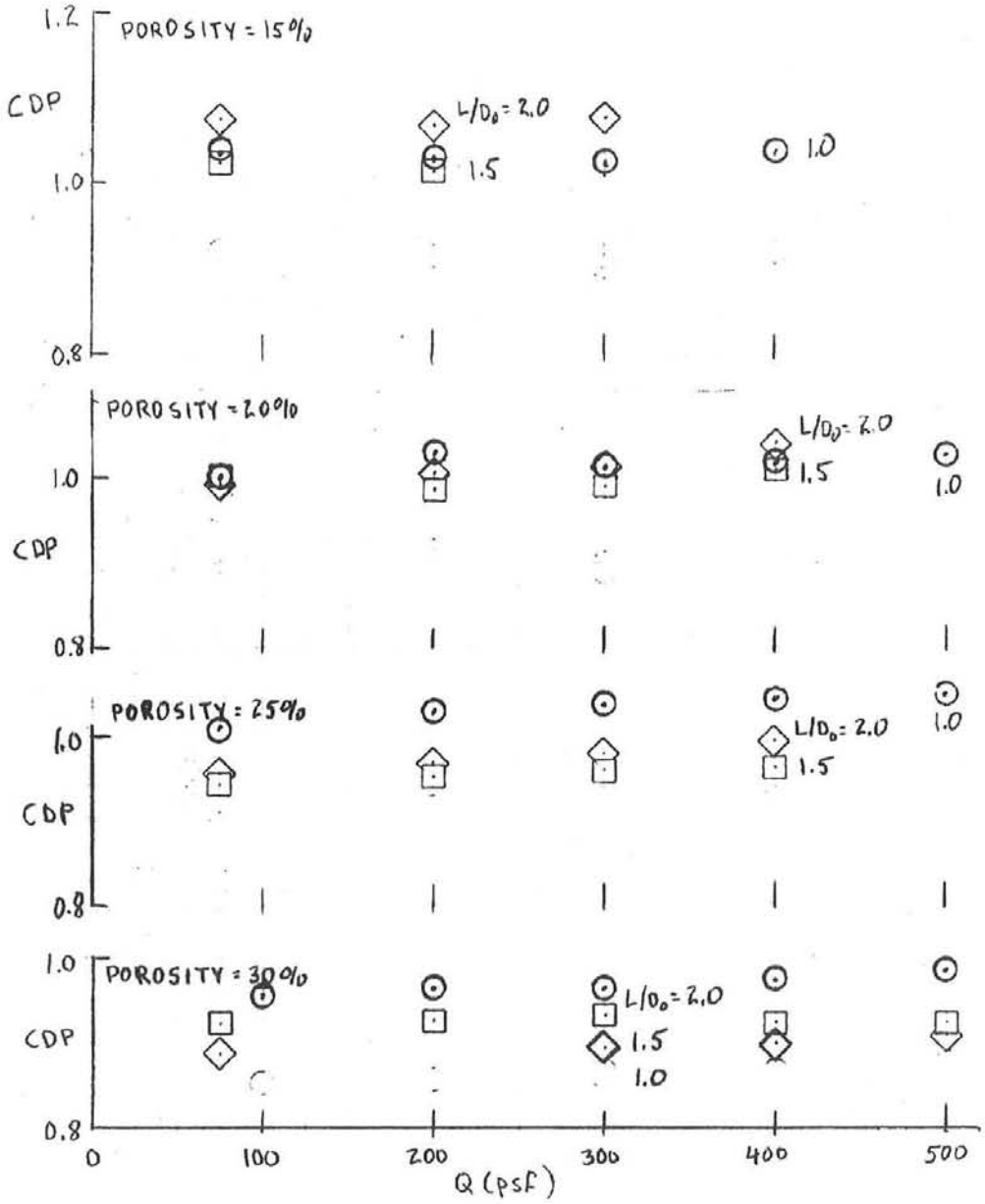


Figure 5 - Plot of CDP versus Dynamic Pressure (Q) for Fully Disreefed Parachutes with L/D_0 as Parameter

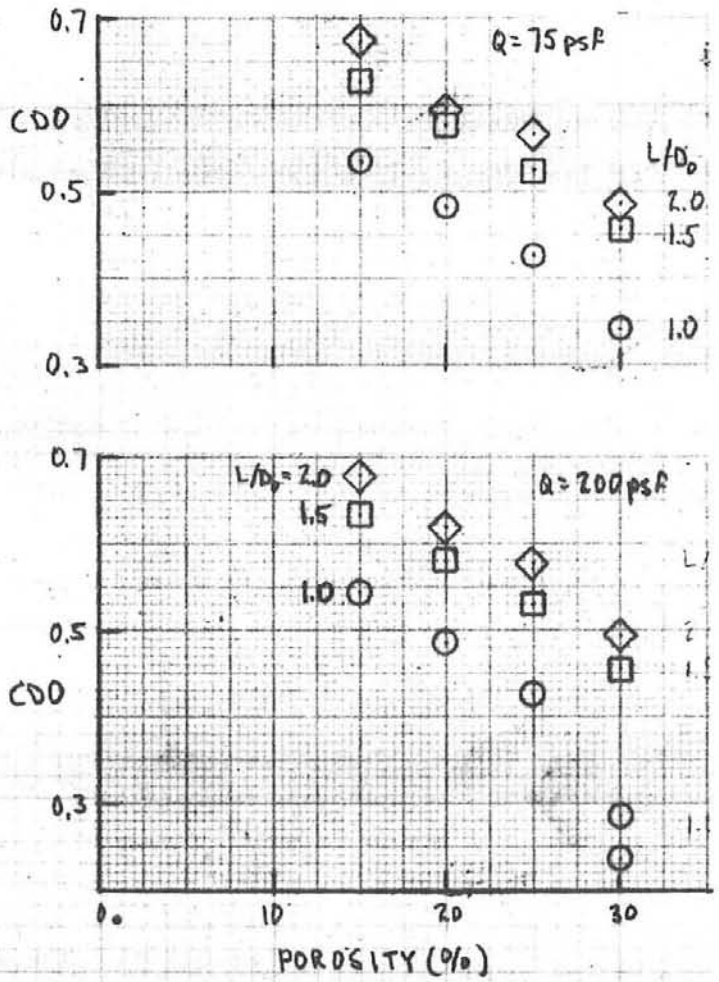


Figure 6 - Plot of CDO versus Porosity for Fully Disreefed Parachutes with L/D_0 as Parameter

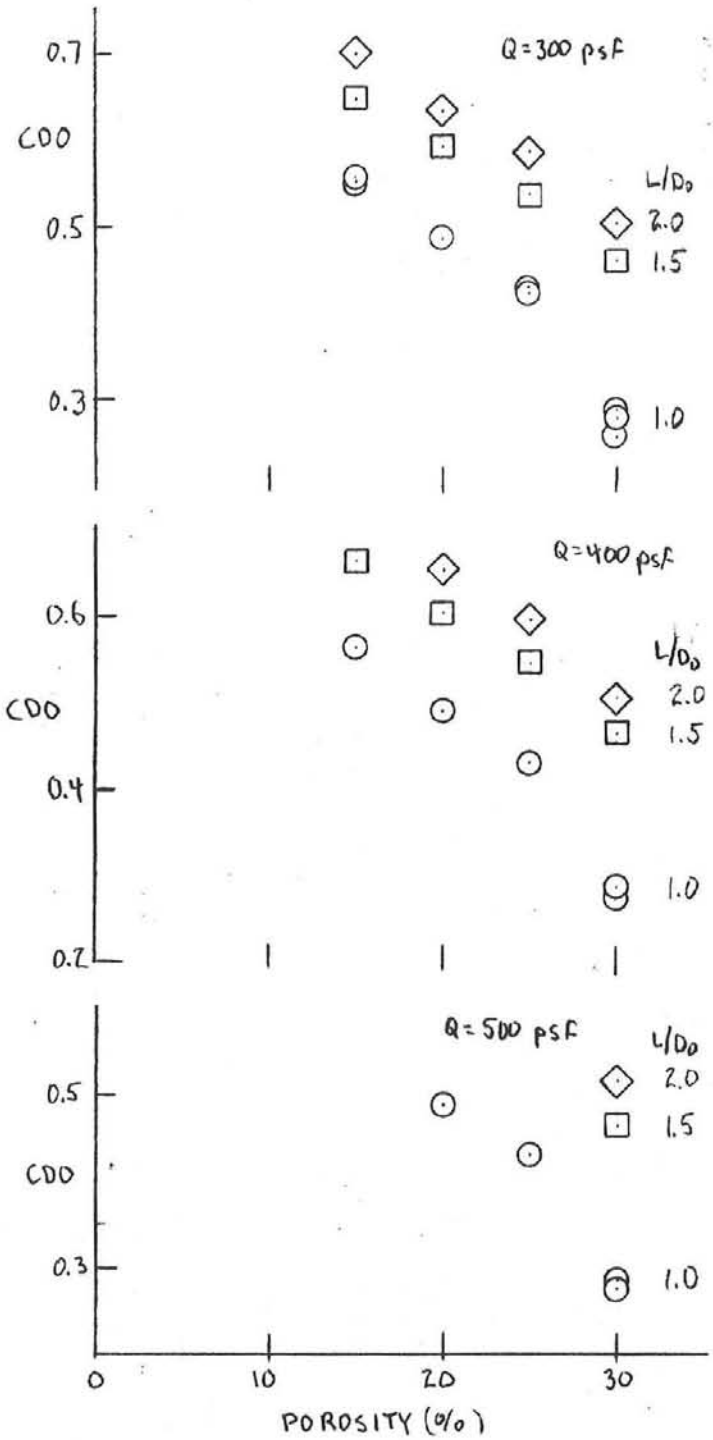


Figure 6 - Concluded

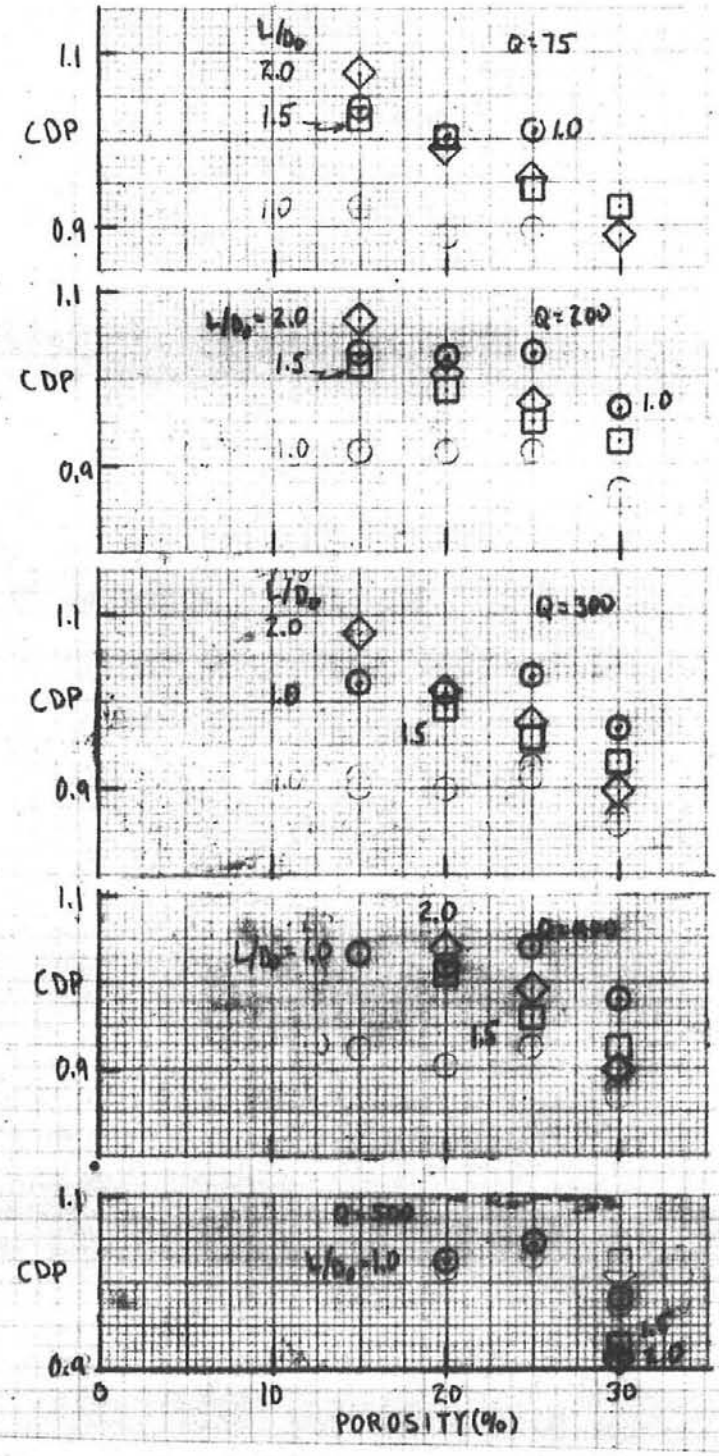


Figure 7 - Plot of CDP versus Porosity for Fully Disreefed Parachutes with L/D_o as Parameter

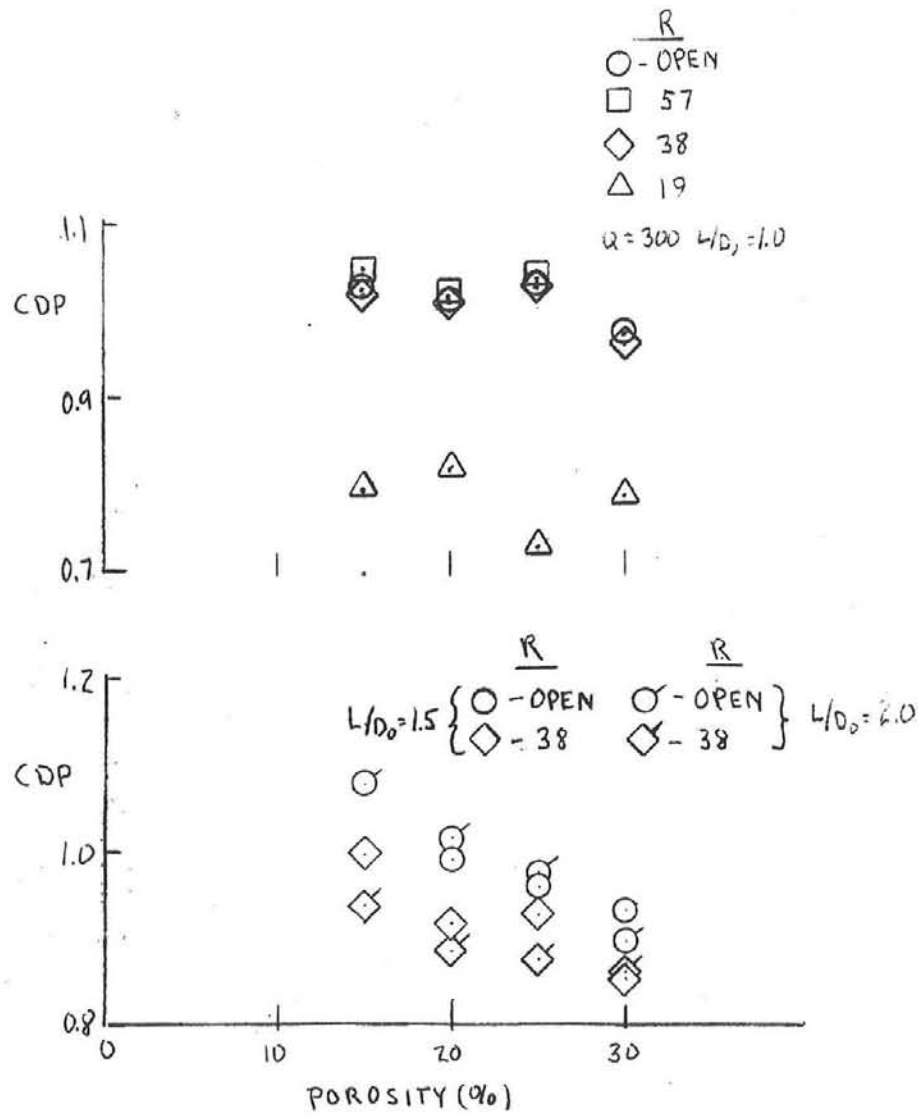


Figure 8 - Plot of CDP versus Porosity for Reefed Parachutes with Reefing Ratio (R) as Parameter

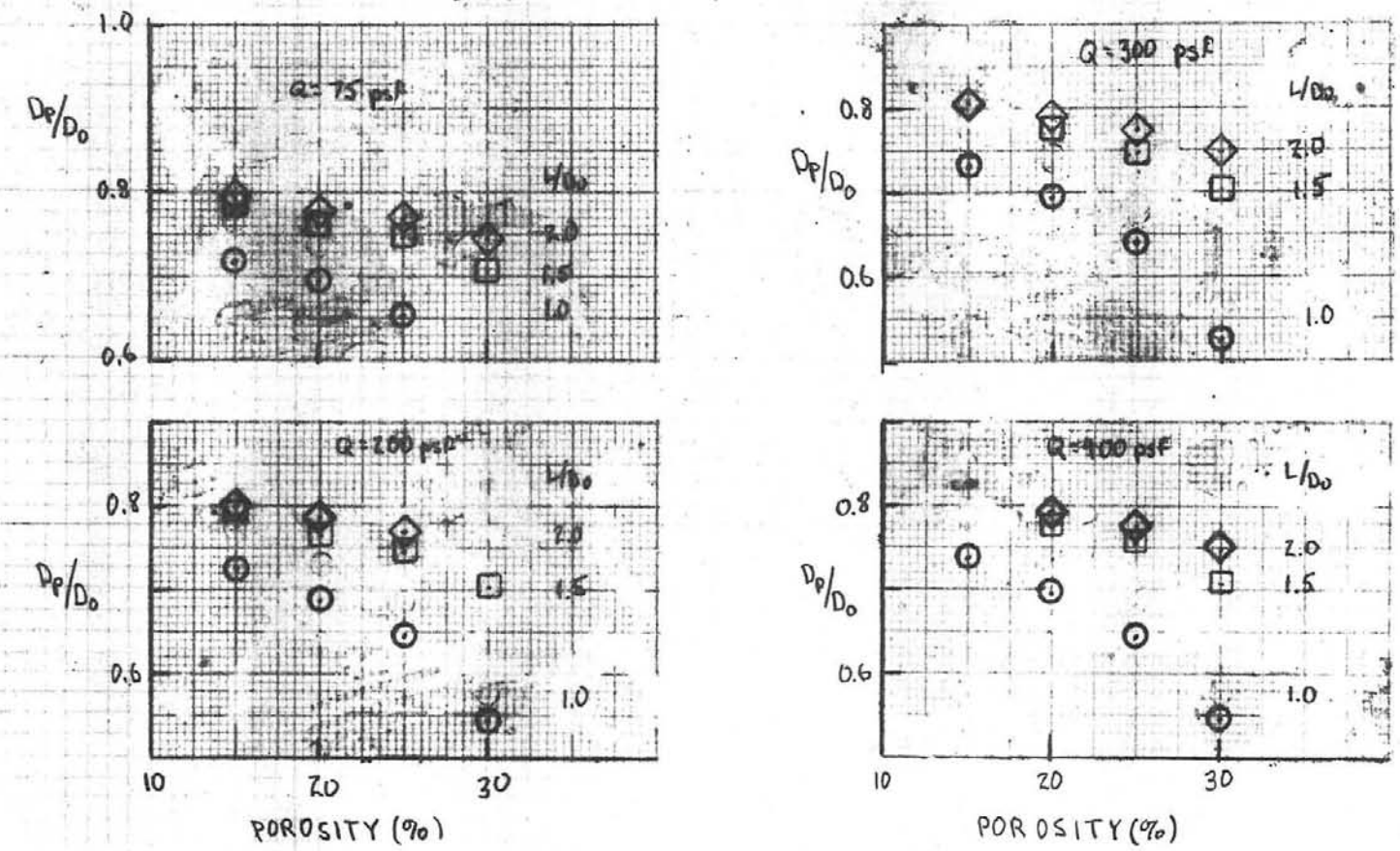


Figure 9 - Plot of Ratio of Inflated to Constructed Parachute Diameter (D_p/D_o) versus Porosity with L/D_o as Parameter

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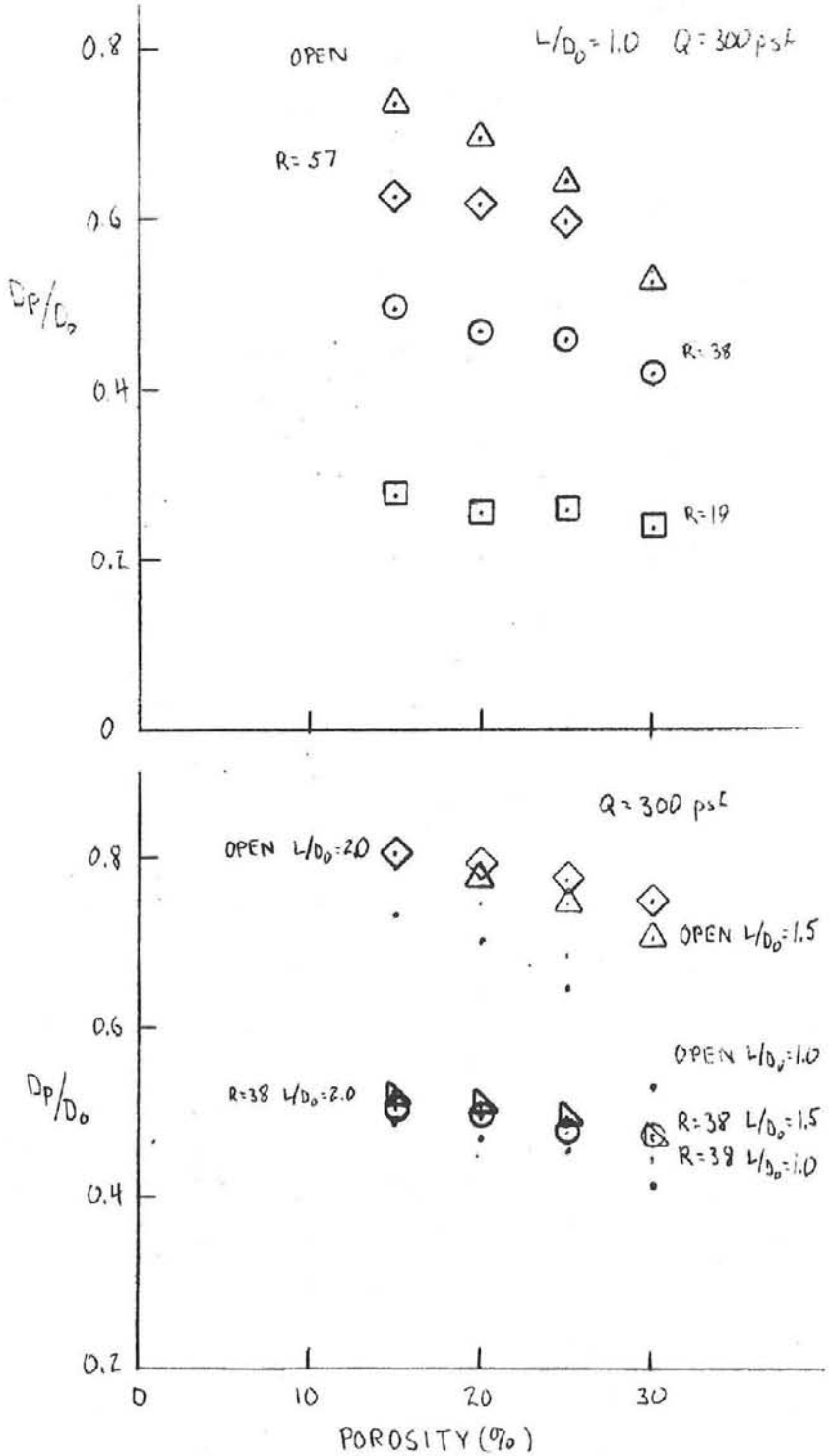


Figure 10 - Plot of Ratio of Inflated to Constructed Parachute Diameter (D_p/D_o) versus Porosity with Reefing Ratio (R) as Parameter

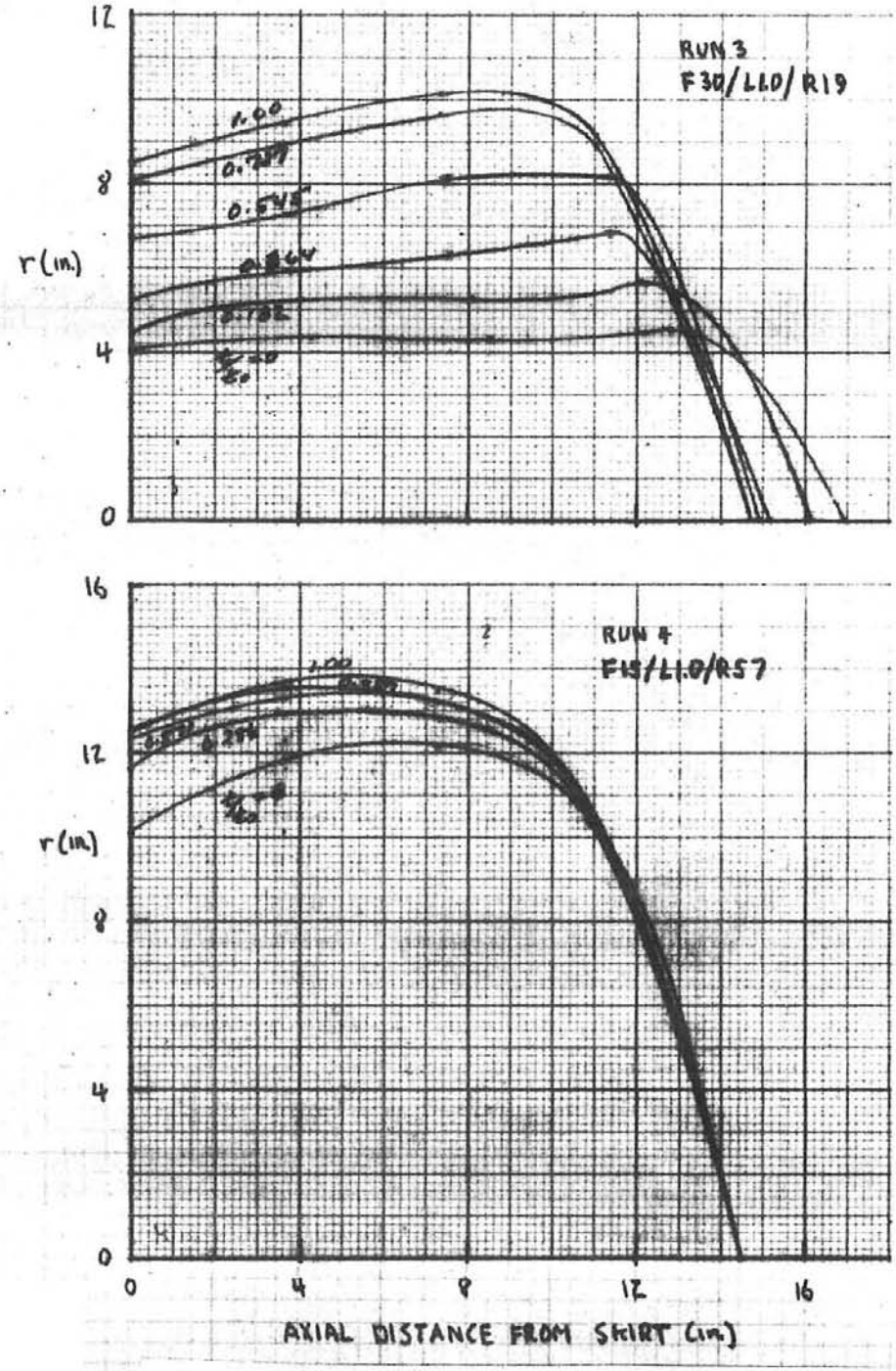
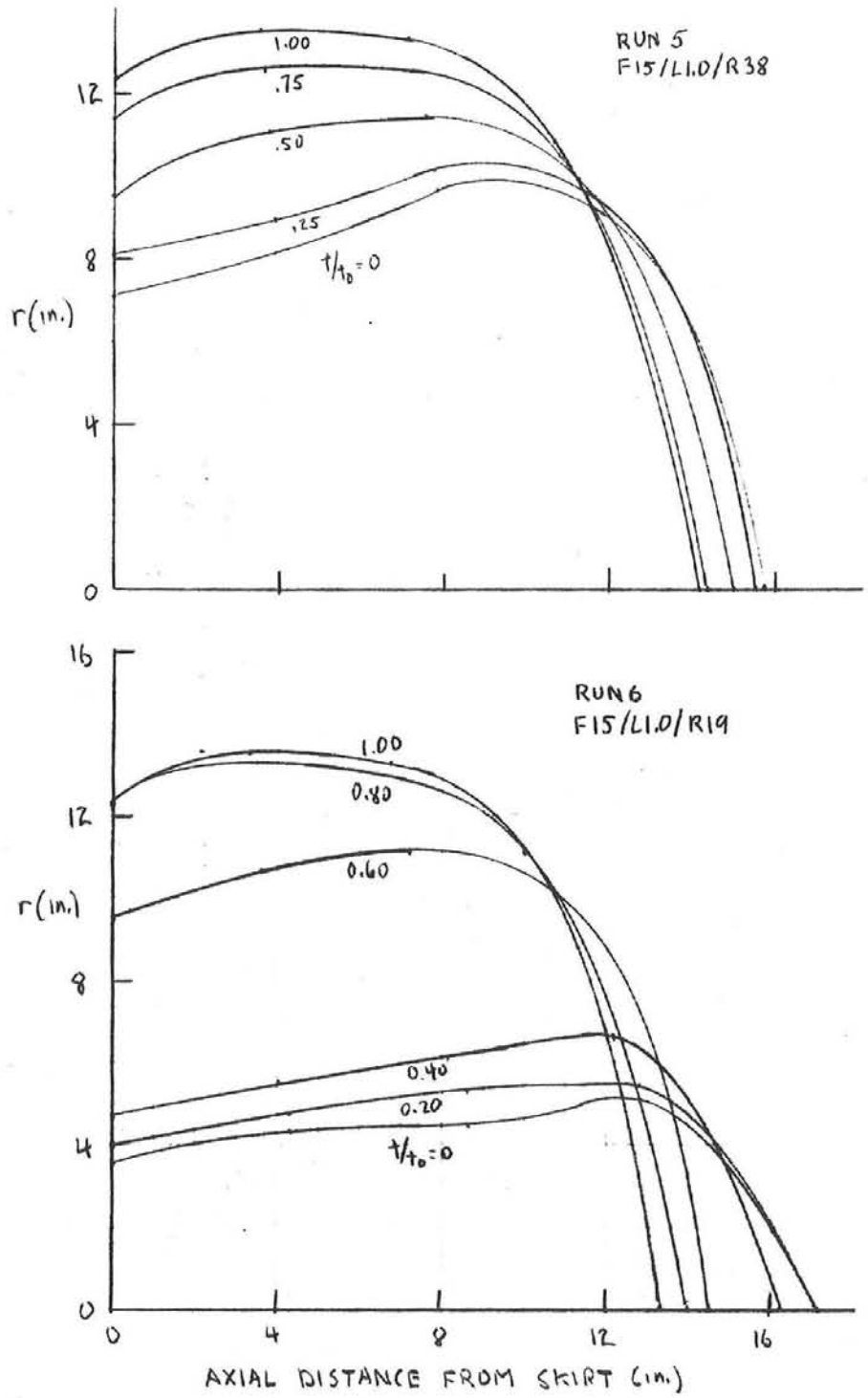


Figure 11 - Parachute Shape as a Function of Time



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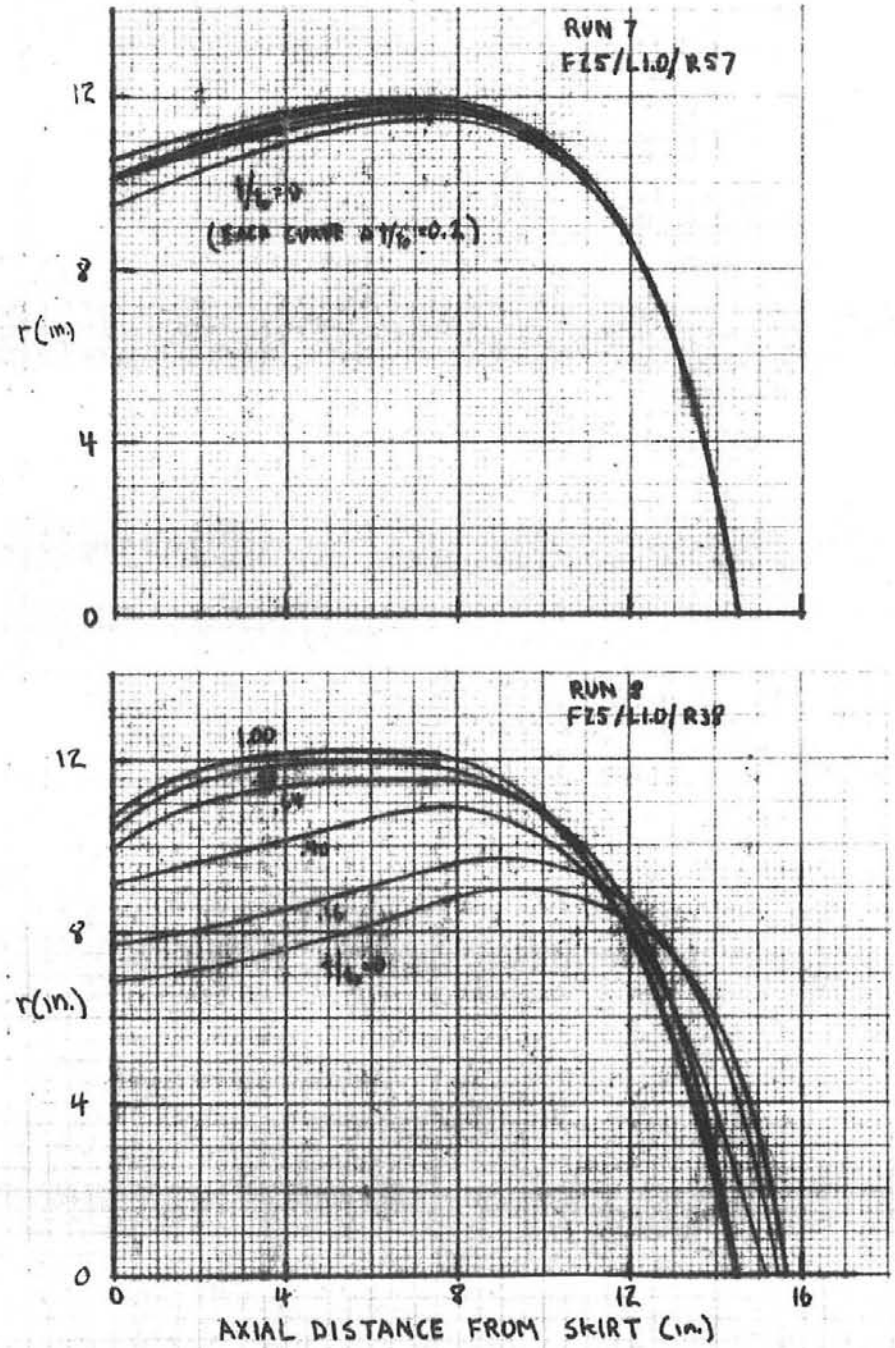


Figure 11 - Continued

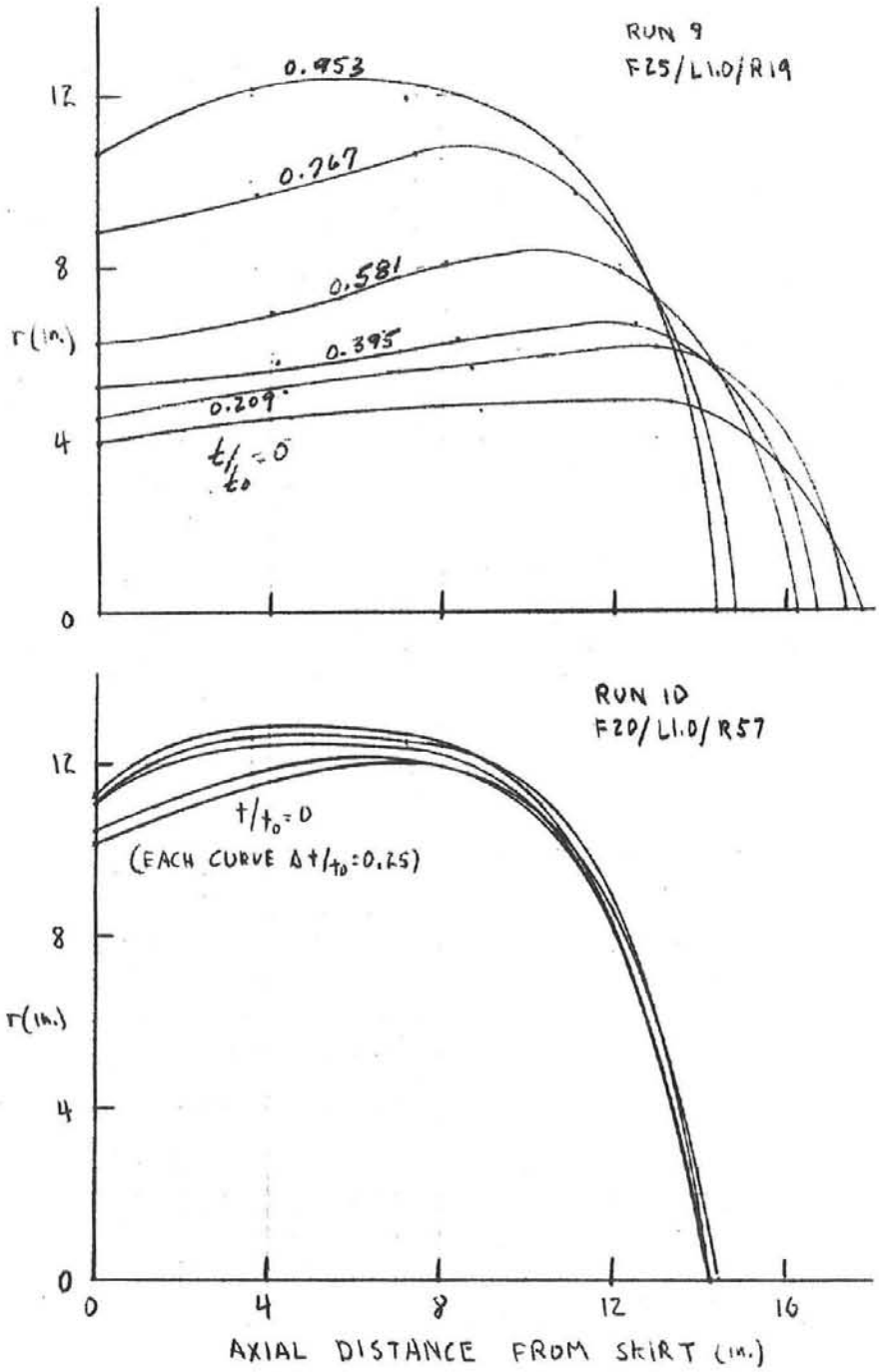
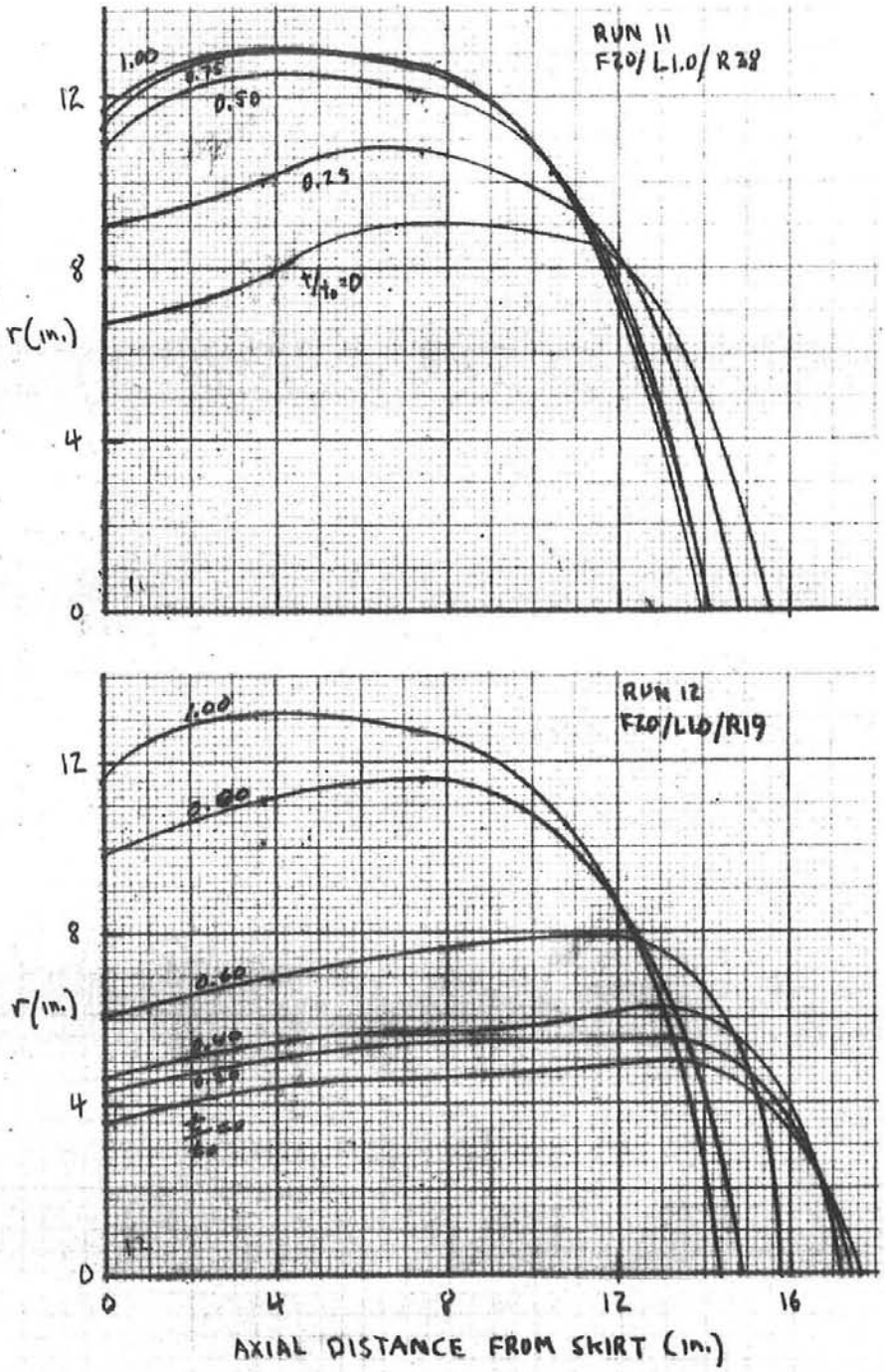


Figure 11 - Continued



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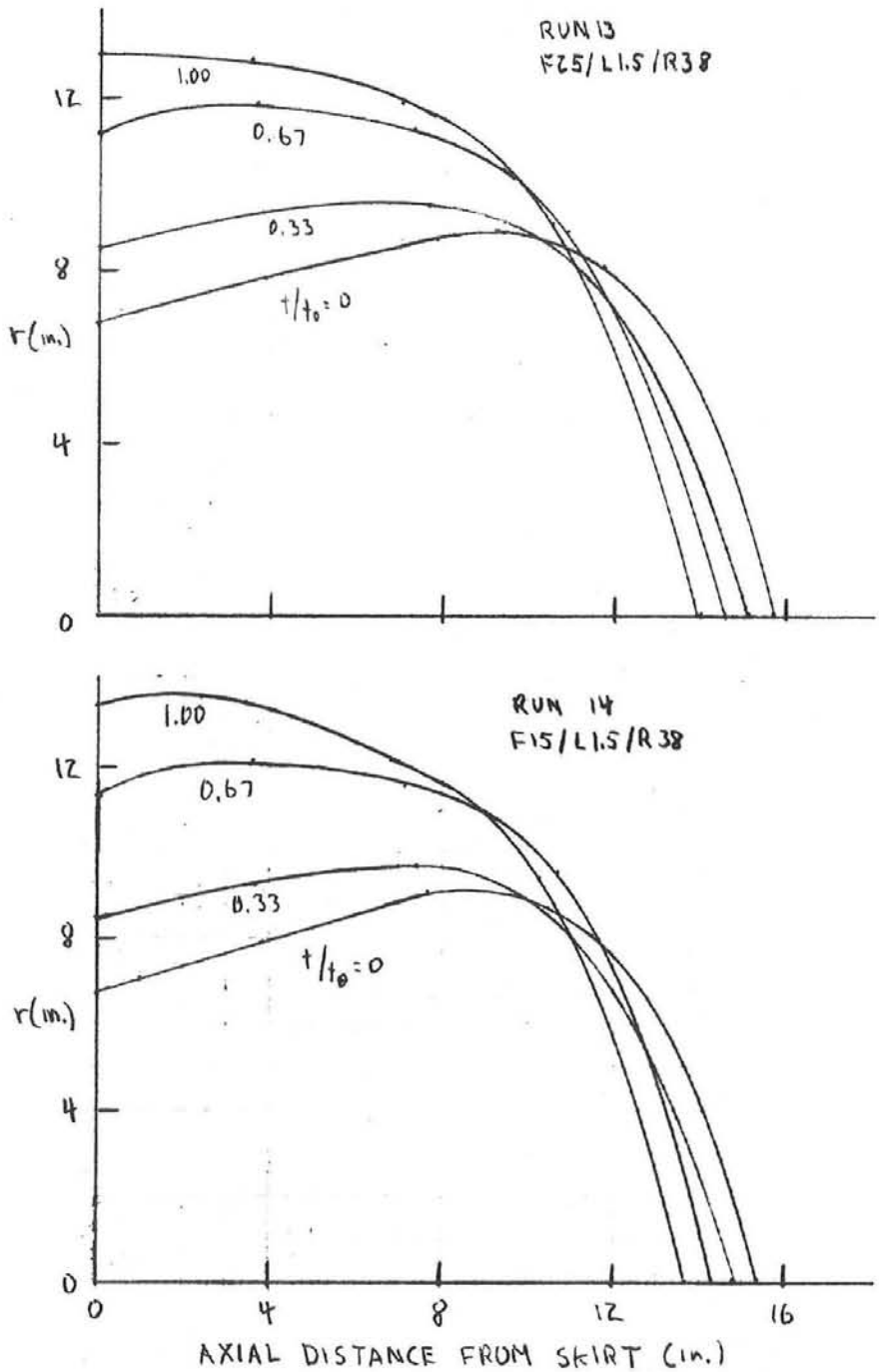

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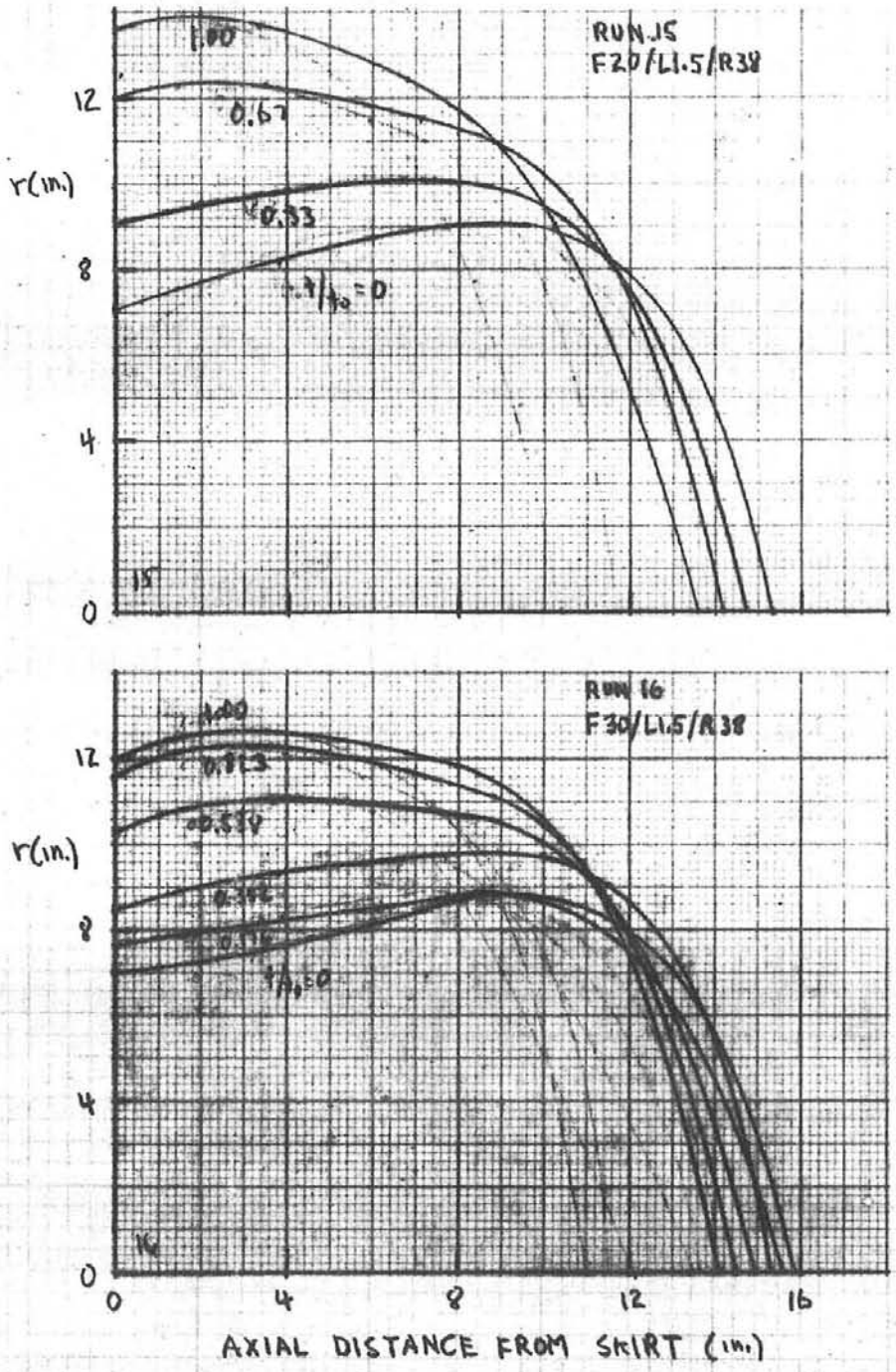
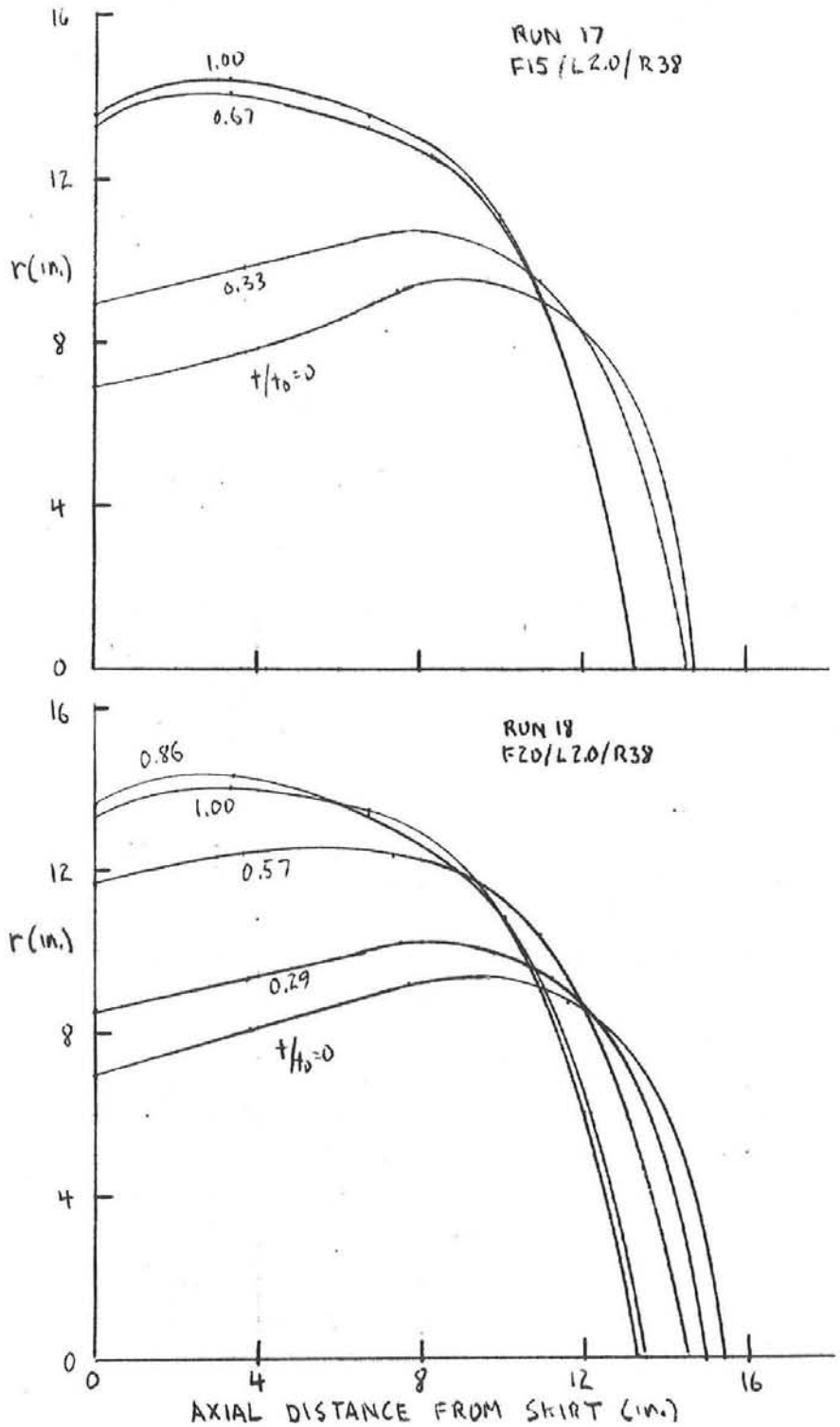


Figure 11 - Continued



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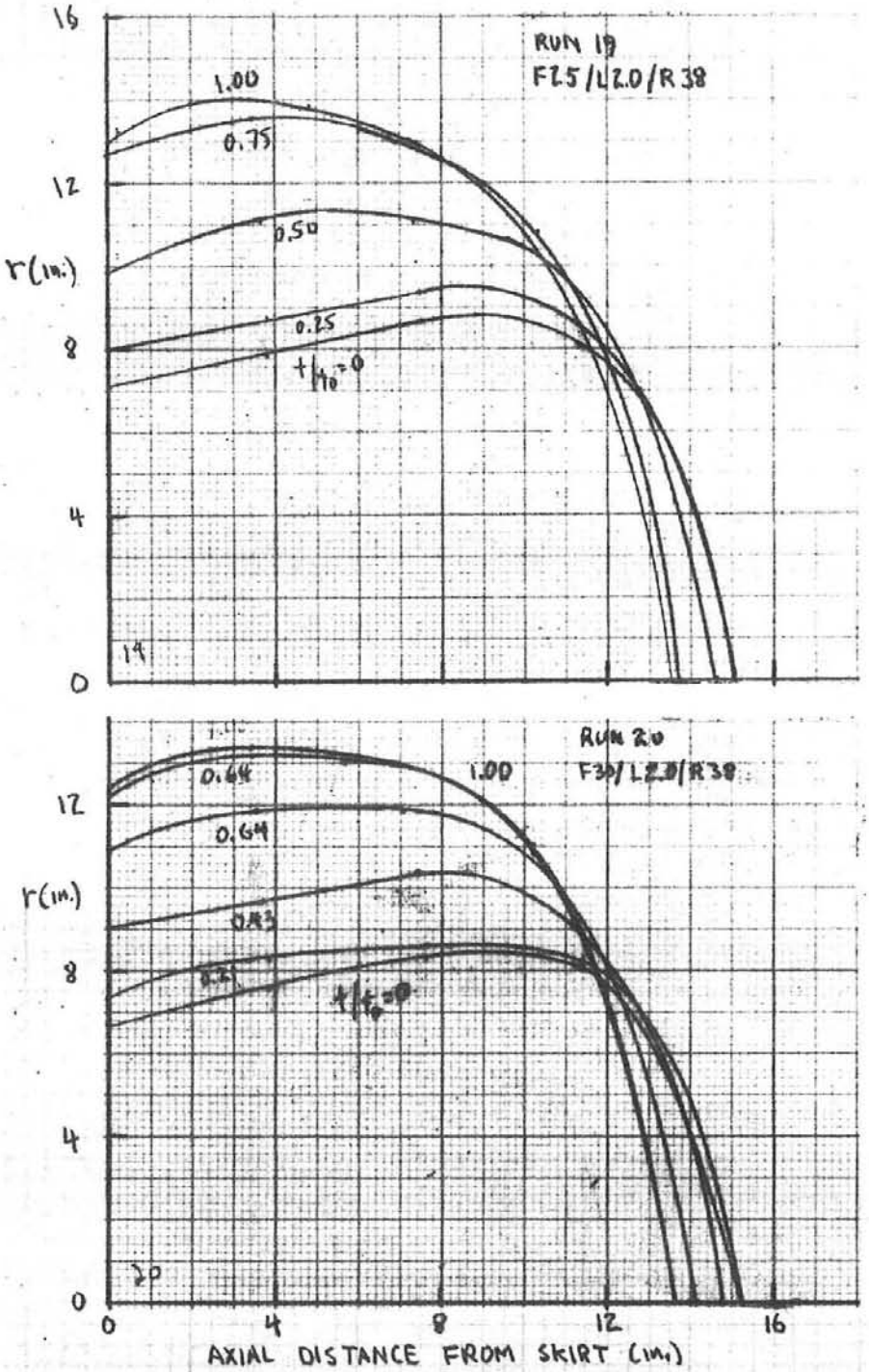

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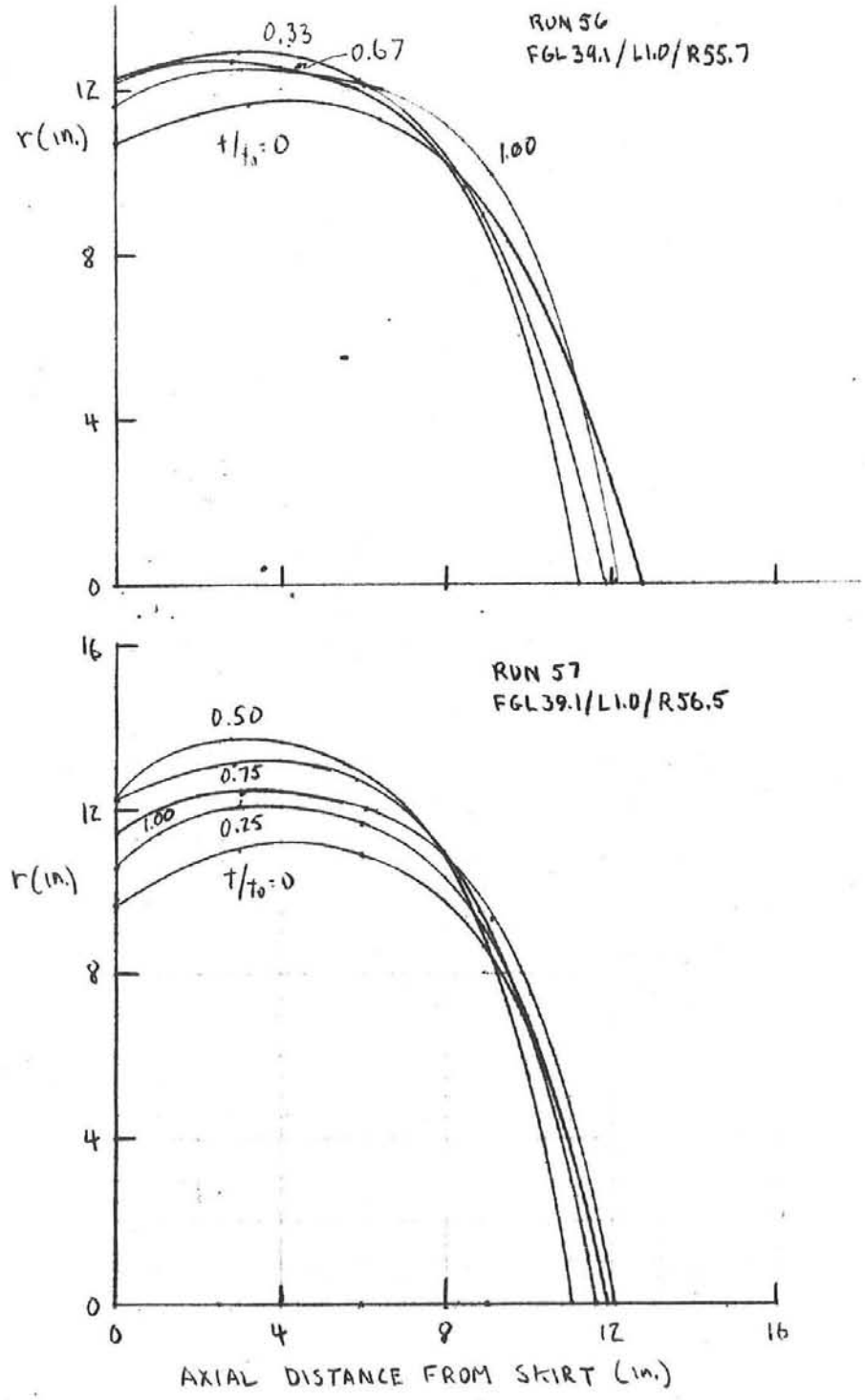

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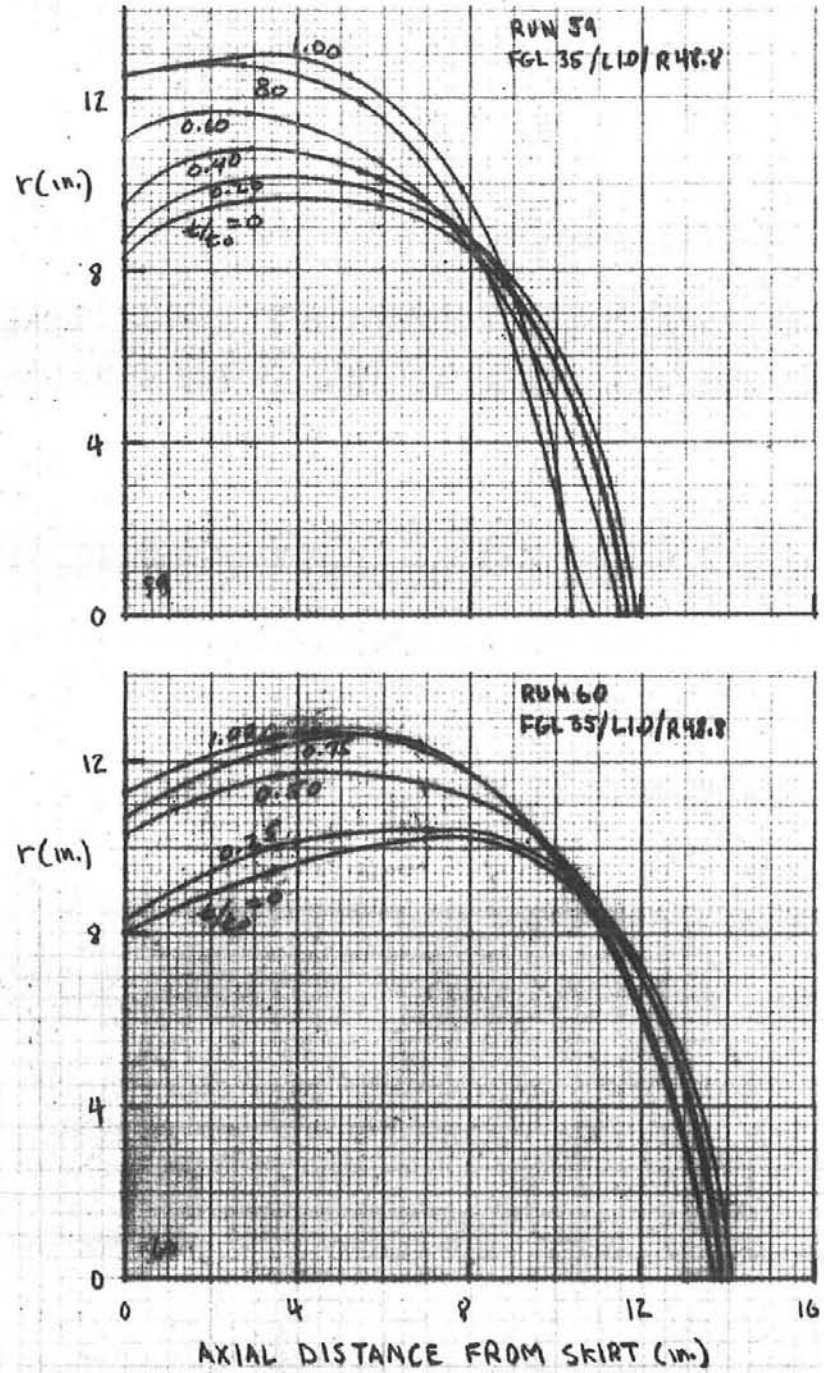

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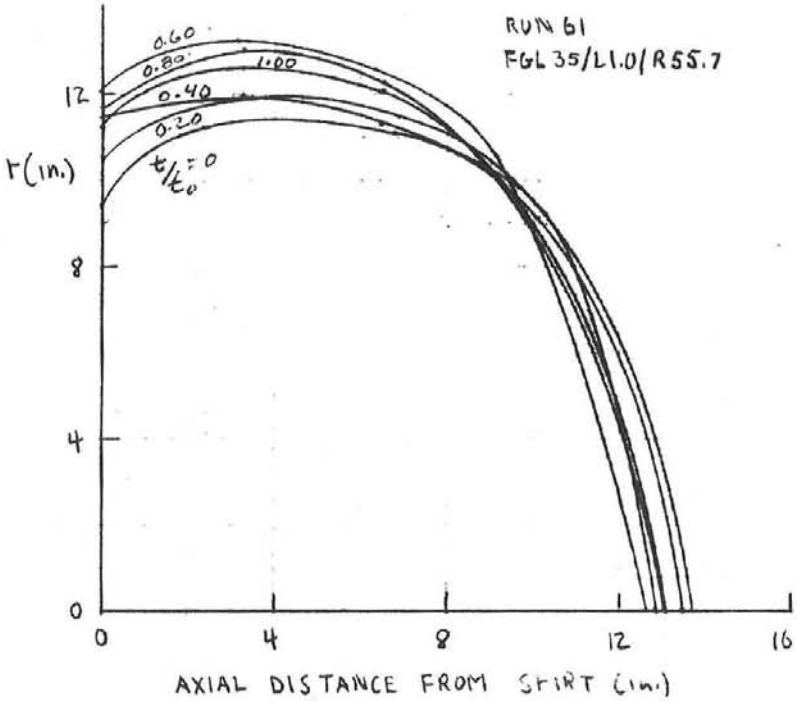


Figure 11 - Concluded

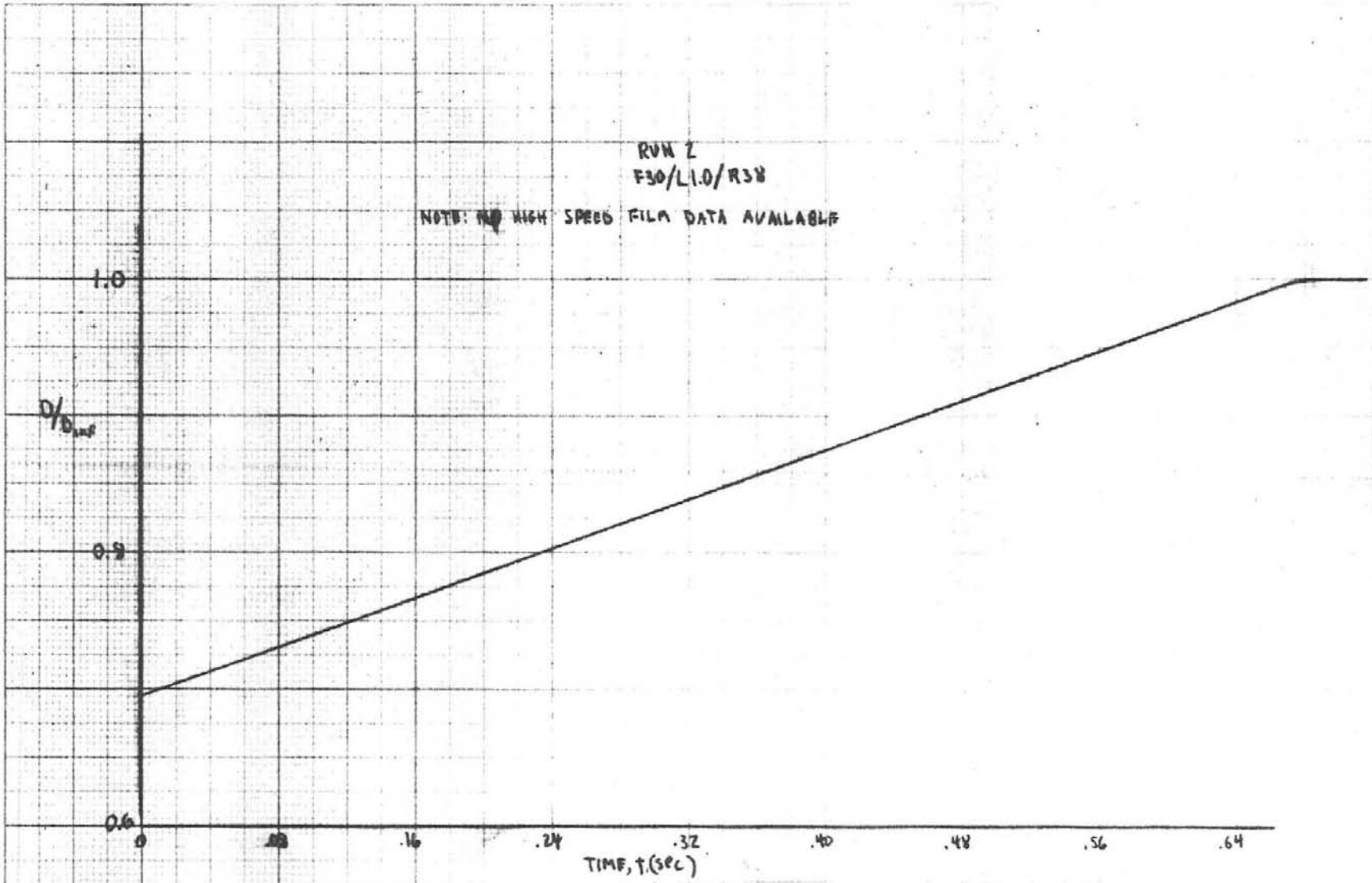
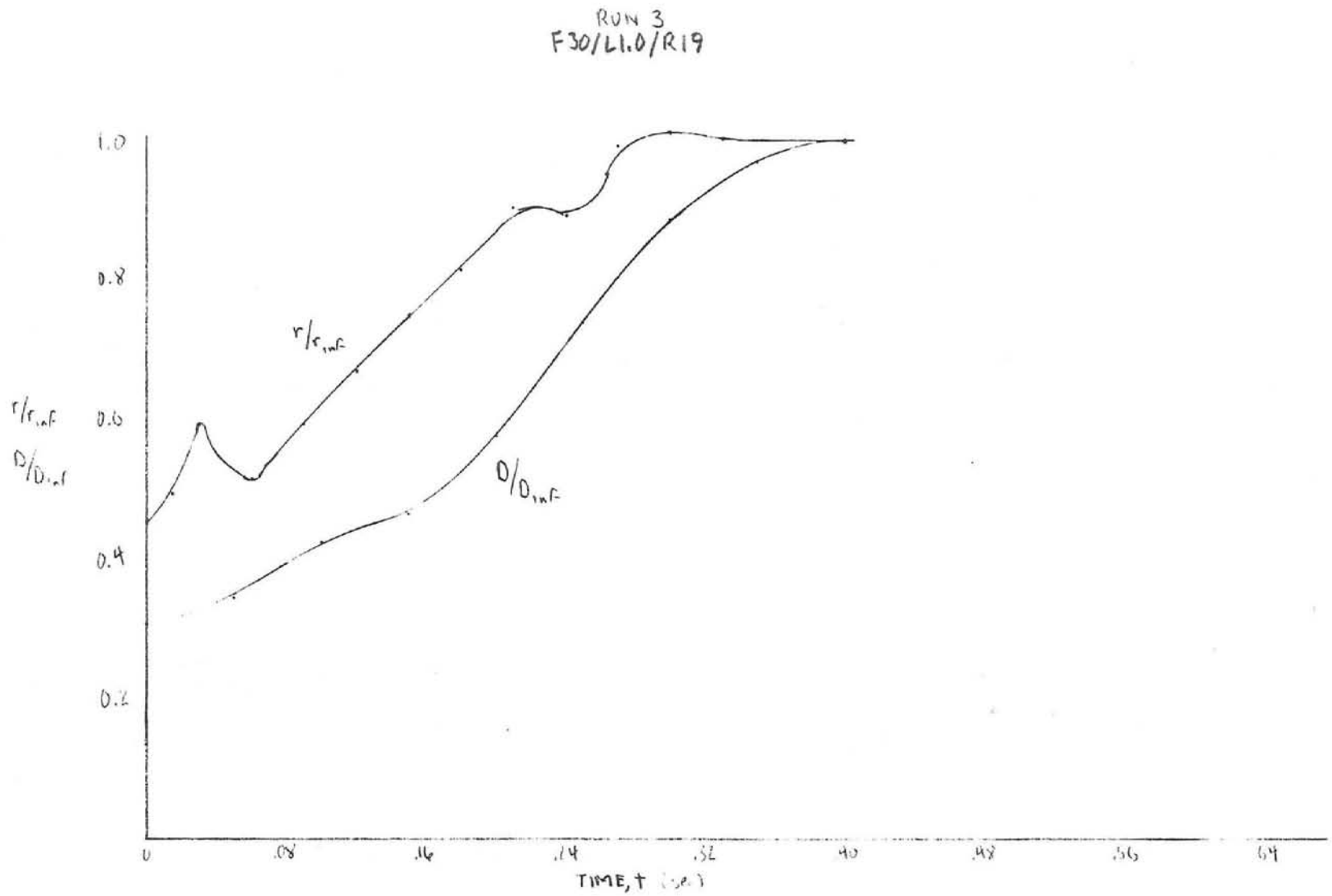


Figure 12 - Dimensionless Drag and Dimensionless Radius as a Function of Time from the Initiation of Disreefing



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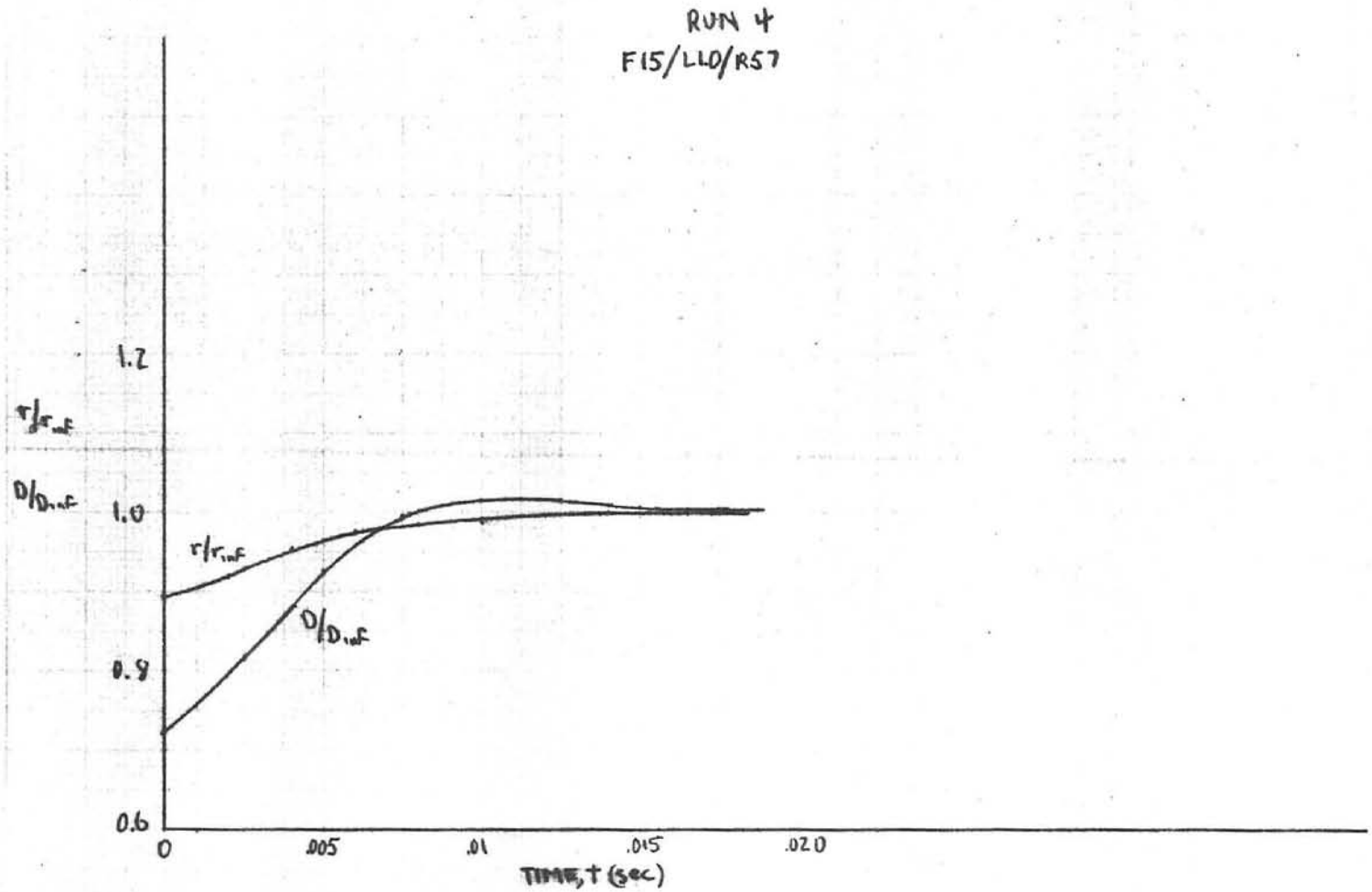


Figure 12 - Continued

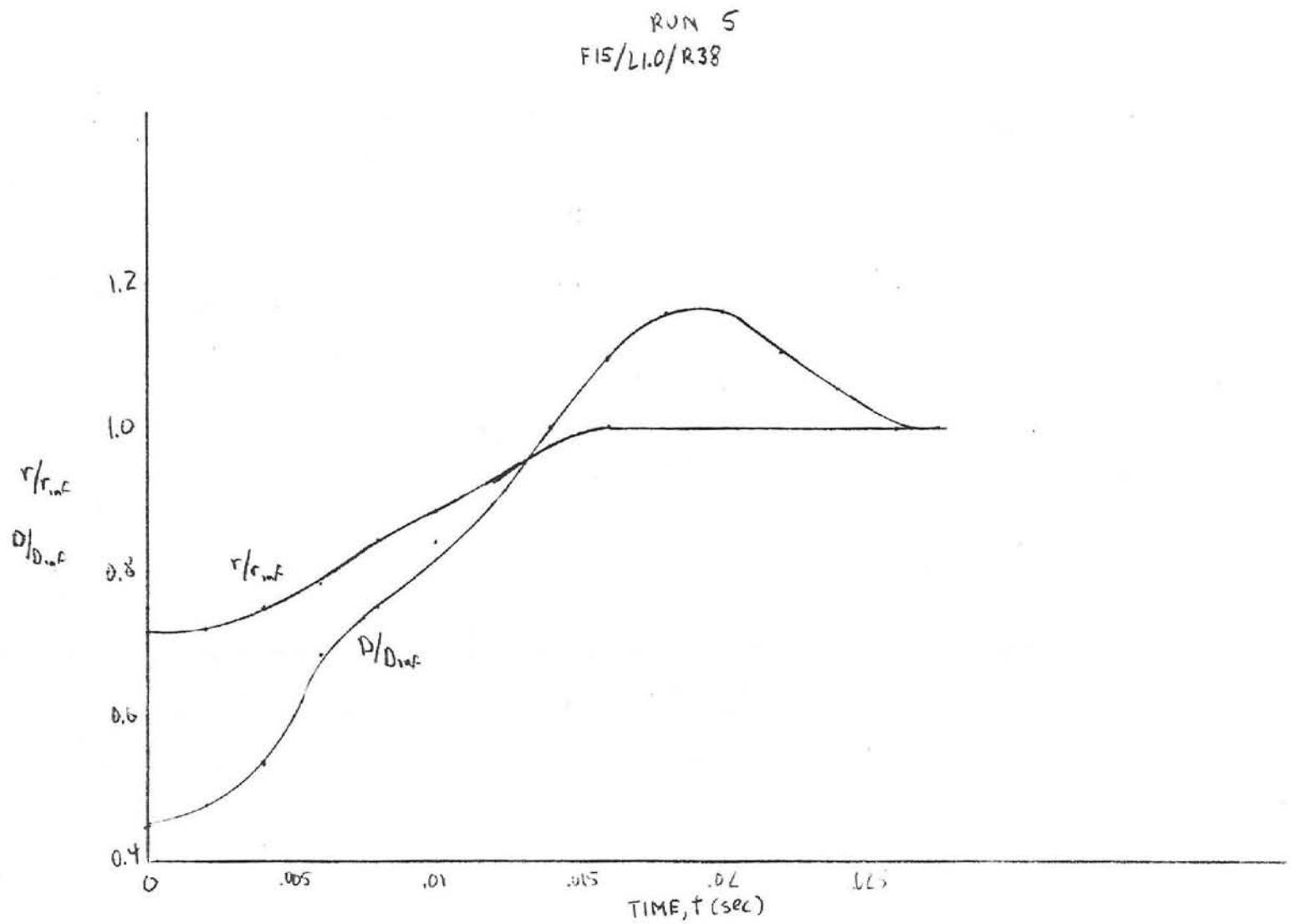


Figure 12- Continued

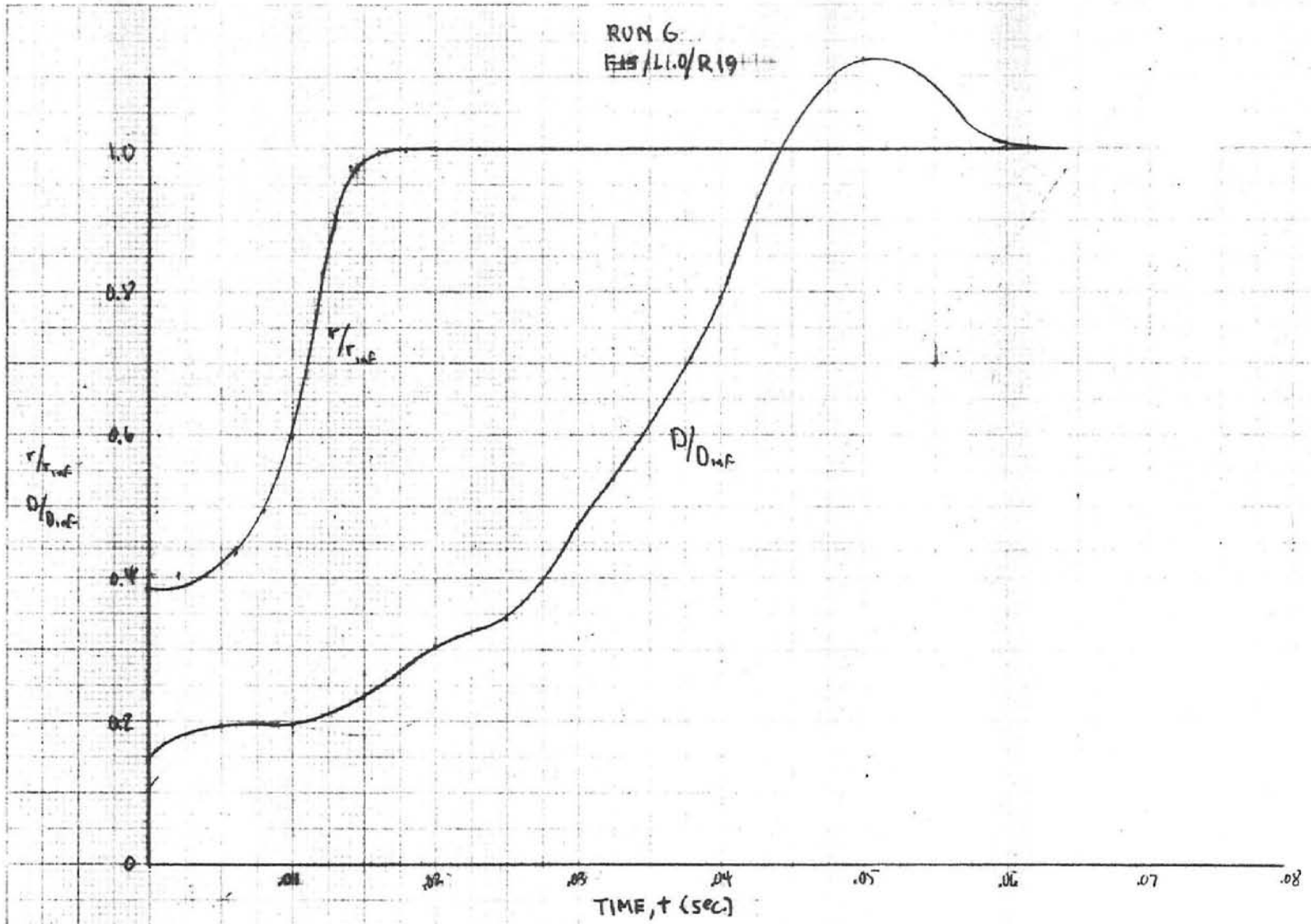


Figure 12 - Continued

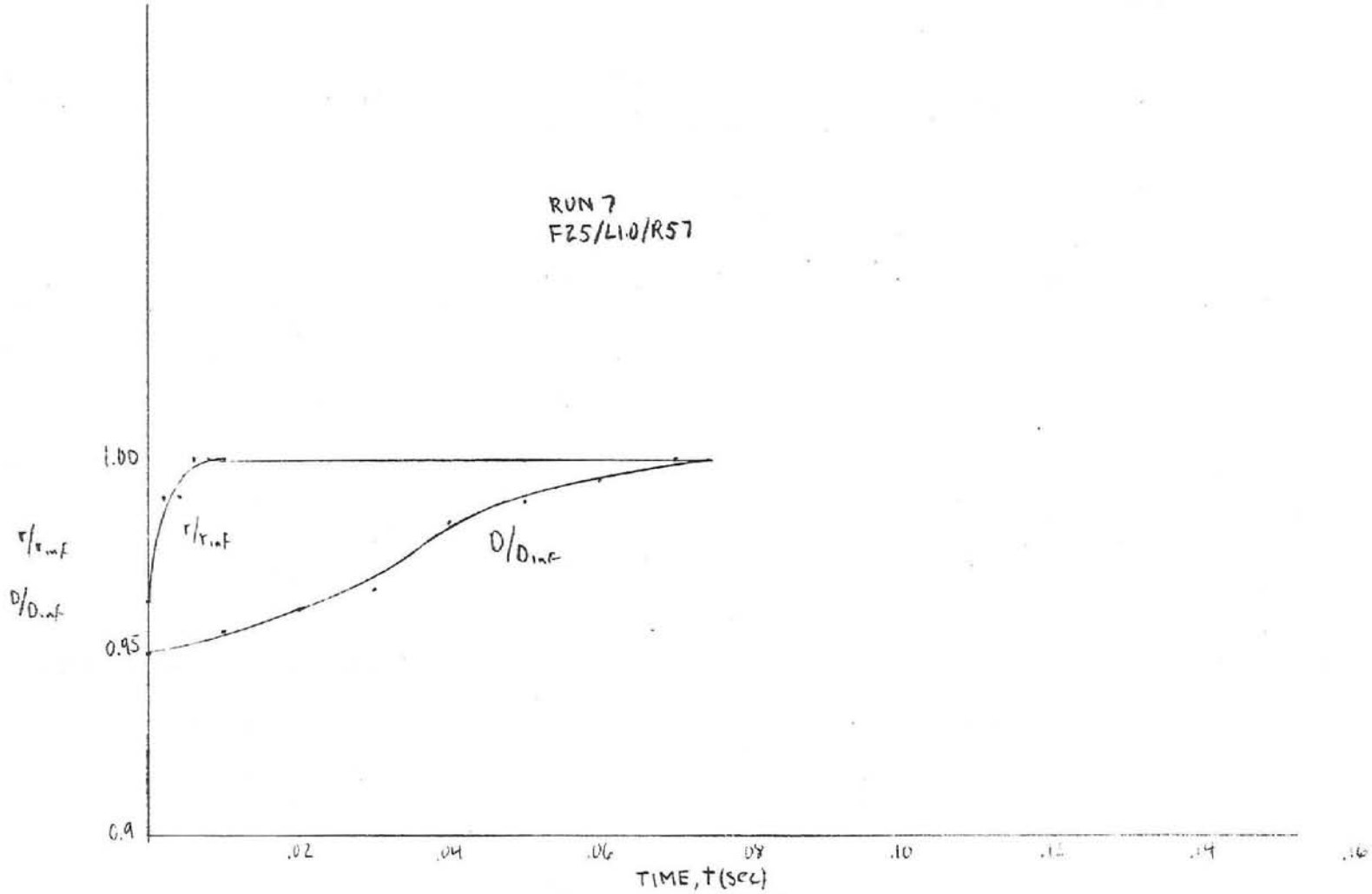


Figure 12 - Continued

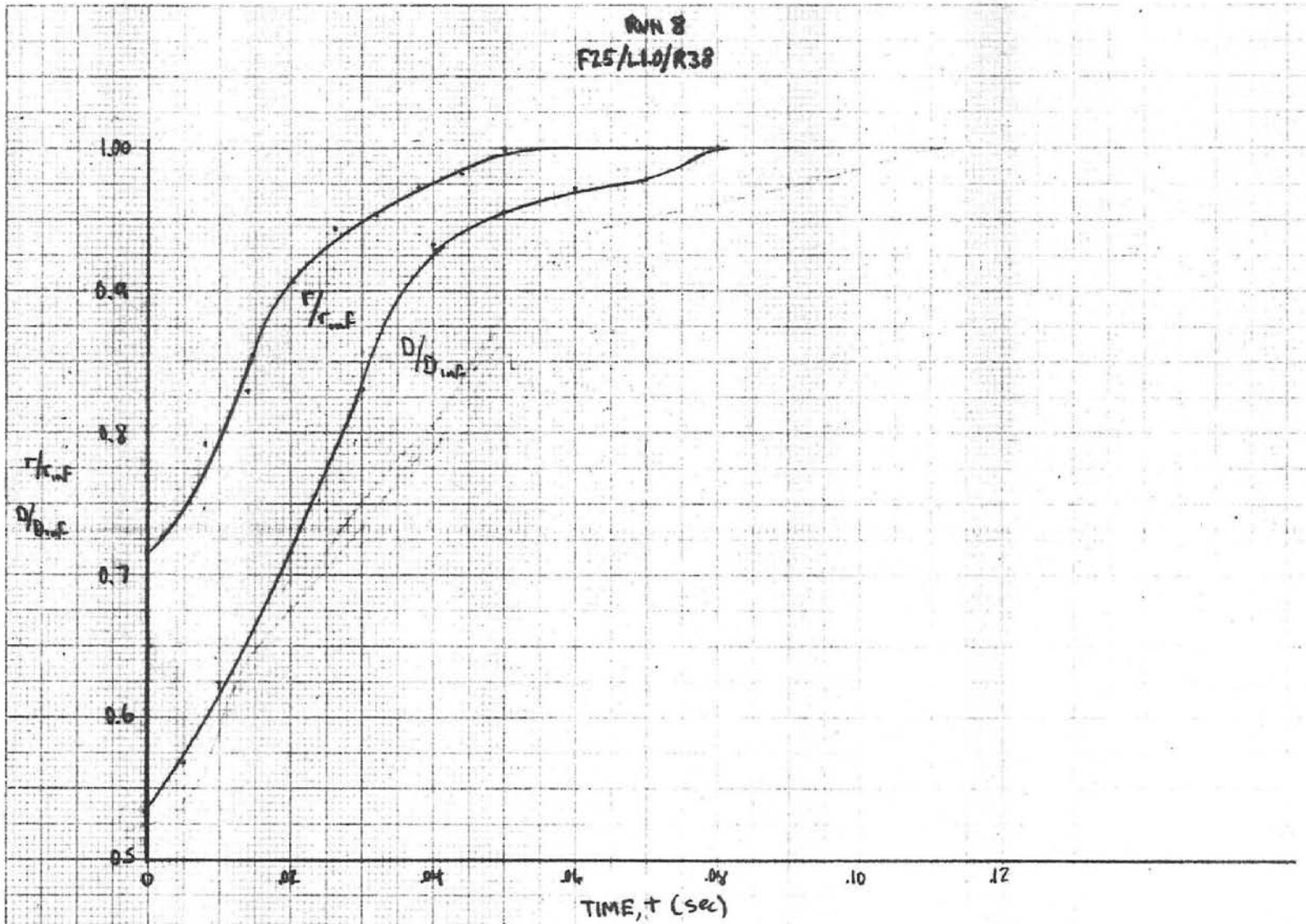
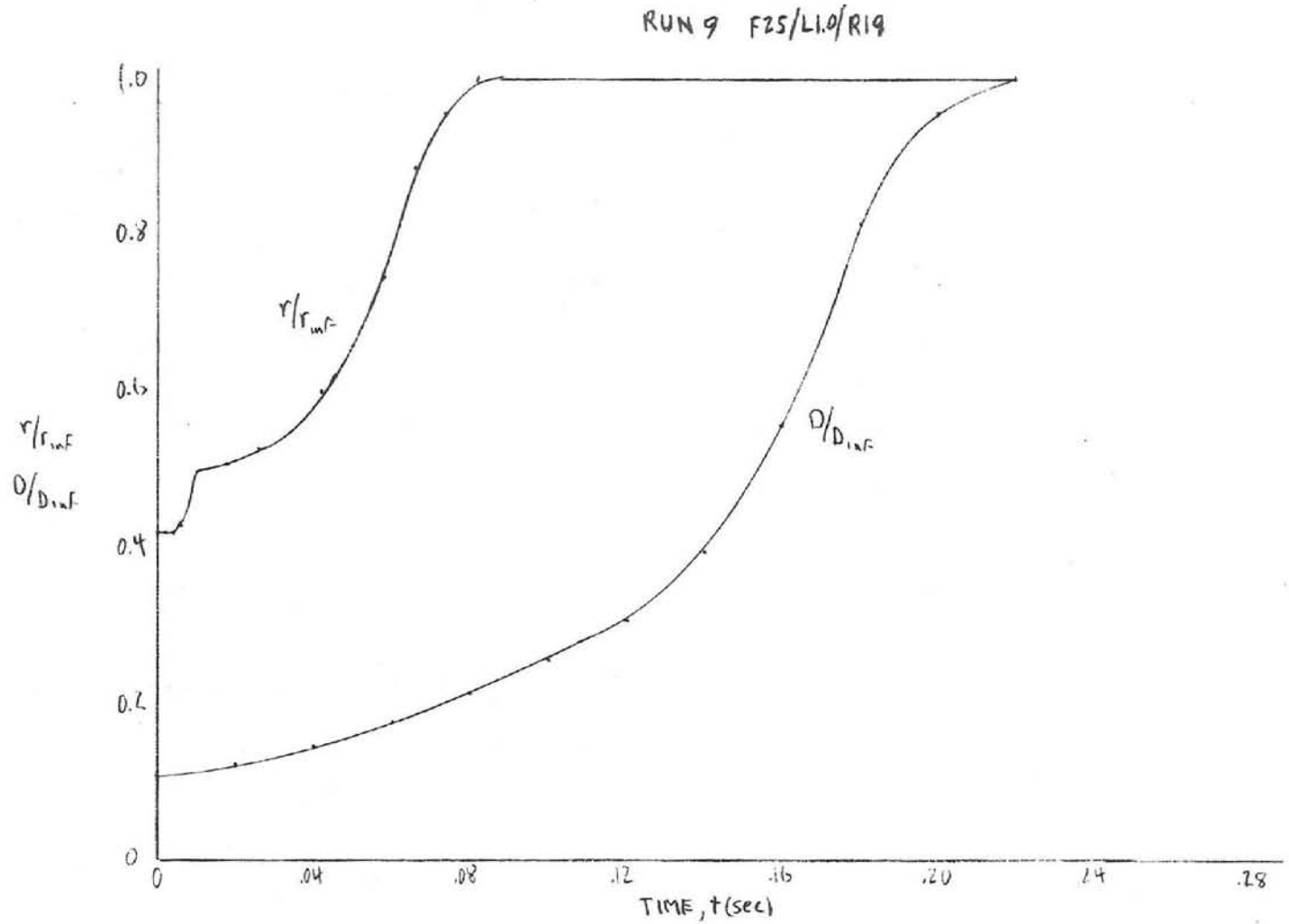


Figure 12 - Continued



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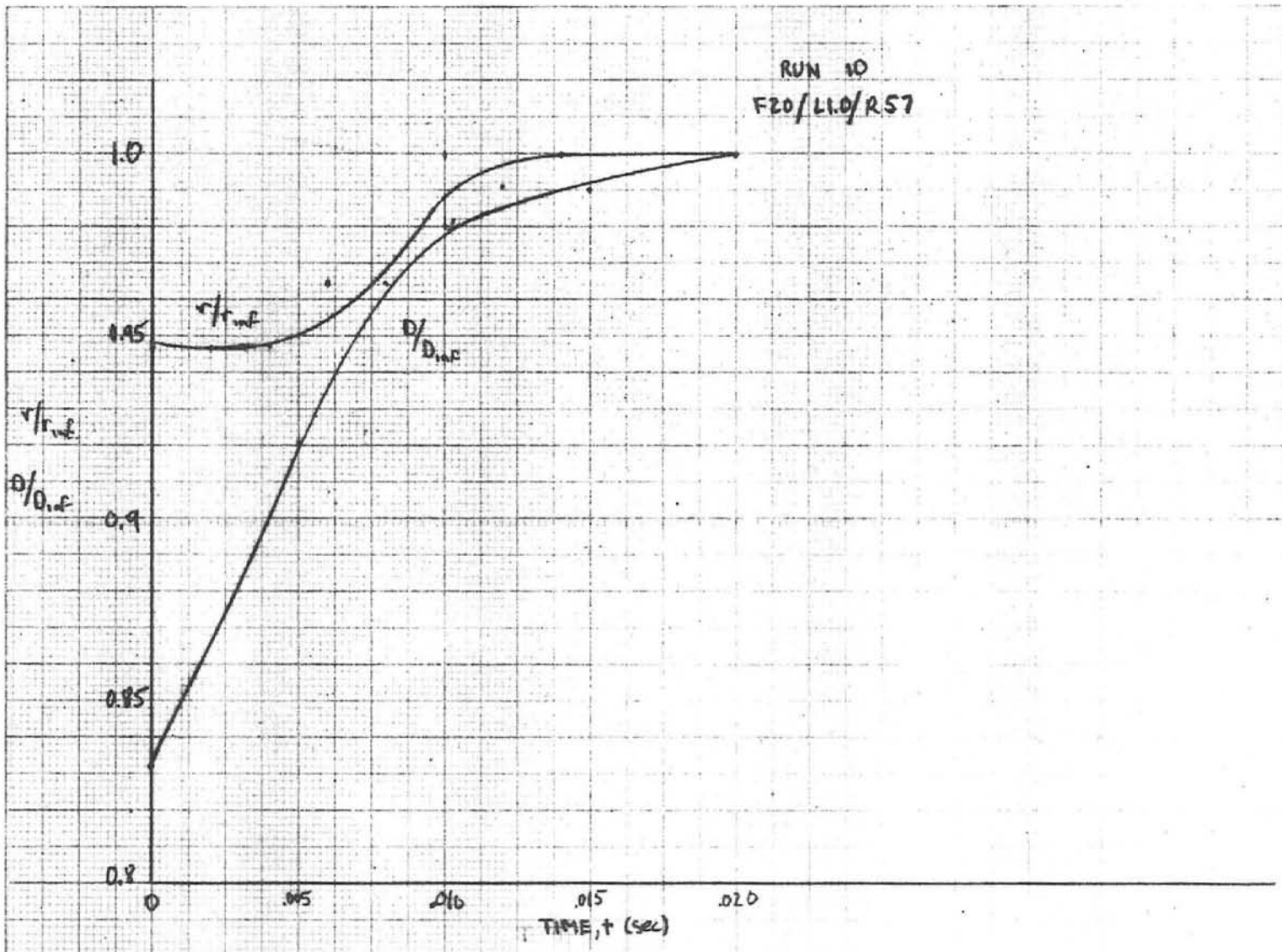


Figure 12 - Continued

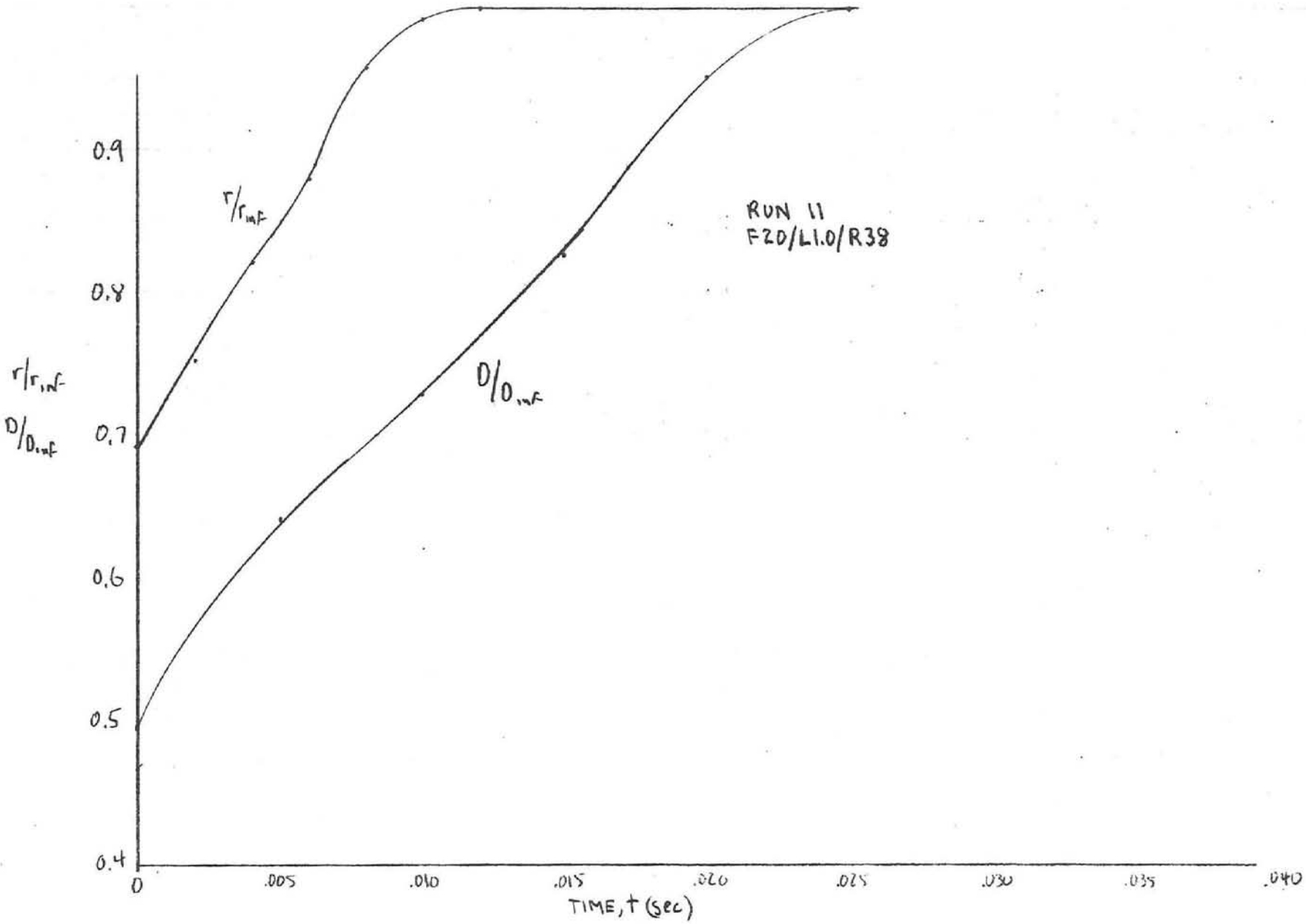


Figure 12 - Continued

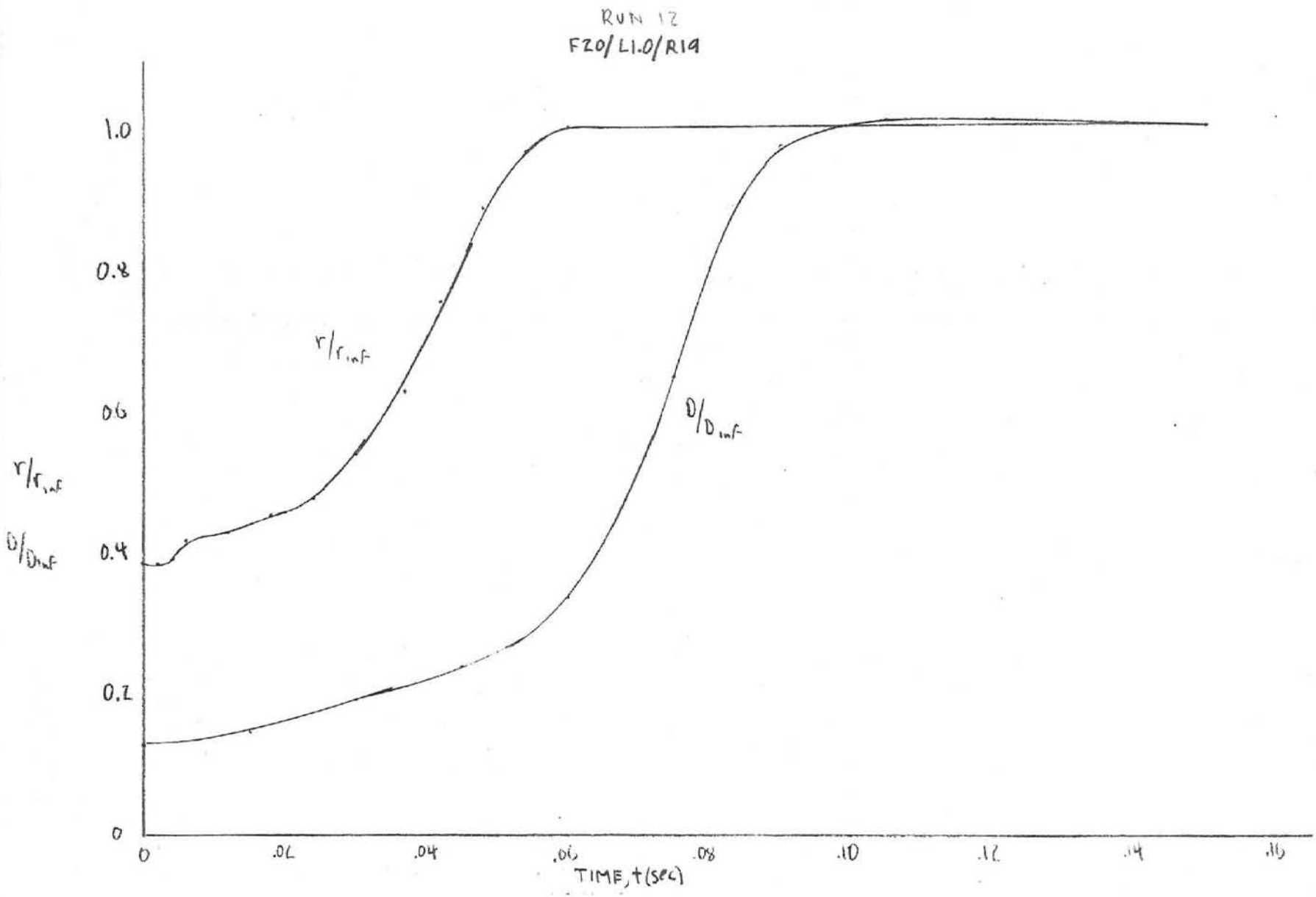


Figure 12 - Continued

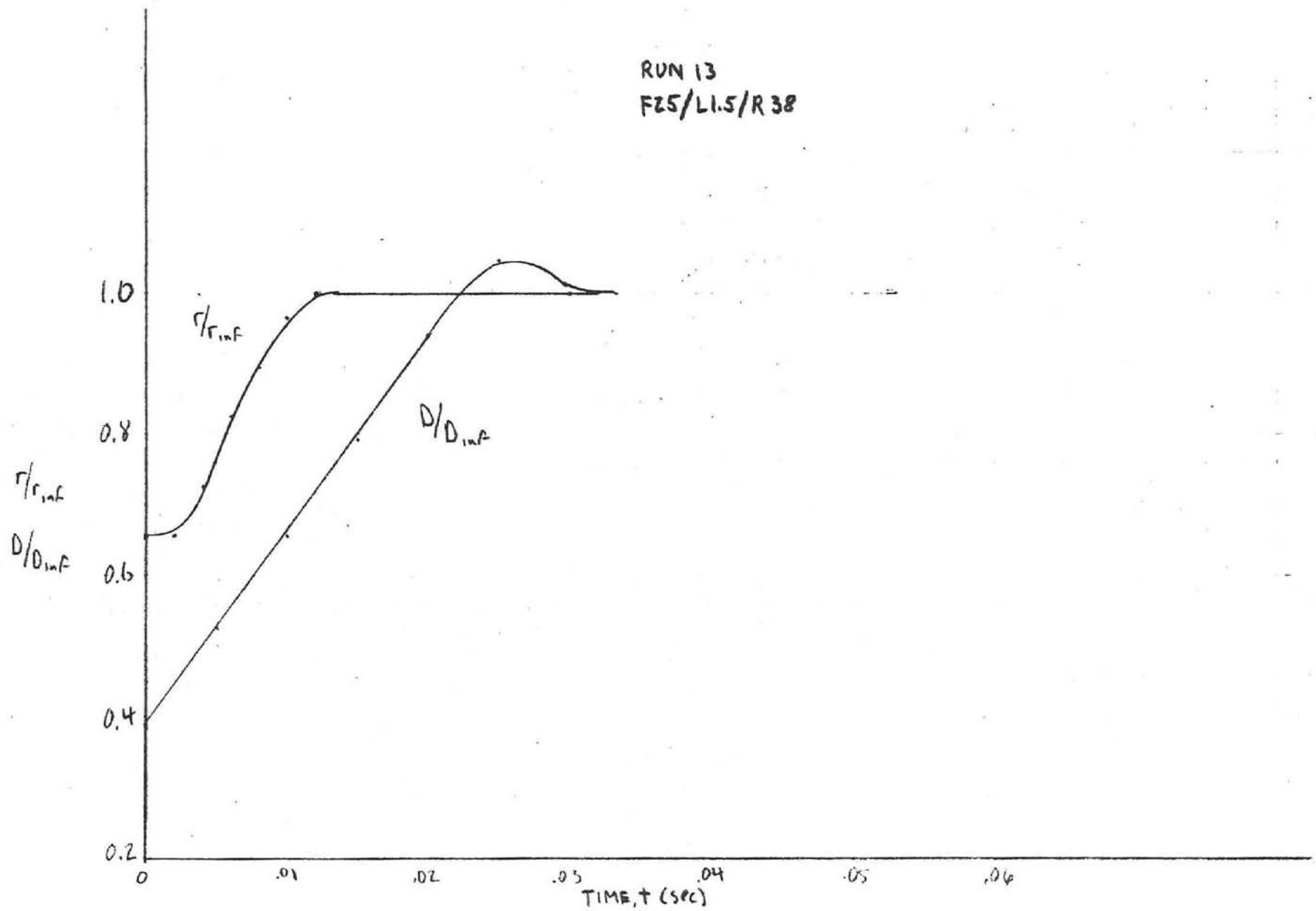


Figure 12 - Continued

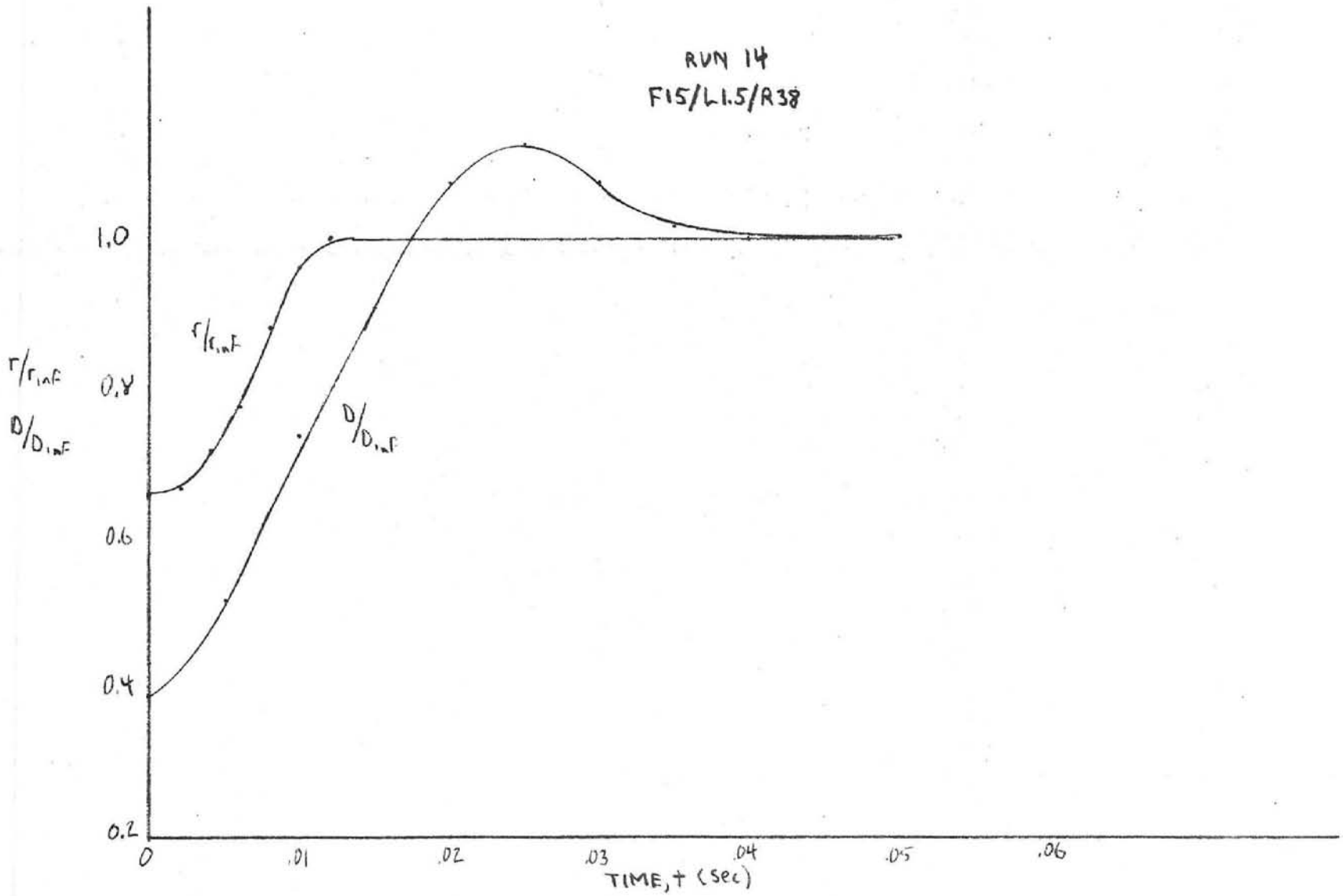


Figure 12 - Continued

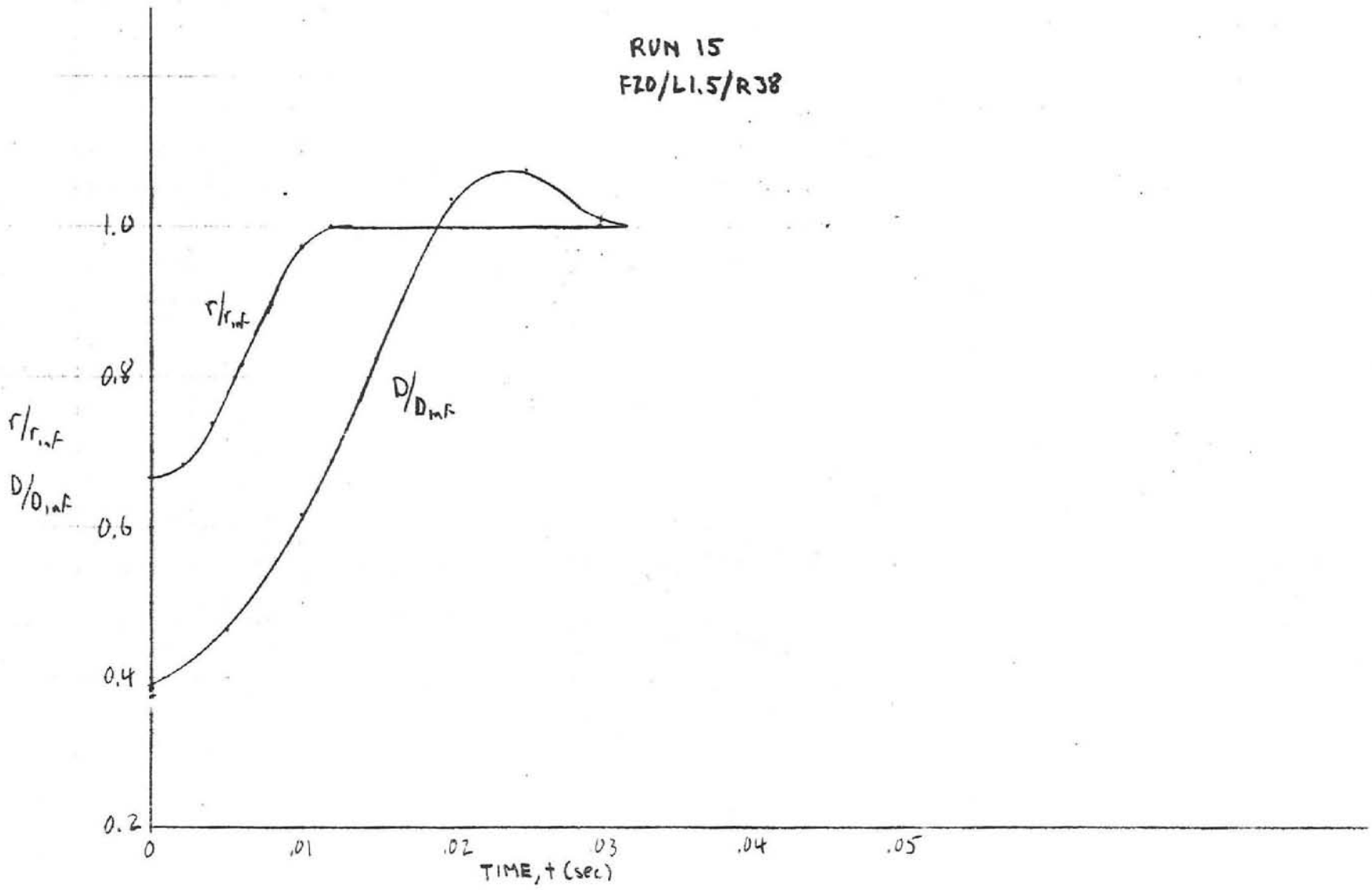


Figure 12 - Continued

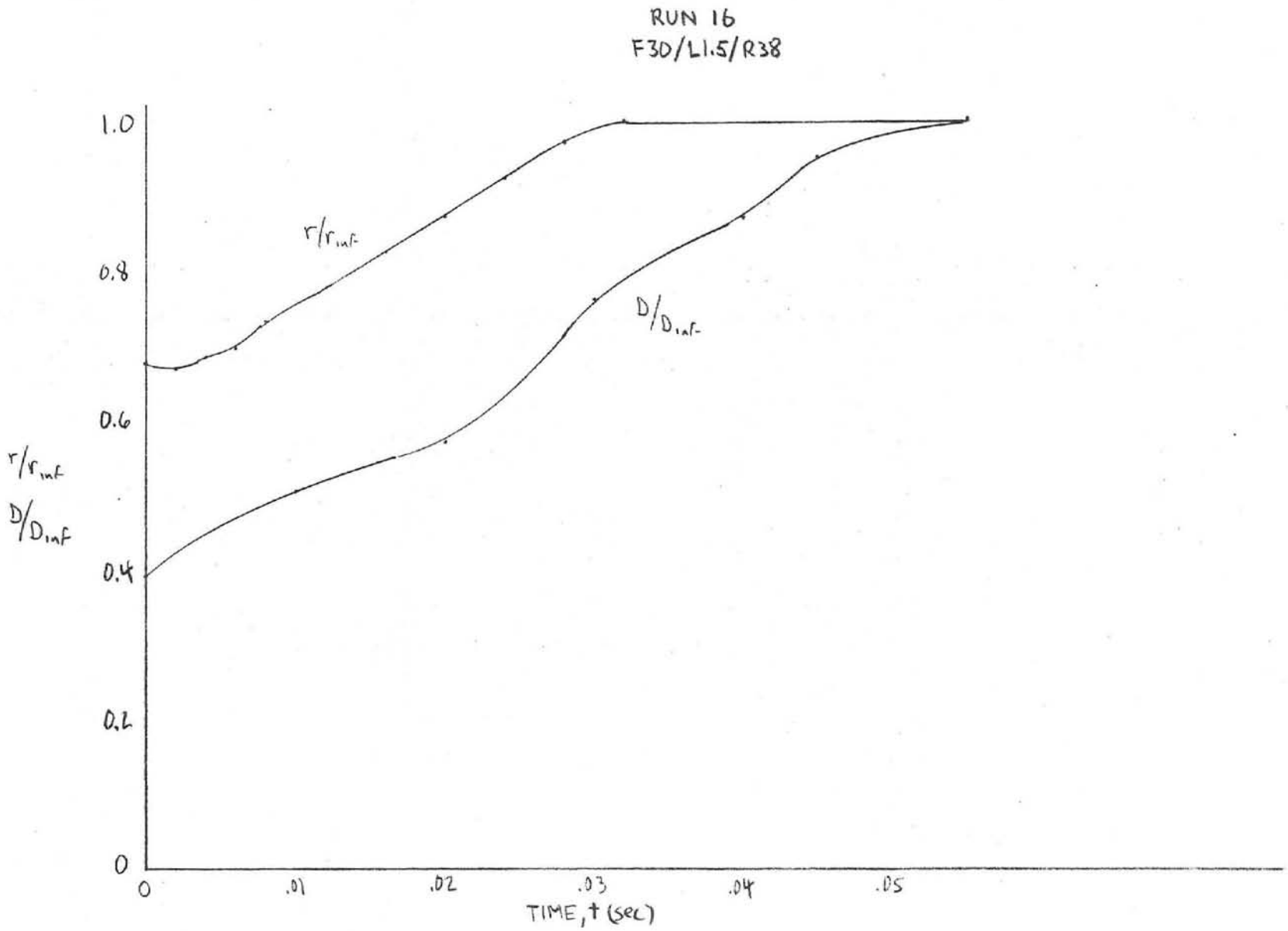


Figure 12 - Continued

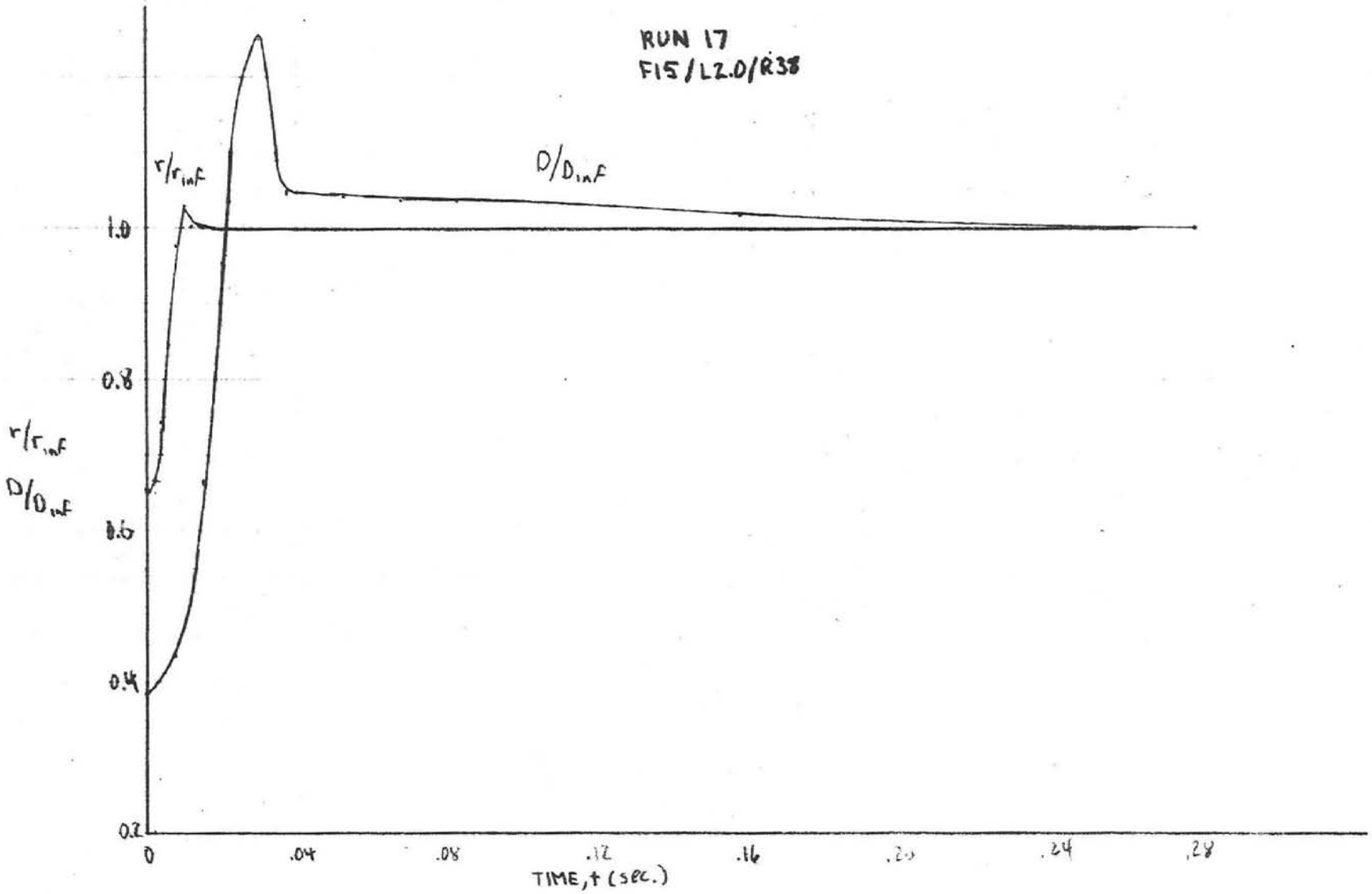


Figure 12 - Continued

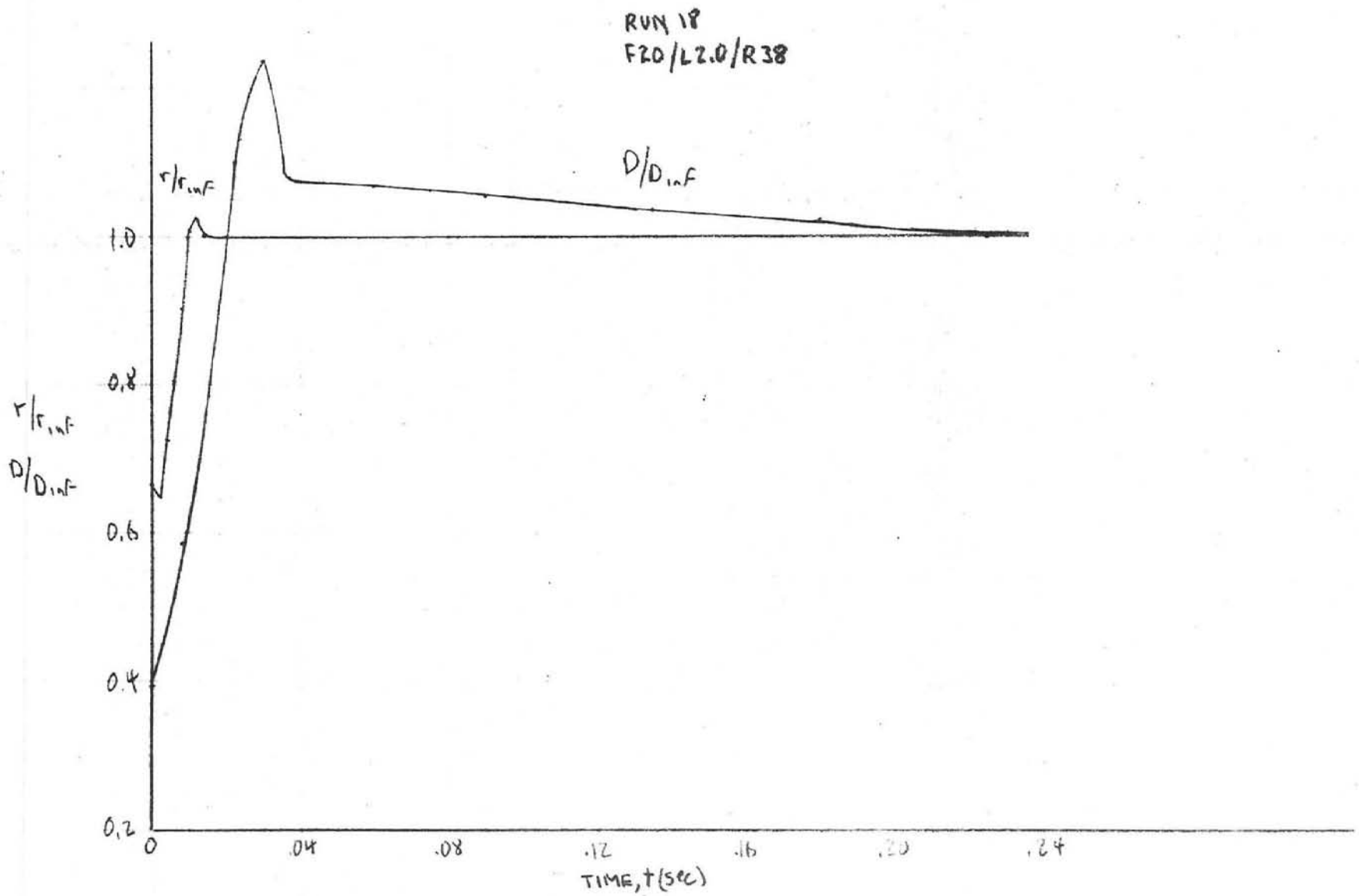


Figure 12 - Continued

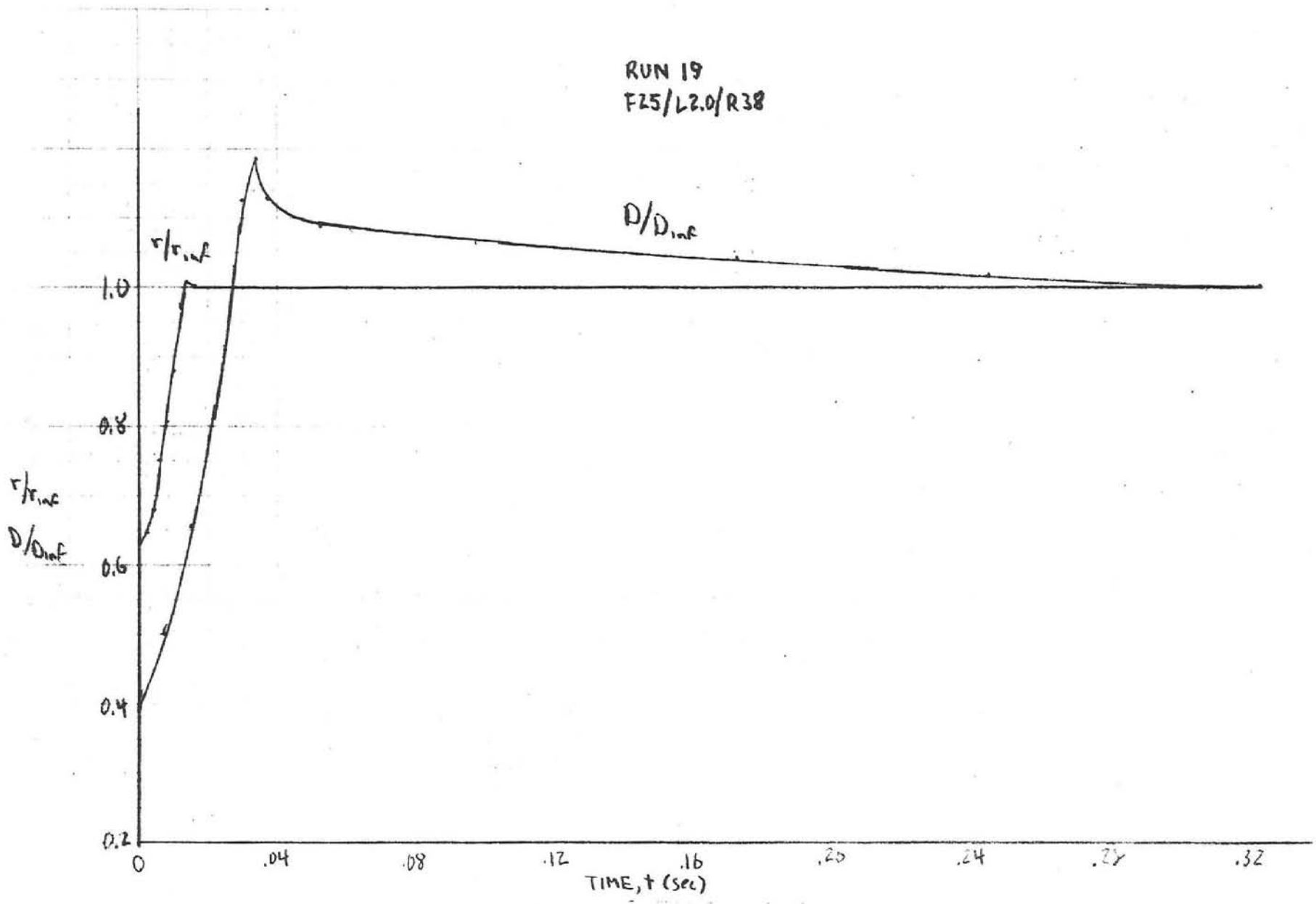


Figure 12 - Continued

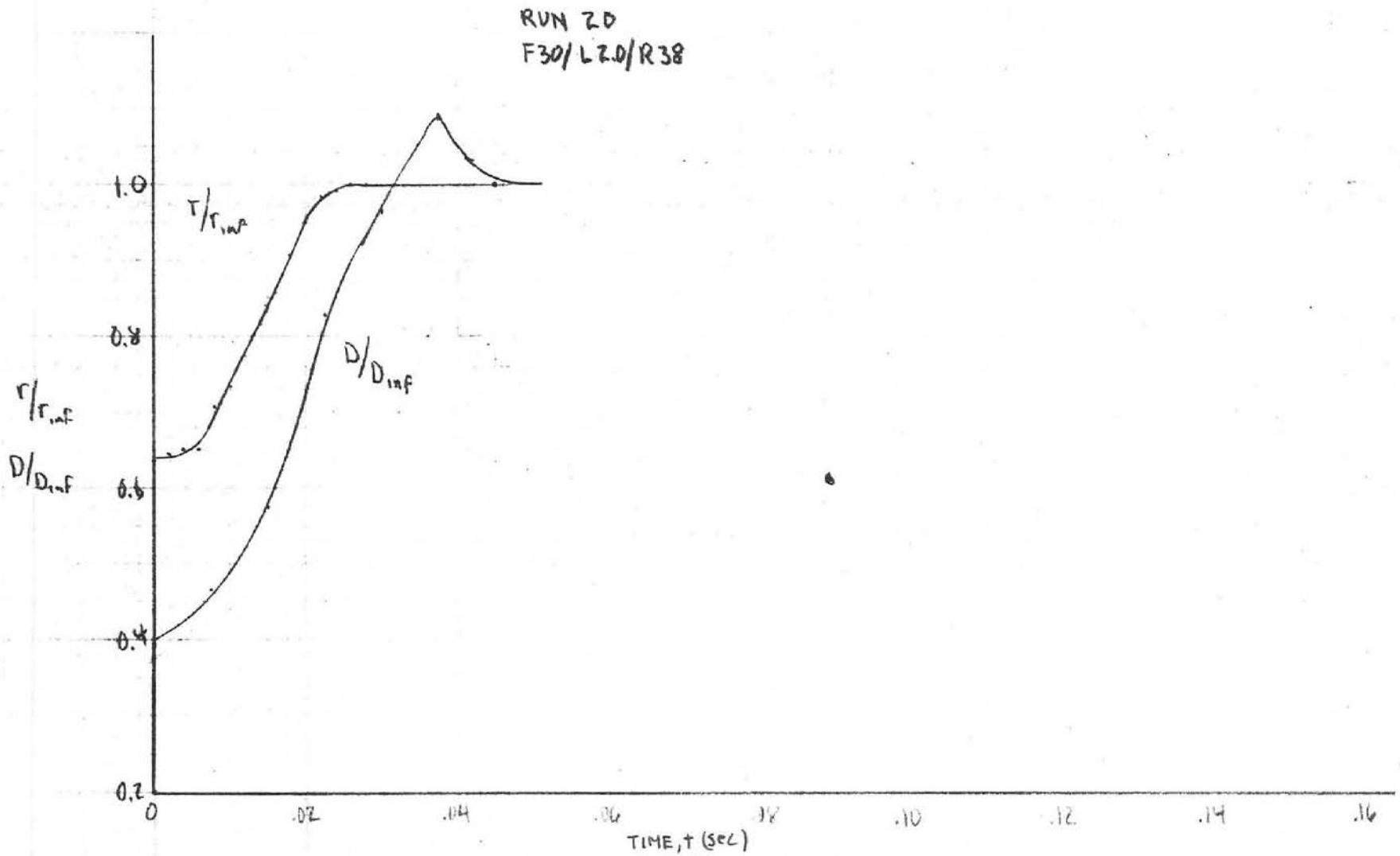


Figure 12 - Continued

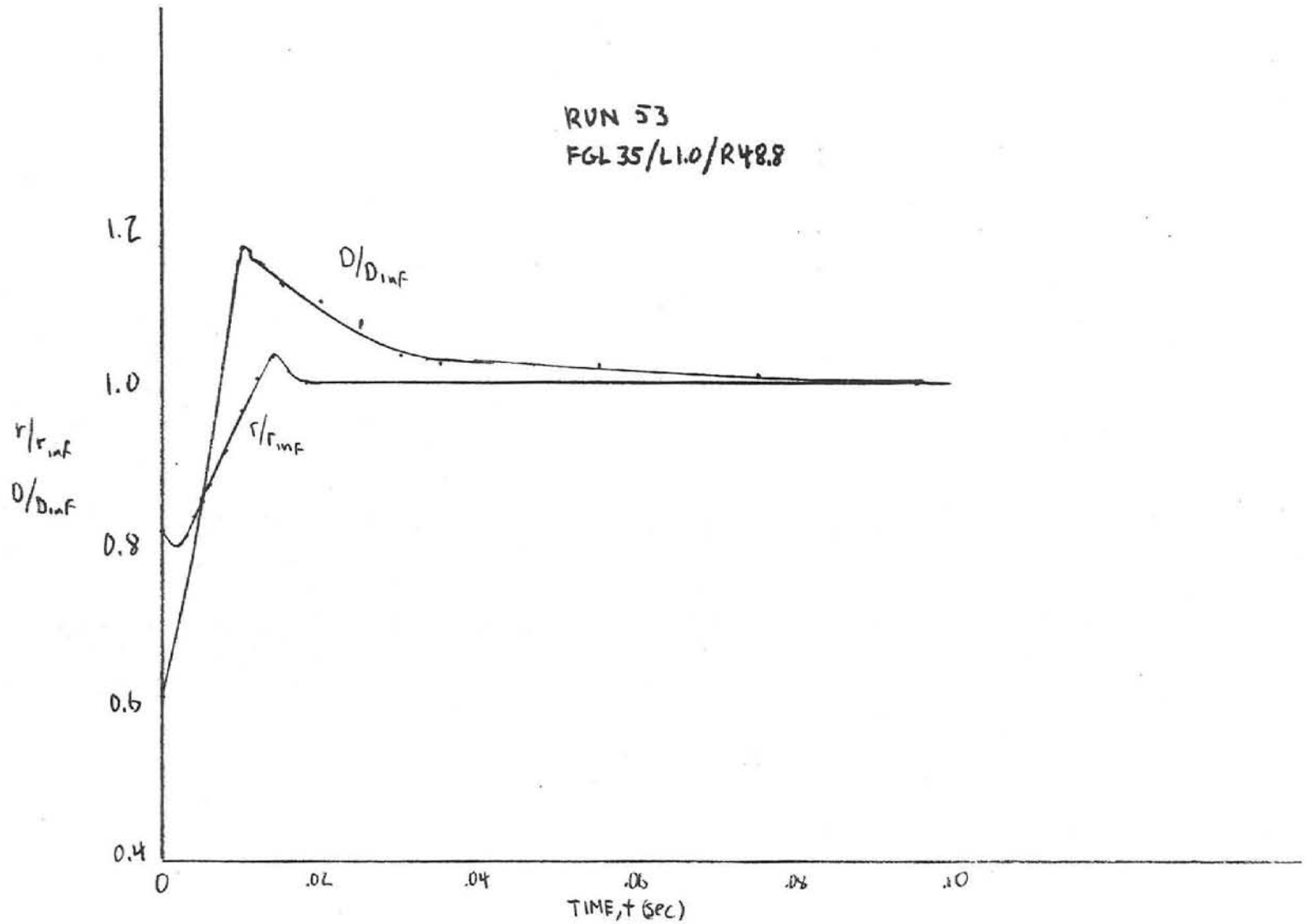


Figure 12 - Continued

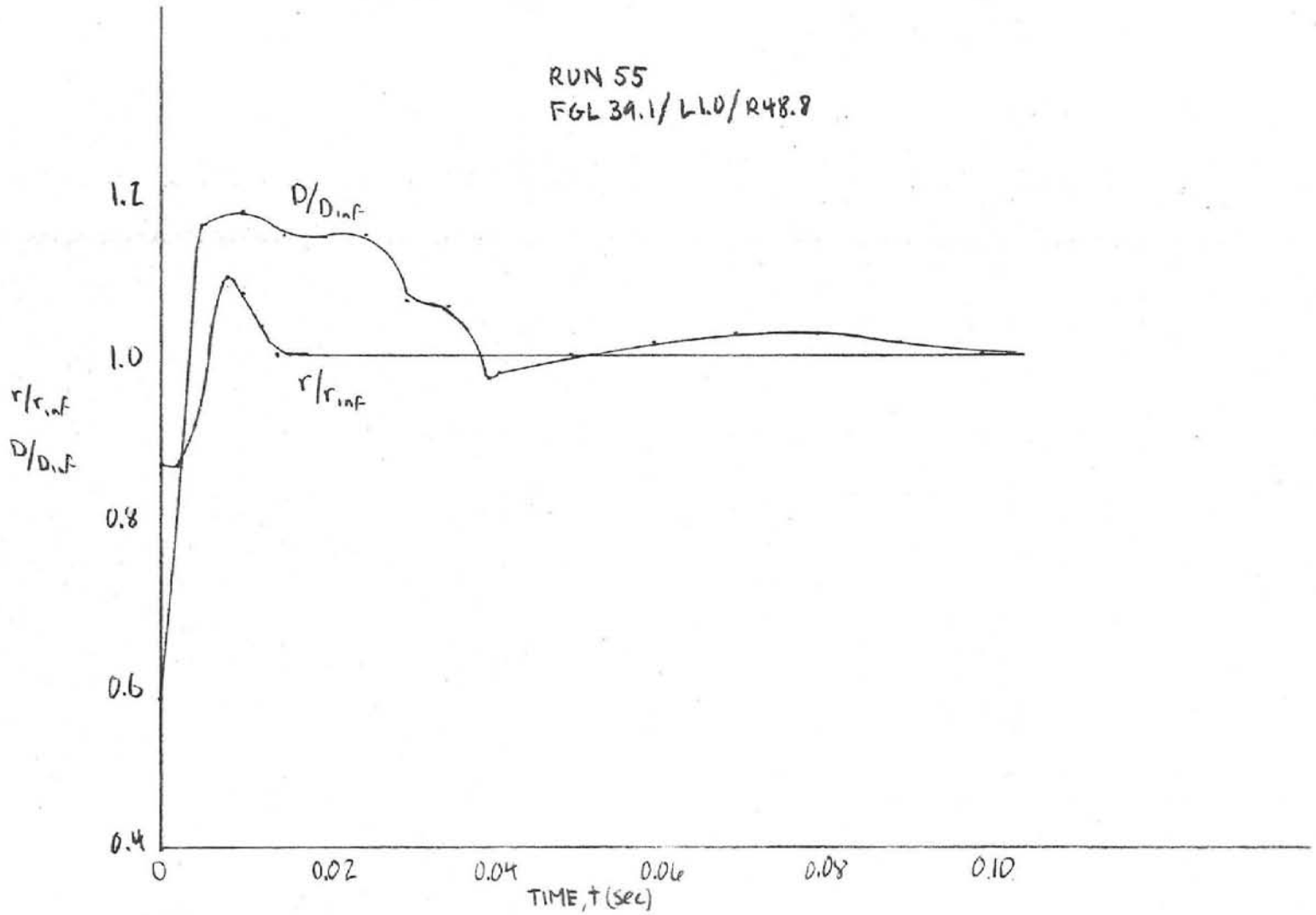


Figure 12 - Continued

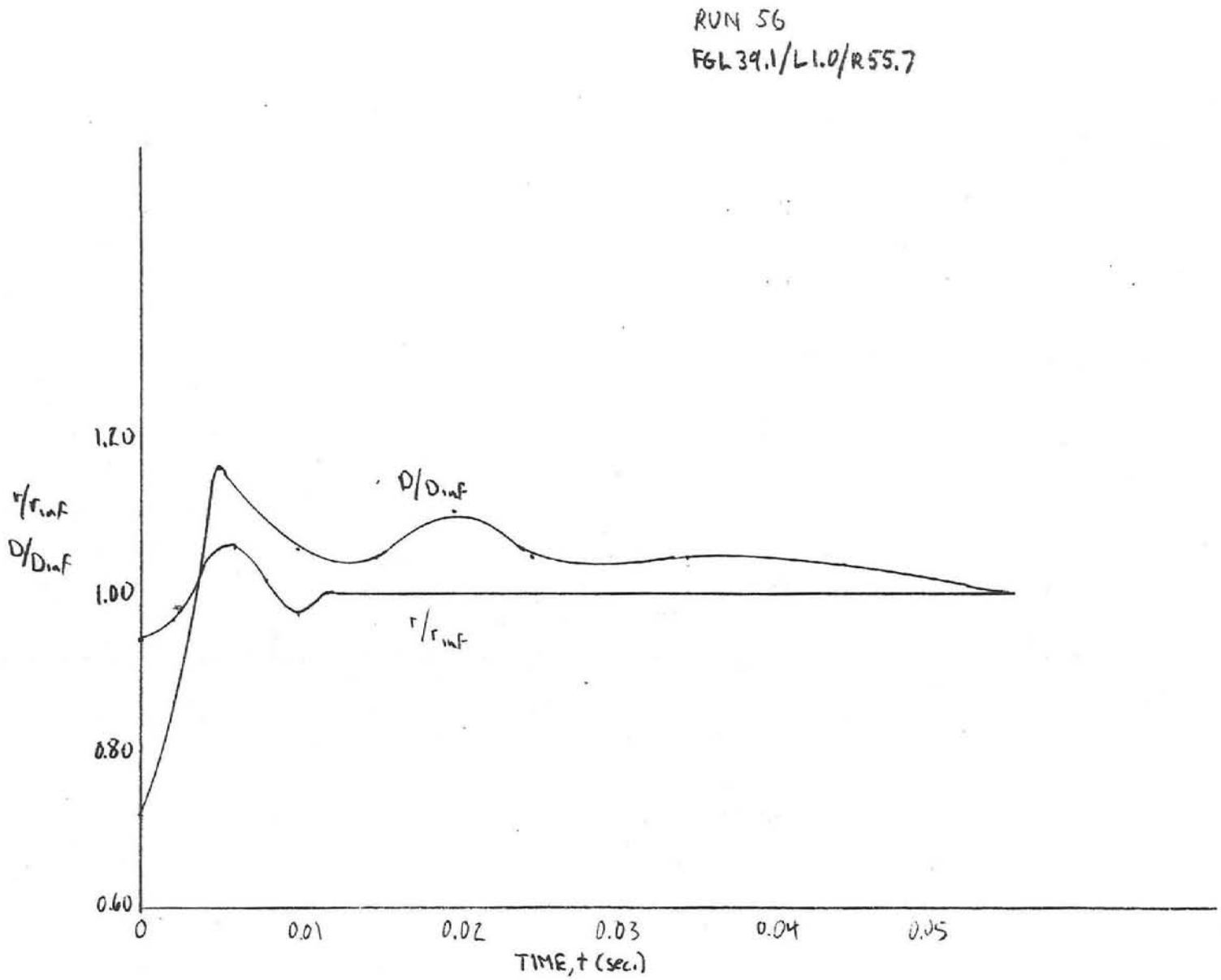


Figure 12 - Continued

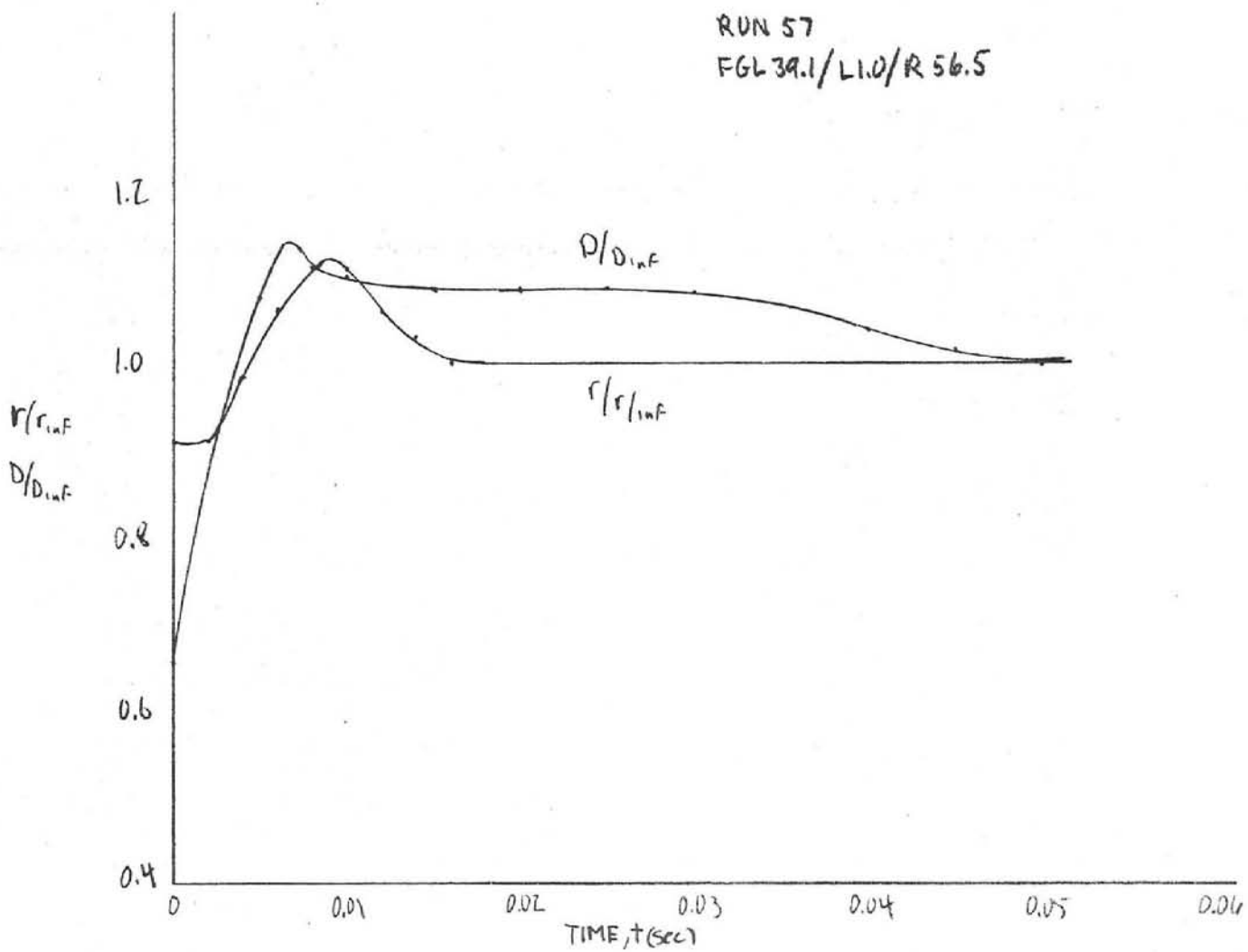


Figure 12 - Continued

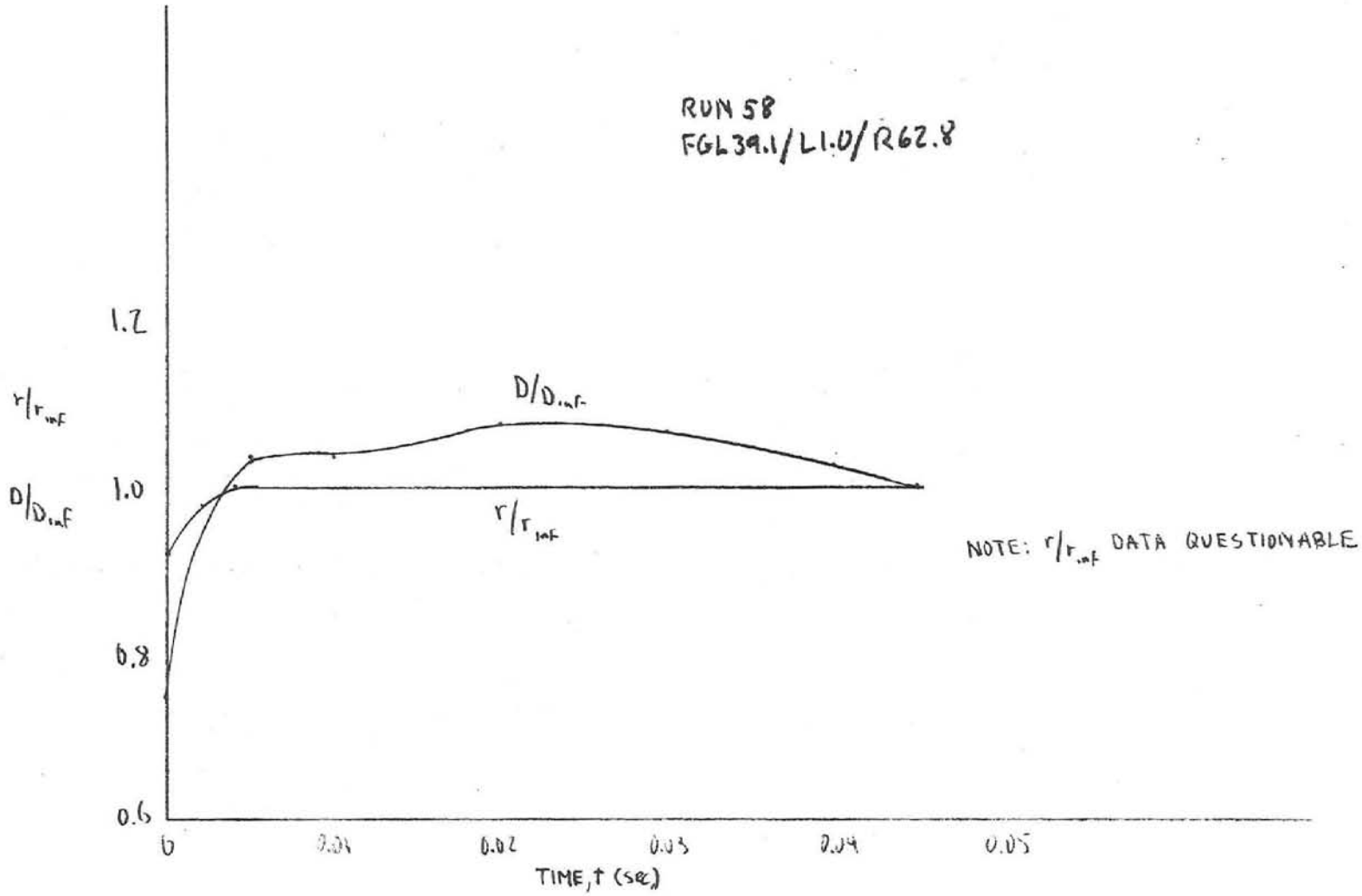


Figure 12 - Continued

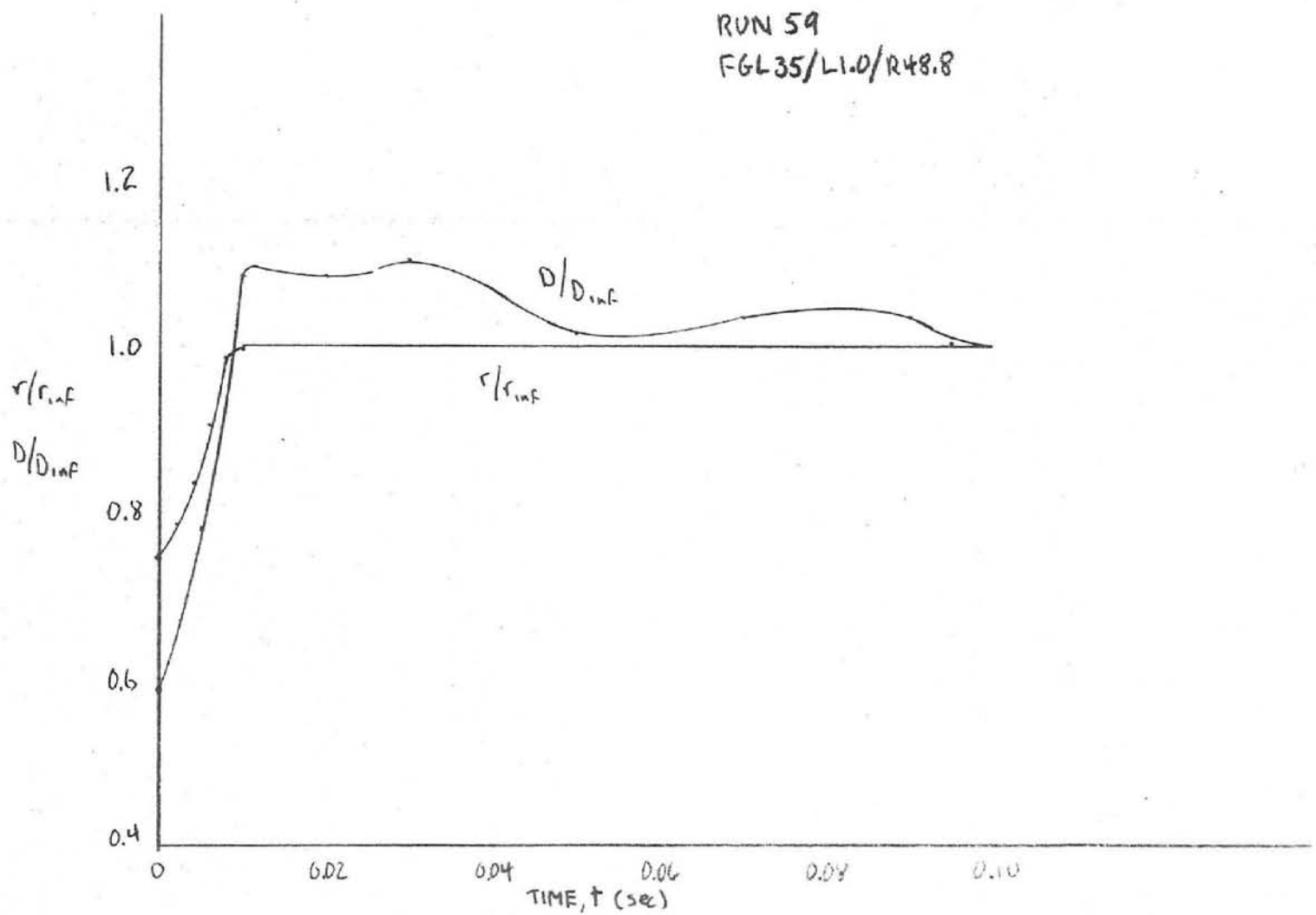


Figure 12 - Continued

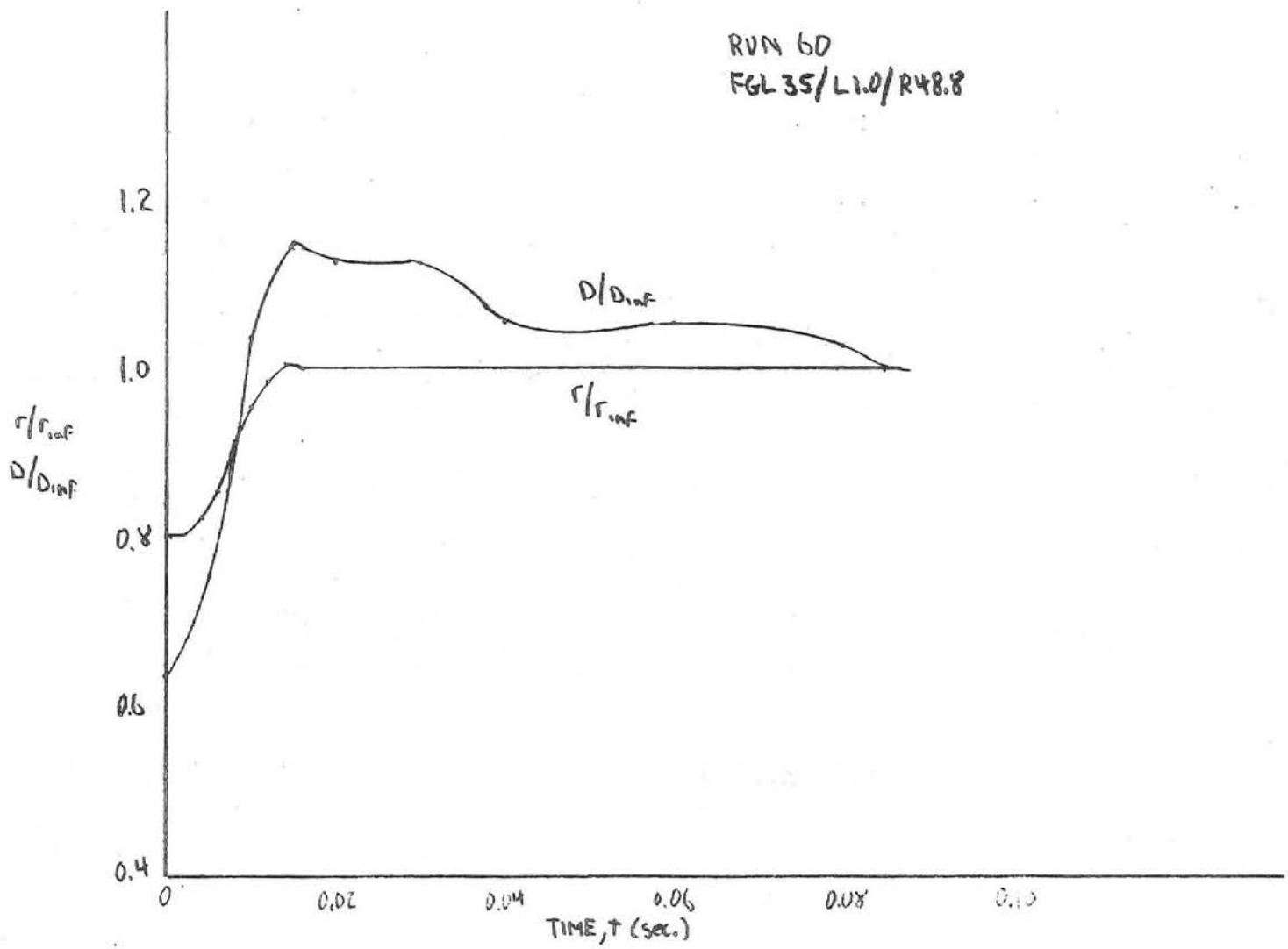


Figure 12 - Continued

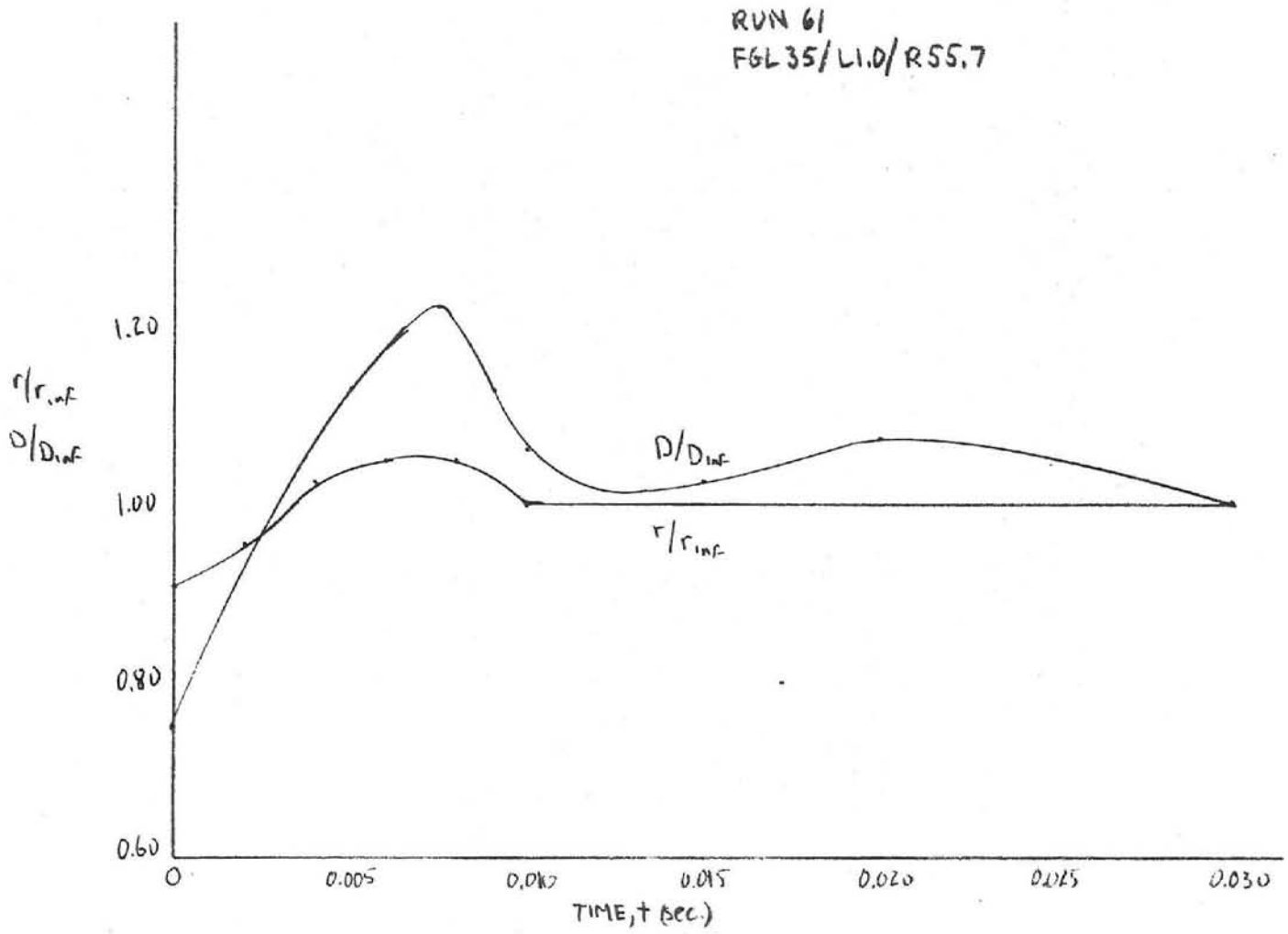


Figure 12 - Concluded

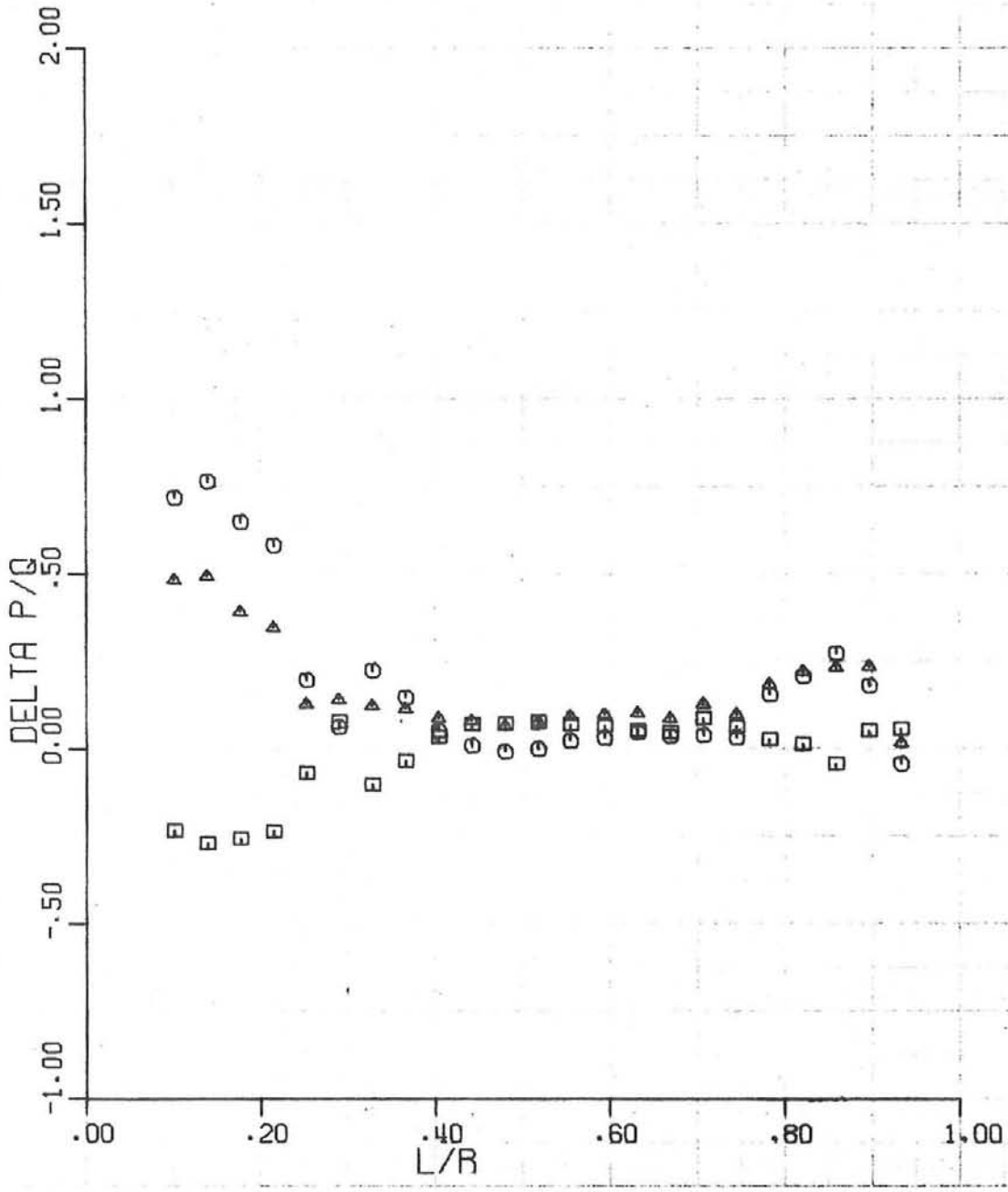
APPENDIX A

PRESSURE DATA ALONG PARACHUTE SURFACE

DELTA P/Q vs L/R

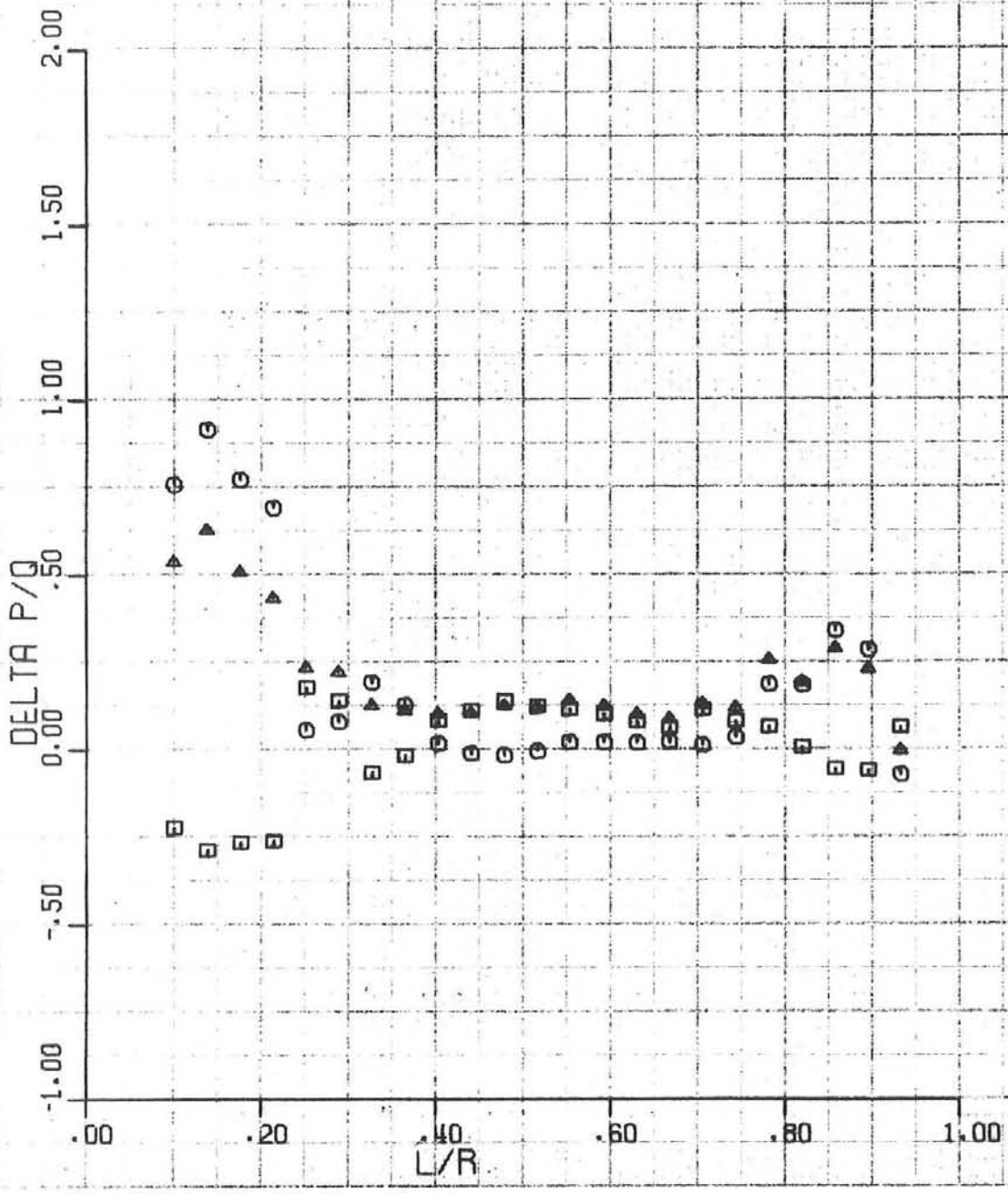
POINT 105 POROSITY= 25.00
Q= 75.73 SHRDL= 1.00
CDOBAL= .0677 REEFL= 19.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



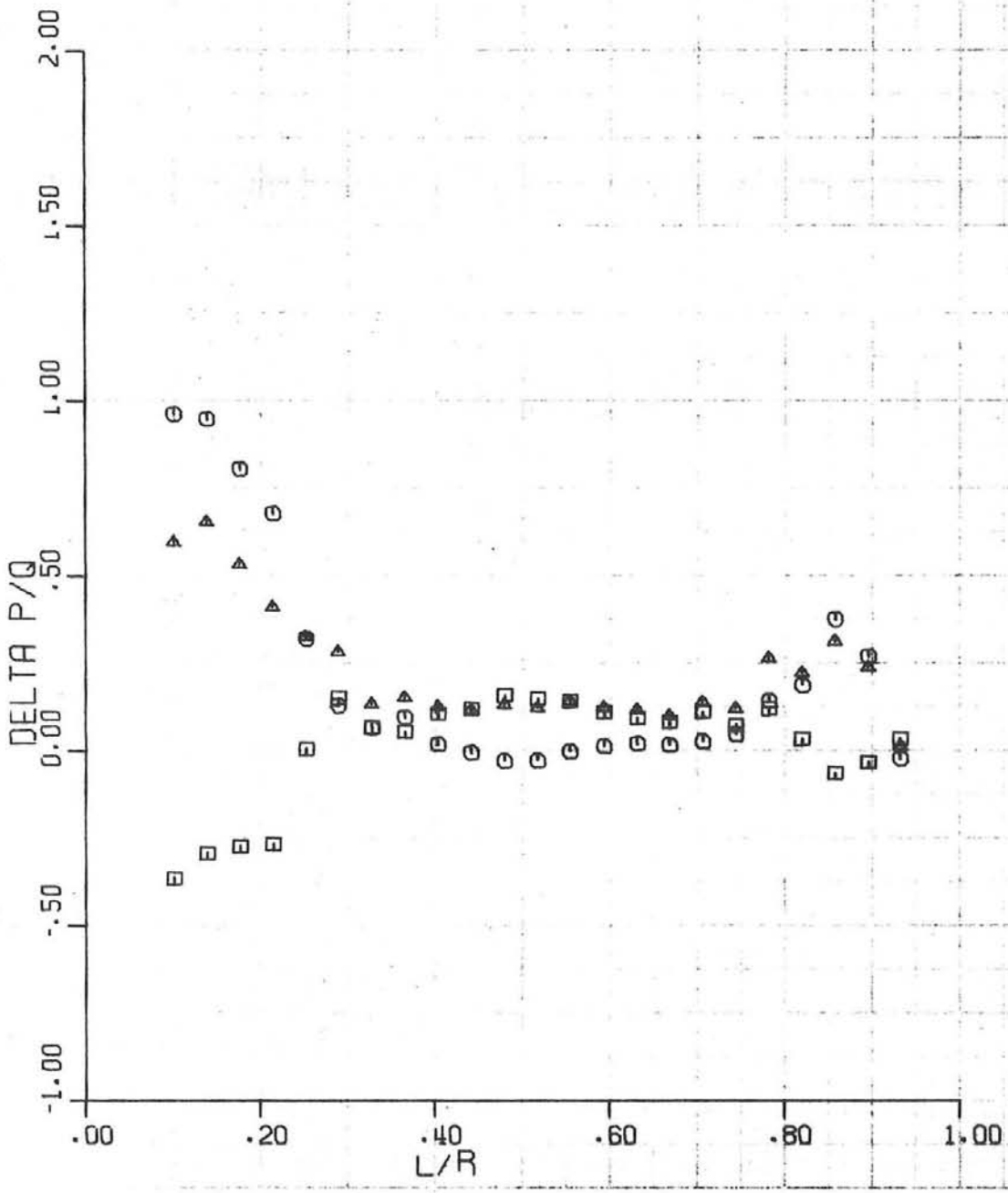
POINT 106 POROSITY= 25.00
Q= 207.28 SHRDL= 1.00
CDOBAL= .0665 REEFL= 19.00

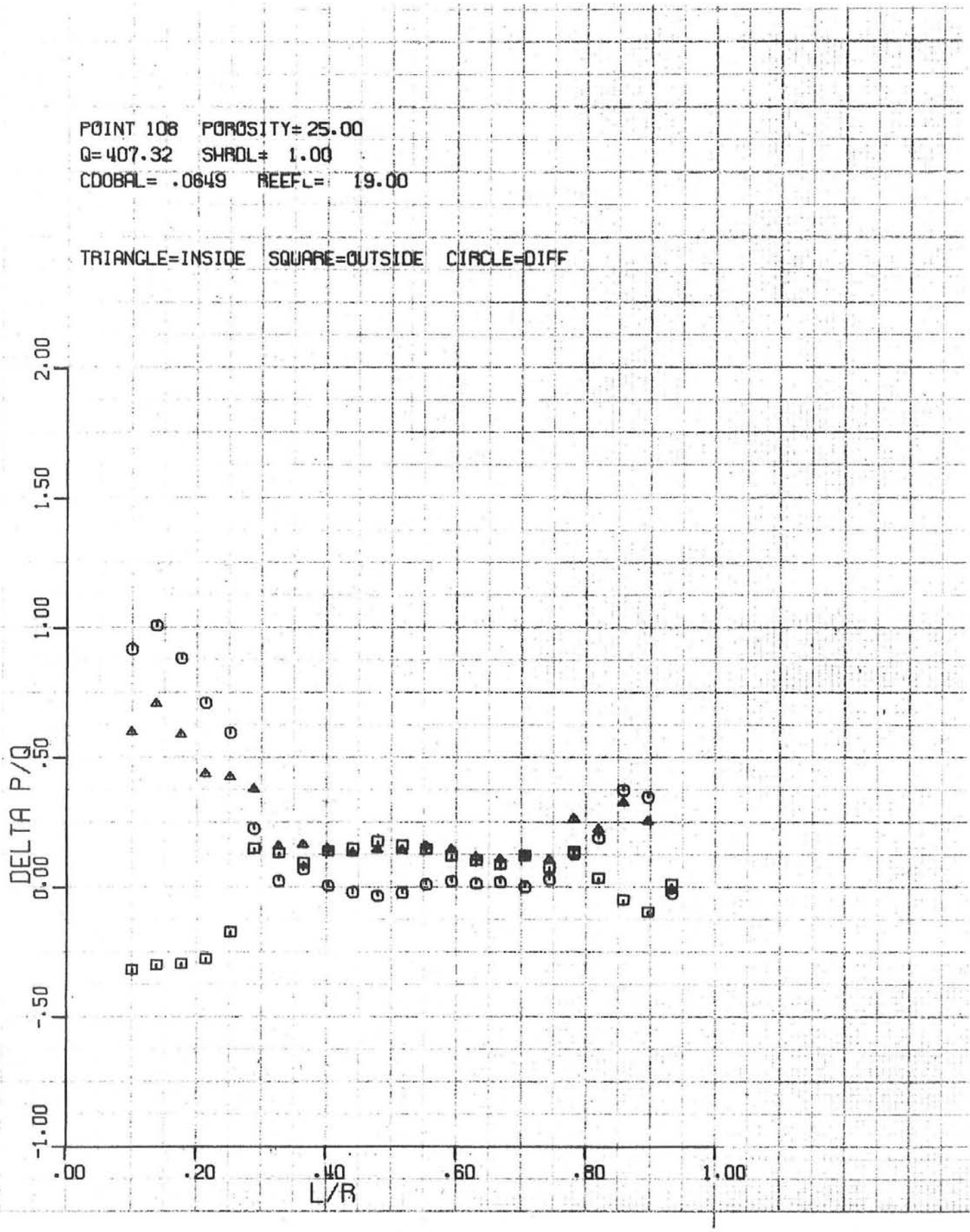
TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



POINT 107 POROSITY= 25.00
Q= 307.73 SHRDL= 1.00
CDOBAL= .0651 REEFL= 19.00

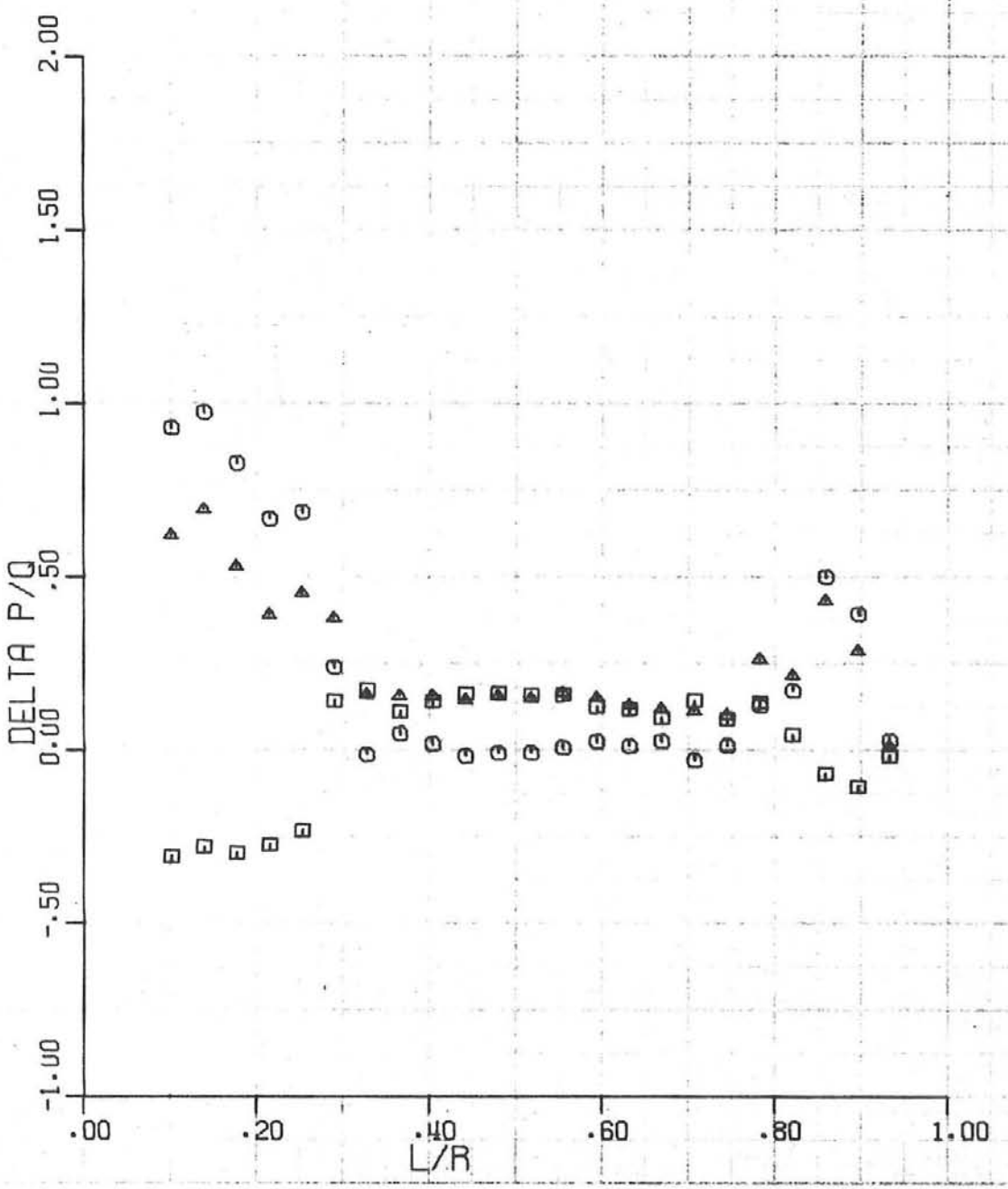
TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF




POINT 108 POROSITY= 25.00
Q= 407.32 SHROL= 1.00
CDOBAL= .0649 REEFL= 19.00
TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF
DELTA P/Q
2.00
1.50
1.00
.50
0.00
-.50
-1.00
.00
.20
.40
.60
.80
1.00
L/R

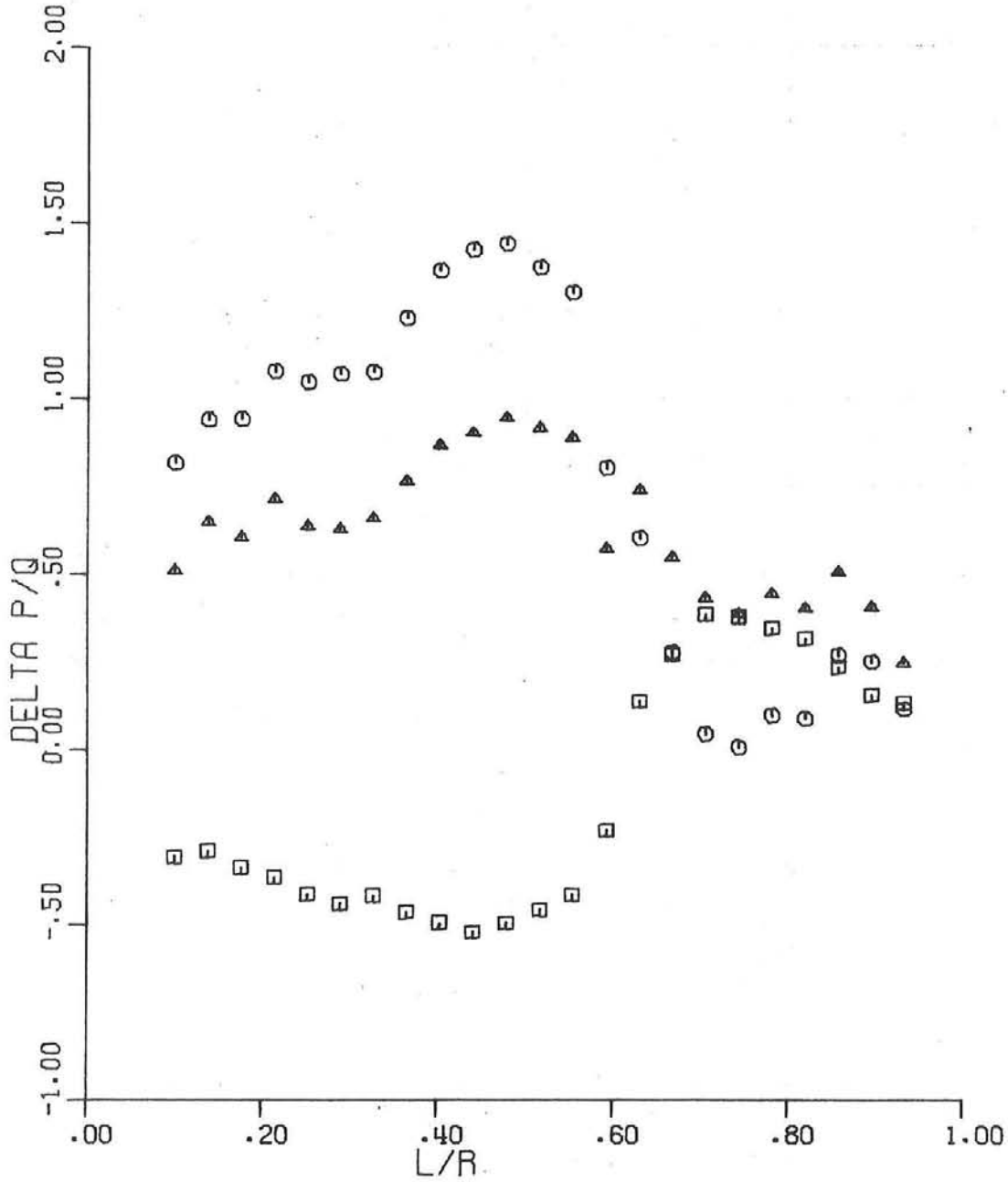
POINT 109 POROSITY= 25.00
Q= 508.15 SHRDL= 1.00
CDOBAL= .0643 REEFL= 19.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



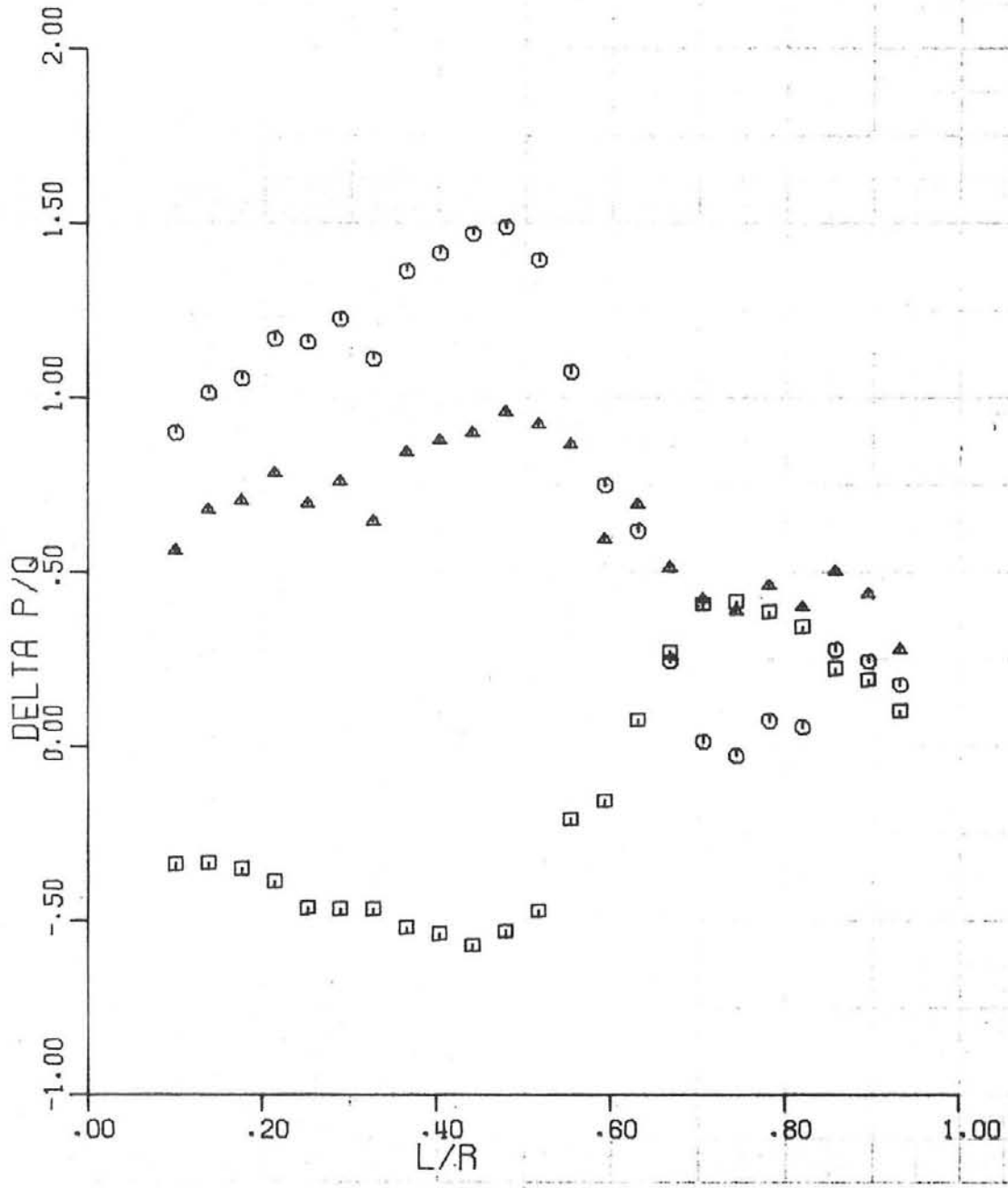
POINT 110 POROSITY= 25.00
Q= 72.40 SHROL= 1.00
CDOBAL= .2168 REEFL= 38.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



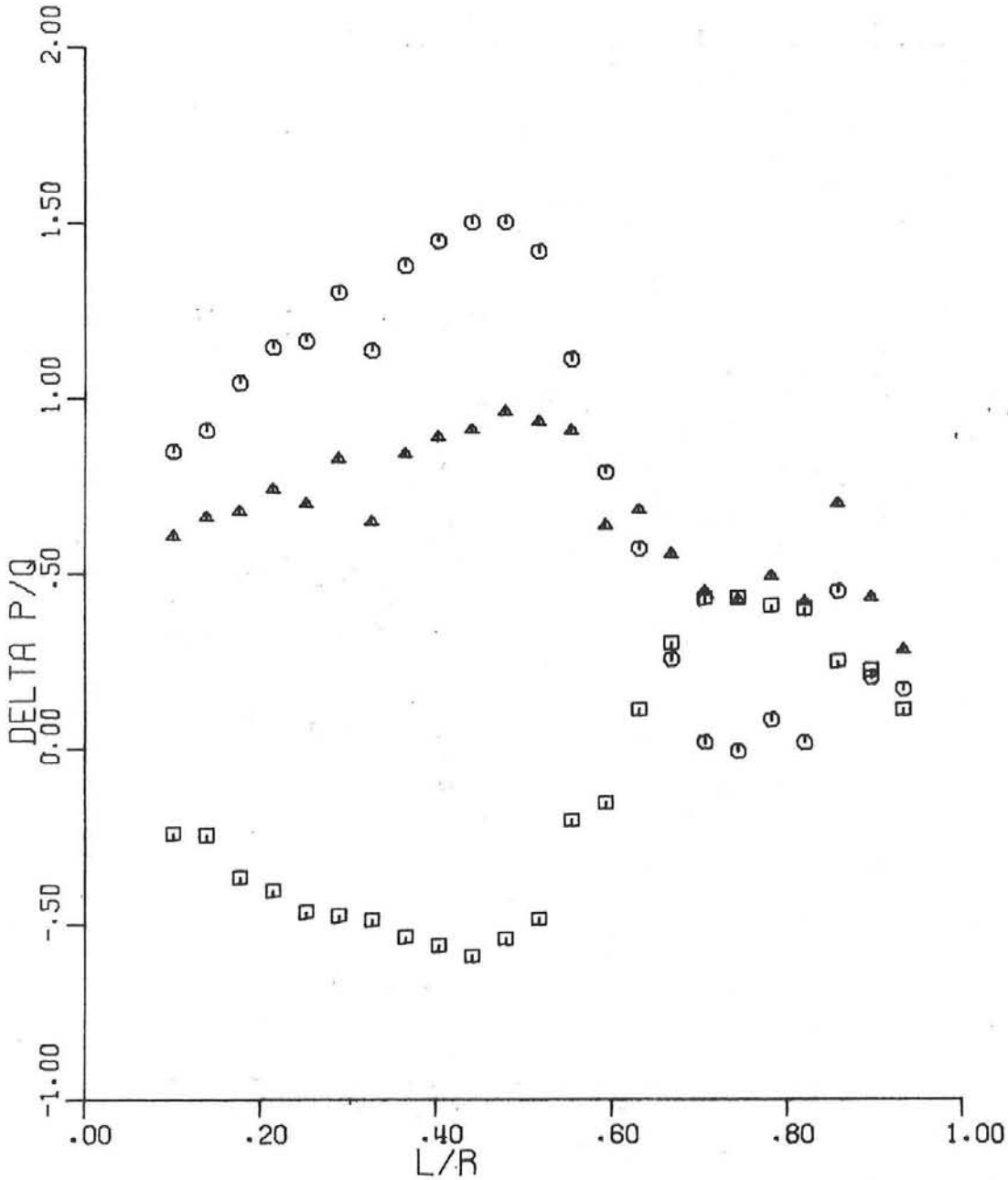
POINT 112 POROSITY= 25.00
Q= 206.20 SHRDL= 1.00
CDOBAL= .2217 REEFL= 38.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



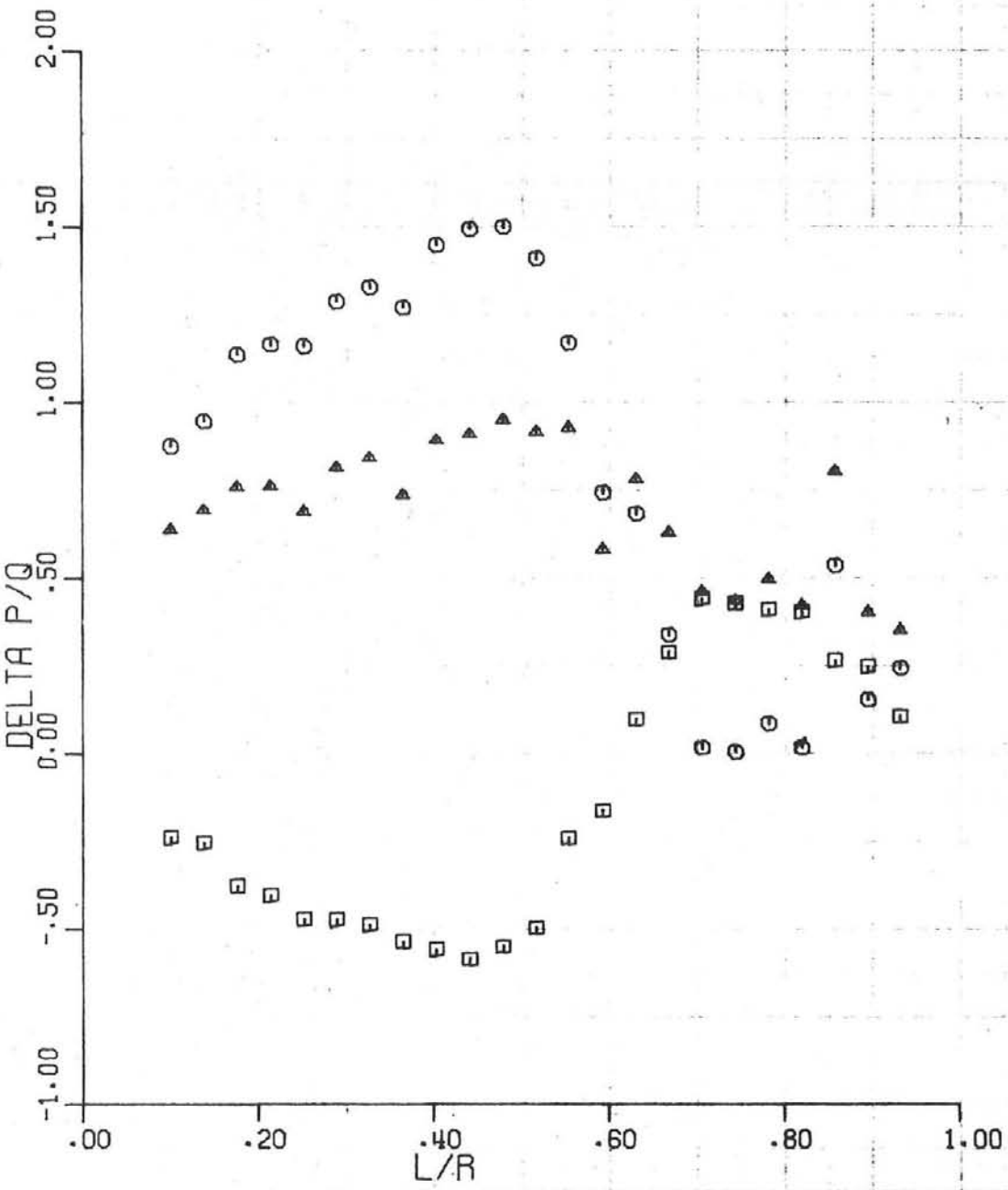
POINT 113 POROSITY= 25.00
Q= 304.36 SHROL= 1.00
CDOBAL= .2280 REEFL= 38.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



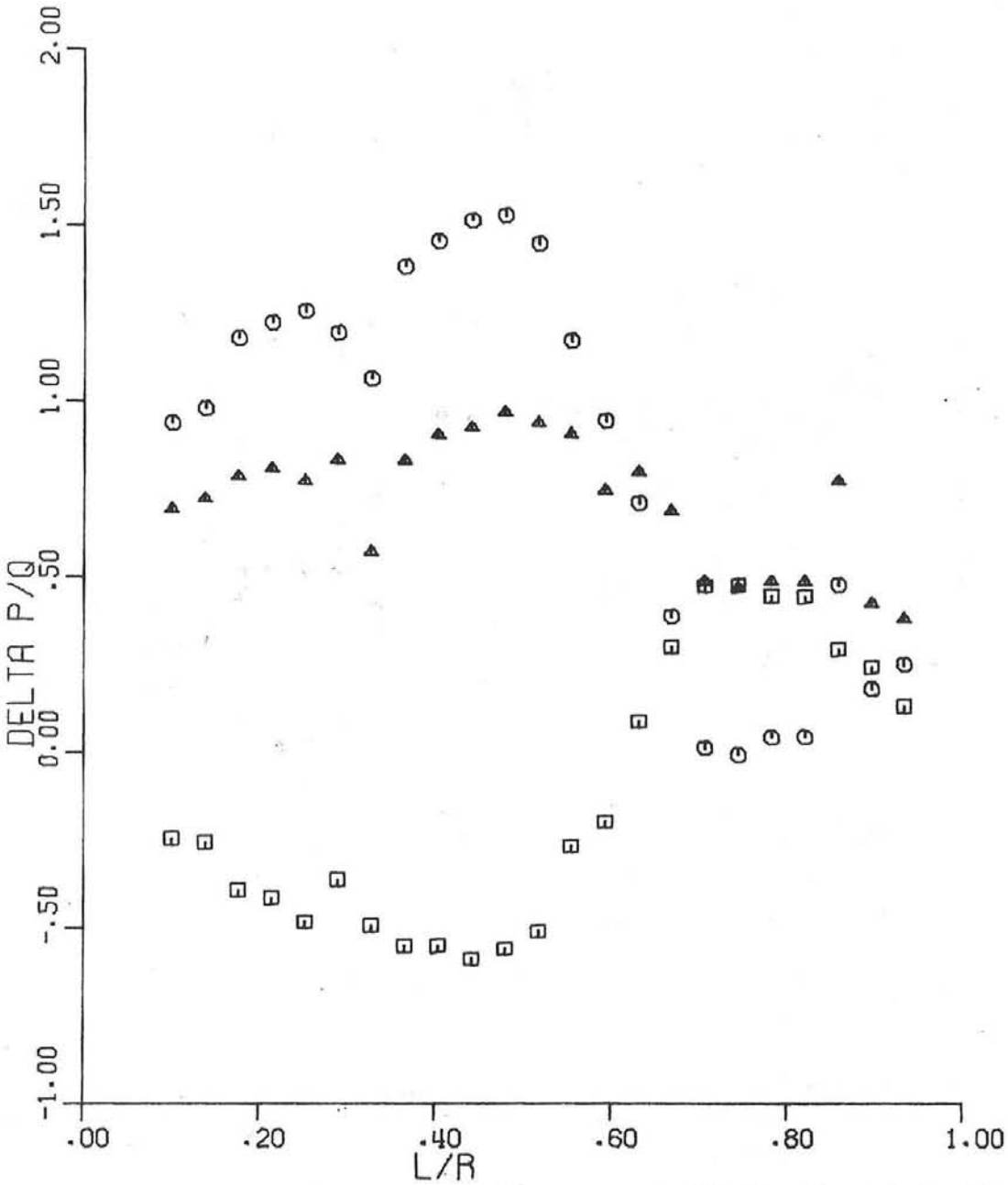
POINT 114 POROSITY= 25.00
Q= 303.82 SHRDL= 1.00
CDOBAL= .2280 REEFL= 38.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



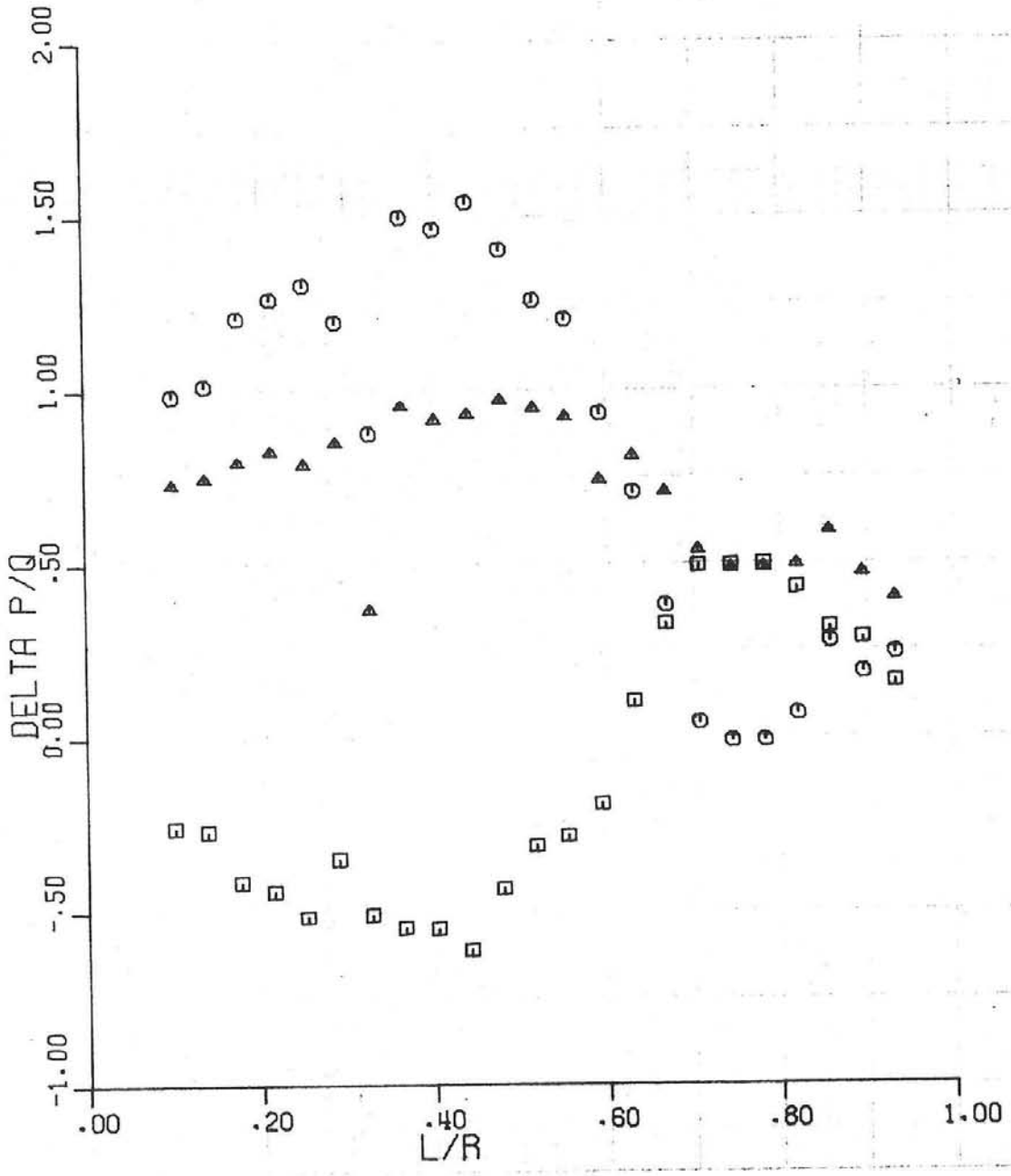
POINT 115 POROSITY= 25.00
Q= 410.00 SHRDL= 1.00
CDOBAL= .2328 REEFL= 38.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



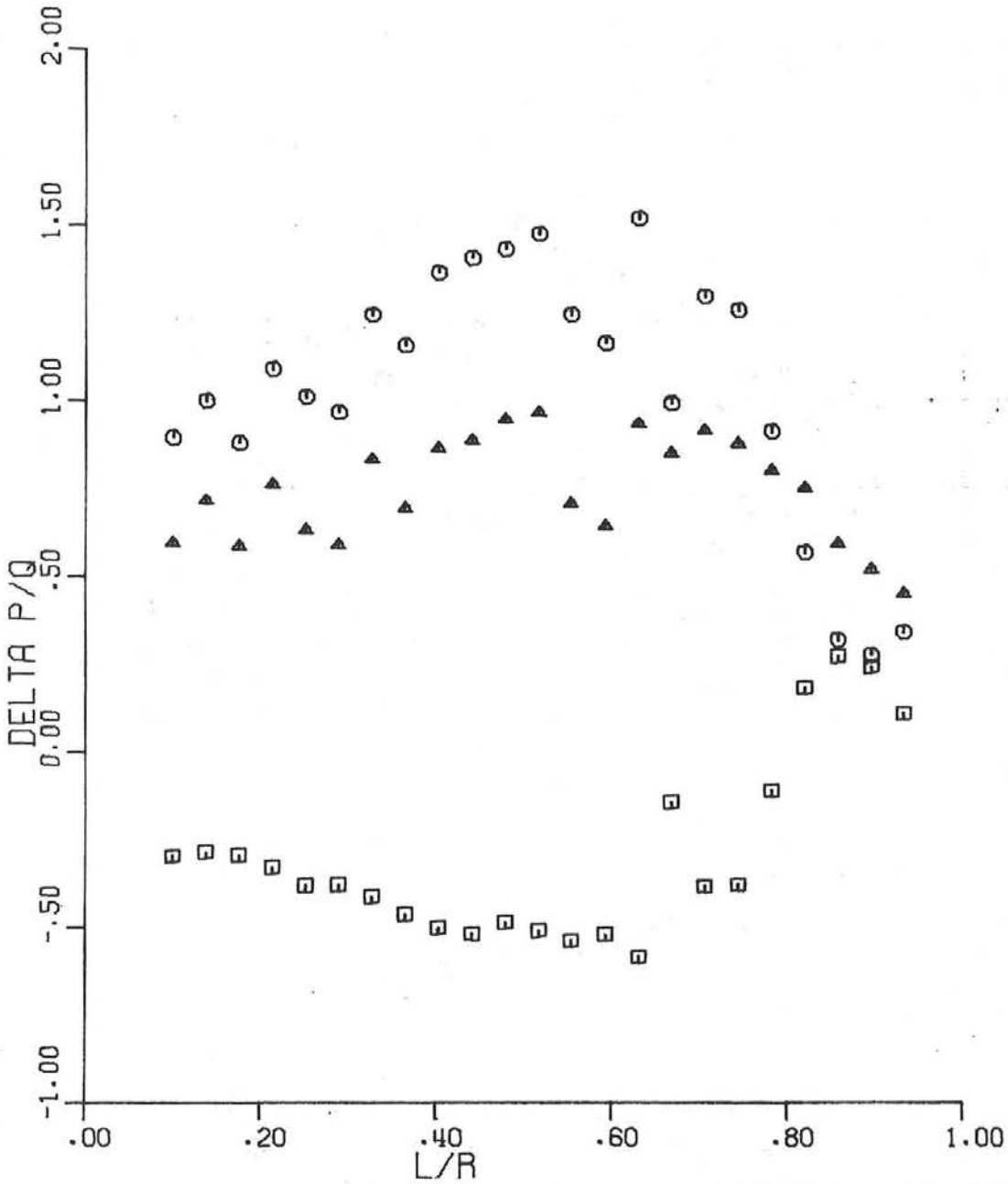
POINT 116 POROSITY= 25.00
Q= 507.66 SHROL= 1.00
CDOBAL= .2421 REEFL= 38.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



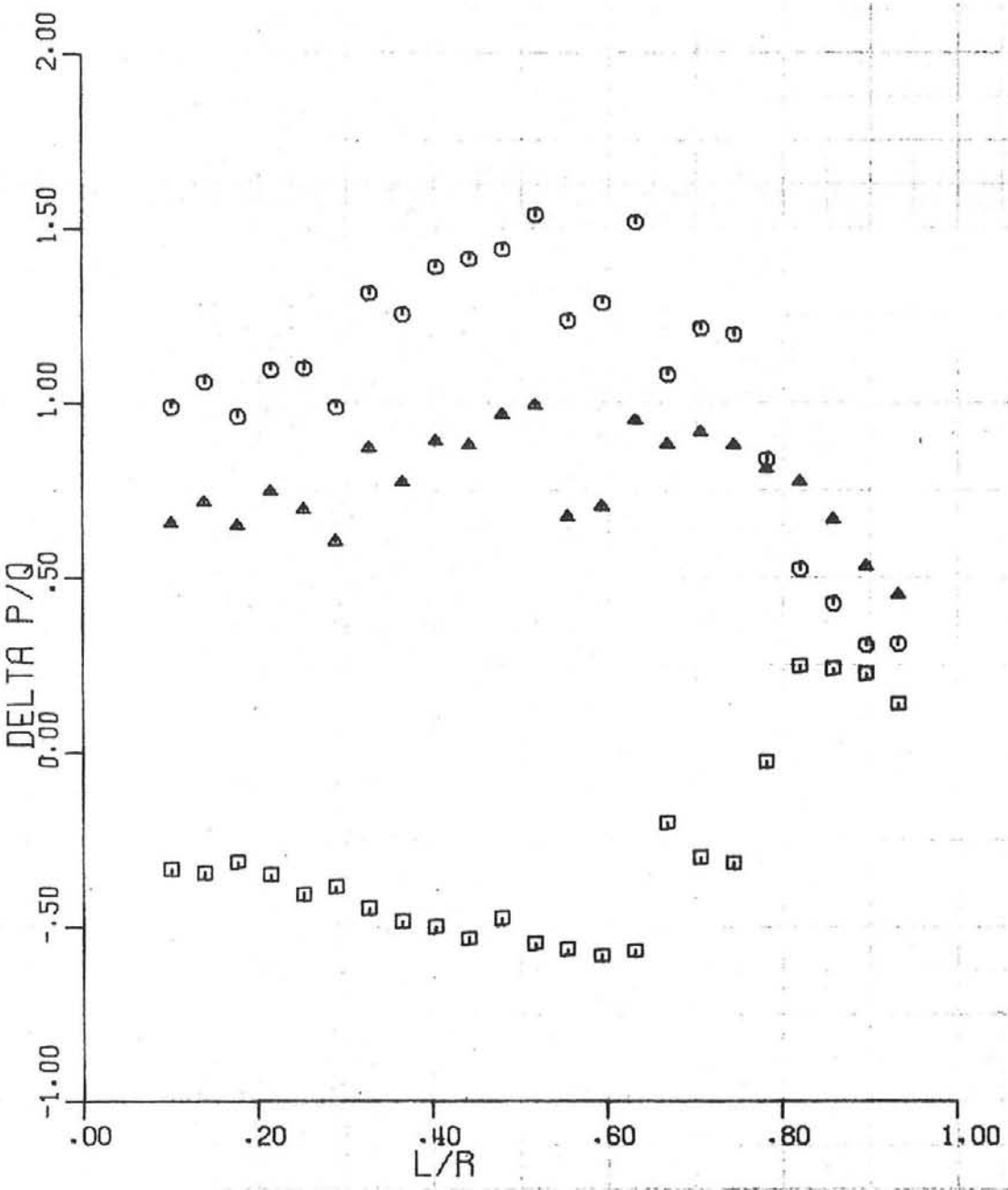
POINT 117 POROSITY= 25.00
Q= 75.34 SHRDL= 1.00
CDOBAL= .3655 REEFL= 57.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



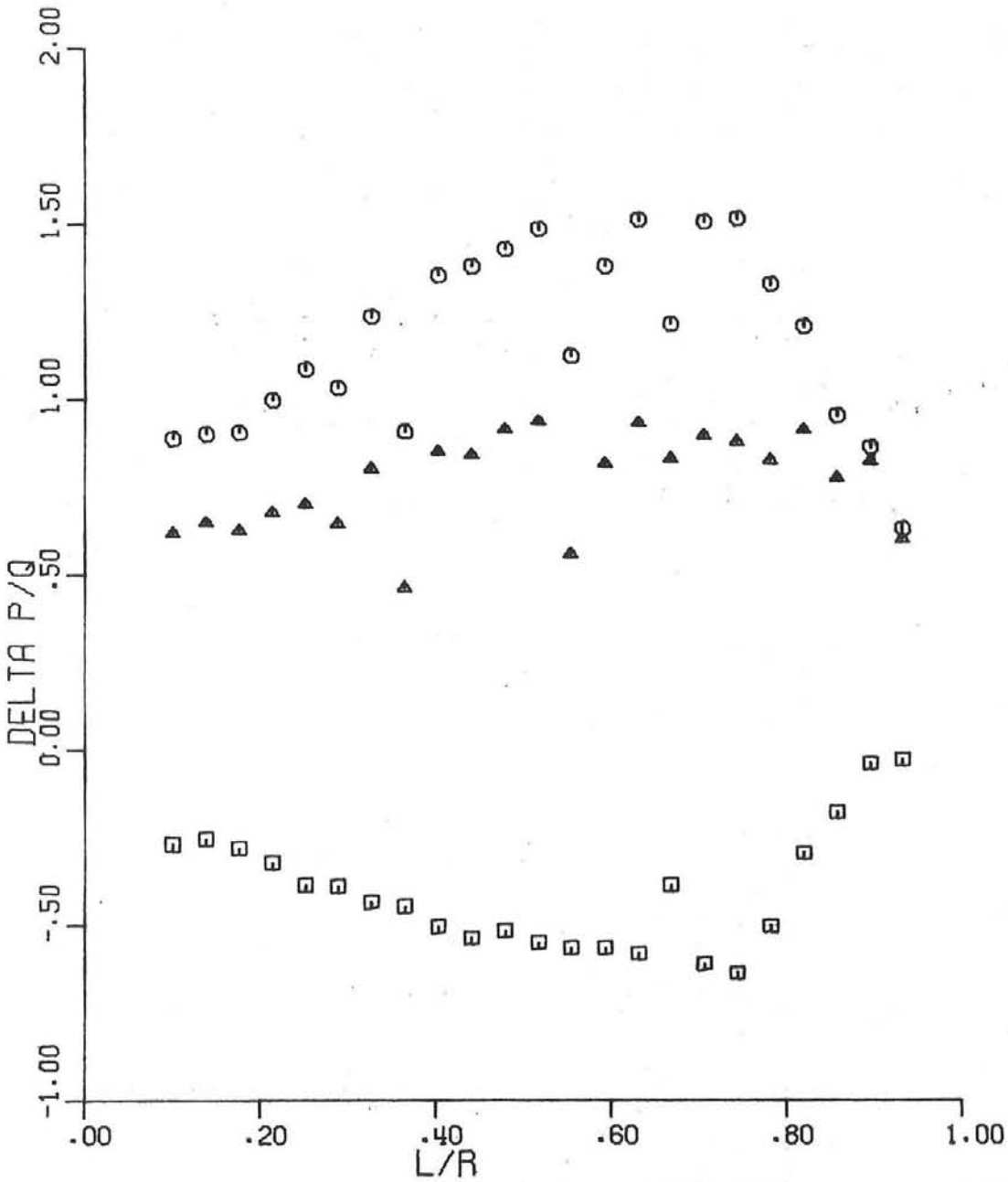
POINT 118 POROSITY= 25.00
Q= 202.84 SHRDL= 1.00
CDOBAL= .3734 REEFL= 57.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



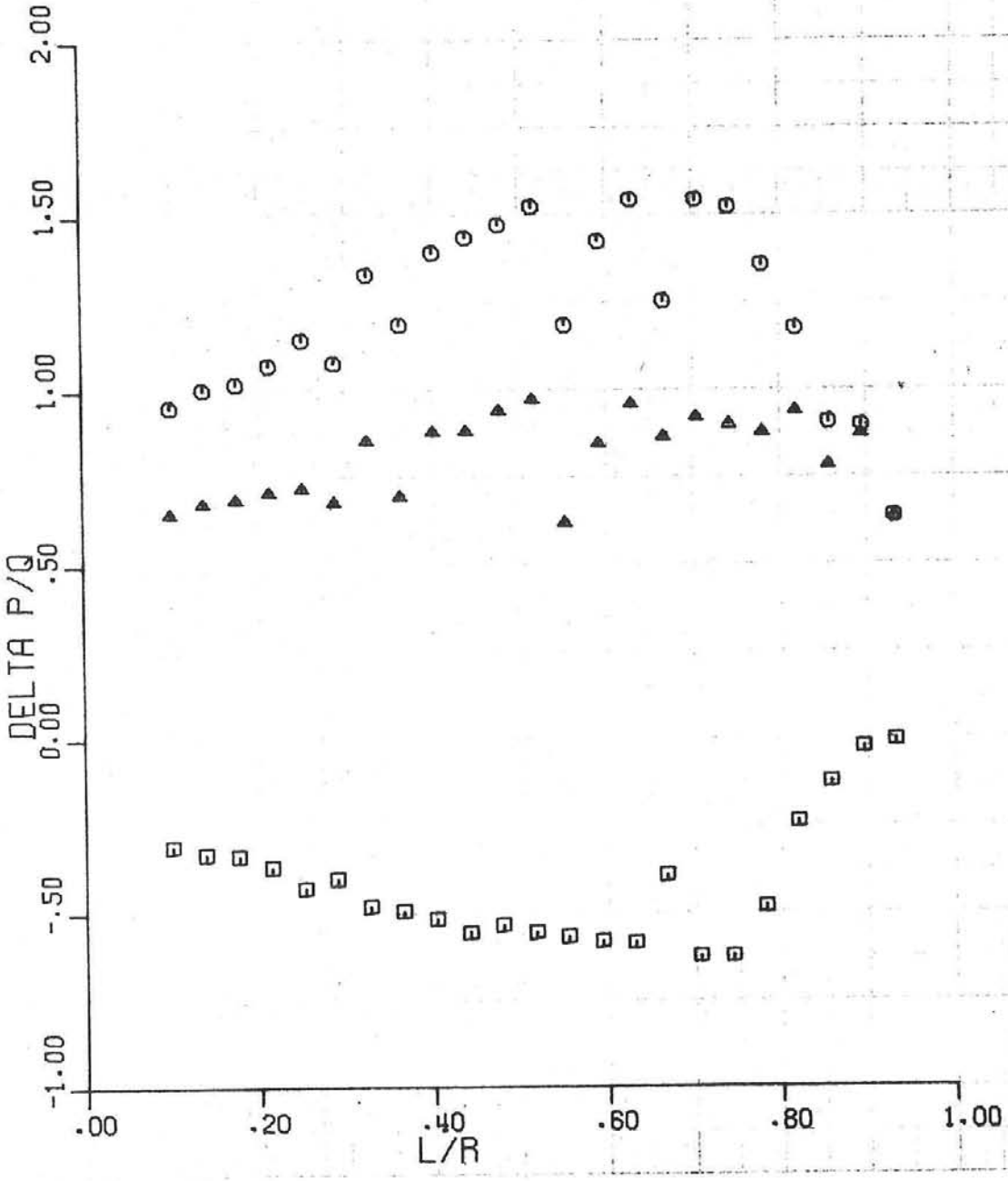
POINT 119 POROSITY= 25.00
Q= 78.99 SHRDL= 1.00
CDOBAL= .4738 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



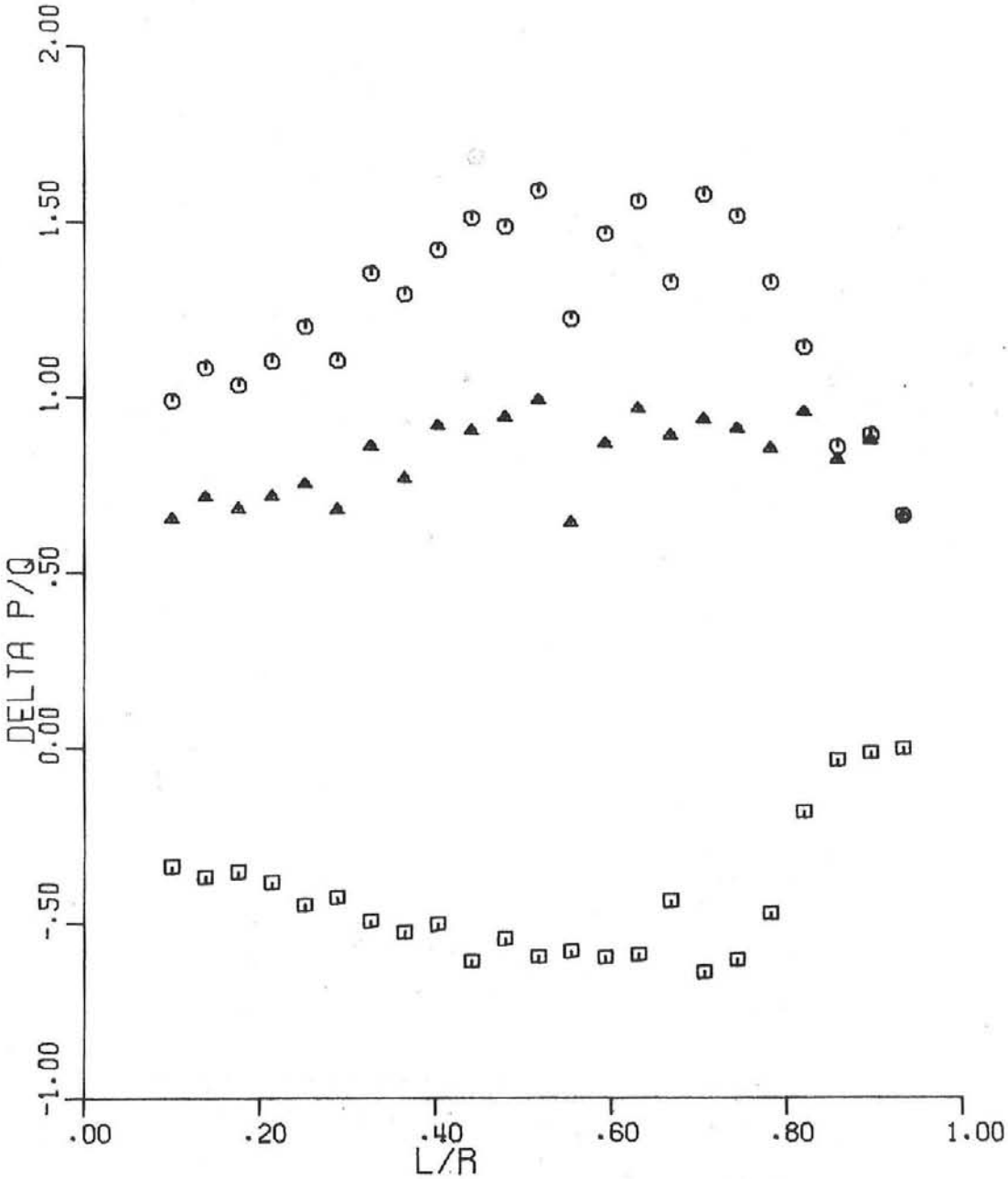
POINT 120 POROSITY= 25.00
Q= 202.24 SHRDL= 1.00
CDOBAL= .4889 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



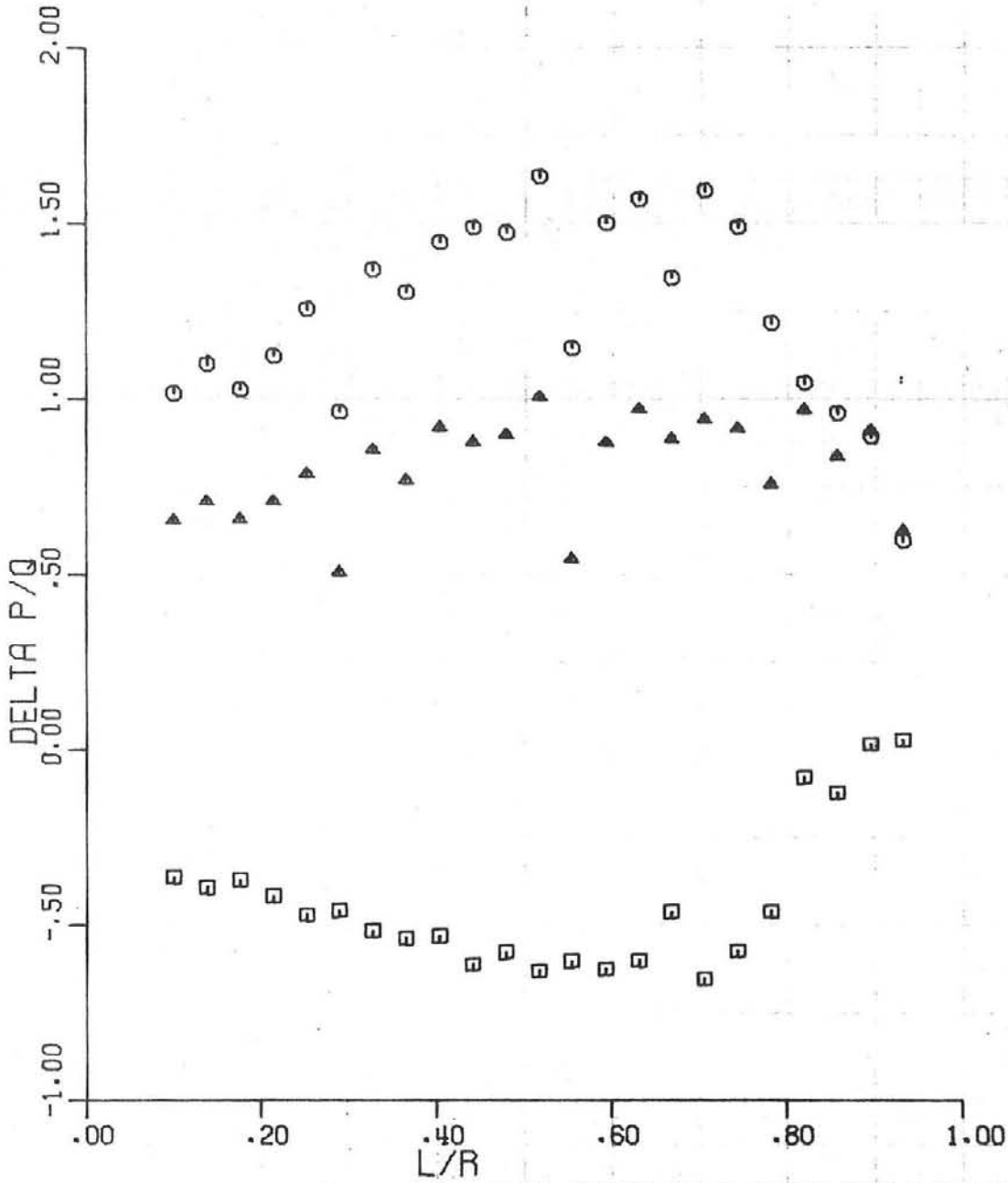
POINT 122 POROSITY= 25.00
Q= 303.30 SHRDL= 1.00
CDOBAL= .4981 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



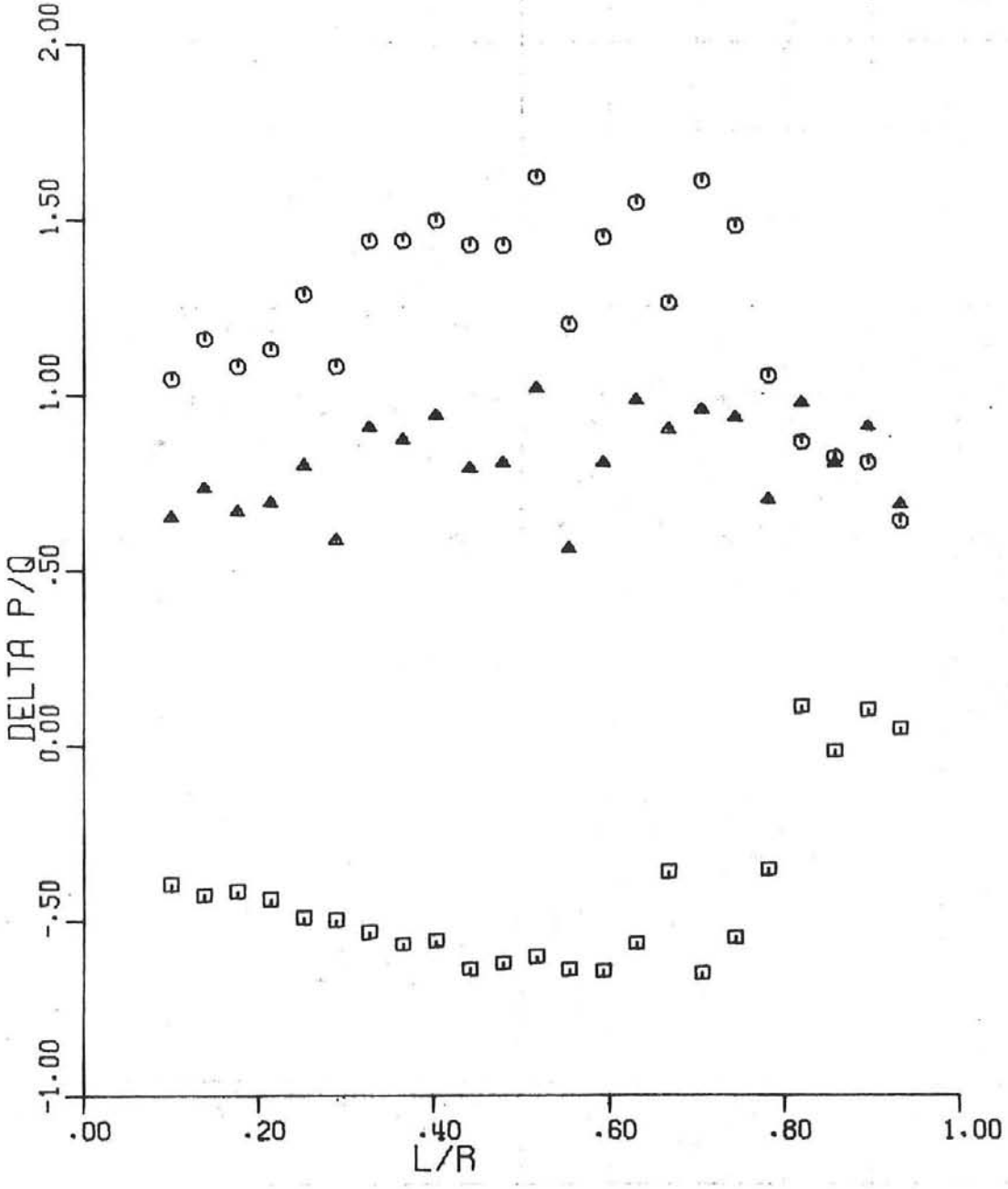
POINT 123 POROSITY= 25.00
Q= 405.56 SHRDL= 1.00
CDOBAL= .5060 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



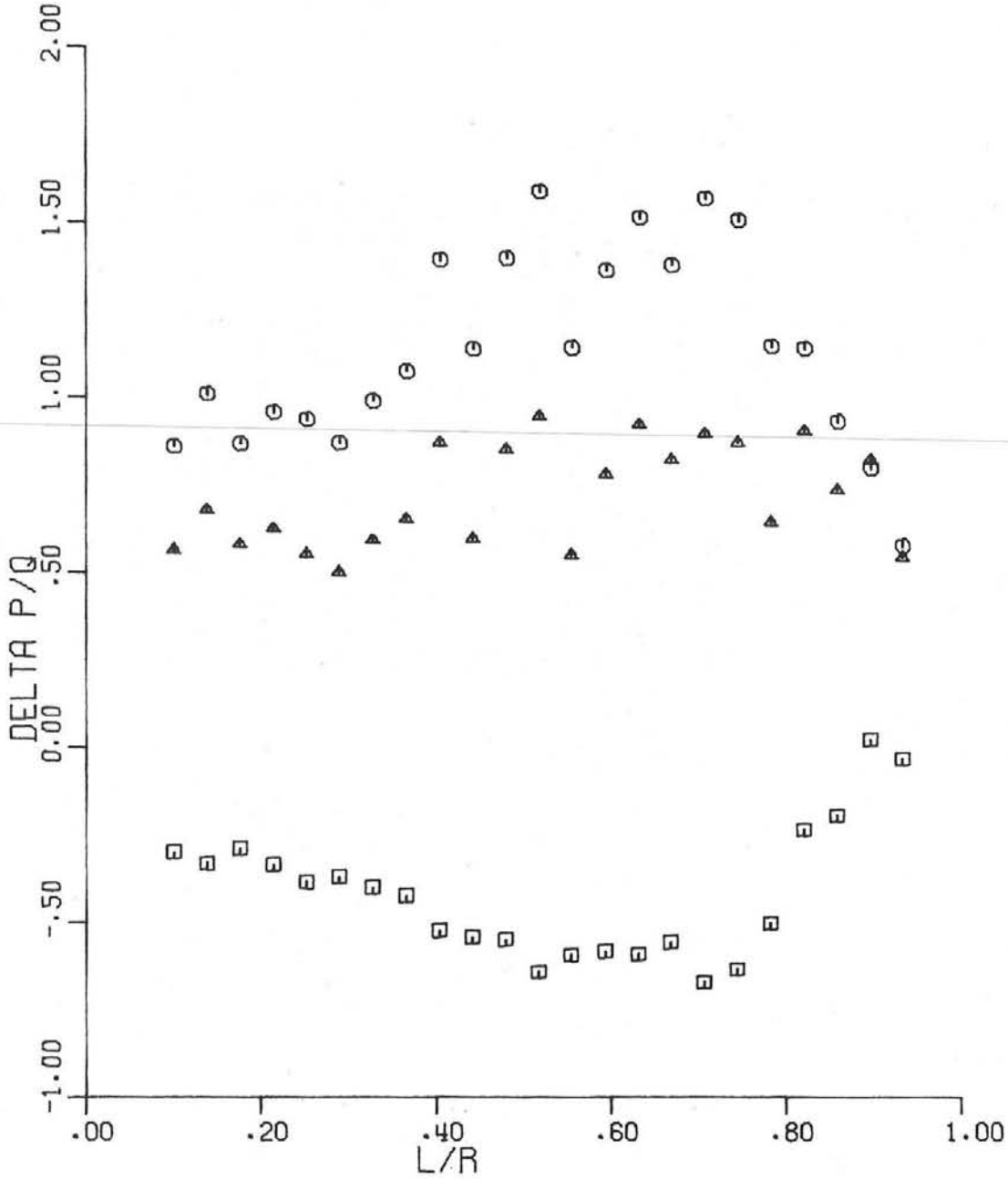
POINT 124 POROSITY= 25.00
Q= 506.43 SHRDL= 1.00
CDOBAL= .5105 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



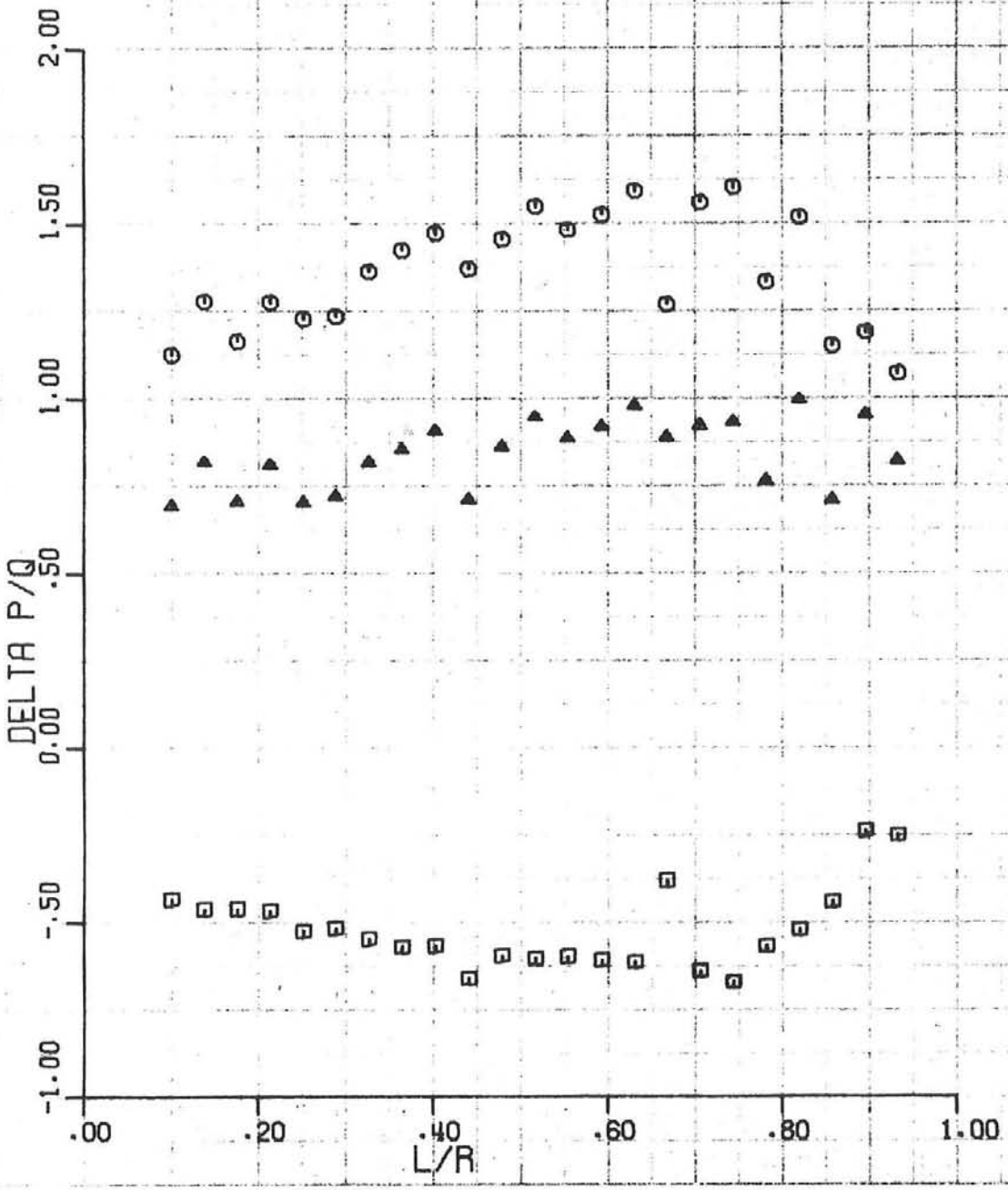
POINT 125 POROSITY= 25.00
Q= 79.08 SHRDL= 1.00
CDOBAL= .4716 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



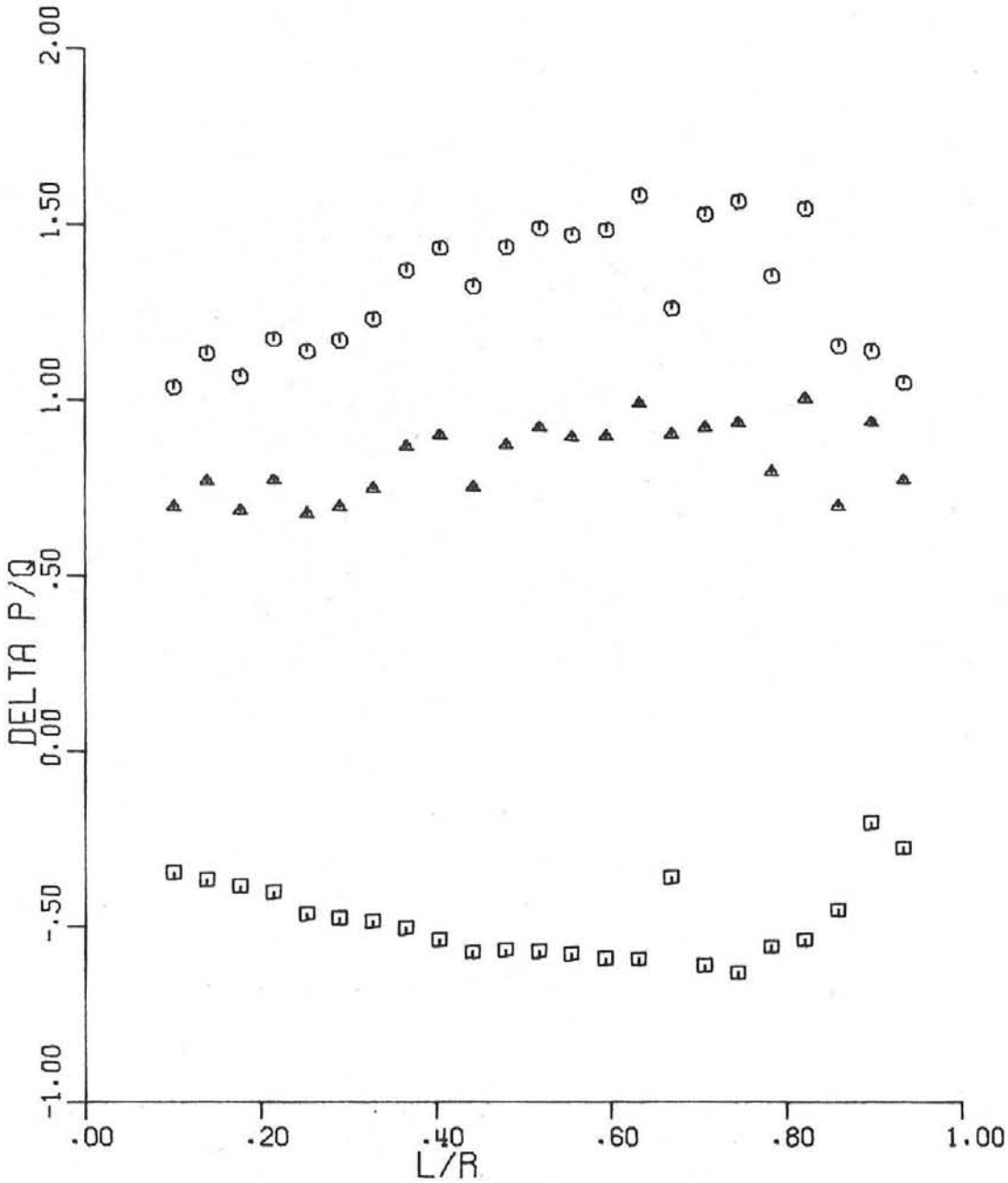
POINT 127 POROSITY= 25.00
Q= 202.93 SHRDL= 1.50
CDOBAL= .5912 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



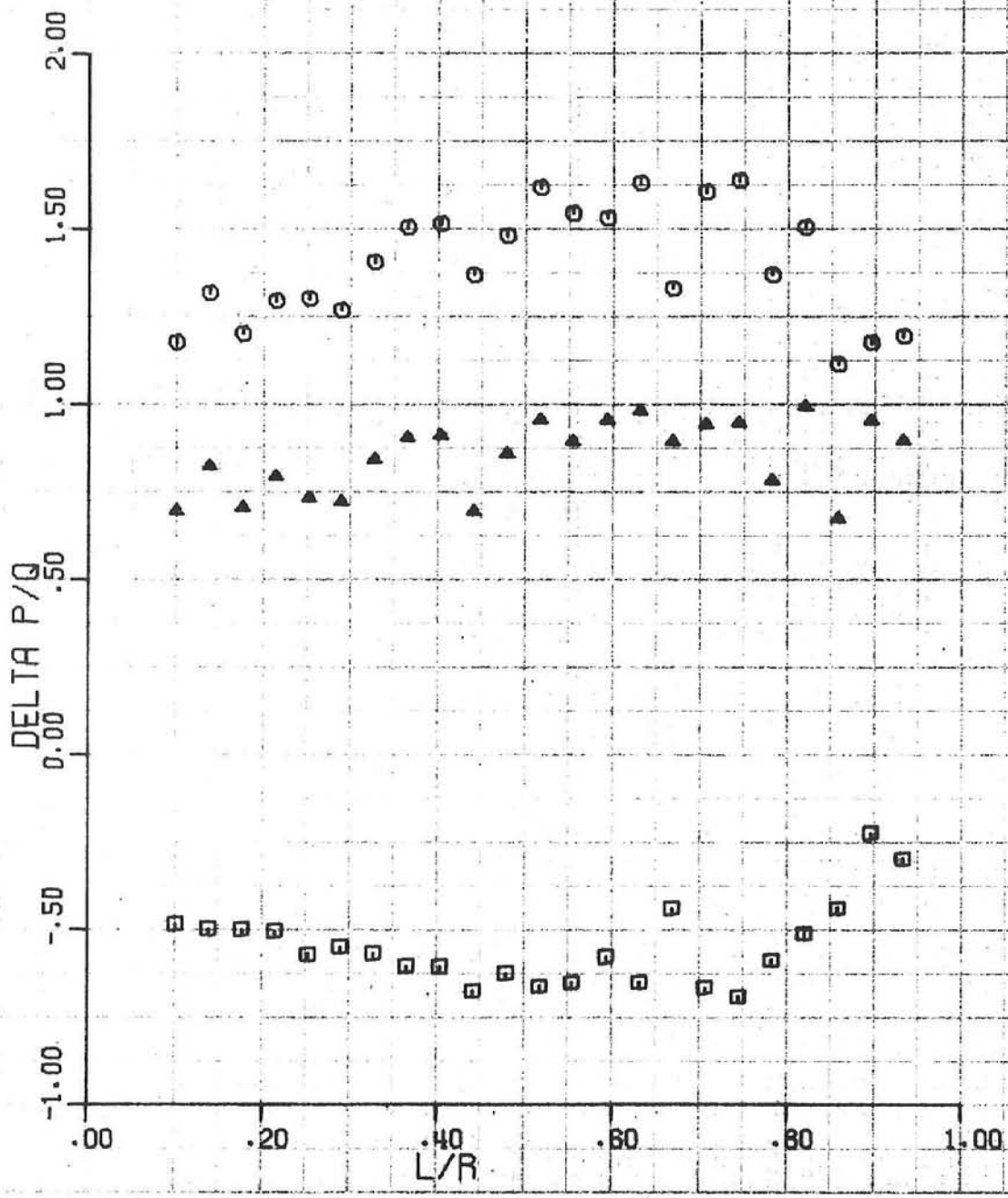
POINT 126 POROSITY= 25.00
Q= 75.15 SHRDL= 1.50
CDOBAL= .5754 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



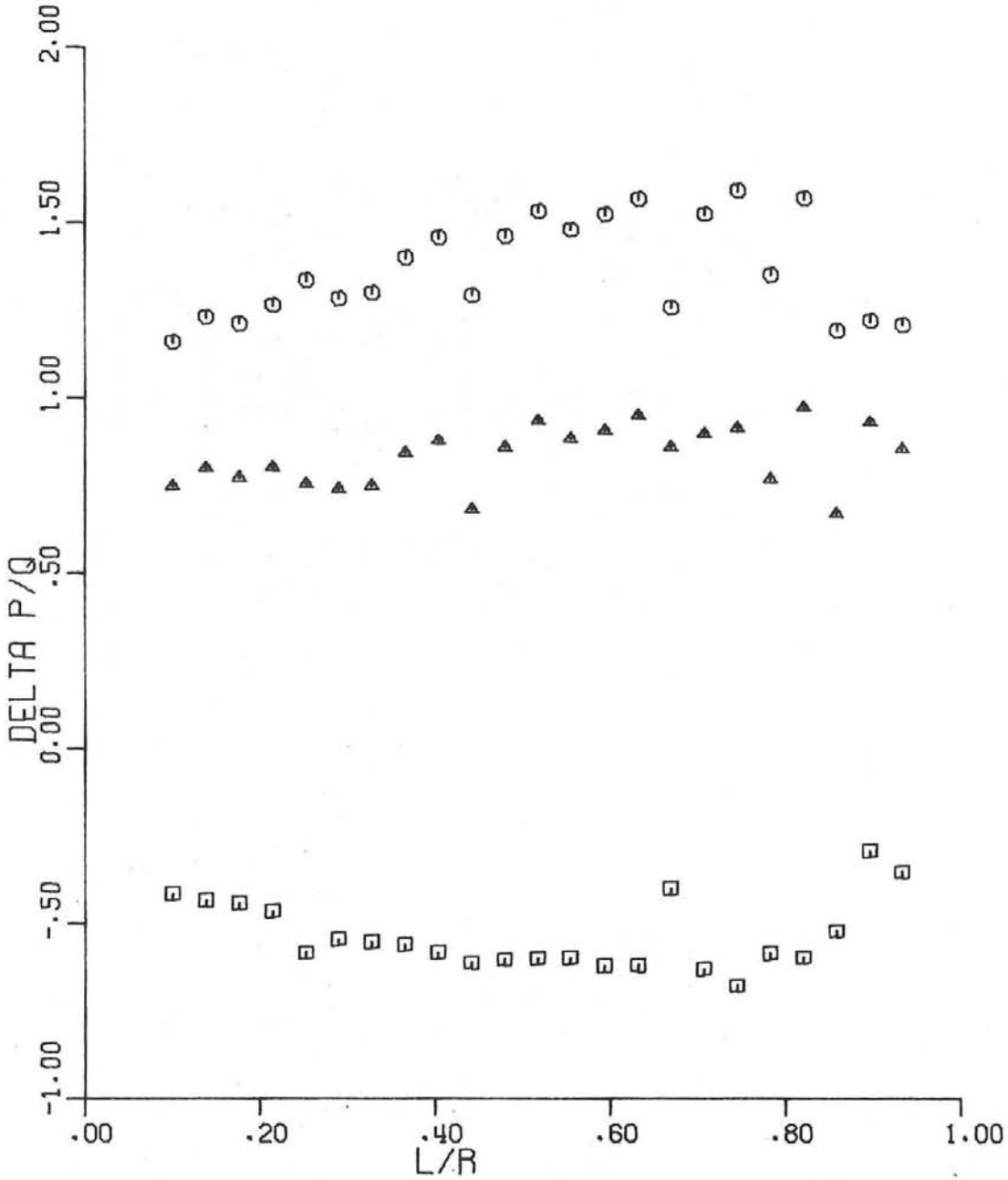
POINT 128 POROSITY= 25.00
Q= 300.32 SHRDL= 1.50
CDOBAL= .6085 REEFL= 0.00

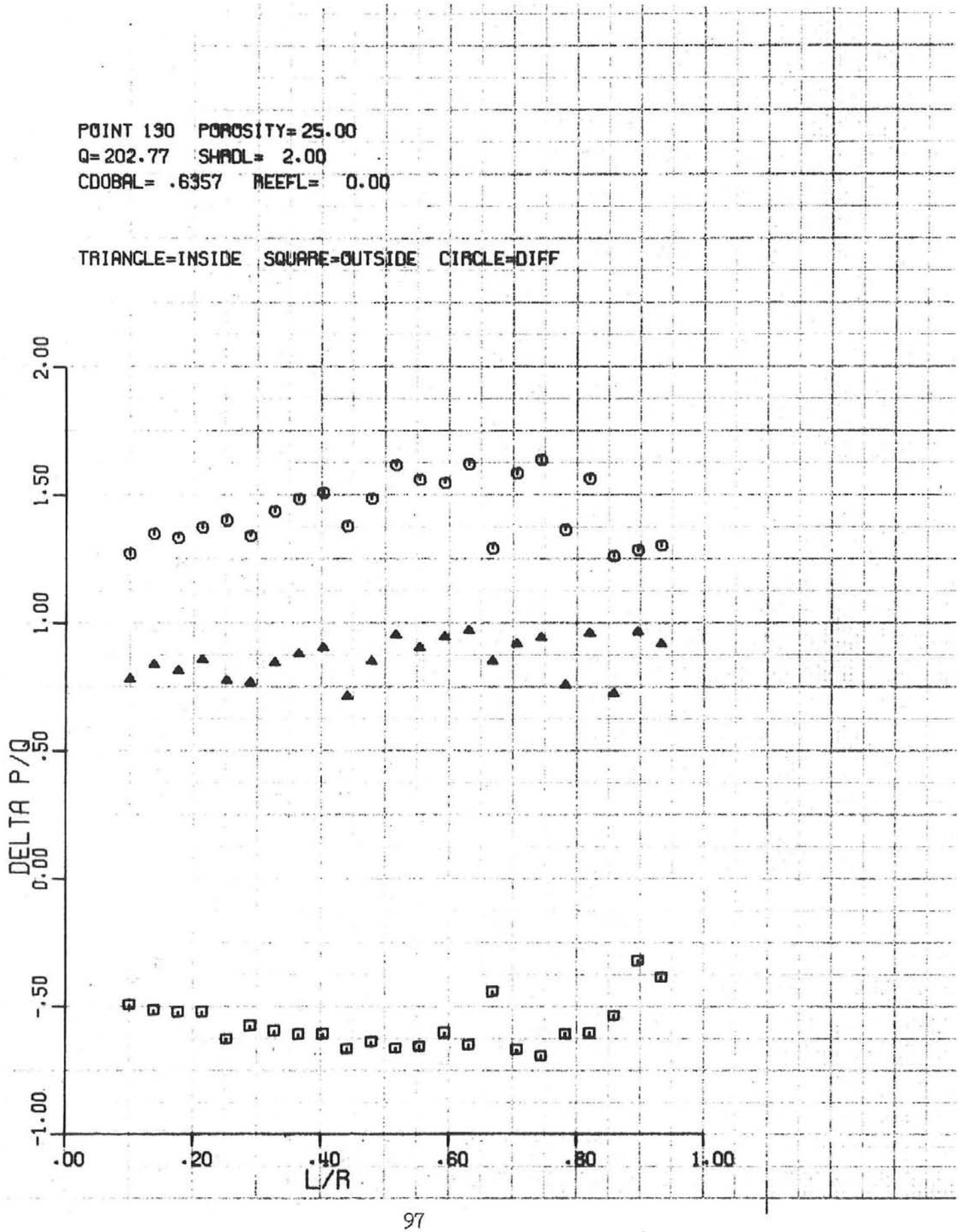
TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



PØINT 129 PØRØSITY=25.00
Q=75.09 SHRDL= 2.00
CDOBAL= .6128 REEFL= 0.00

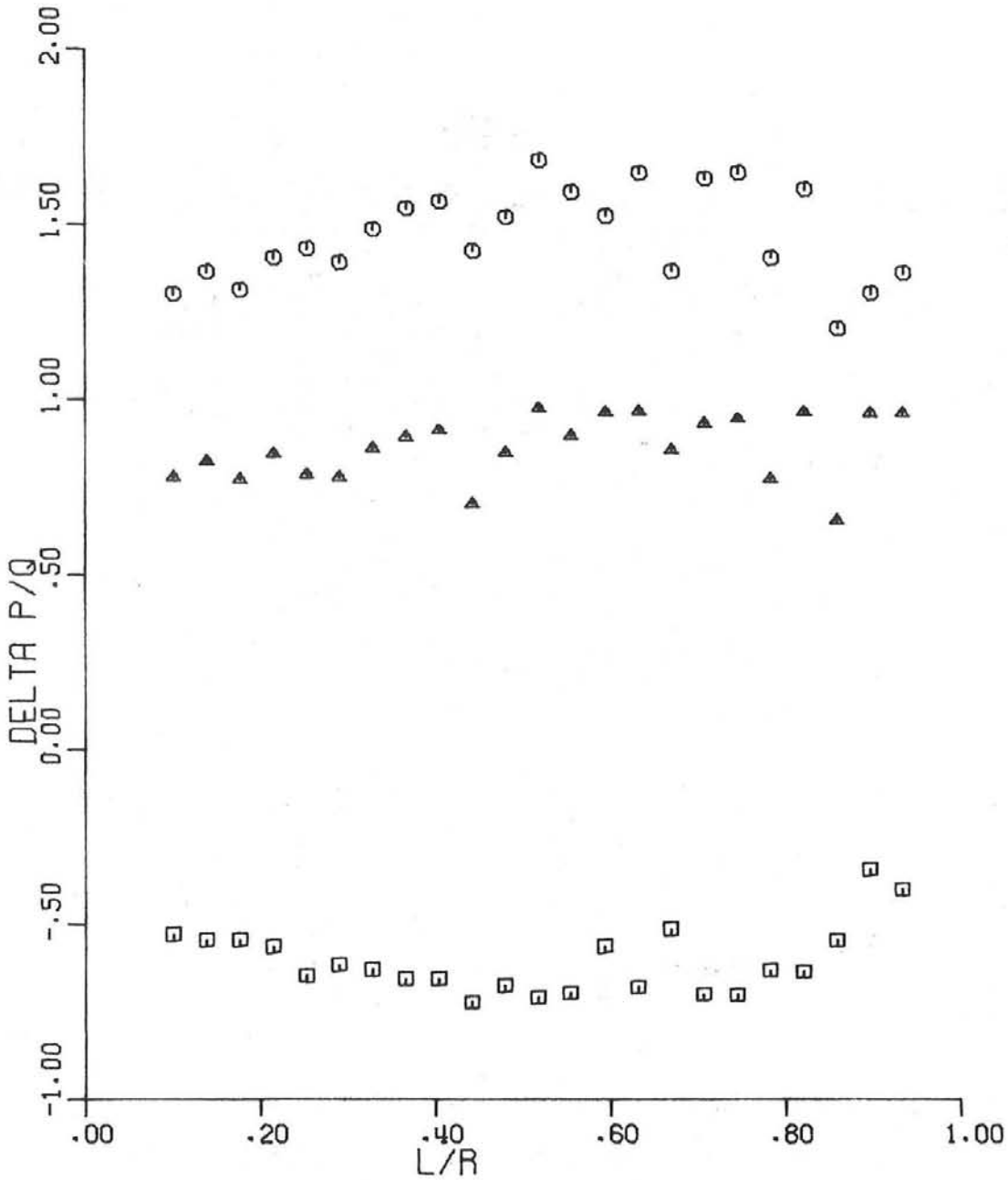
TRIANGLE=INSIDE SQUARE=ØUTSIDE CIRCLE=DIFF




POINT 130 POROSITY= 25.00
Q= 202.77 SHADL= 2.00
CDOBAL= .6357 REEFL= 0.00
TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF
DELTA P/Q
2.00
1.50
1.00
.50
0.00
-.50
-1.00
.00
.20
.40
.60
.80
1.00
L/R

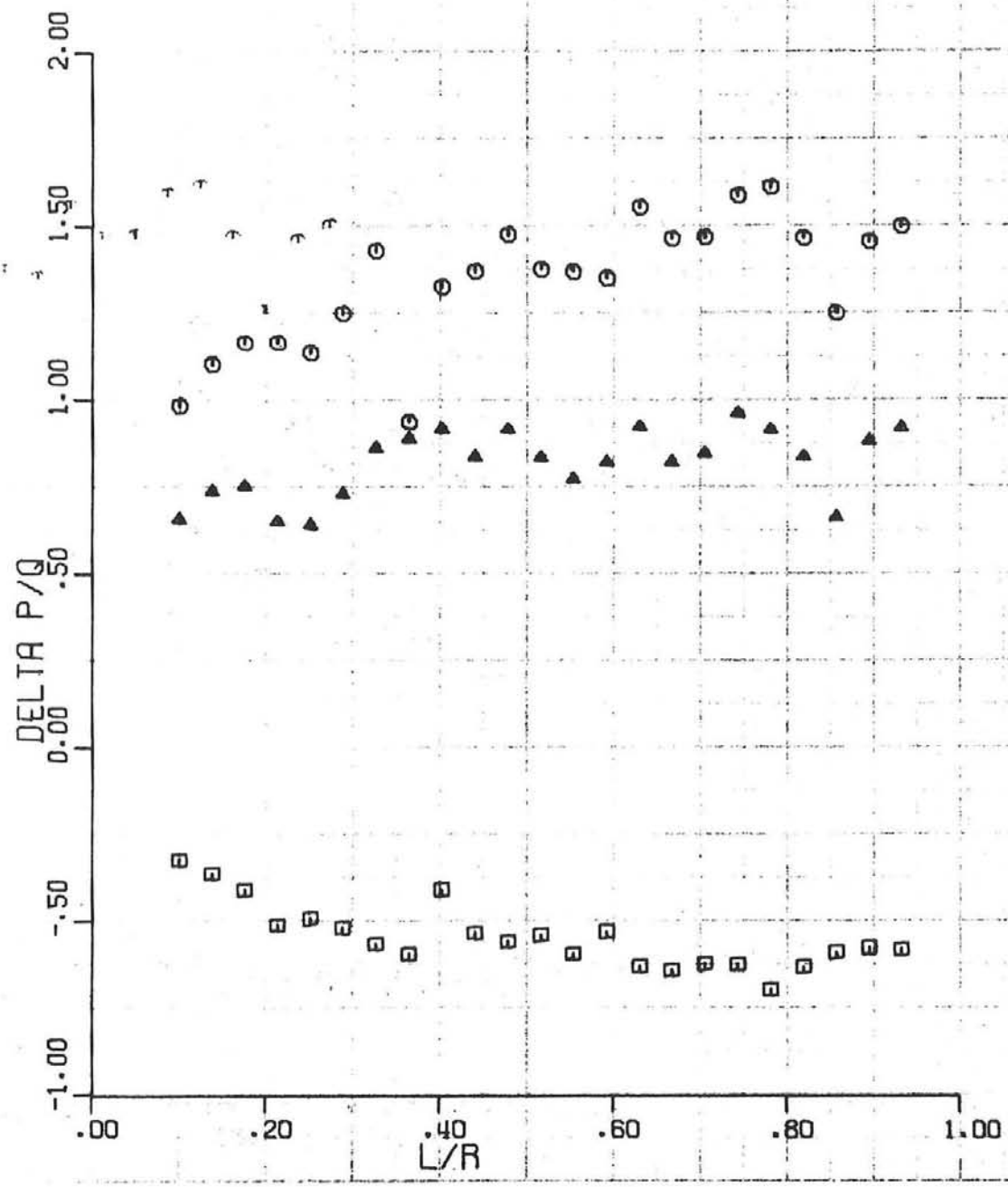
POINT 131 POROSITY= 25.00
Q= 299.99 SHROL= 2.00
CDOBAL= .6534 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



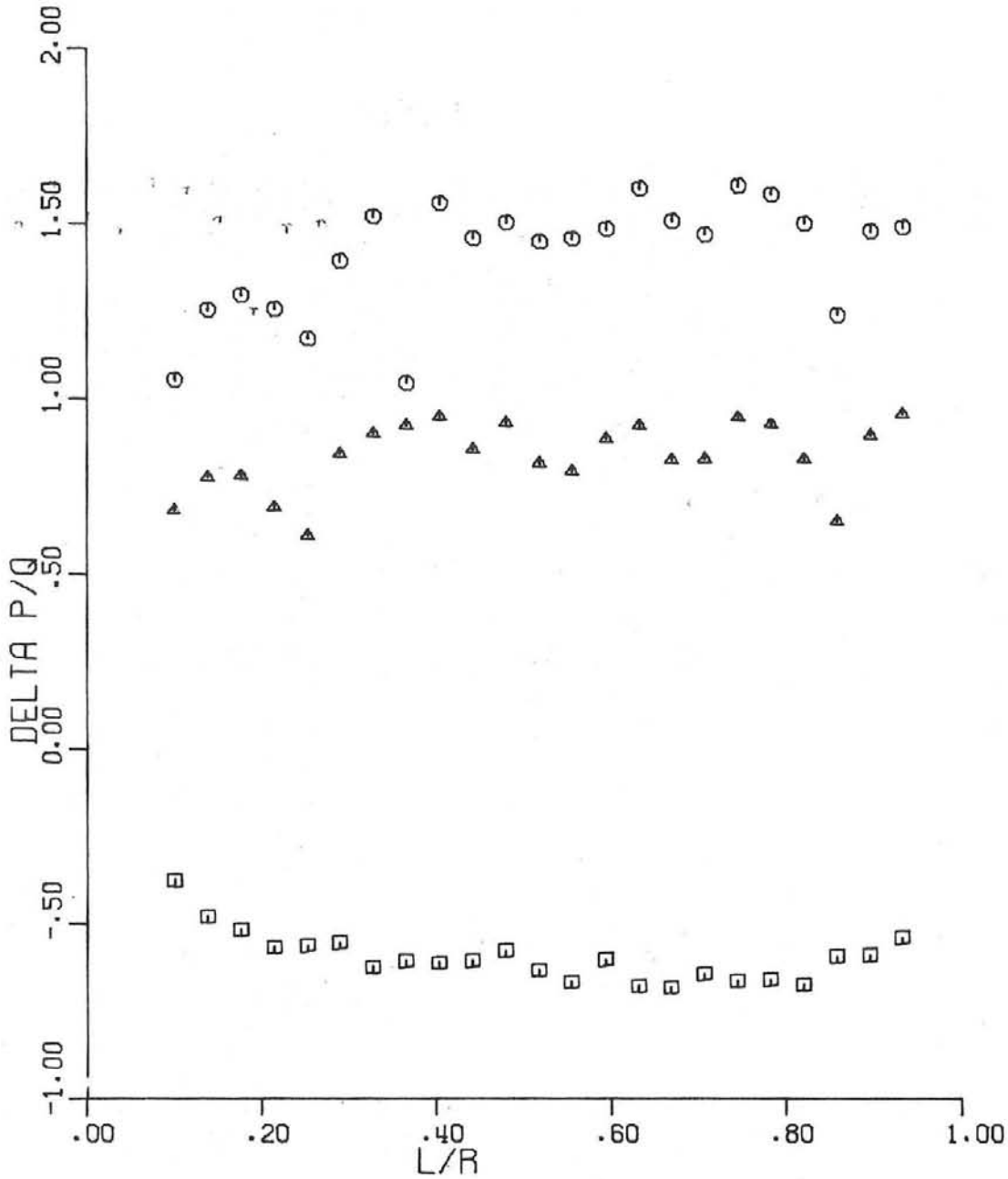
POINT 132 POROSITY= 20.00
Q= 75.04 SHRDL= 2.00
CDOBAL= .6287 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



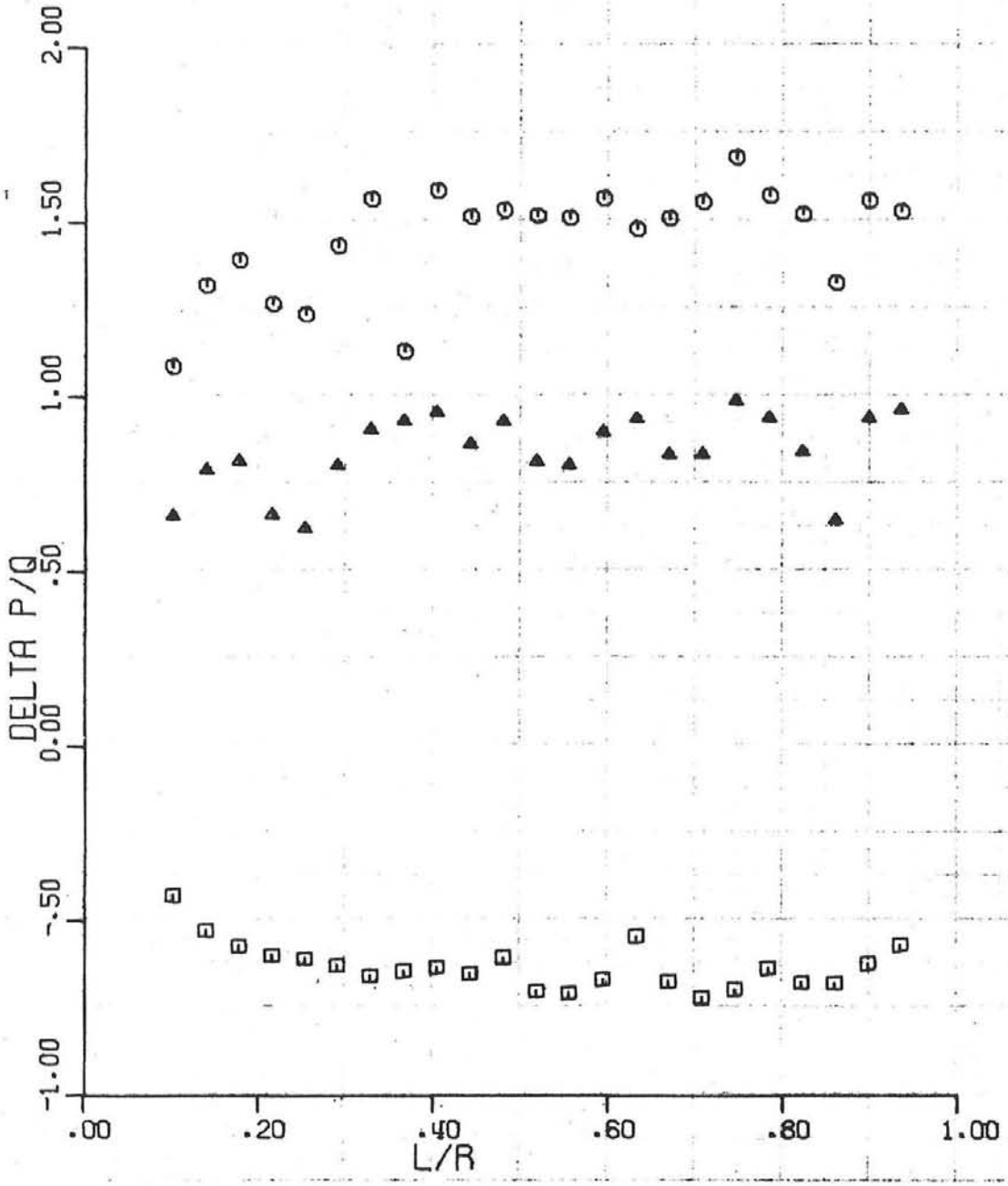
POINT 133 POROSITY= 20.00
Q= 203.64 SHROL= 2.00
CDOBAL= .6620 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



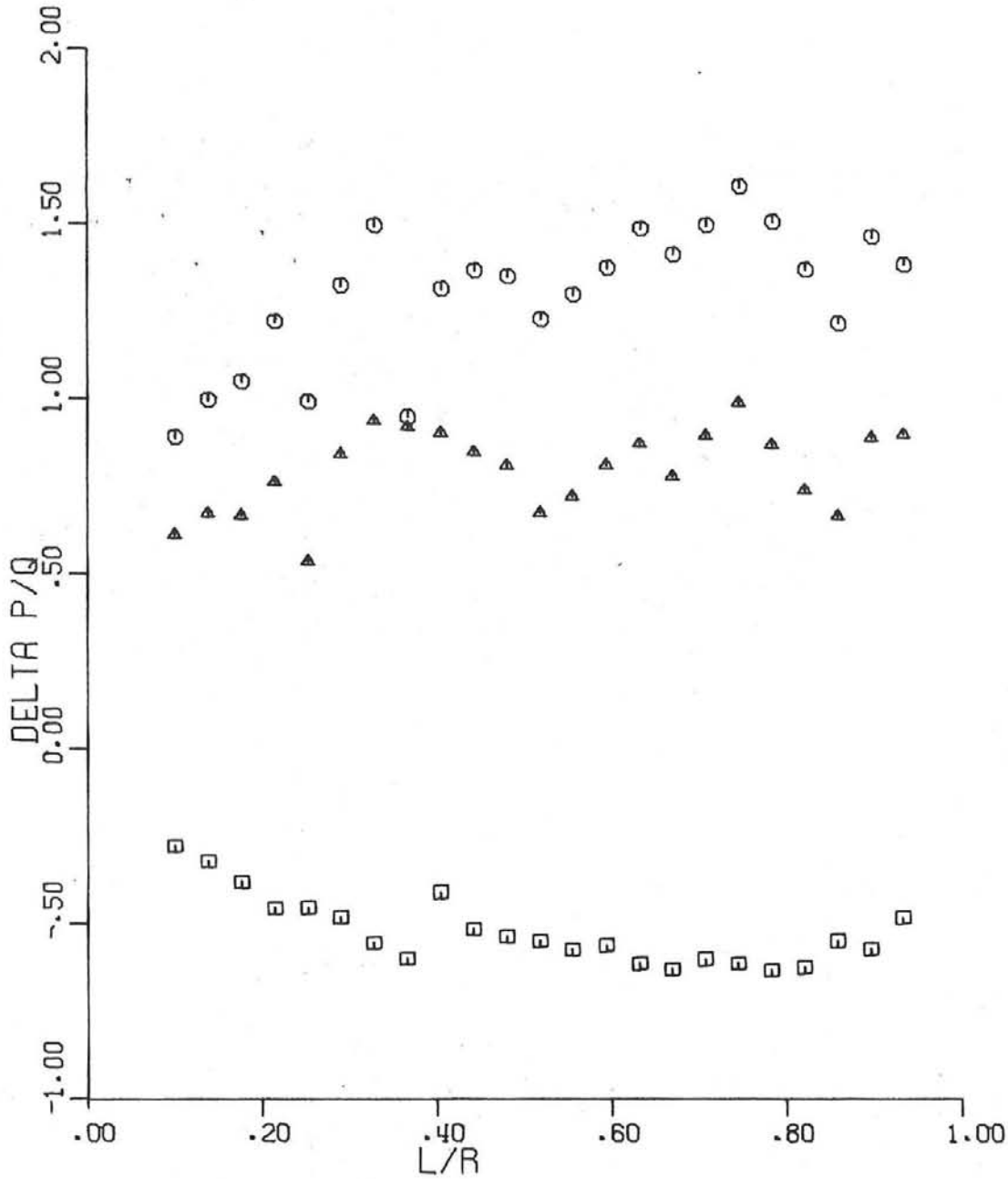
POINT 134 POROSITY= 20.00
Q= 304.52 SHRDL= 2.00
CDOBAL= .6882 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



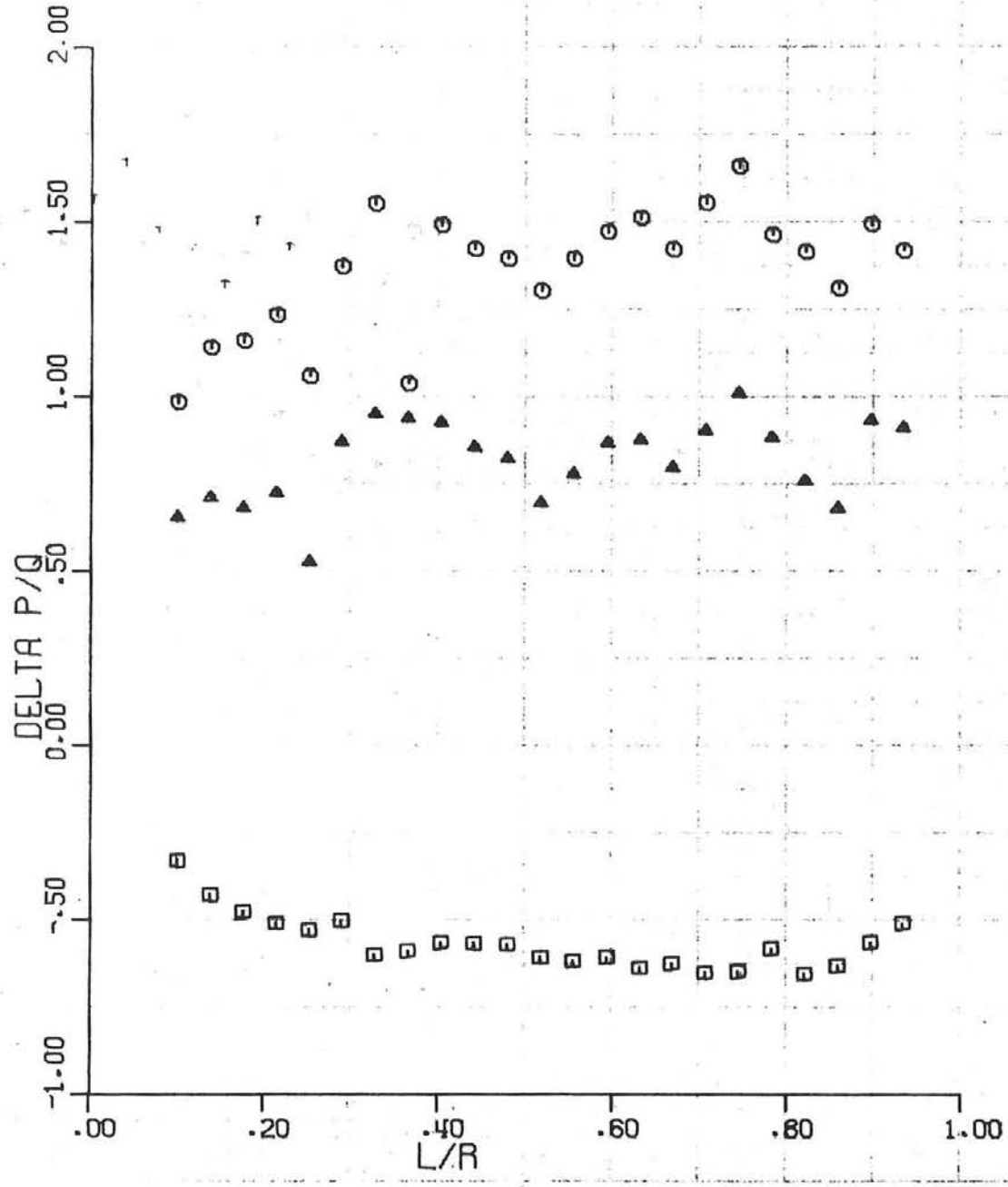
POINT 135 POROSITY= 20.00
Q= 74.57 SHRDL= 1.50
CDOBAL= .6016 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



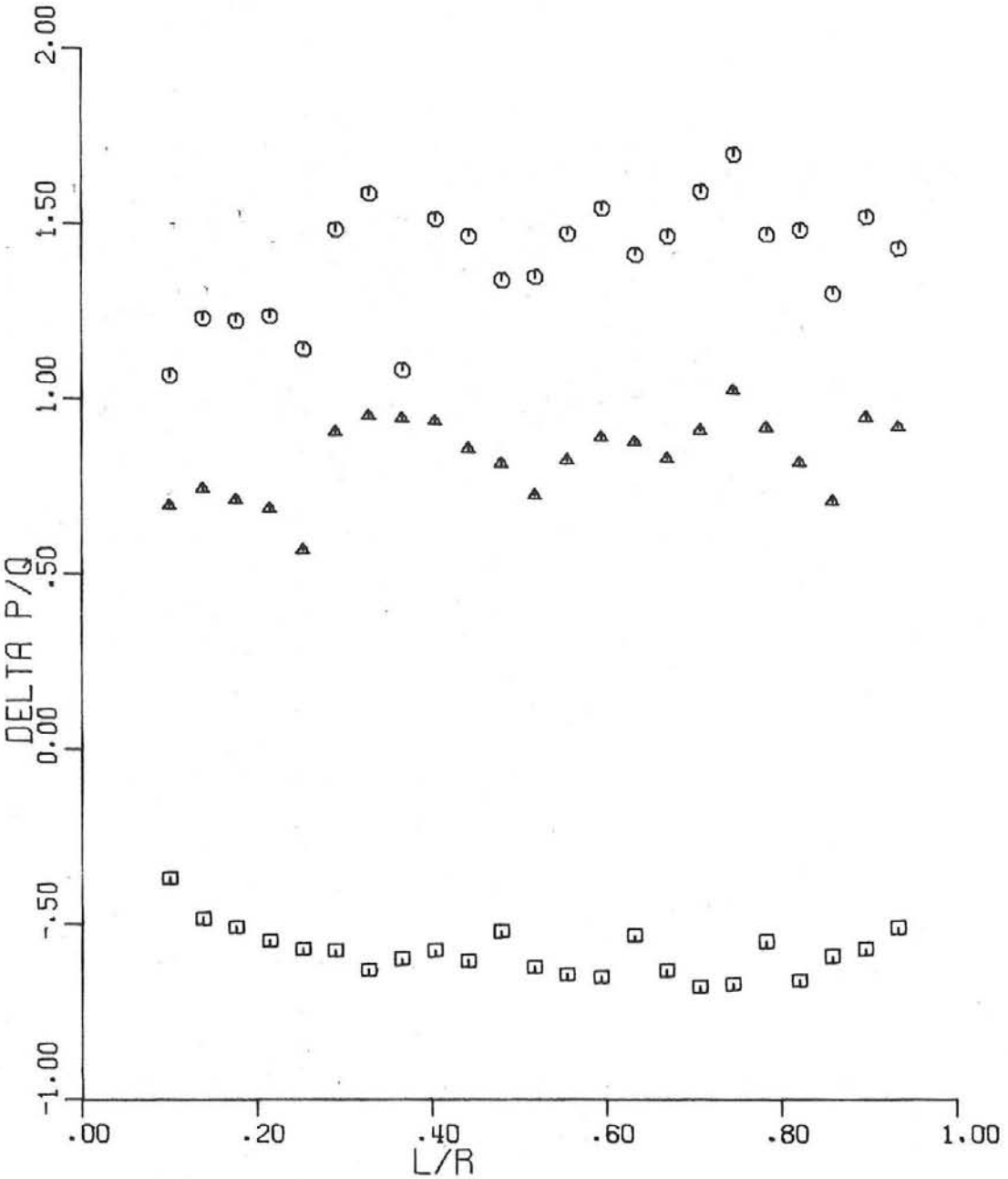
POINT 136 POROSITY=20.00
Q=202.17 SHRDL= 1.50
CDOBAL= .6258 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



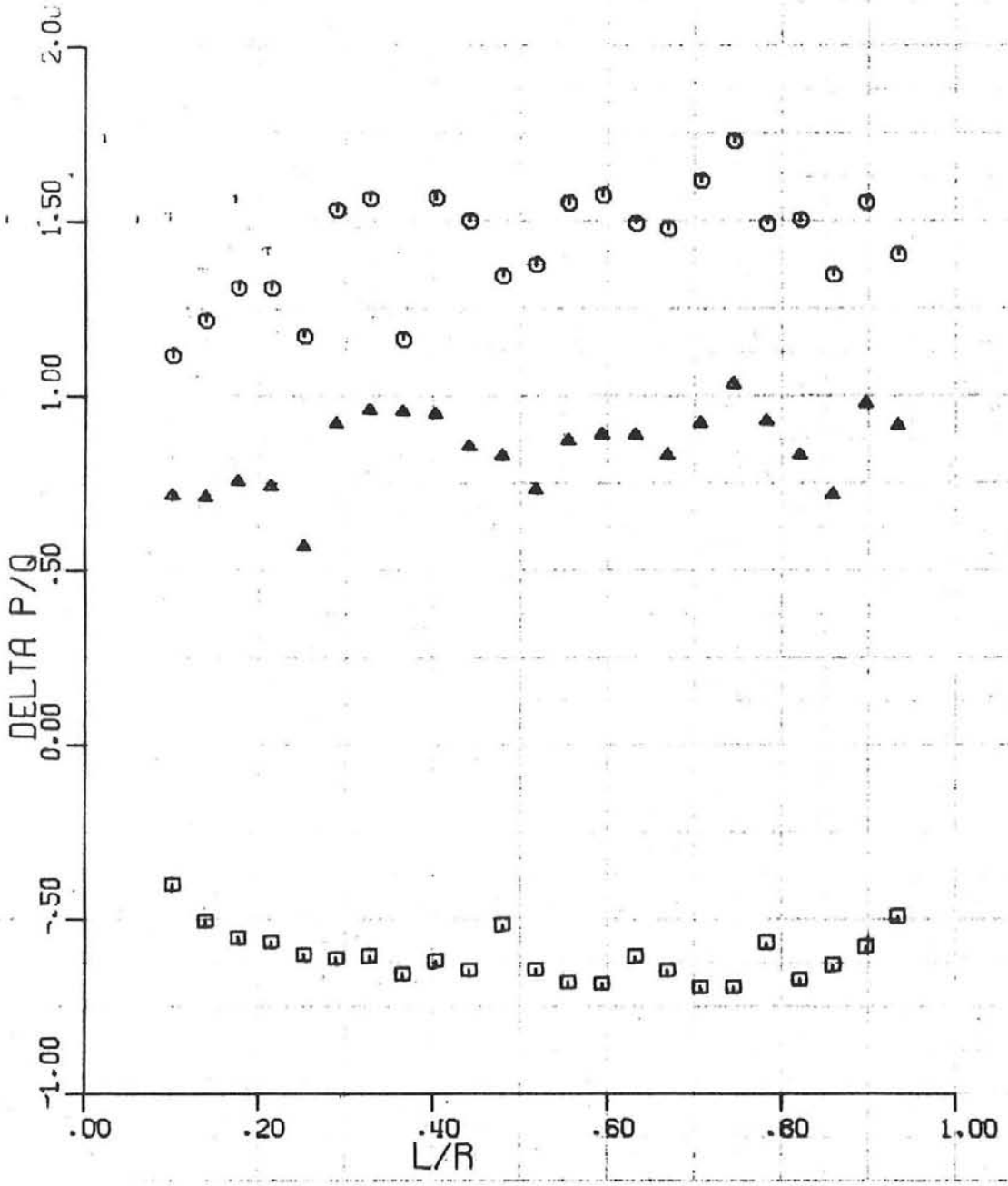
POINT 137 POROSITY= 20.00
Q= 304.21 SHRDL= 1.50
CDOBAL= .6440 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



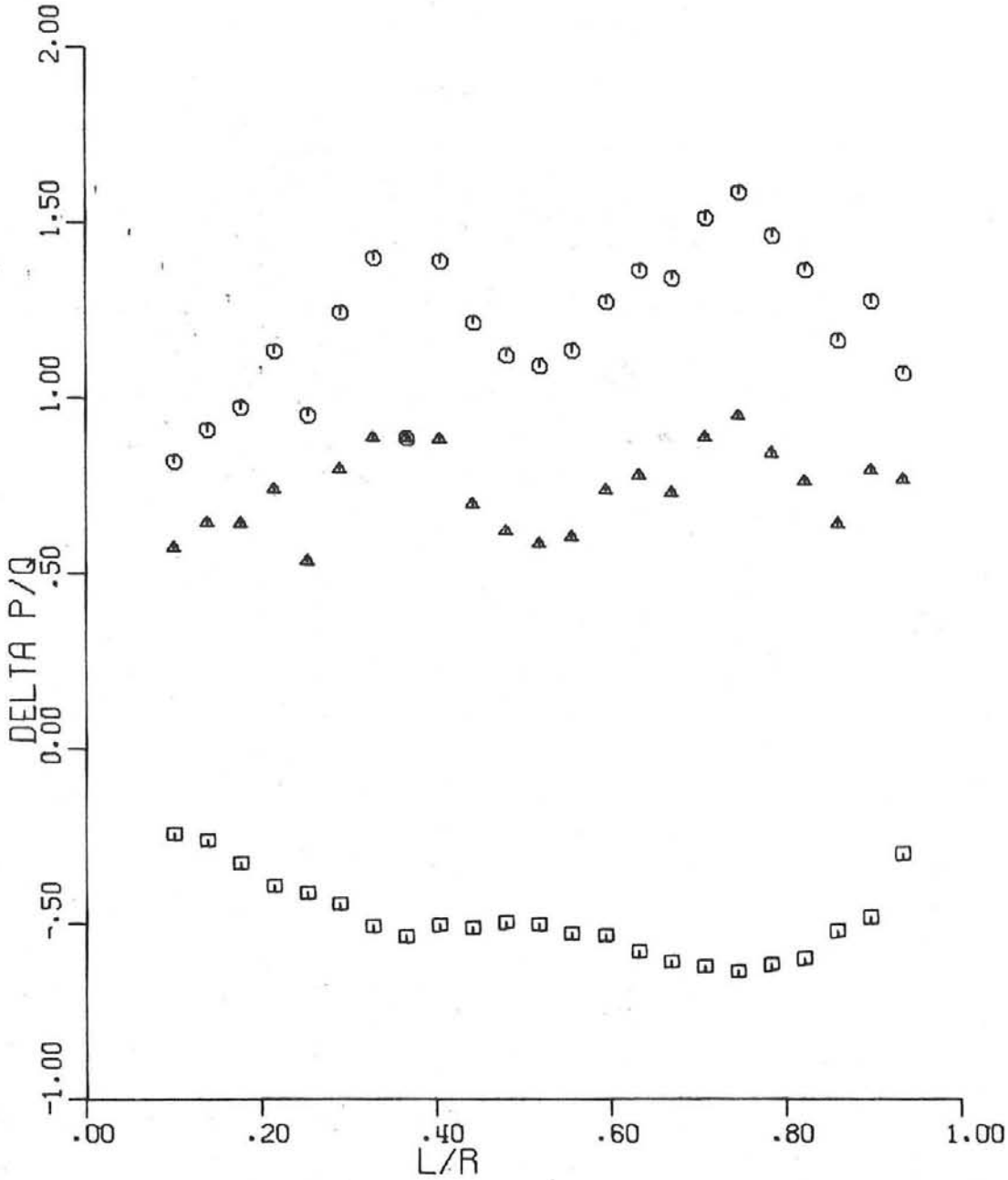
POINT 138 POROSITY= 20.00
Q= 385.71 SHRDL= 1.50
CDOBAL= .6591 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



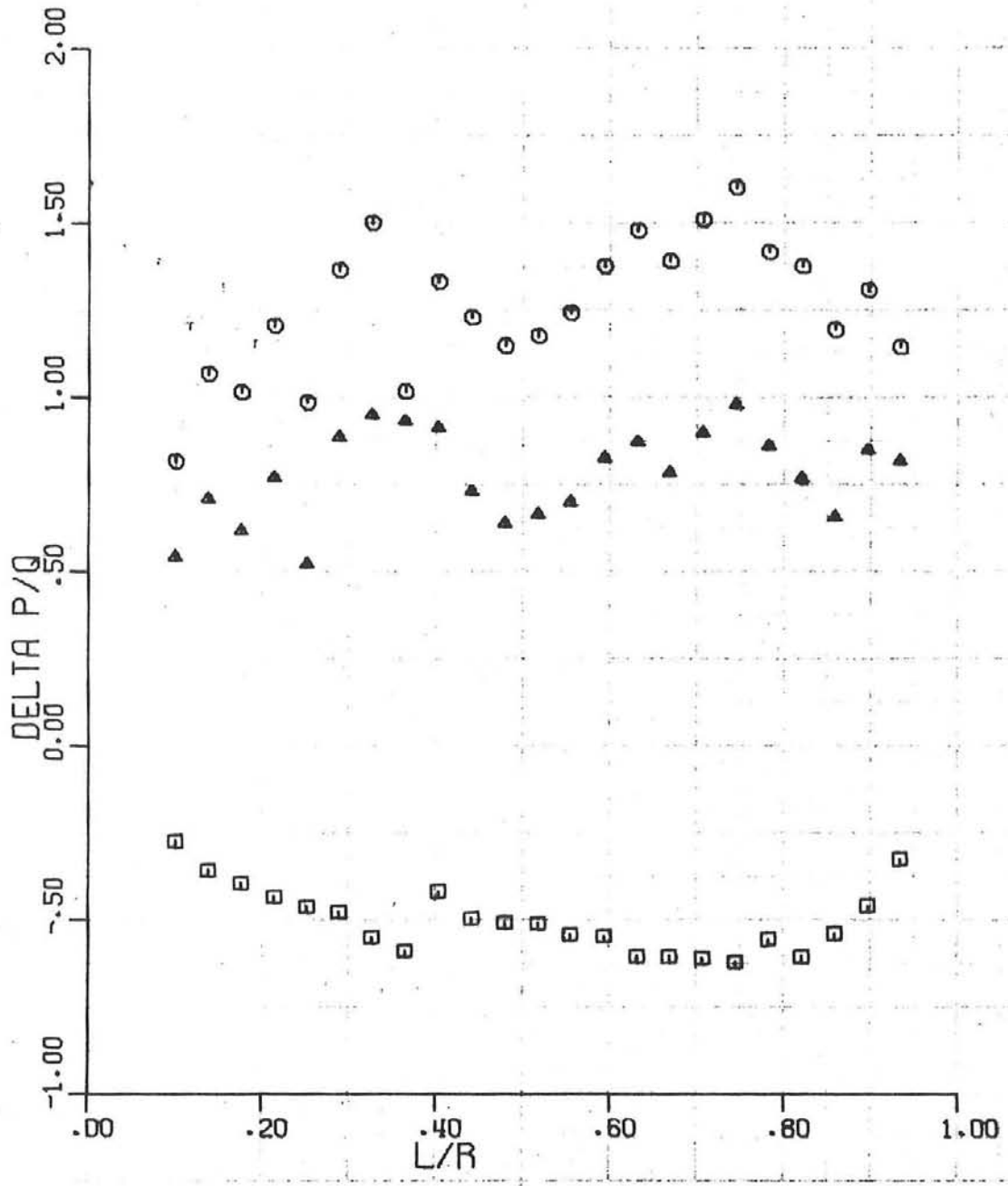
POINT 139 POROSITY= 20.00
Q= 75.84 SHRDL= 1.00
CDOBAL= .5273 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



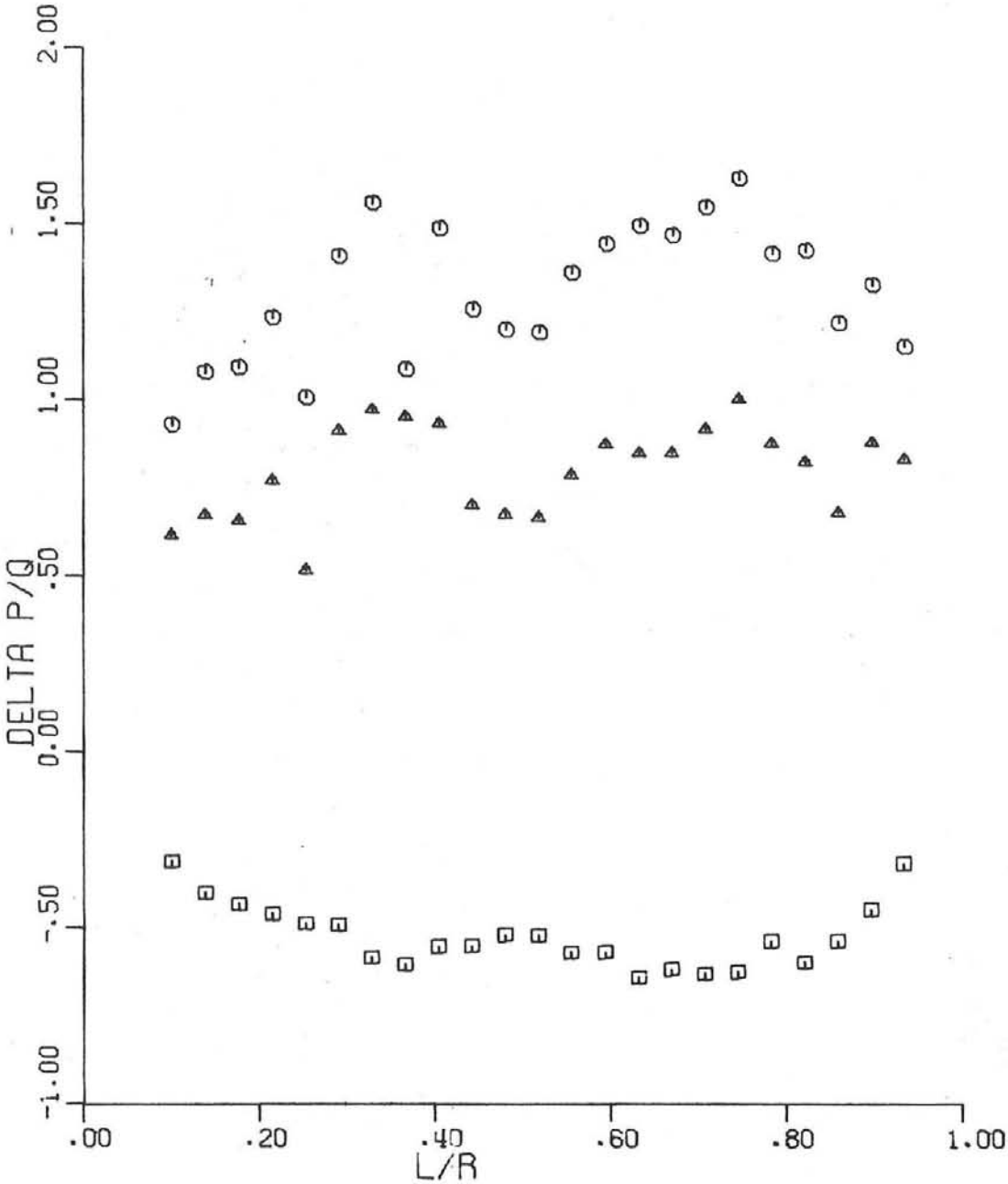
POINT 140 POROSITY= 20.00
Q= 203.91 SHRDL= 1.00
CDOBAL= .5462 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



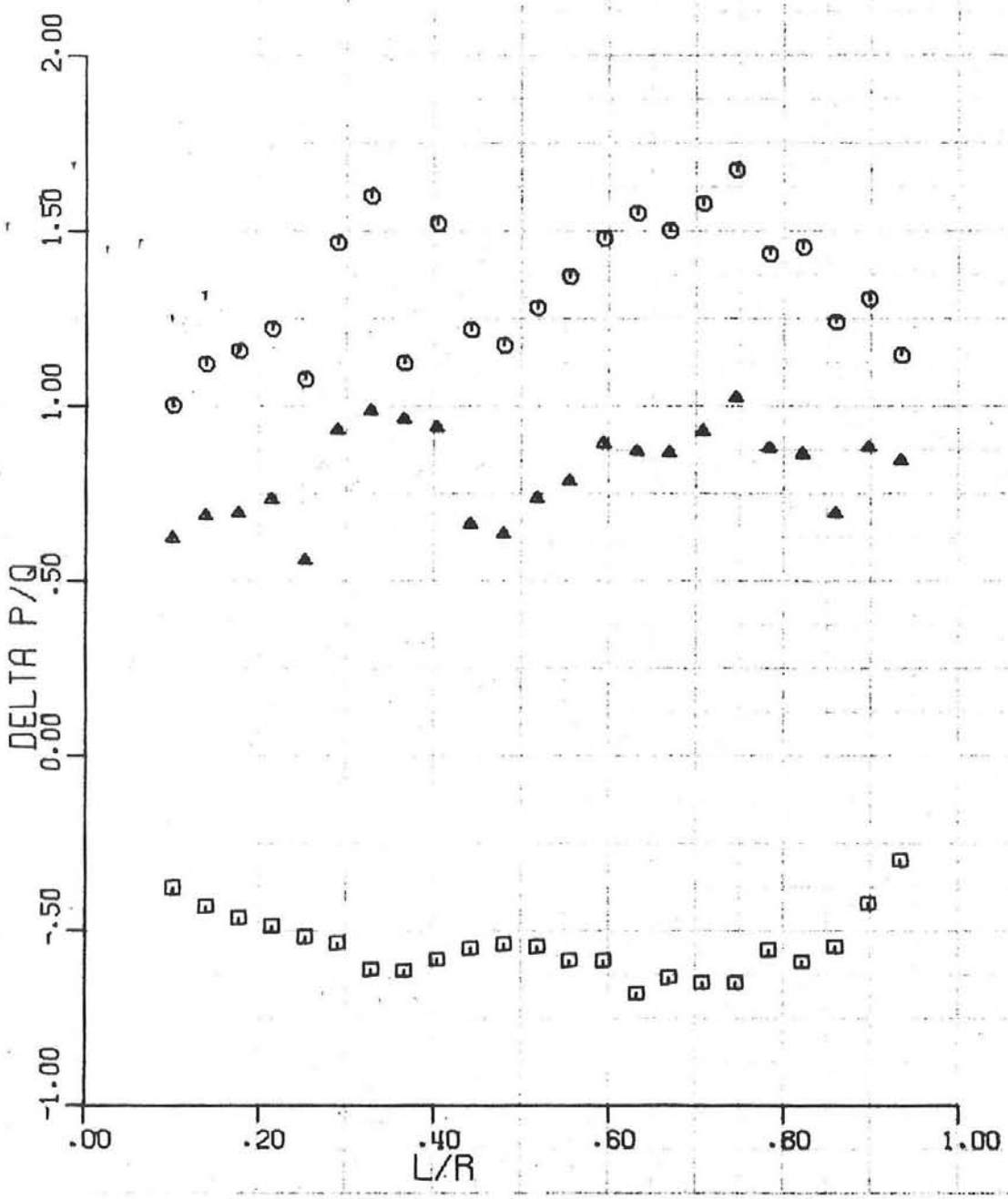
POINT 141 POROSITY= 20.00
Q= 303.07 SHRDL= 1.00
CDOBAL= .5615 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



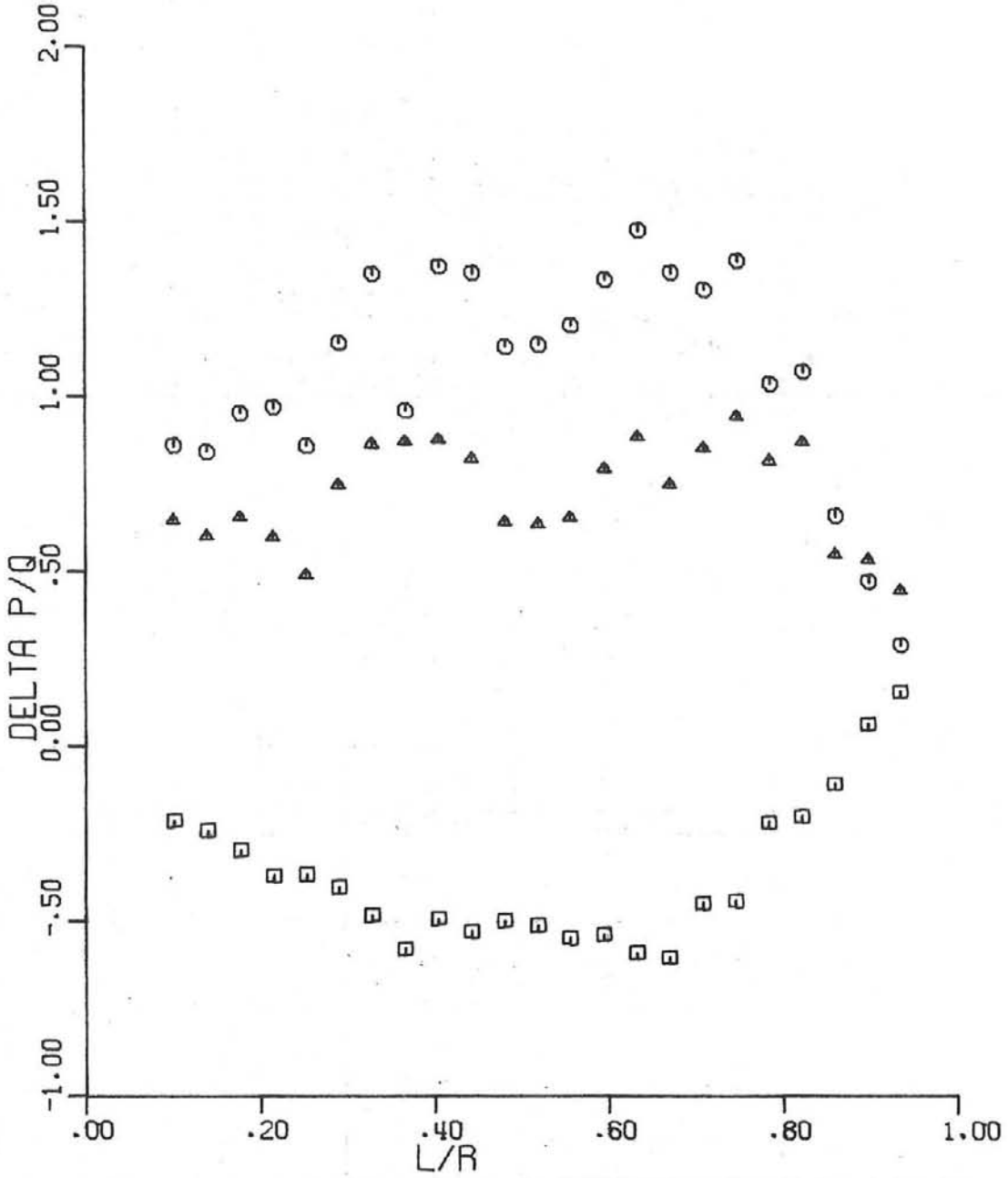
POINT 142 POROSITY=20.00
Q=399.26 SHRDL= 1.00
CDOBAL= .5729 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



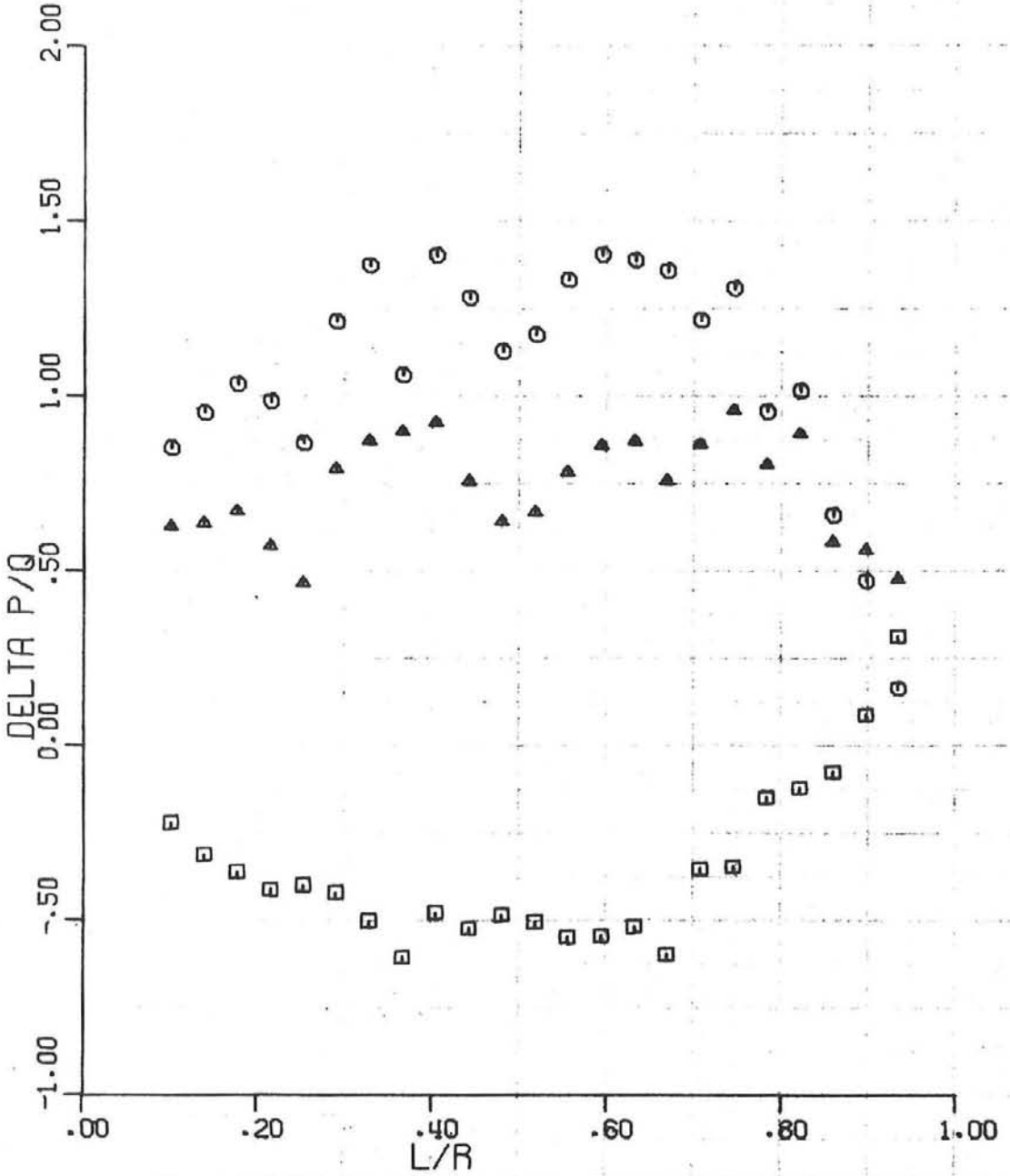
POINT 143 POROSITY= 20.00
Q= 73.78 SHRDL= 1.00
CDOBAL= .3761 REEFL= 57.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



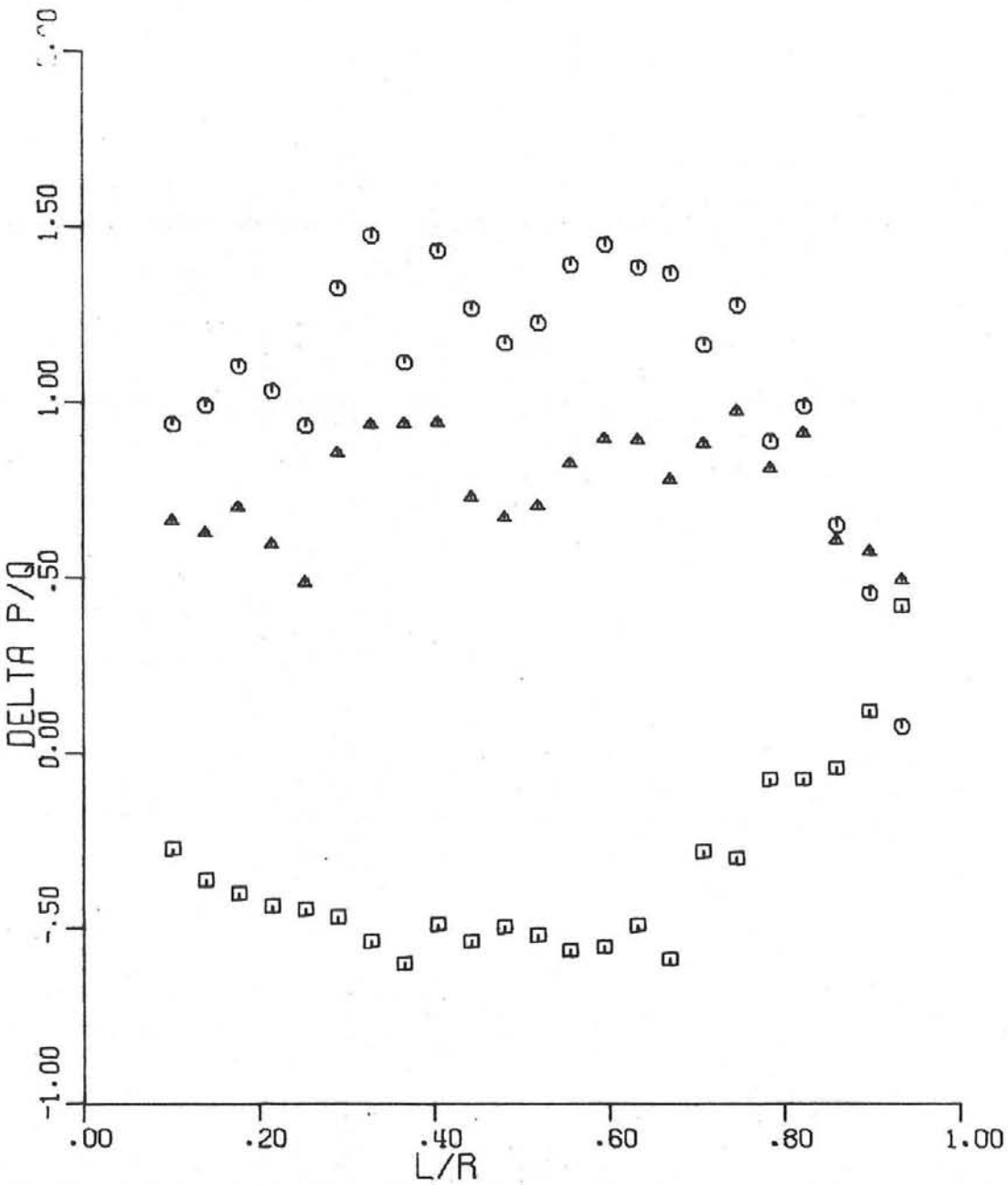
POINT 144 POROSITY= 20.00
Q= 205.41 SHRDL= 1.00
CDOBAL= .3882 REEFL= 57.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



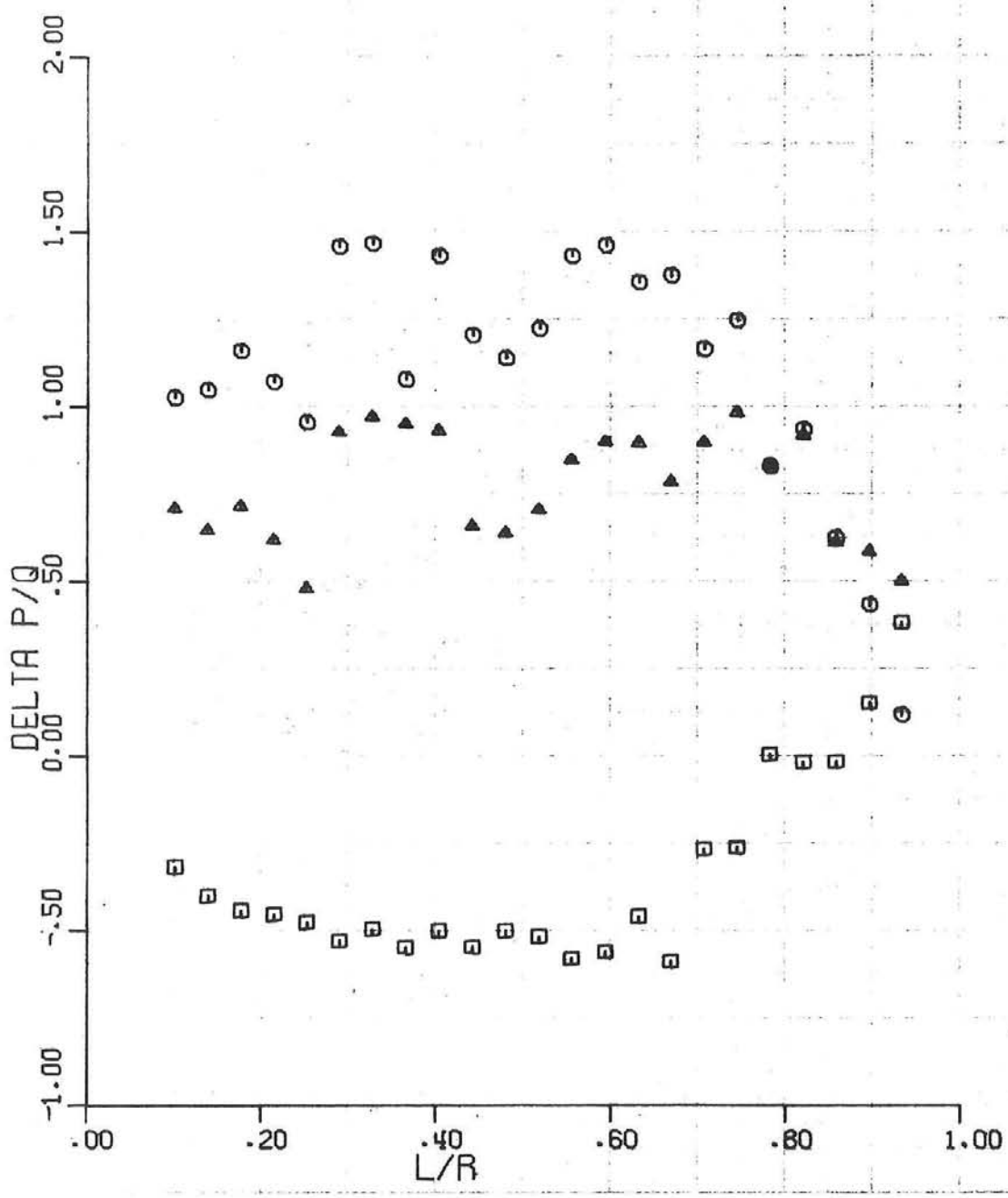
POINT 145 POROSITY=20.00
Q=303.86 SHRDL= 1.00
CDOBAL= .4002 REEFL= 57.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



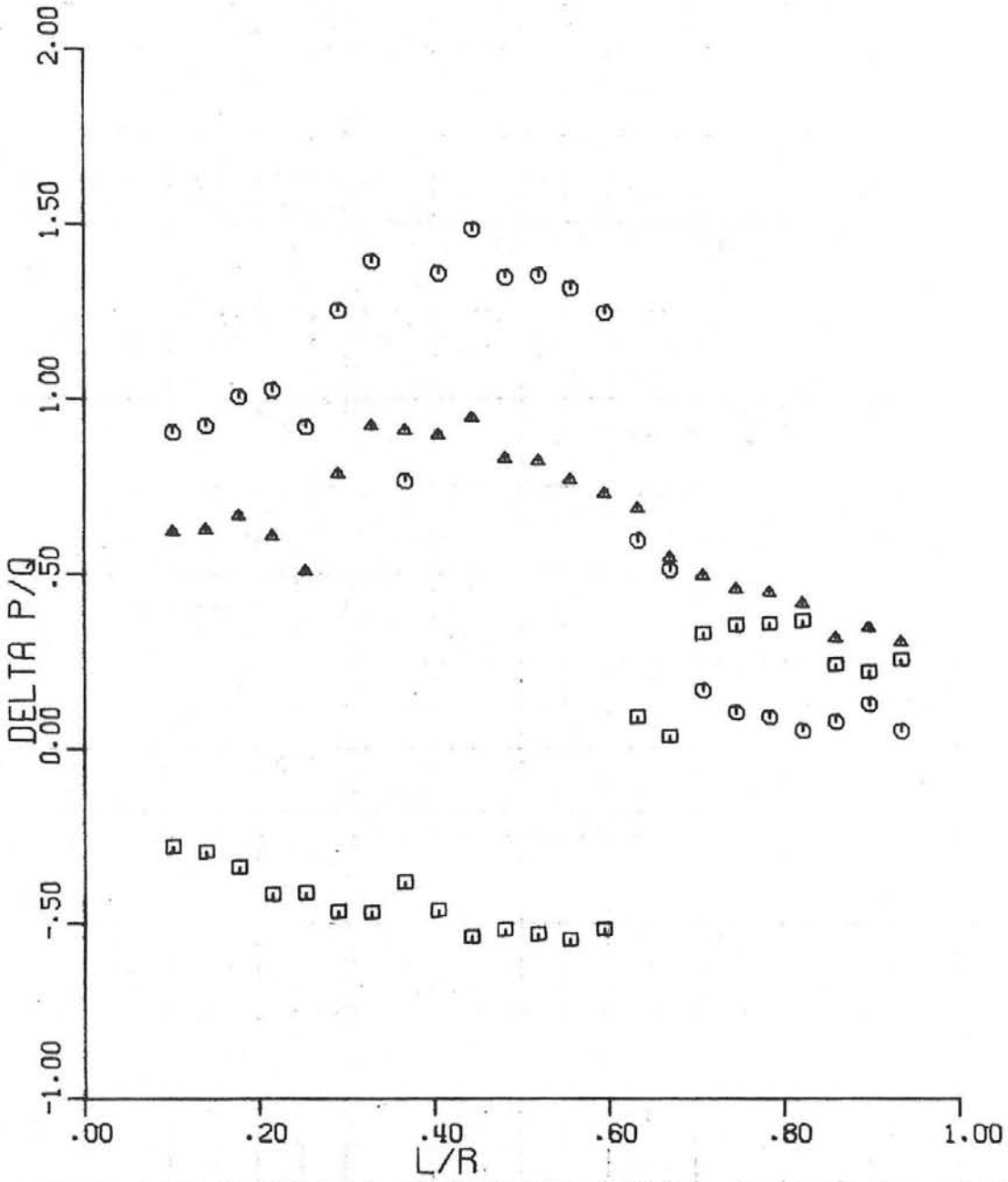
POINT 146 POROSITY= 20.00
Q= 406.33 SHRDL= 1.00
CDOBAL= .4124 REEFL= 57.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



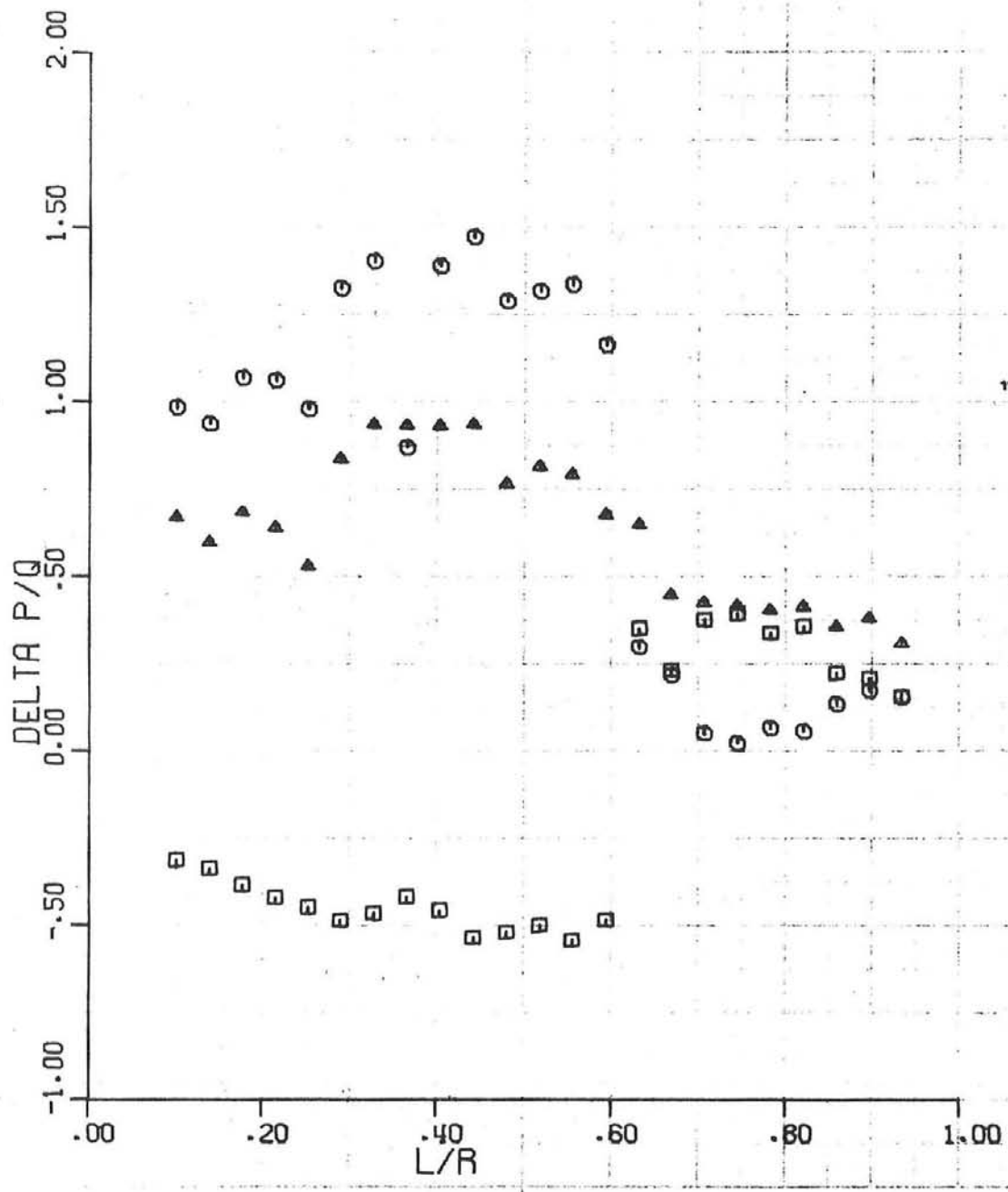
POINT 148 POROSITY= 20.00
Q= 78.59 SHRDL= 1.00
CDOBAL= .2358 REEFL= 38.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



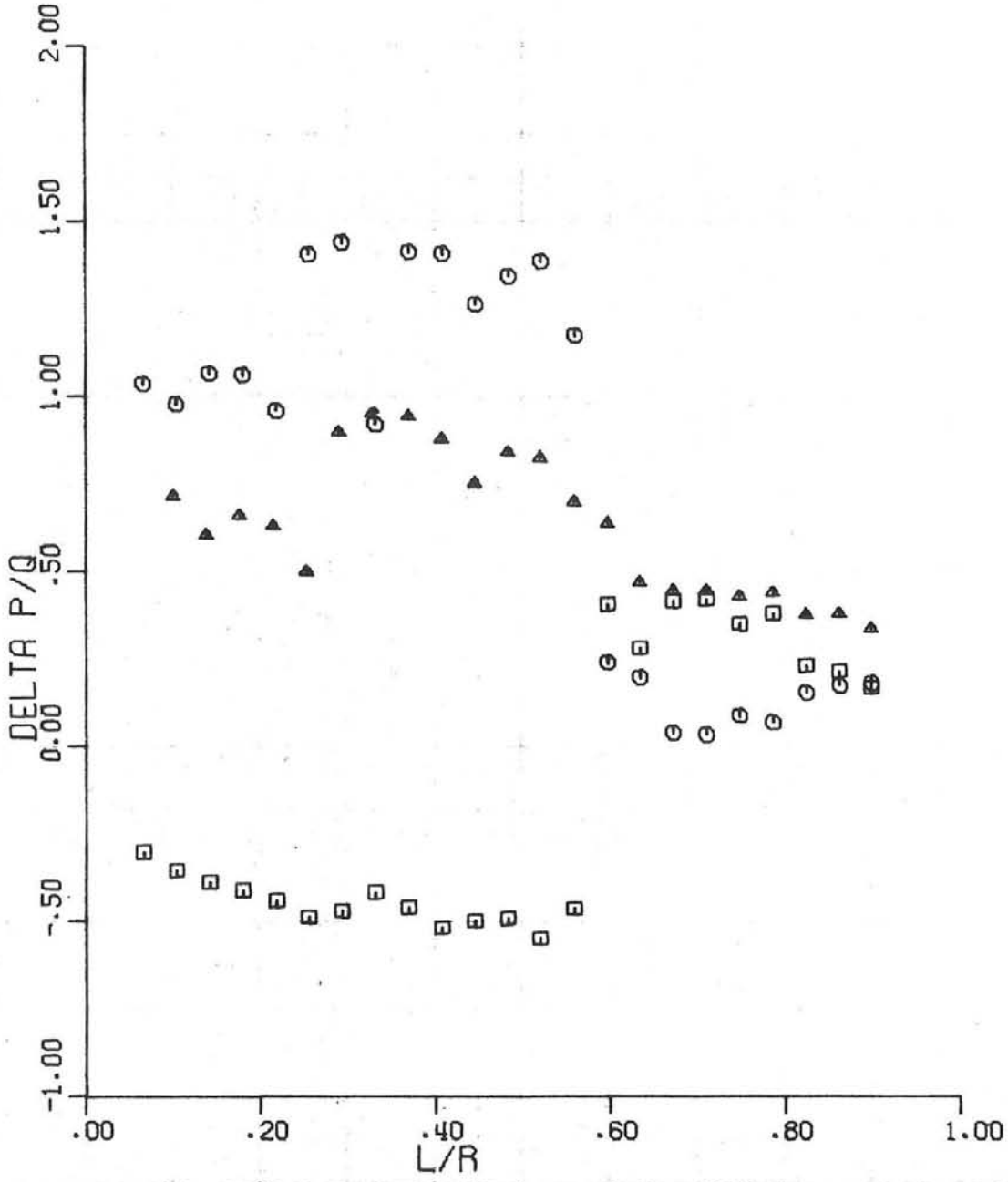
POINT 149 POROSITY= 20.00
Q= 204.12 SHRDL= 1.00
CDOBAL= .2366 REEFL= 38.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



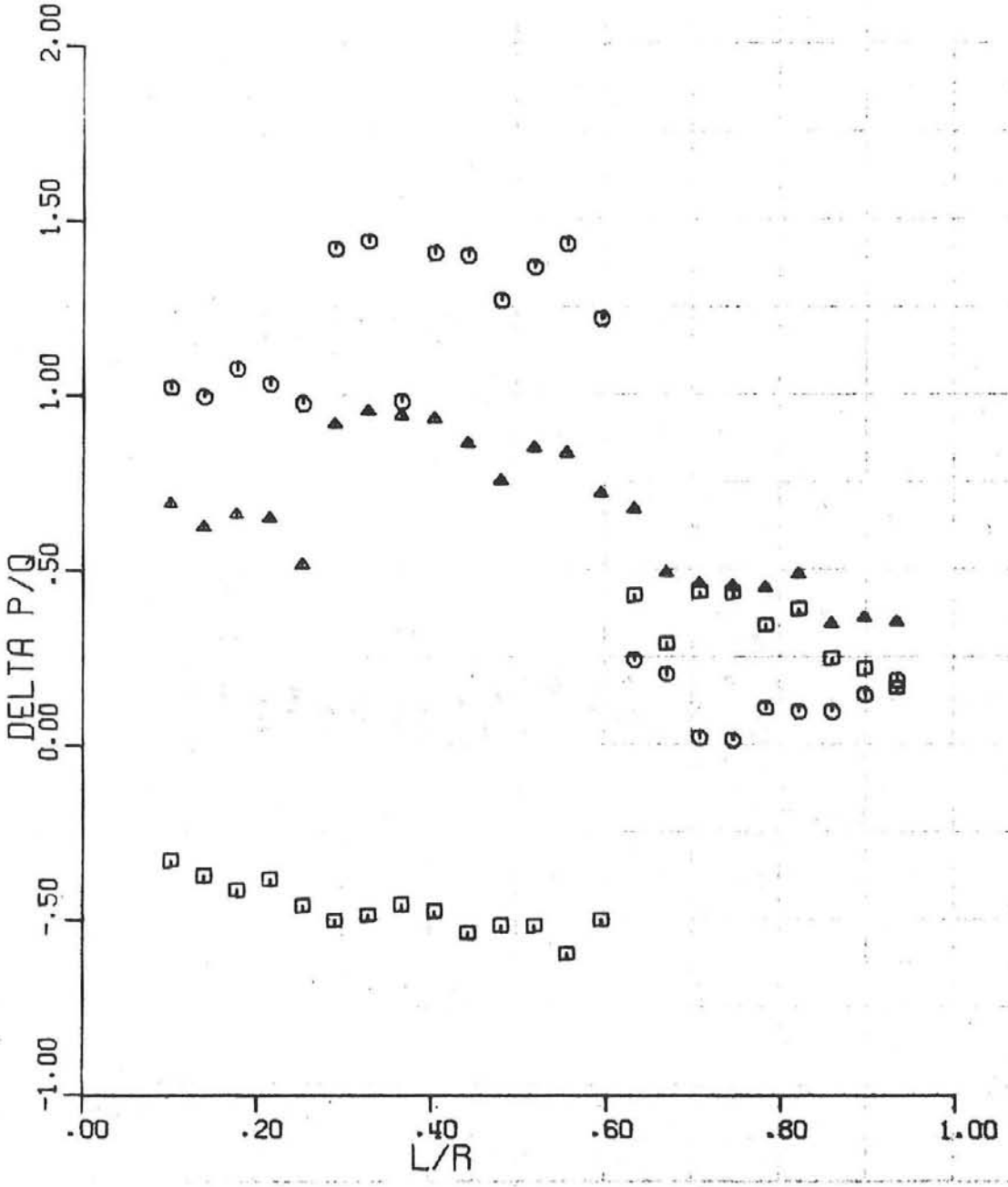
POINT 150 POROSITY= 20.00
Q= 306.01 SHRDL= 1.00
CDOBAL= .2401 REEFL= 38.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



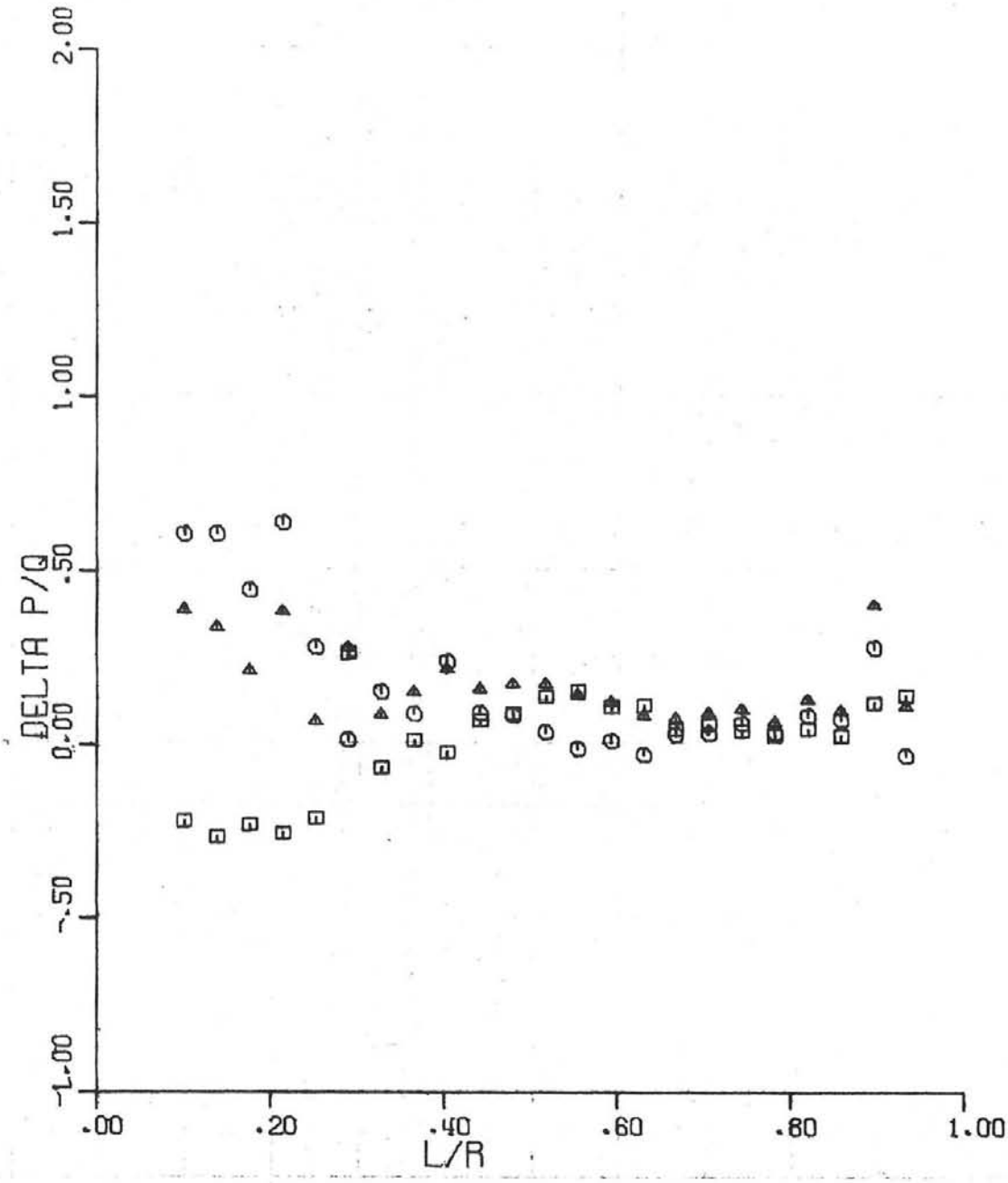
POINT 151 POROSITY= 20.00
Q= 407.10 SHRDL= 1.00
CDOBAL= .2447 REEFL= 38.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



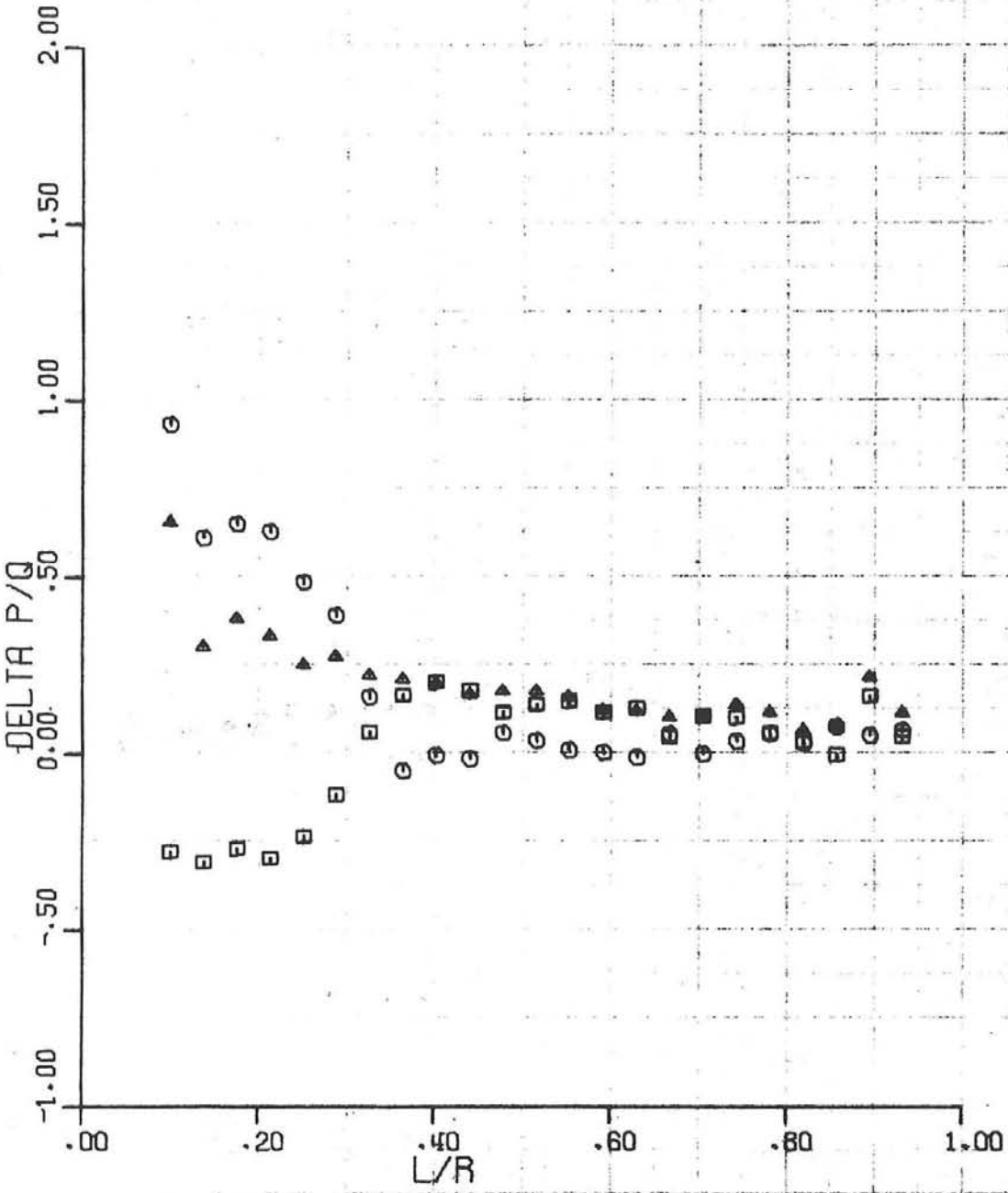
POINT 152 POROSITY= 20.00
Q= 75.40 SHRDL= 1.00
CDOBAL= .0740 REEFL= 19.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



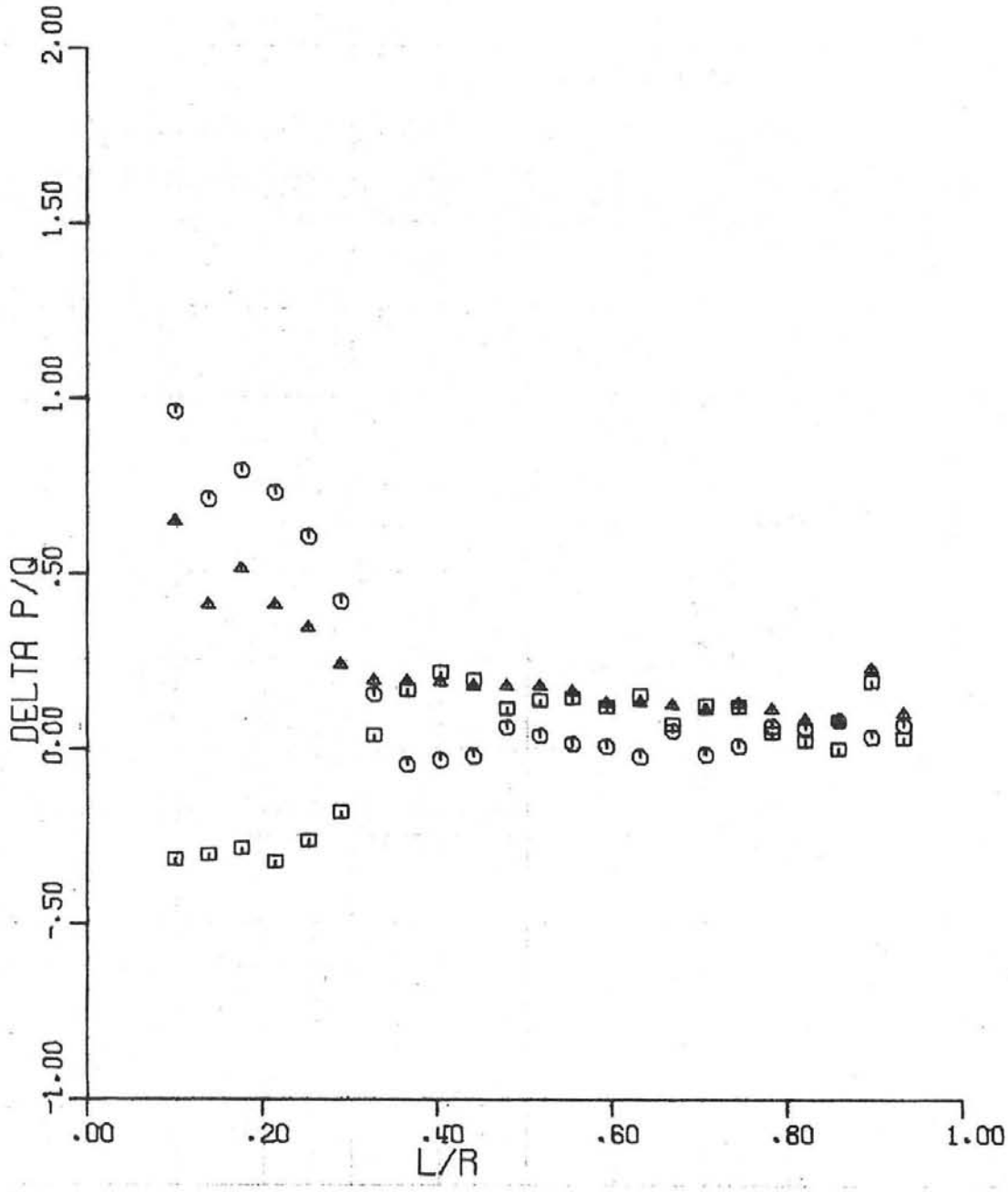
POINT 153 POROSITY= 20.00
Q= 202.04 SHROL= 1.00
CDOBAL= .0759 REEFL= 19.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



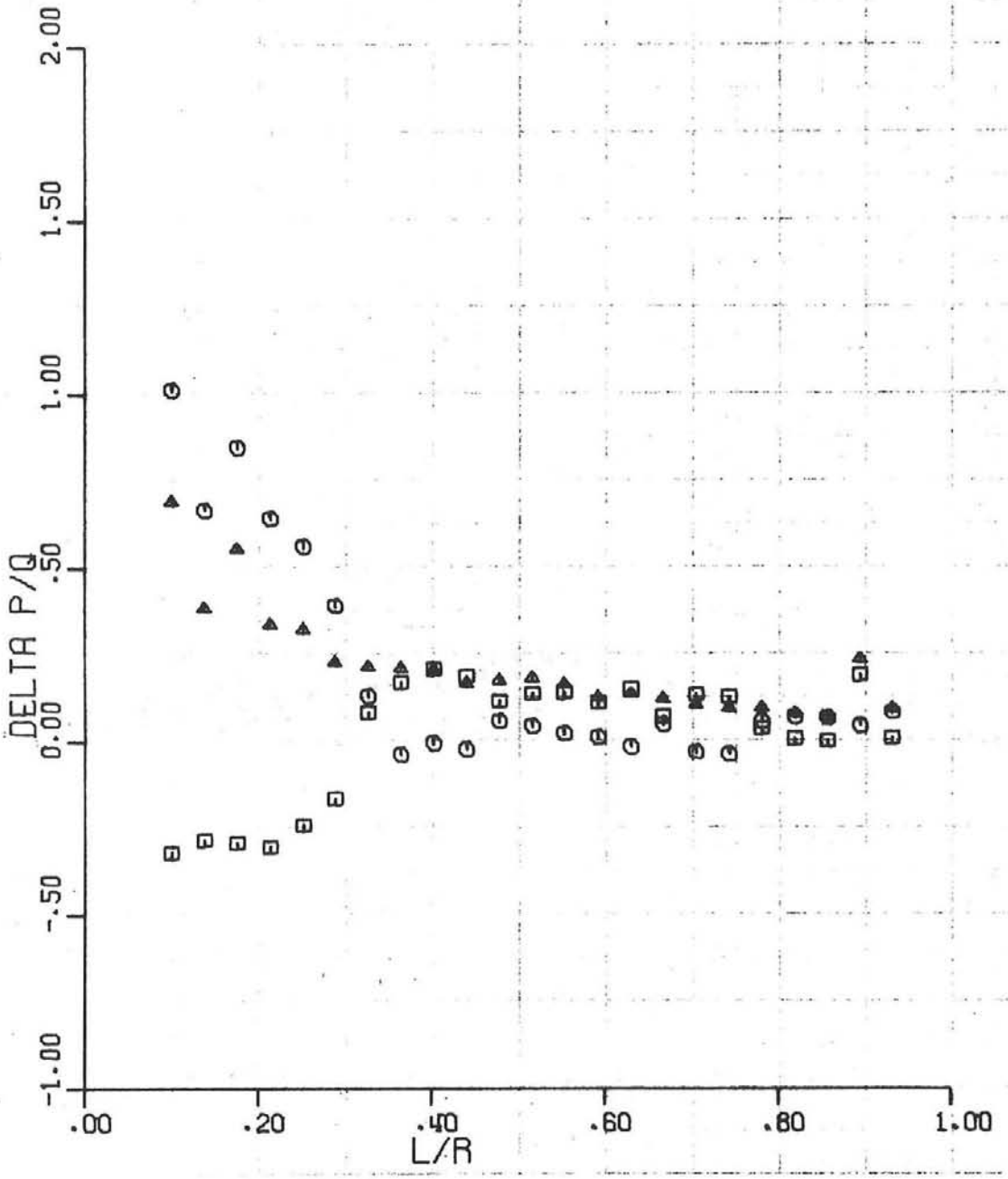
POINT 154 POROSITY= 20.00
Q= 304.48 SHRDL= 1.00
CDOBAL= .0731 REEFL= 19.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



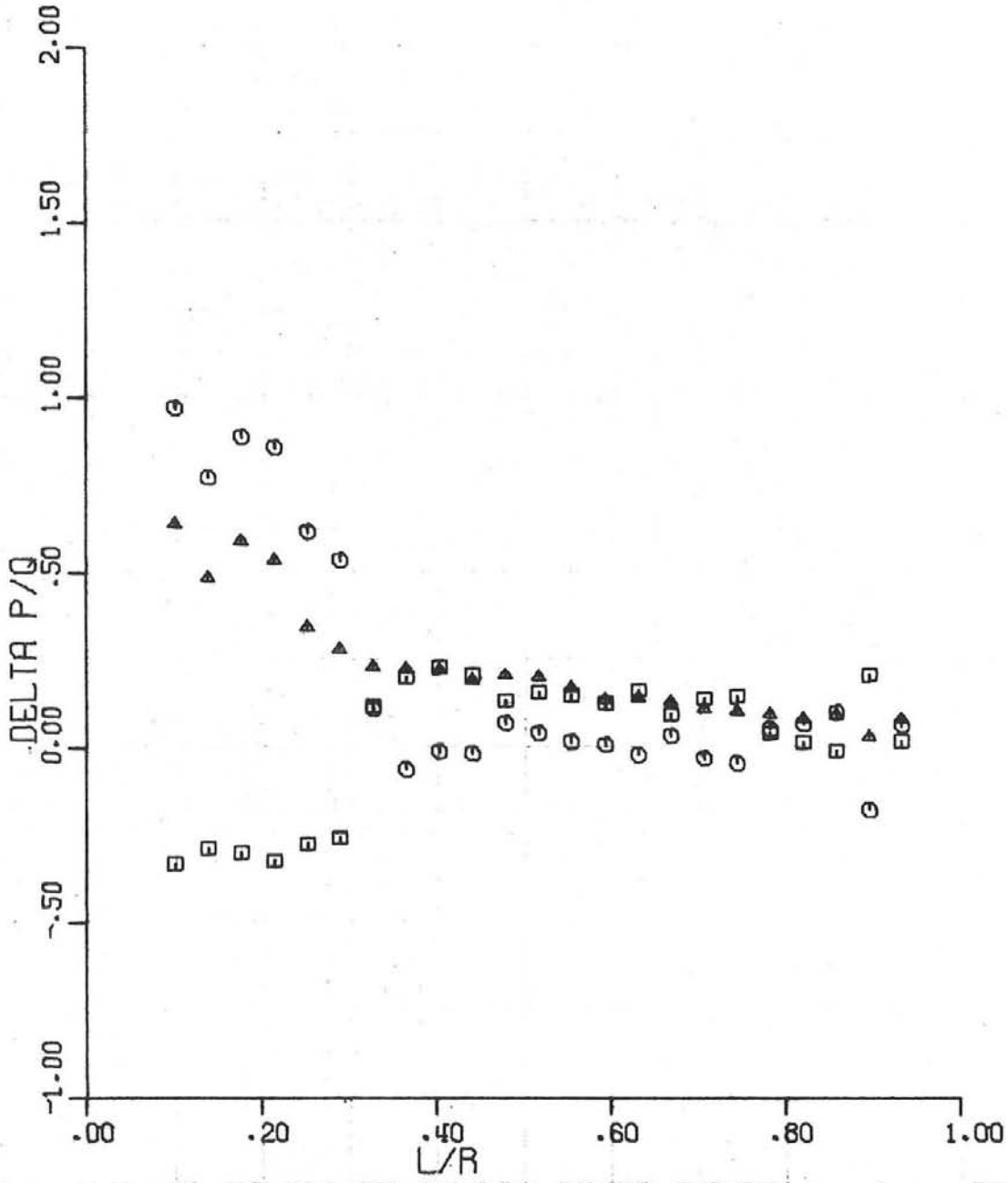
POINT 155 POROSITY= 20.00
Q= 406.77 SHRDL= 1.00
CDOBAL= .0719 REEFL= 19.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



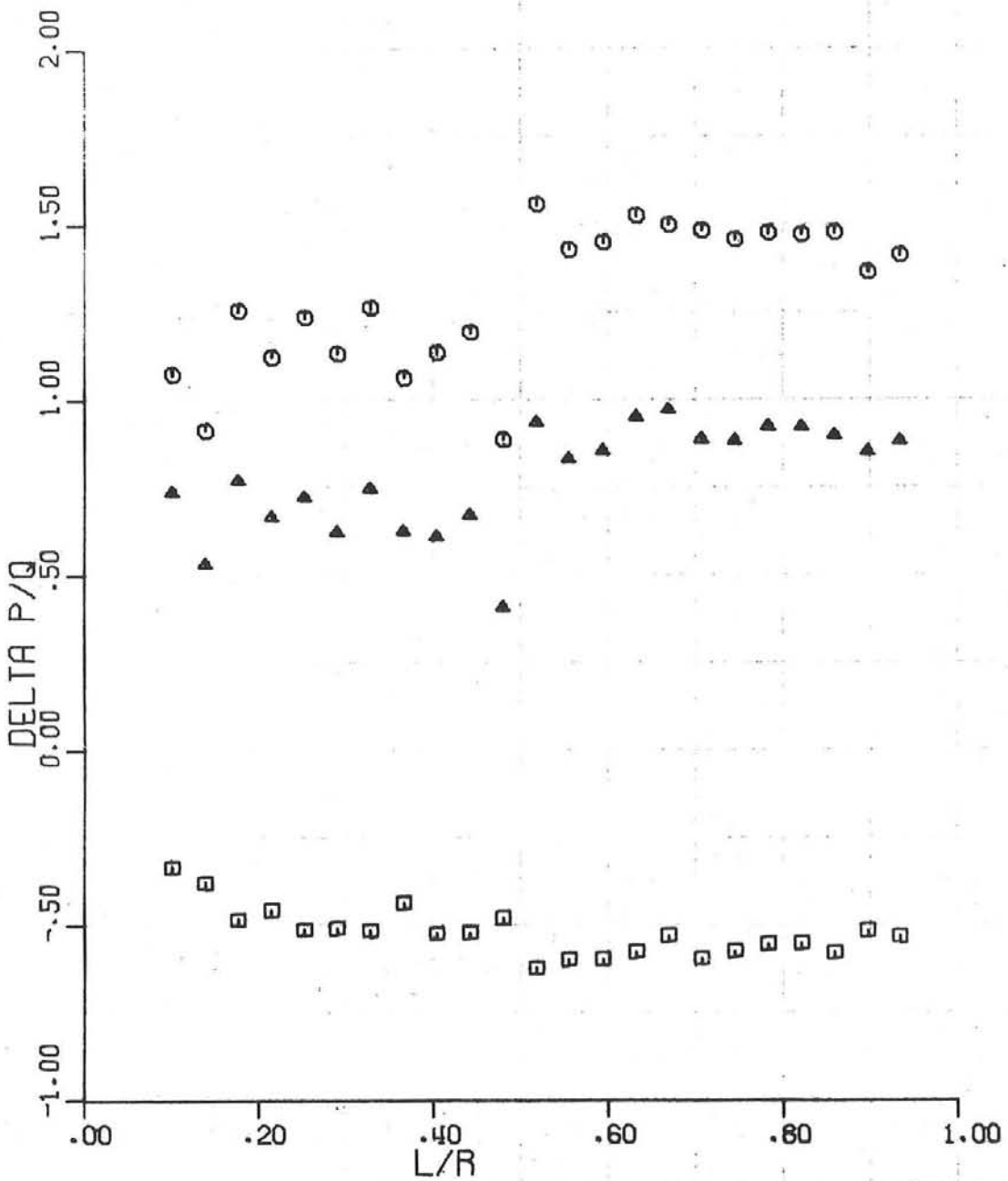
POINT 156 POROSITY= 20.00
Q= 507.31 SHRDL= 1.00
CDOBAL= .0708 REEFL= 19.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



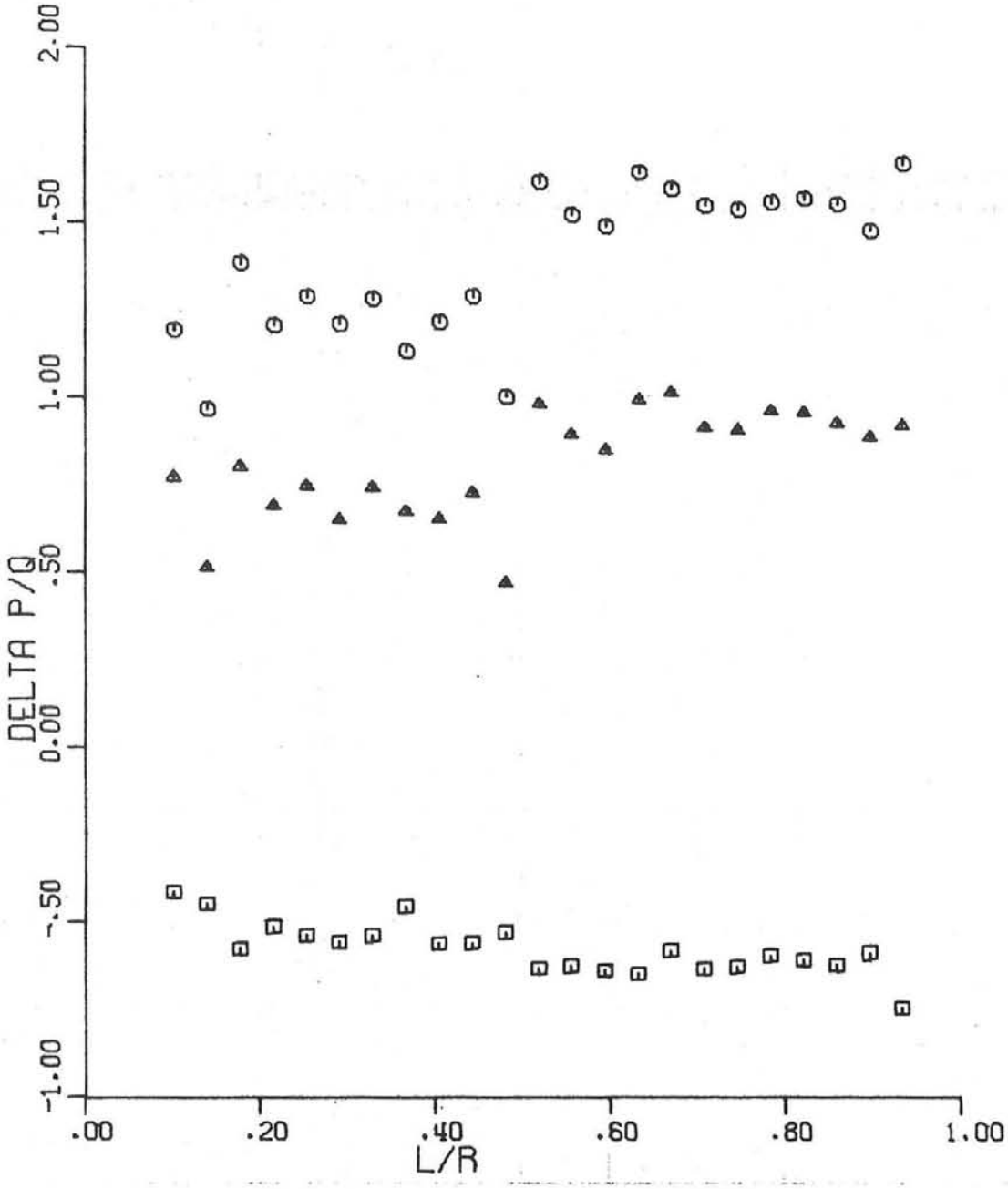
POINT 157 POROSITY= 15.00
Q= 75.84 SHRDL= 2.00
CDOBAL= .6653 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



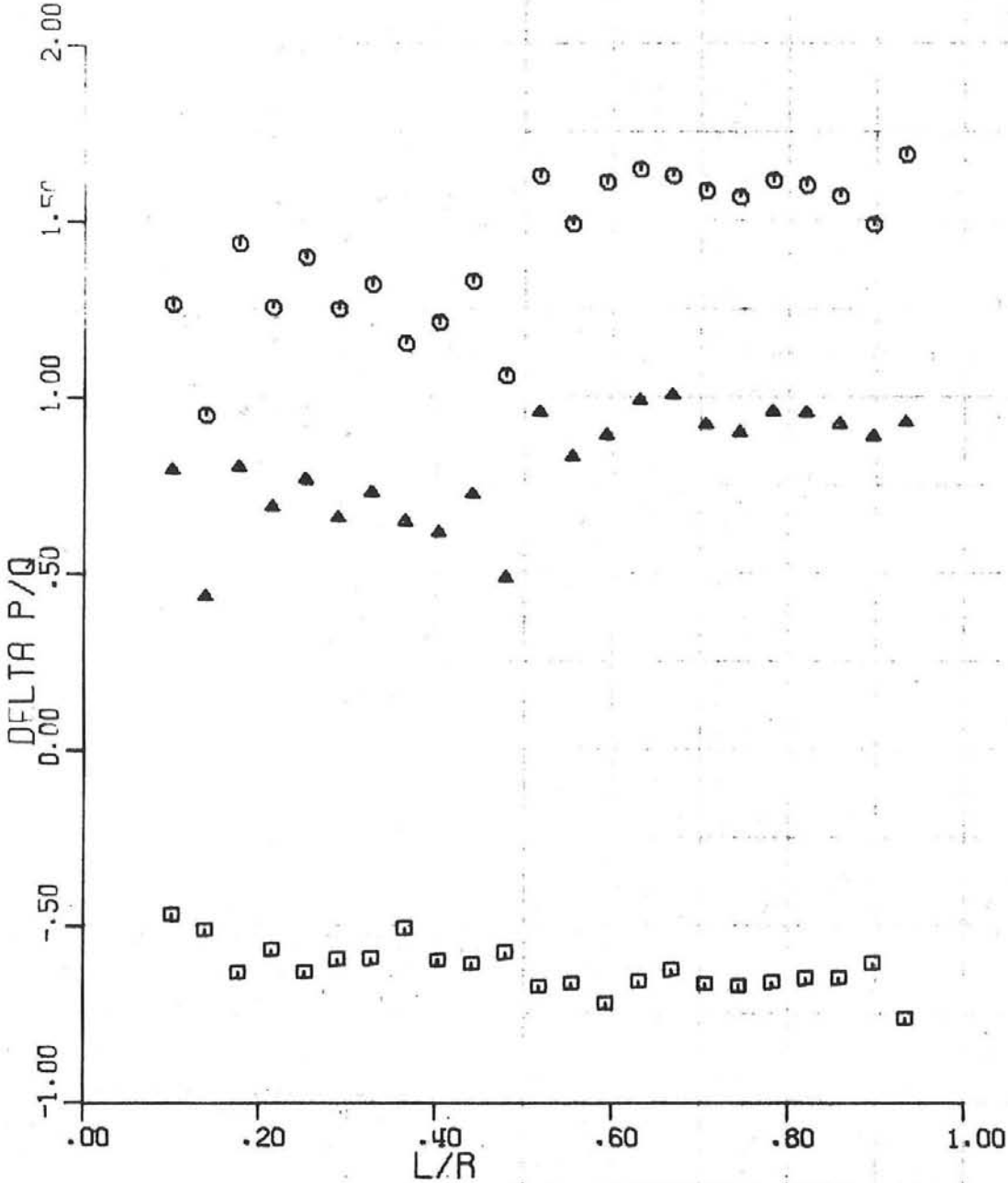
POINT 158 POROSITY= 15.00
Q= 205.88 SHRDL= 2.00
CDOBAL= .7105 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



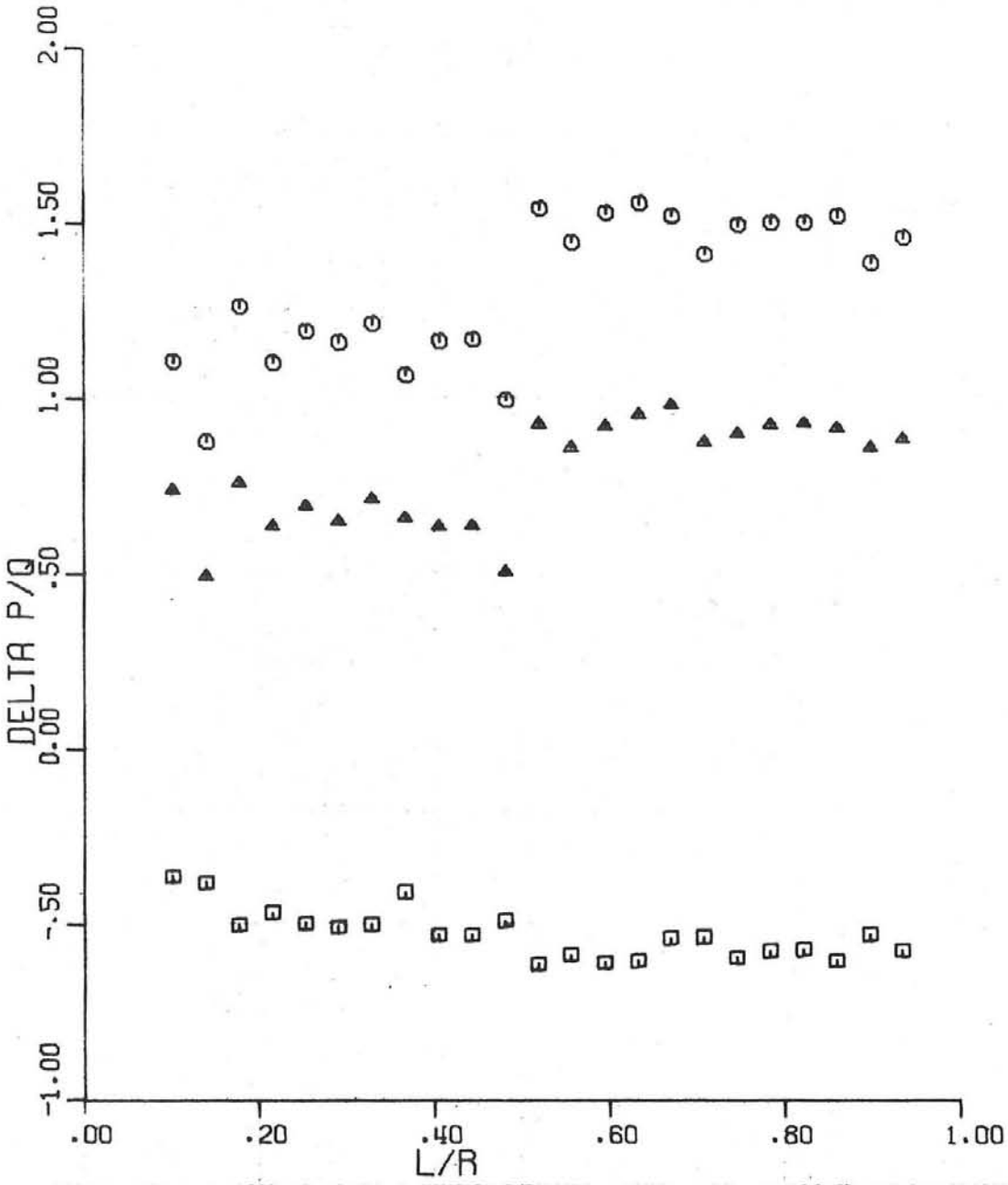
POINT 159 POROSITY= 15.00
Q= 308.36 SHRDL= 2.00
CDOBAL= .7419 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



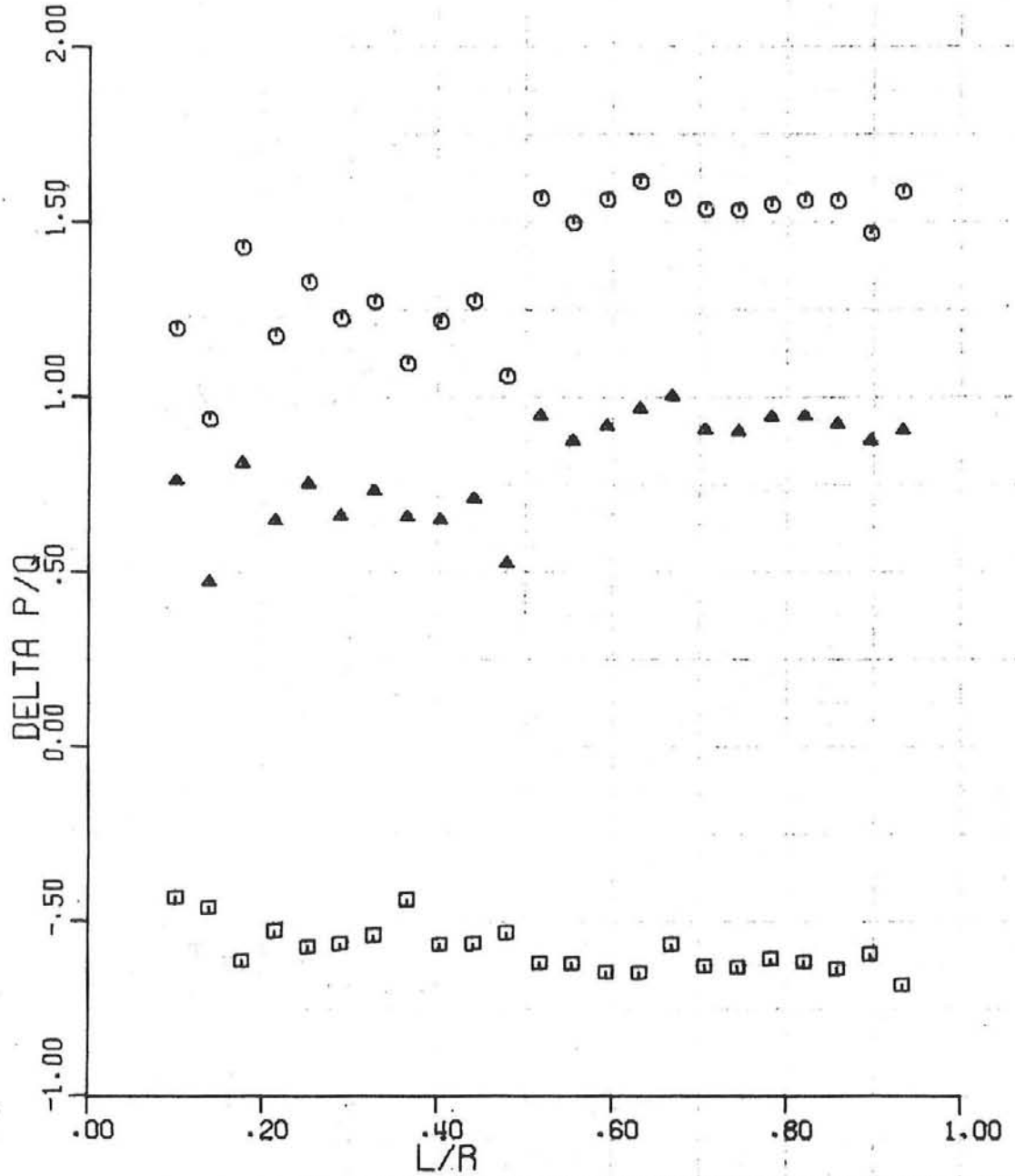
POINT 160 POROSITY= 15.00
Q= 76.19 SHRDL= 2.00
CDOBAL= .6819 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



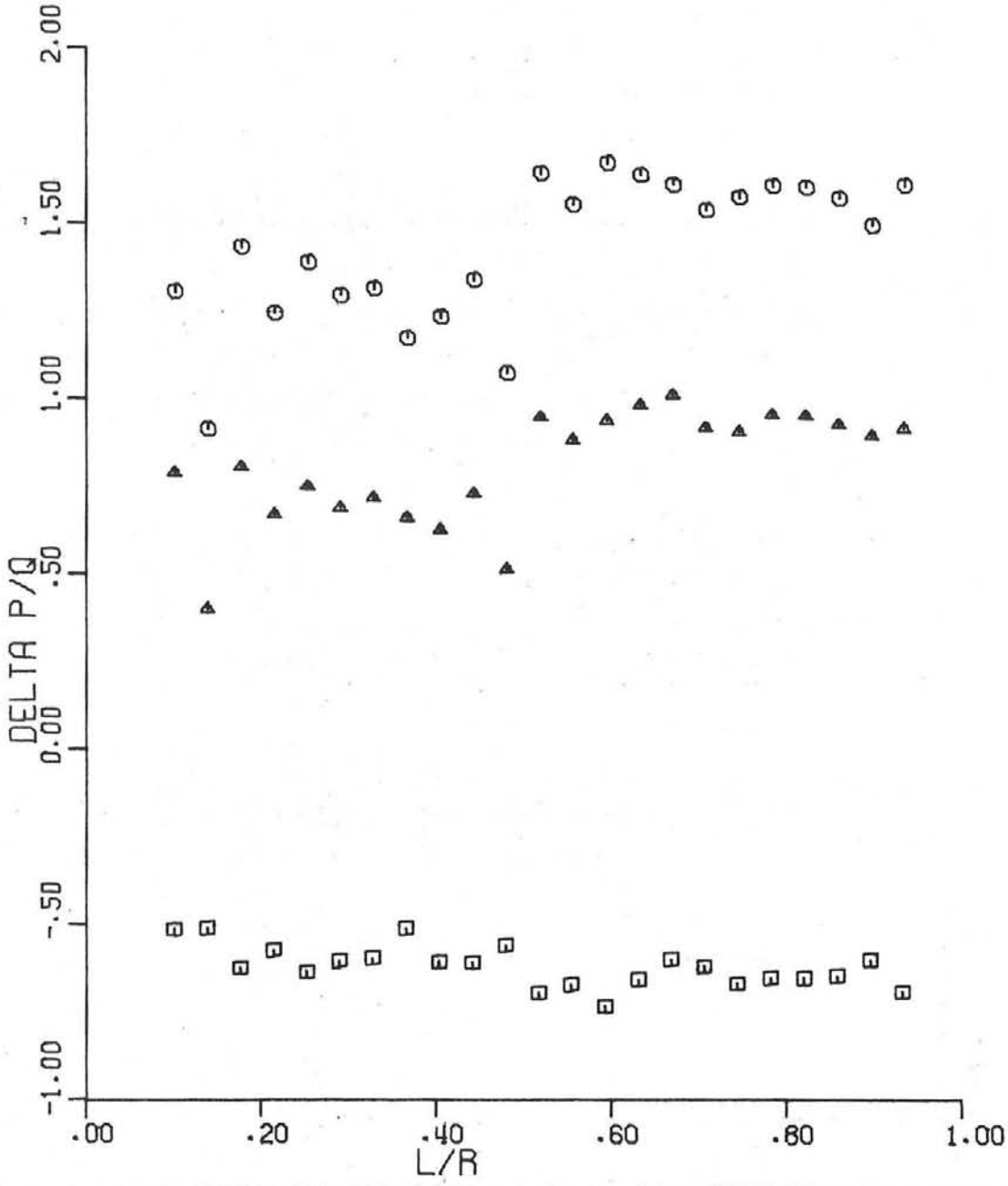
POINT 161 POROSITY= 15.00
Q= 203.29 SHRDL= 2.00
CDOBAL= .7201 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



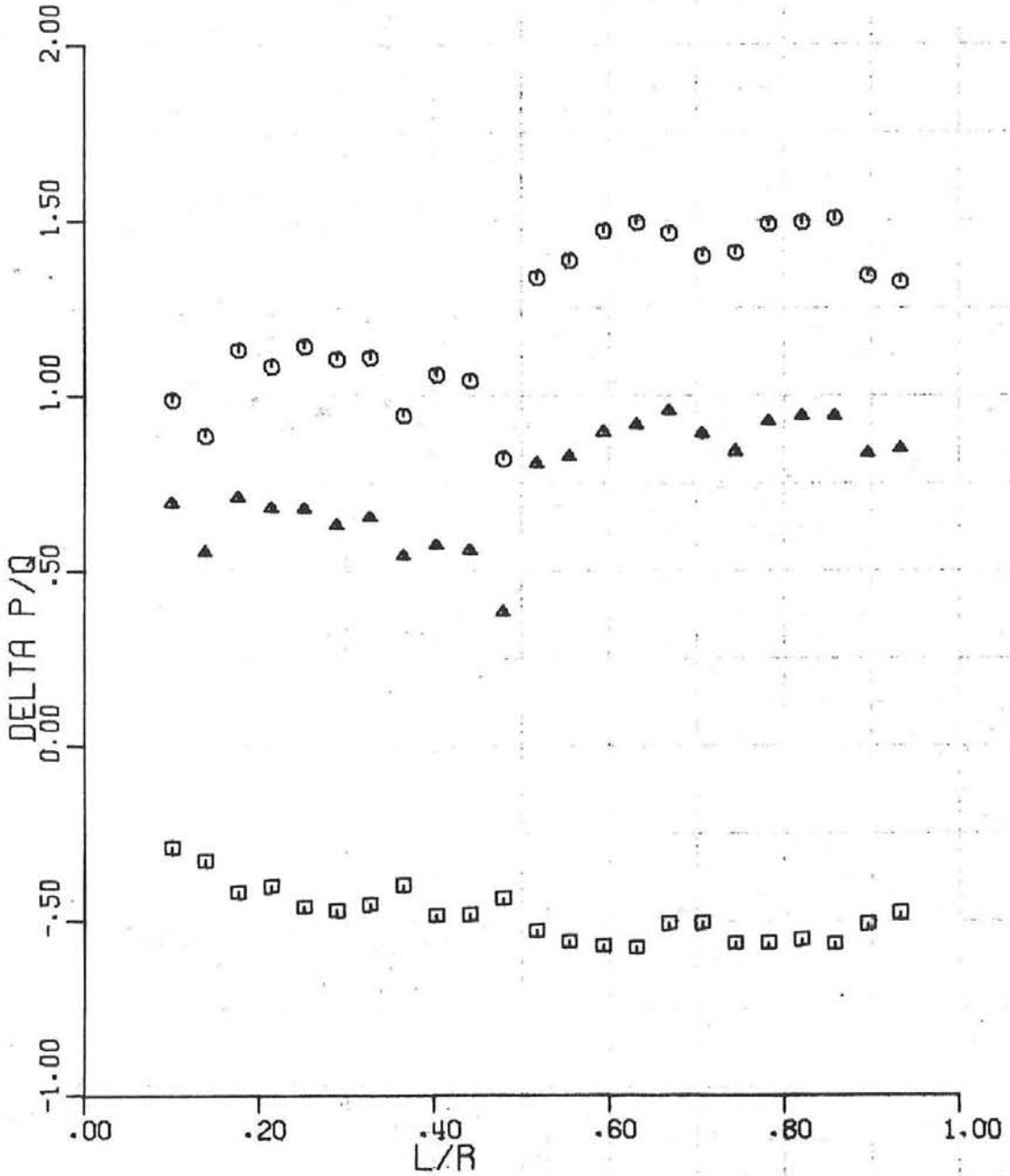
POINT 162 POROSITY= 15.00
Q= 305.70 SHRDL= 2.00
CDOBAL= .7506 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



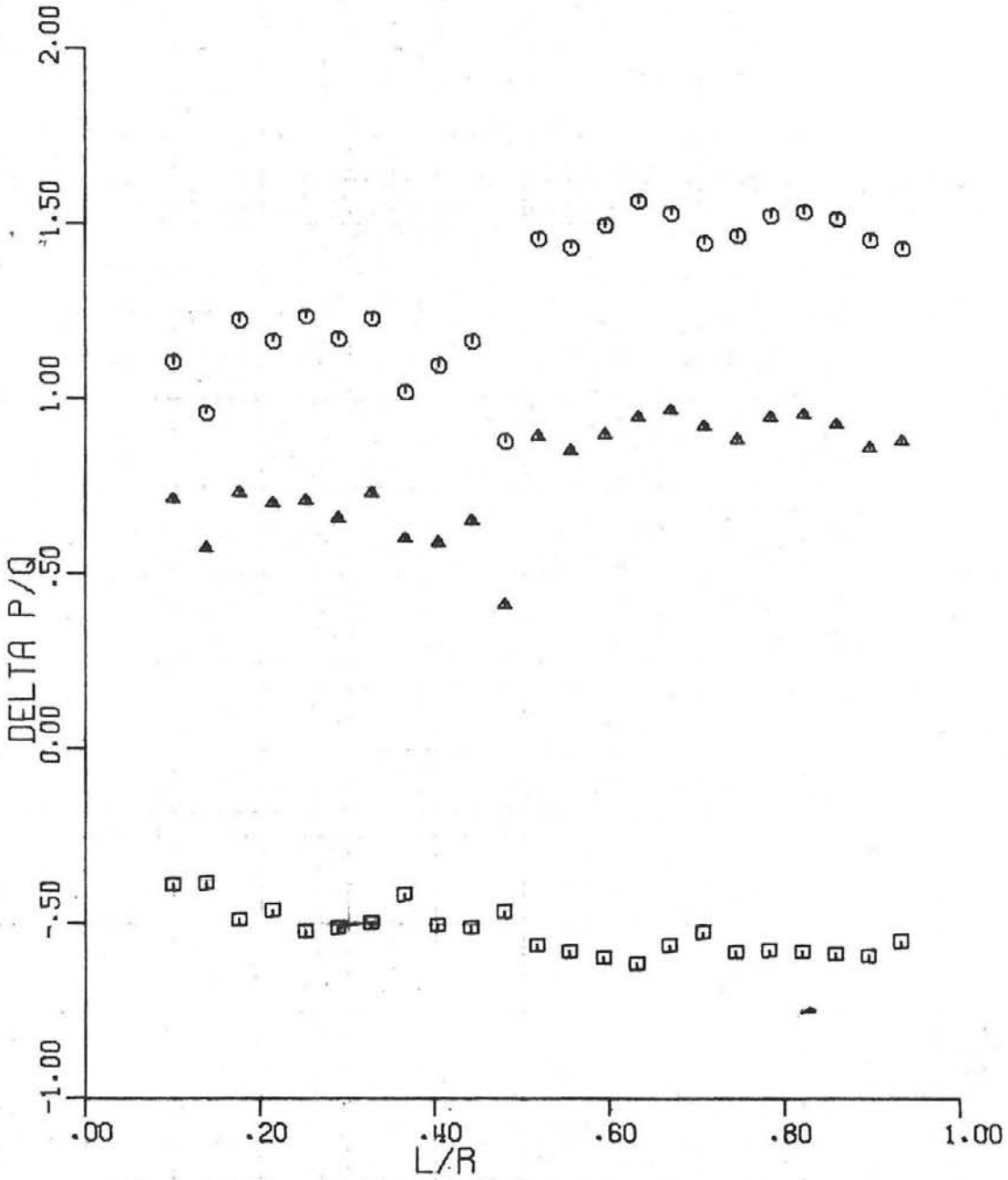
POINT 163 POROSITY= 15.00
Q= 76.85 SHRDL= 1.50
CDOBAL= .6296 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



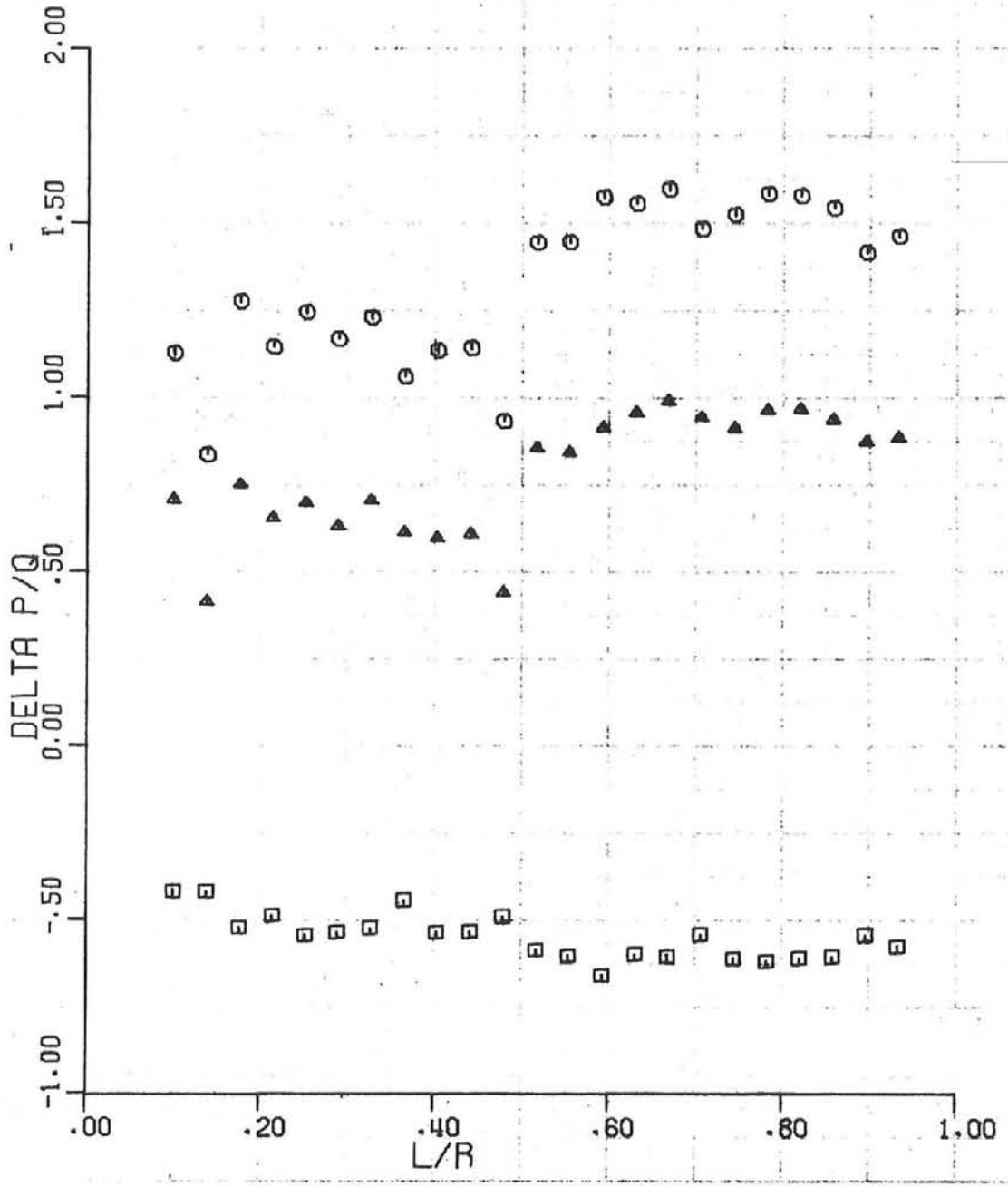
POINT 164 POROSITY= 15.00
Q= 204.95 SHRDL= 1.50
CDOBAL= .6638 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



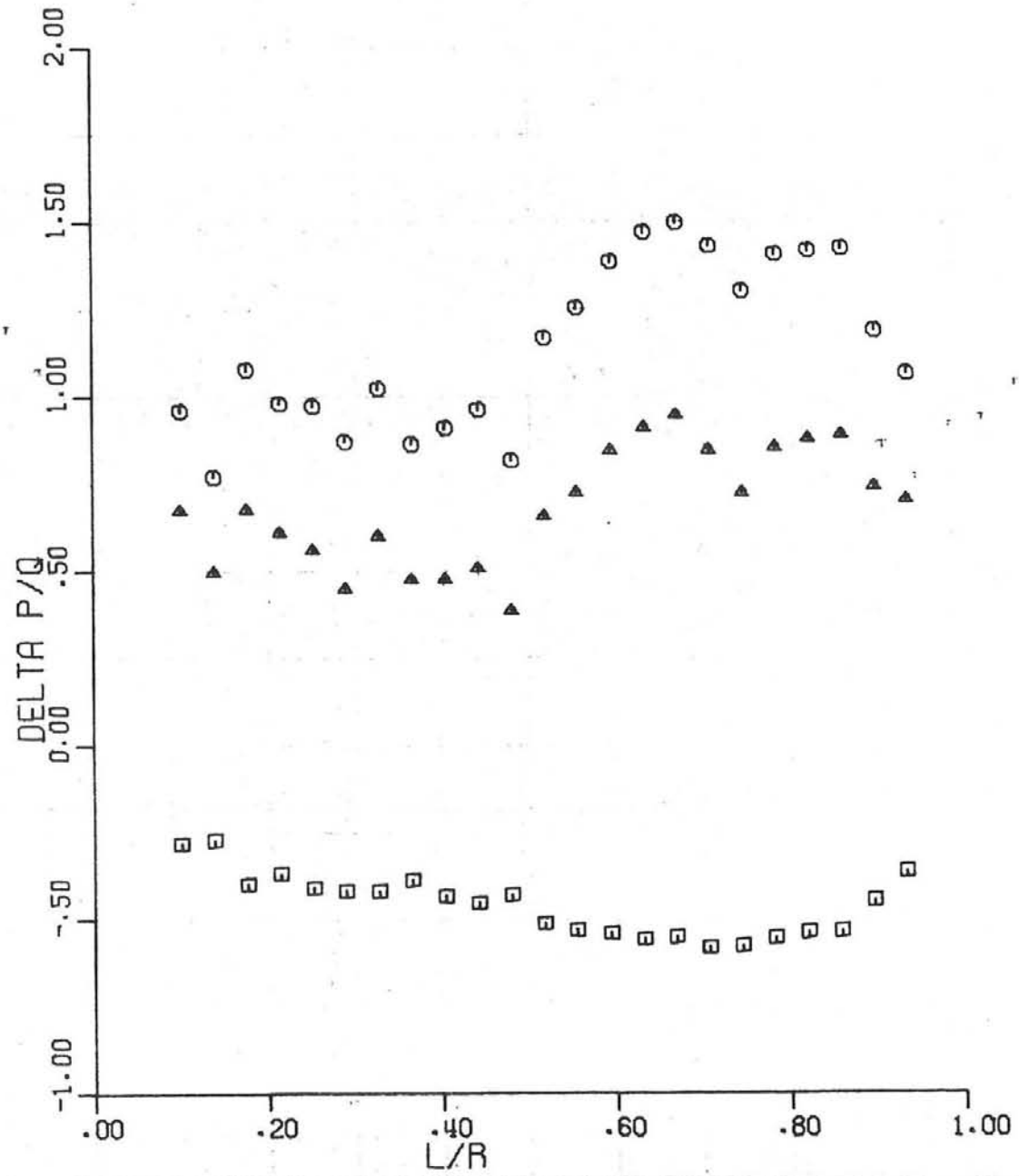
POINT 165 POROSITY= 15.00
Q= 302.10 SHRDL= 1.50
CDOBAL= .6849 MEEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



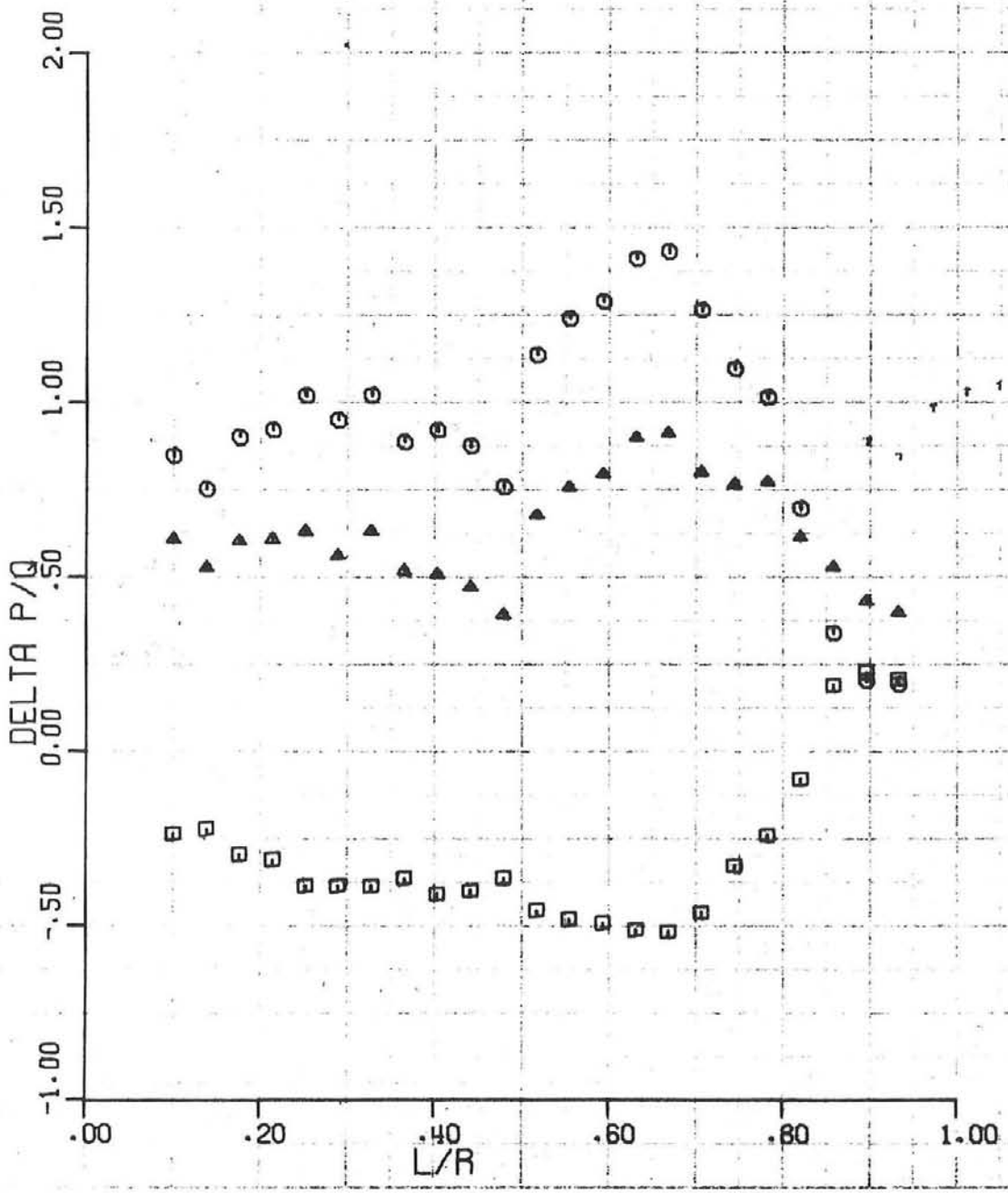
POINT 166 POROSITY= 15.00
Q= 77.15 SHRDL= 1.00
CDOBAL= .5502 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



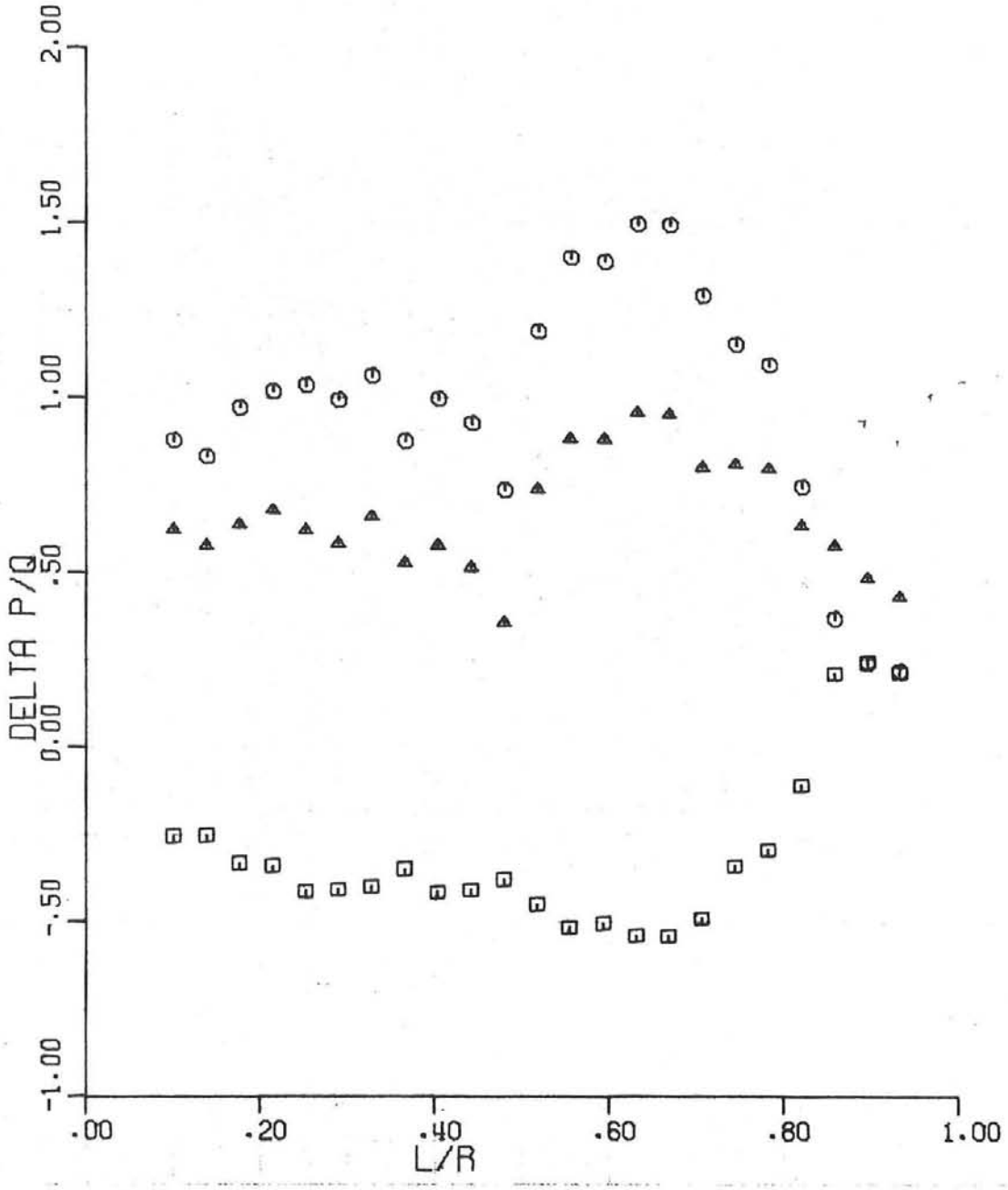
POINT 167 POROSITY= 15.00
Q= 78.80 SHRDL= 1.00
CDOBAL= .3696 REEFL= 57.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



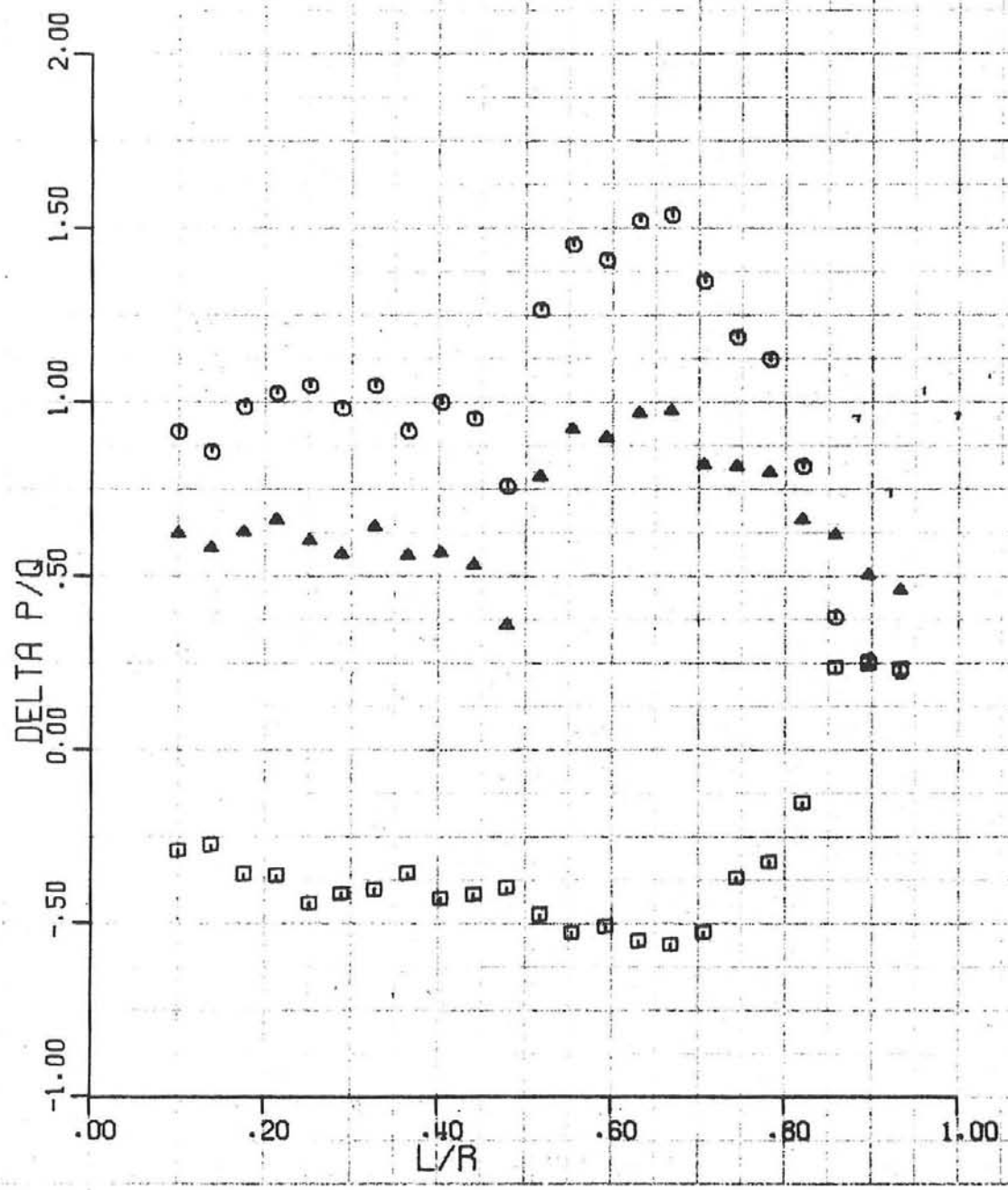
POINT 168 POROSITY= 15.00
Q= 205.39 SHRDL= 1.00
CDOBAL= .3919 REEFL= 57.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



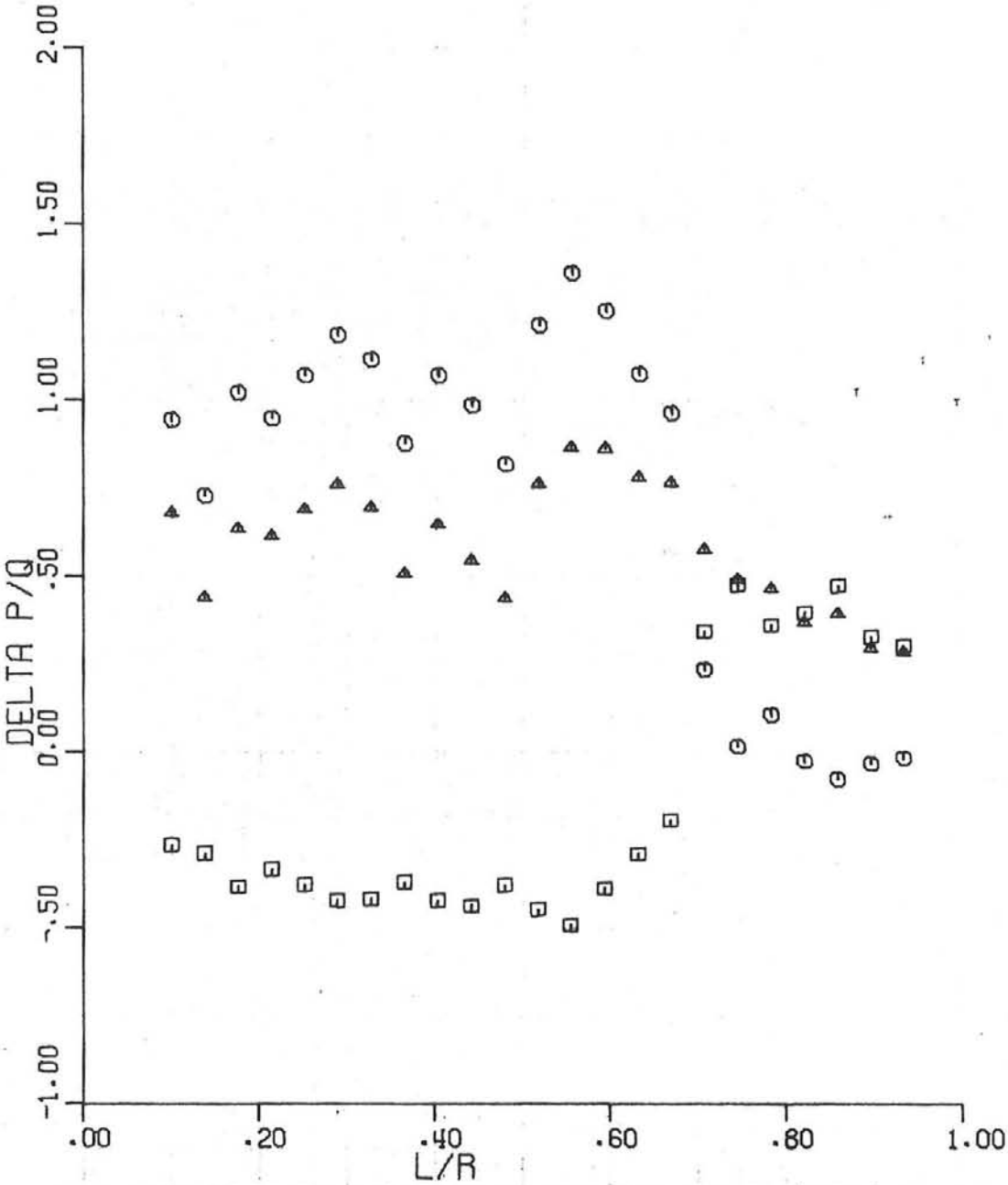
POINT 169 POROSITY= 15.00
Q= 306.80 SHRDL= 1.00
CDOBAL= .4032 REEFL= 57.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



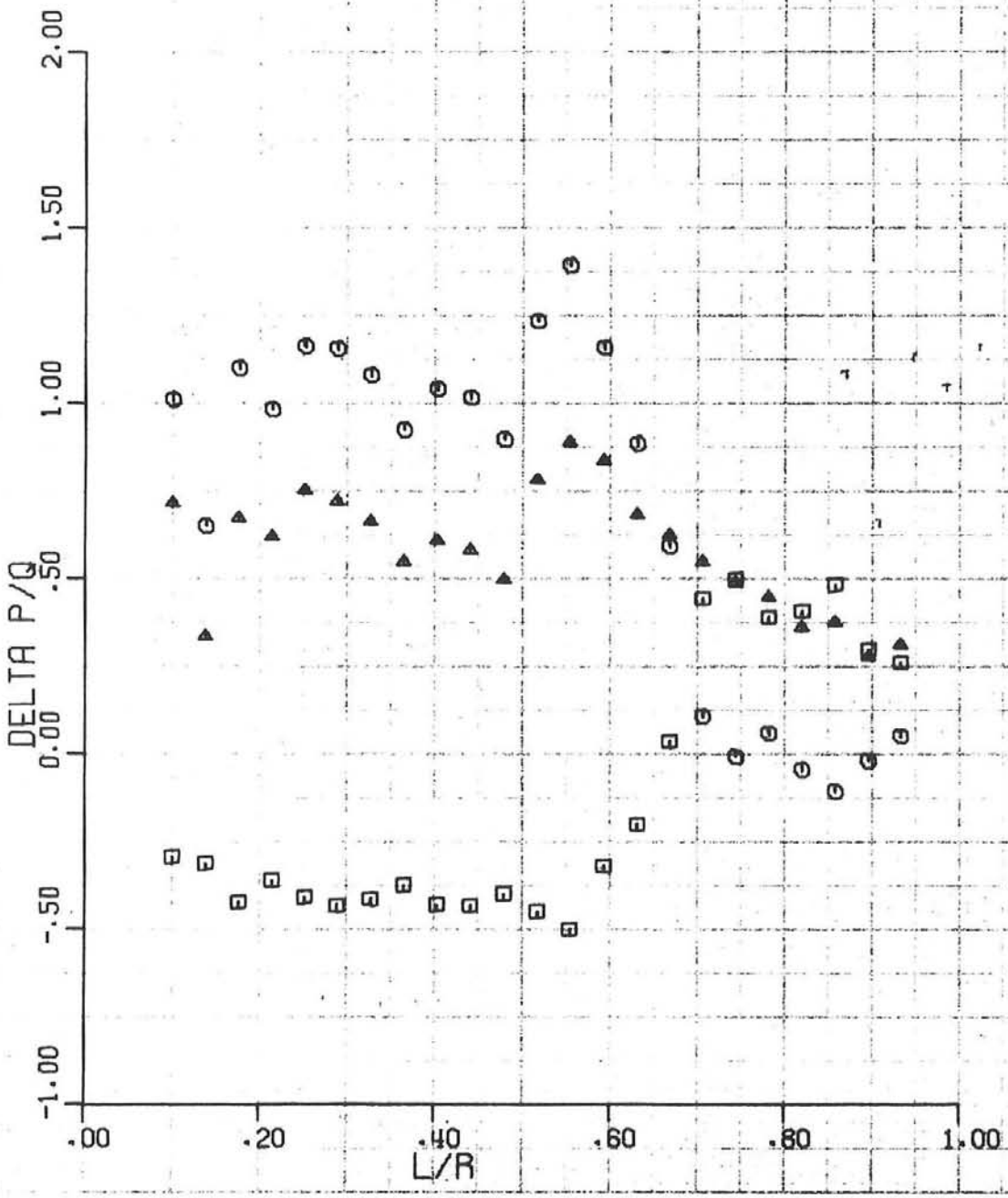
POINT 170 POROSITY= 15.00
Q= 80.64 SHRDL= 1.00
CDOBAL= .2392 REEFL= 38.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



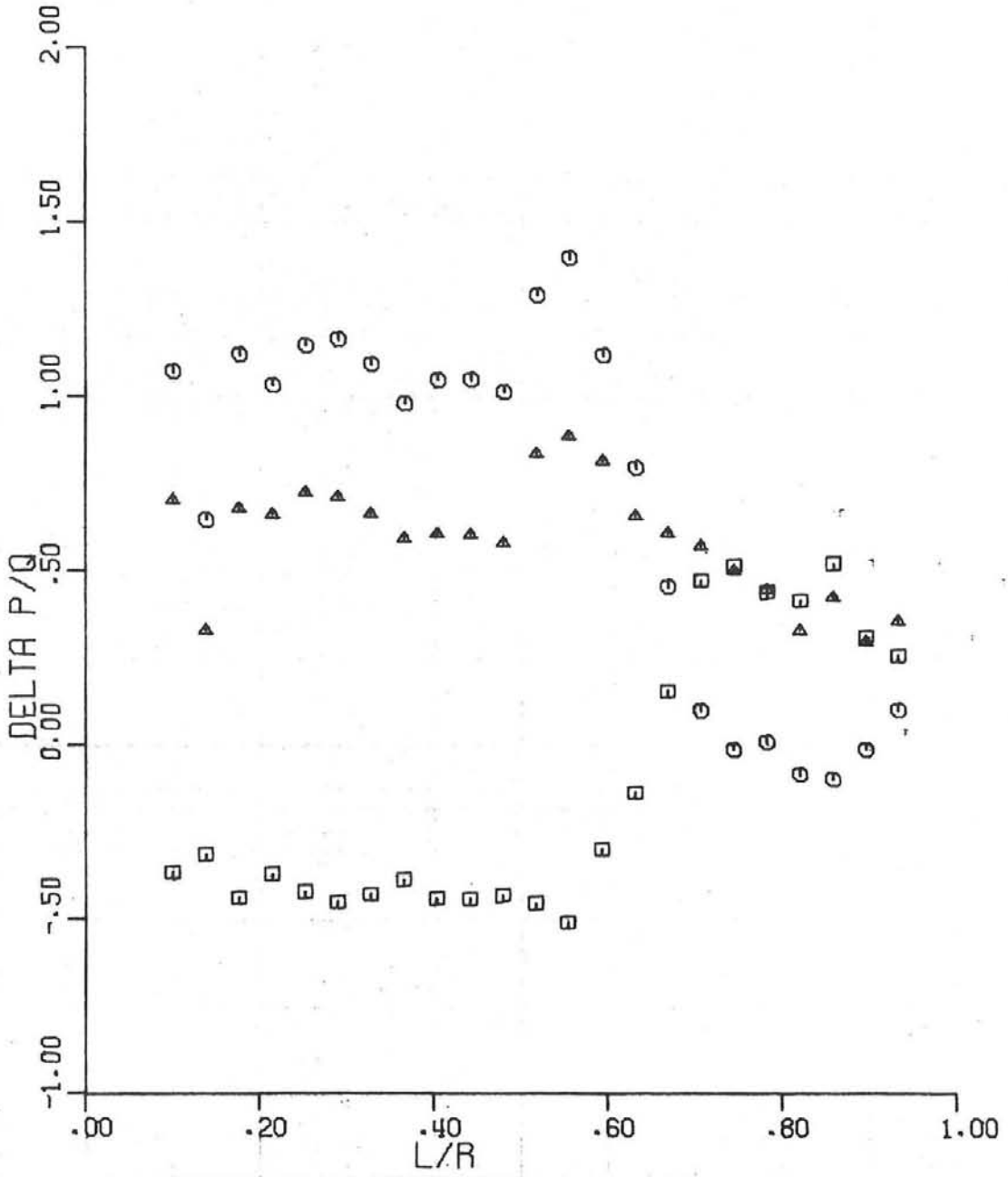
POINT 171 POROSITY= 15.00
Q= 205.21 SHADL= 1.00
CDOBAL= .2463 REEFL= 38.00

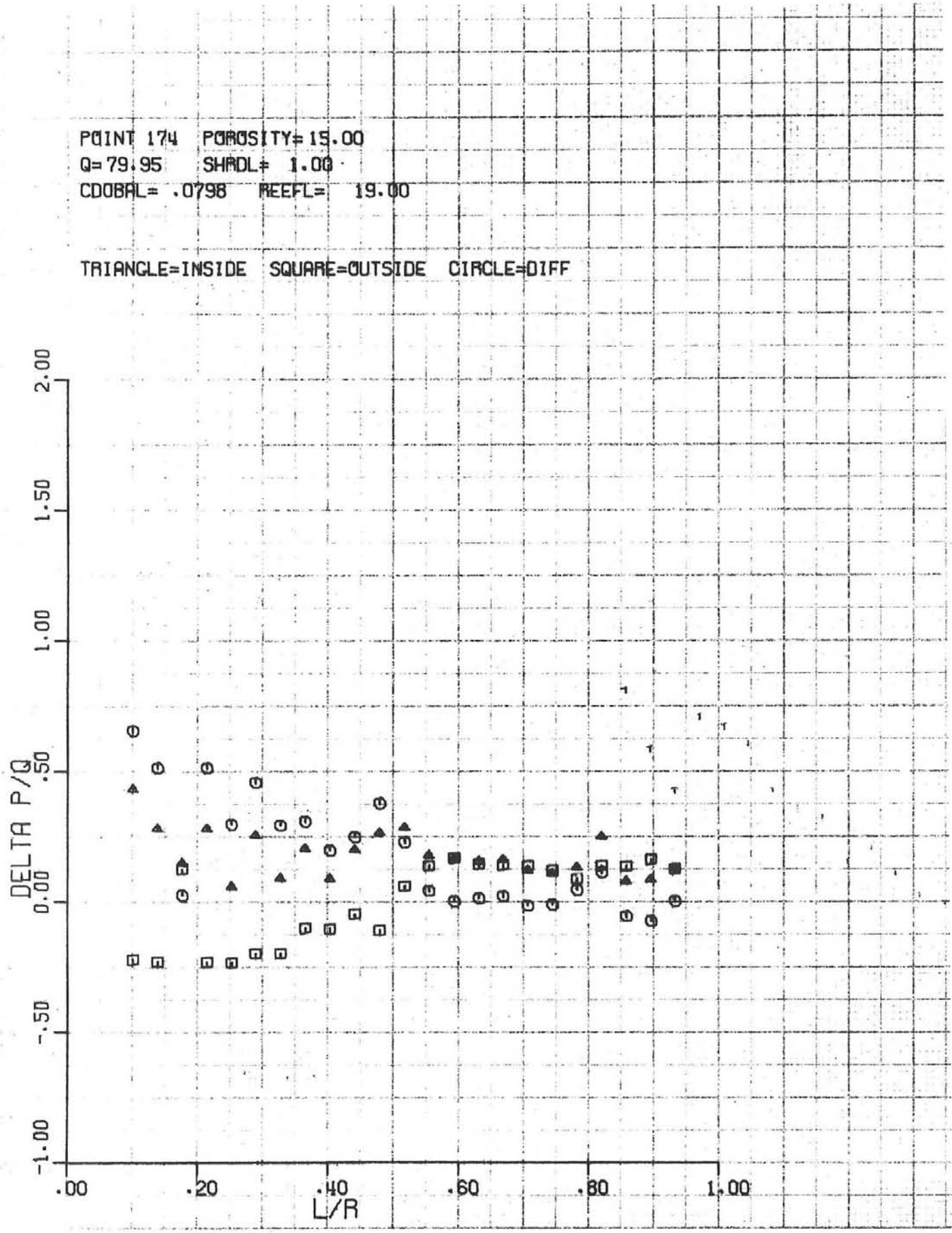
TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



POINT 172 POROSITY= 15.00
Q= 302.85 SHRDL= 1.00
CDOBAL= .2536 REEFL= 38.00

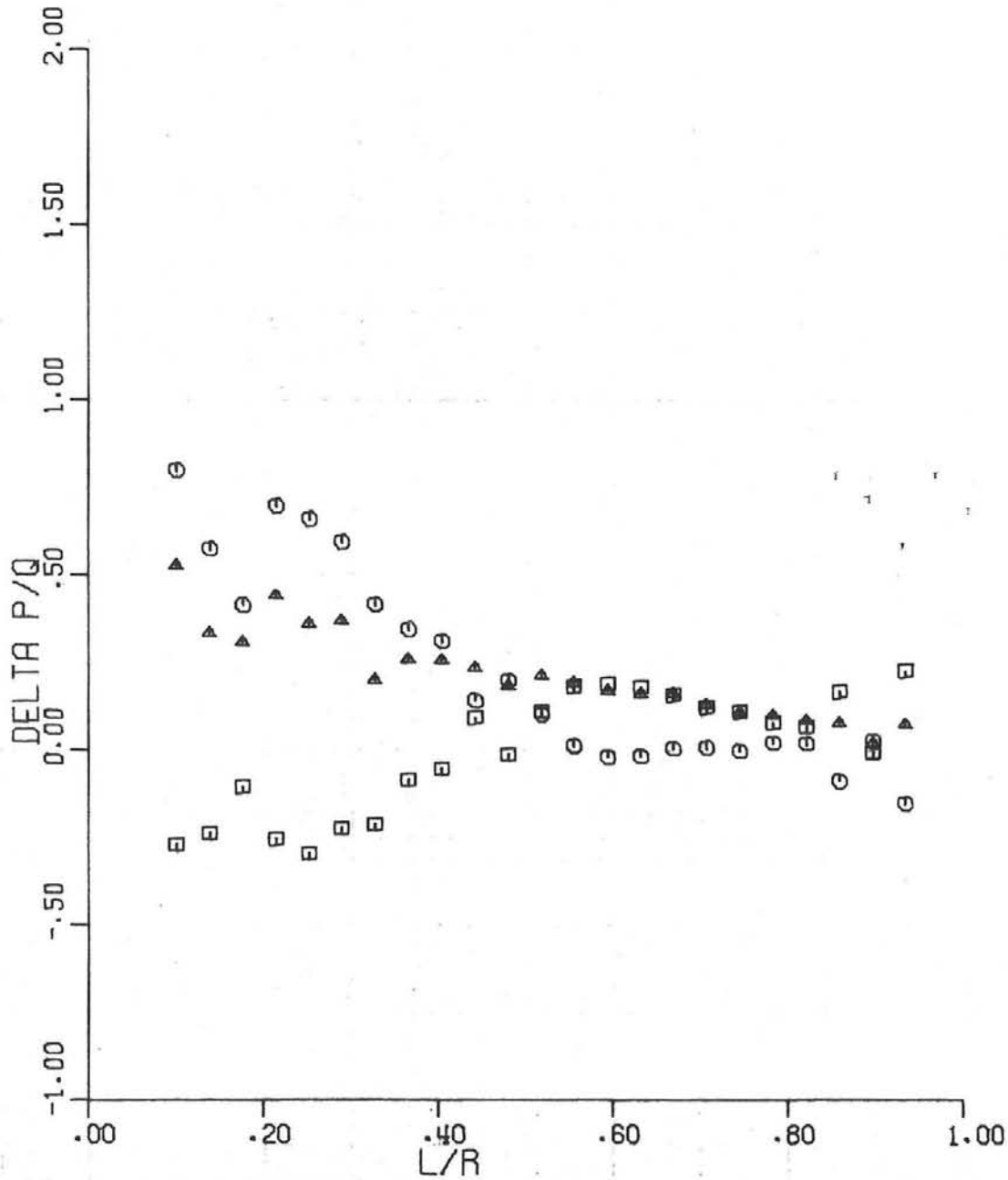
TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF




POINT 174 POROSITY= 15.00
Q= 79.95 SHRDL= 1.00
CDOBAL= .0798 REEFL= 19.00
TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF
DELTA P/Q
2.00
1.50
1.00
.50
0.00
-.50
-1.00
.00
.20
.40
.60
.80
1.00
L/R

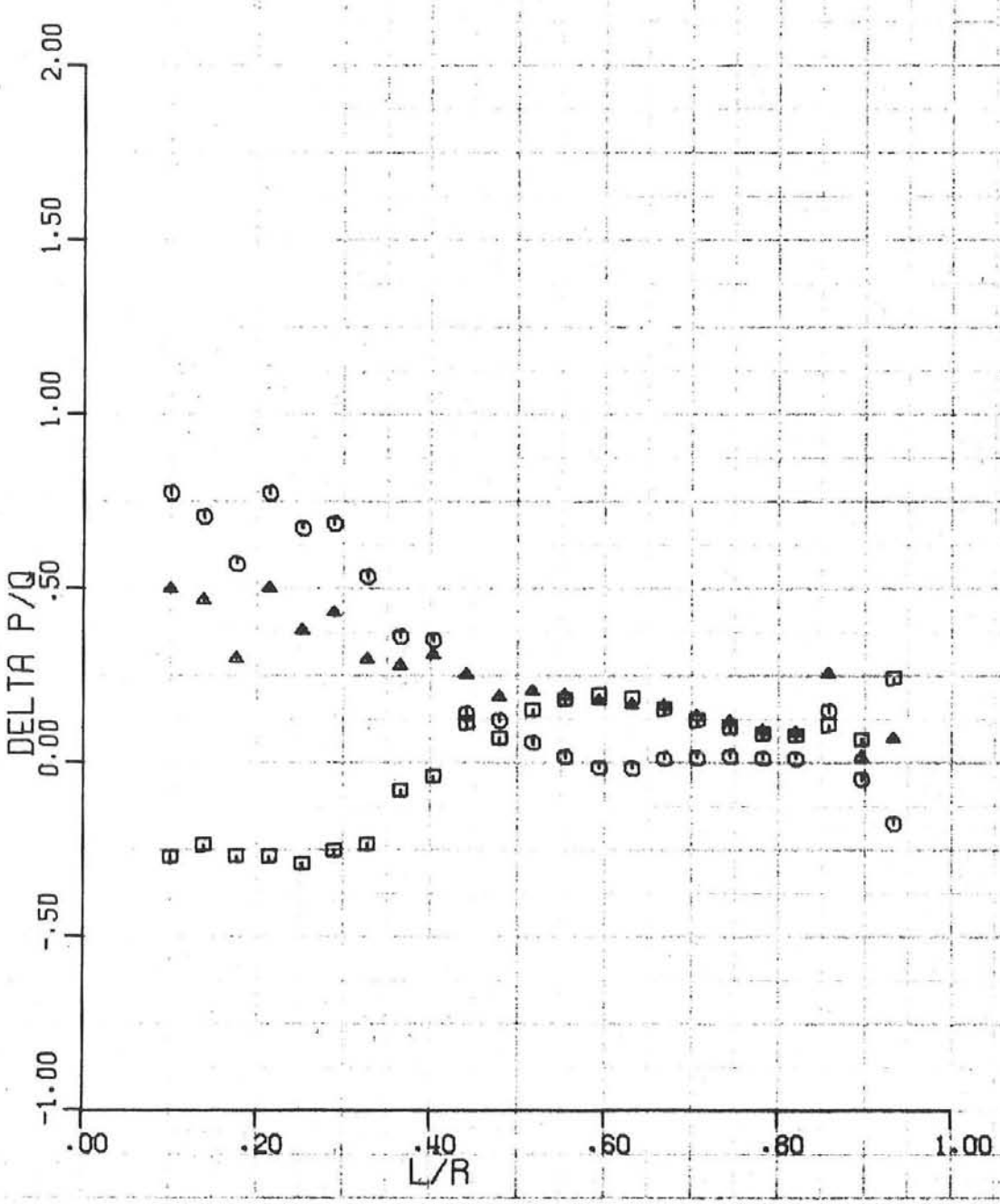
POINT 175 POROSITY= 15.00
Q= 204.39 SHRDL= 1.00
CDOBAL= .0738 REEFL= 19.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



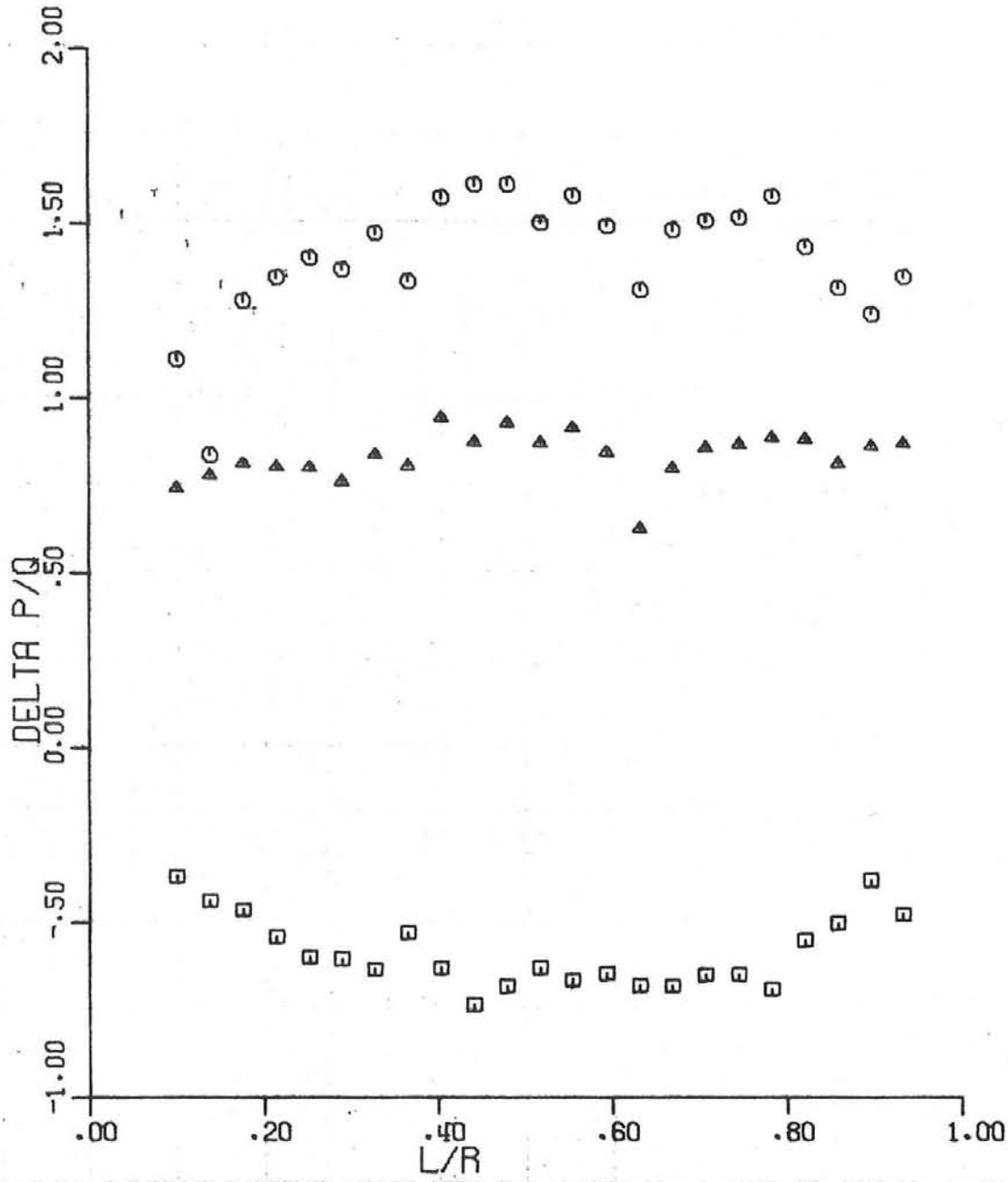
POINT 176 POROSITY= 15.00
Q= 300.12 SHRDL= 1.00
CDOBAL= .0734 REEFL= 19.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



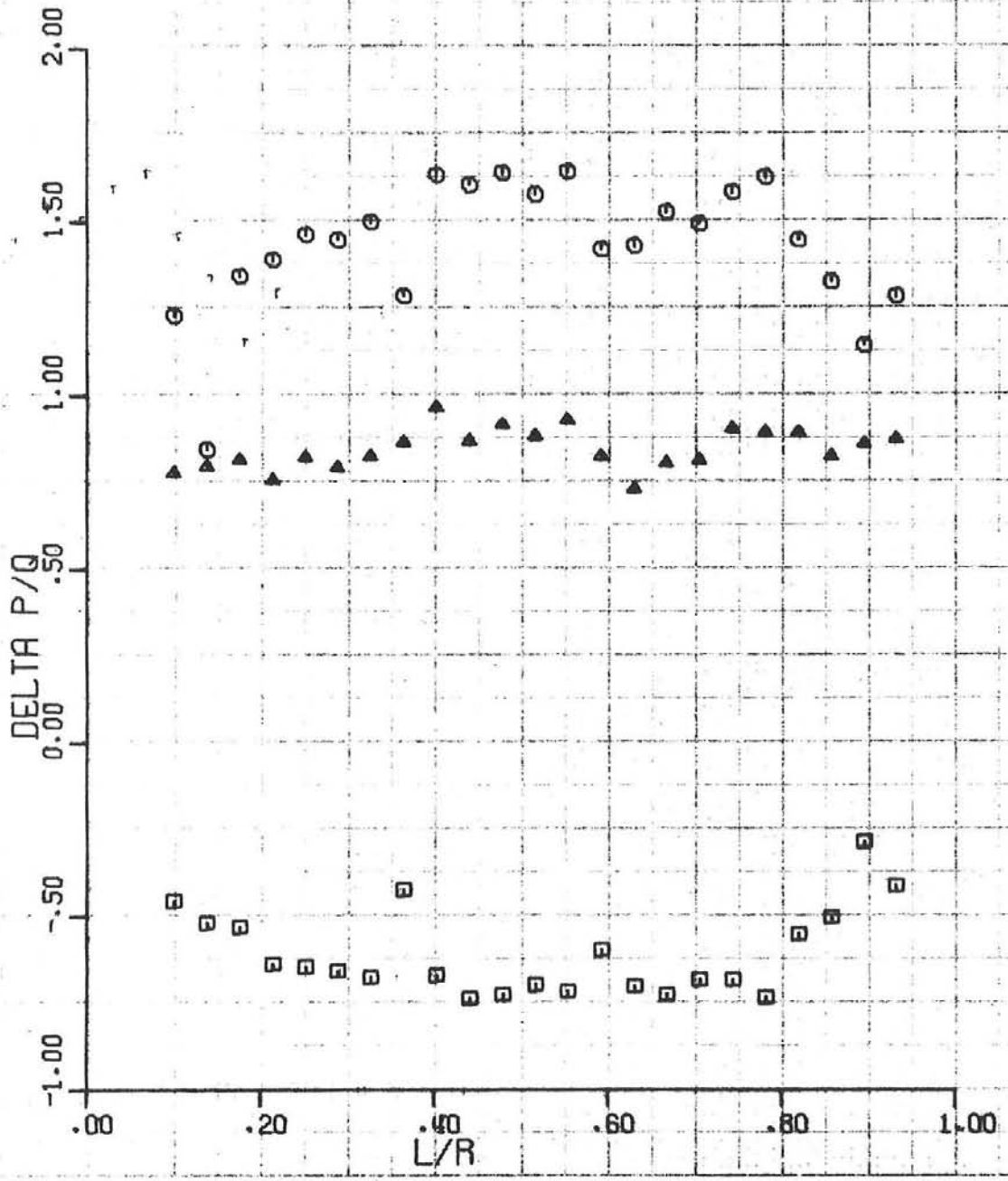
POINT 177 POROSITY= 30.00
Q= 73.77 SHRDL= 2.00
CDOBAL= .5667 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



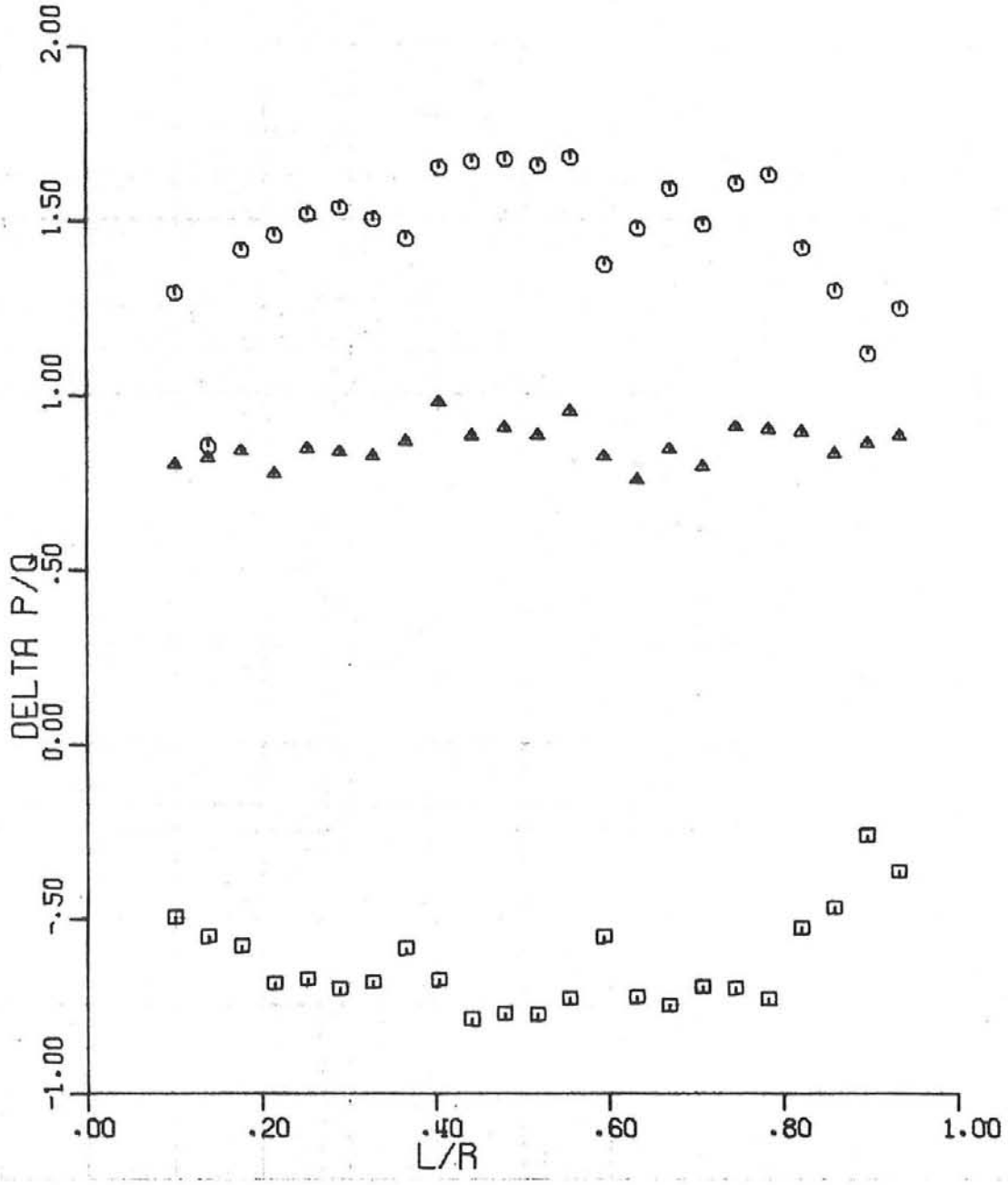
POINT 178 POROSITY= 30.00
Q= 200.39 SHRDL= 2.00
CDOBAL= .5808 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



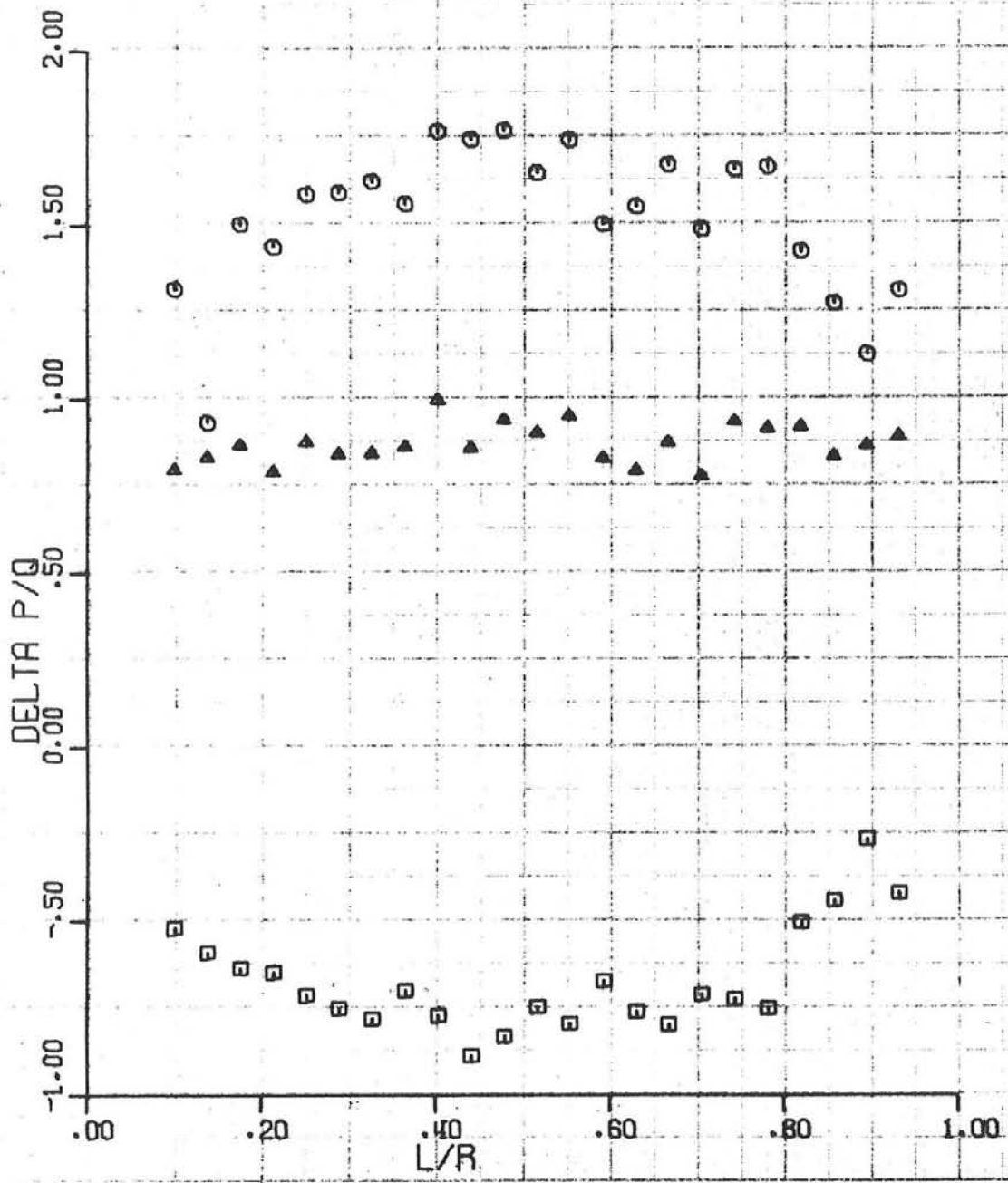
POINT 179 POROSITY= 30.00
Q= 302.39 SHRDL= 2.00
CDOBAL= .5942 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



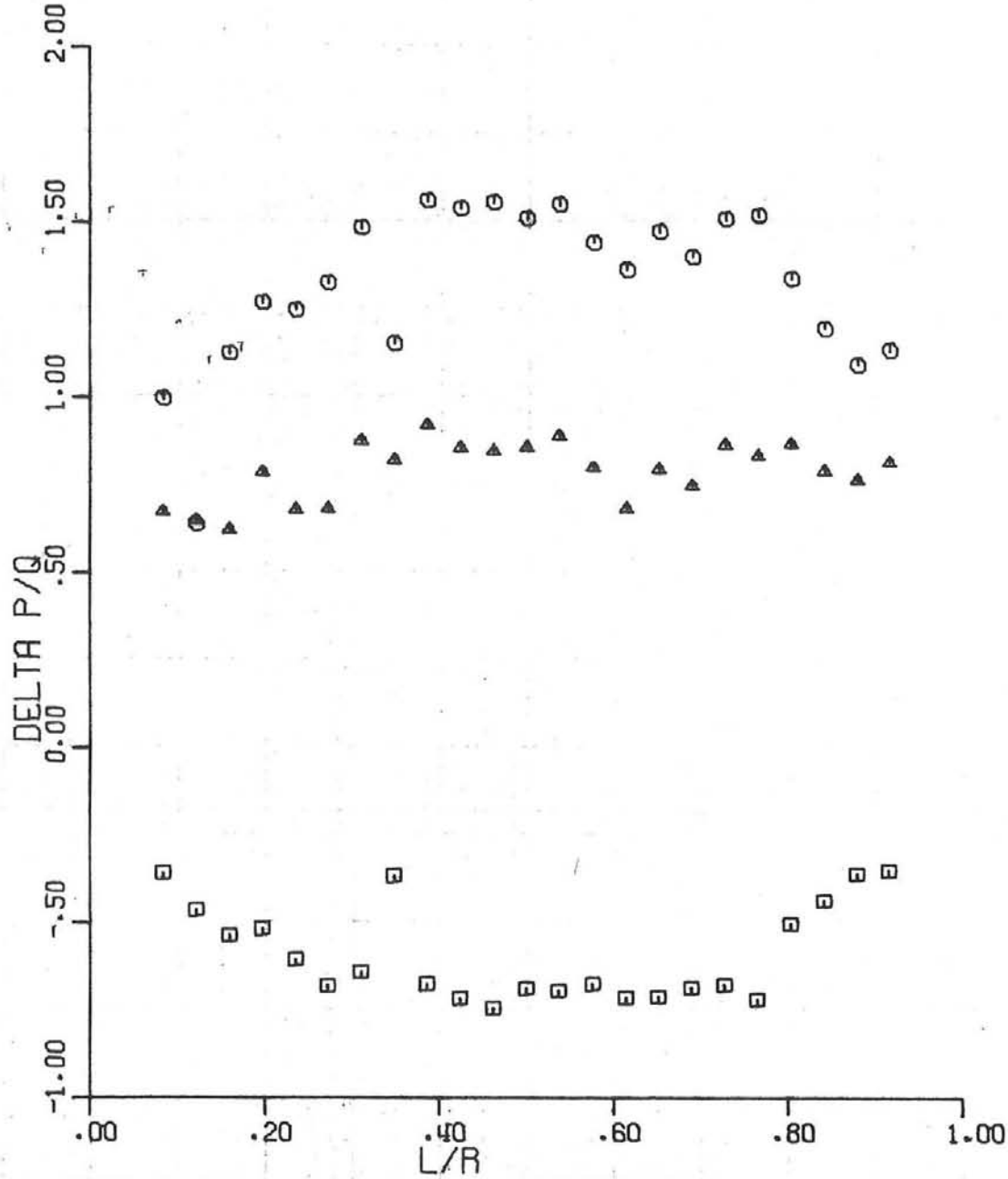
POINT 180 POROSITY= 30.00
Q= 405.47 SHROL= 2.00
CDOBAL= .6082 REEFL= 0.00

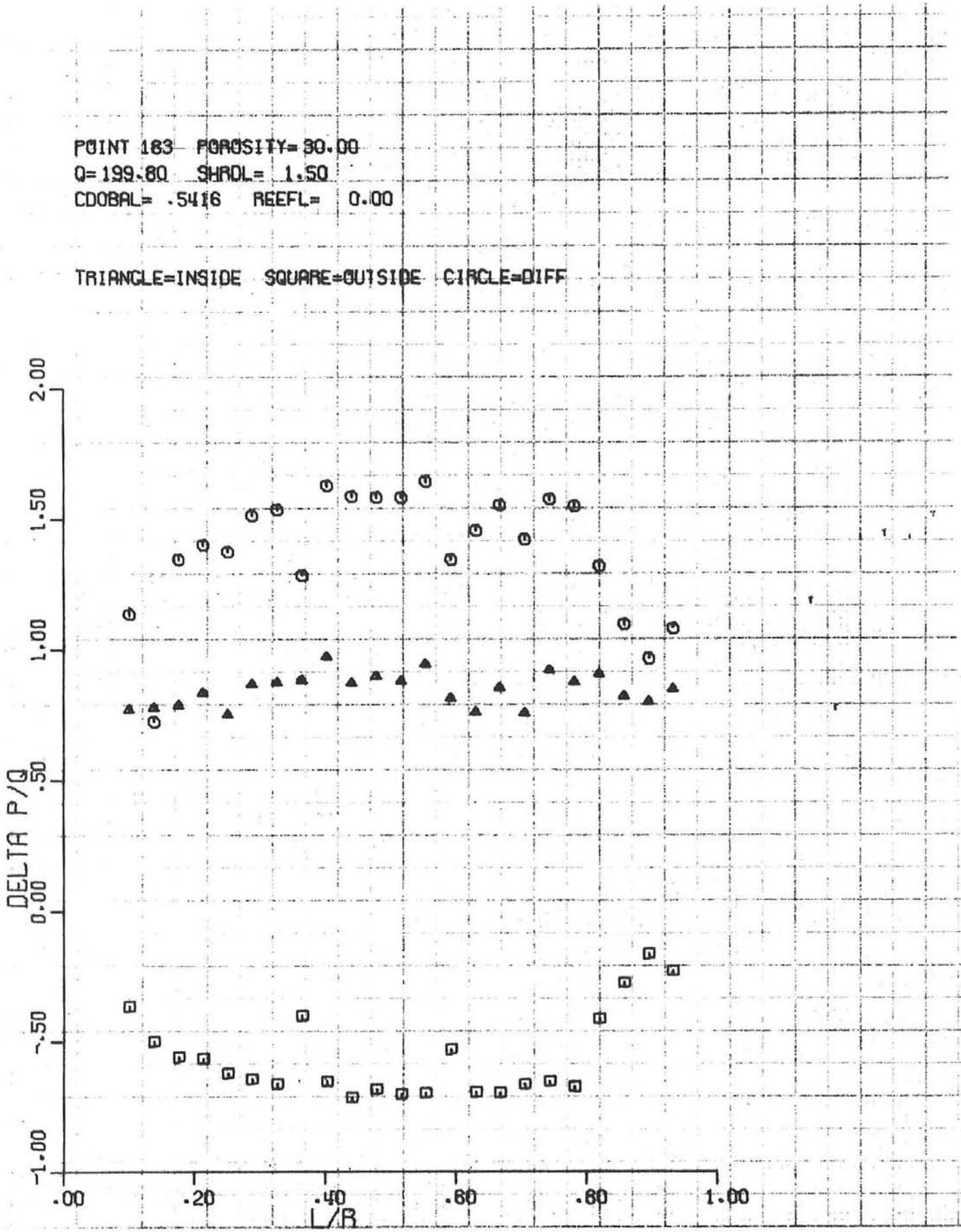
TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



POINT 182 POROSITY= 30.00
Q= 73.99 SHR. = 1.50
CDOBAL= .5288 REEFL= 0.00

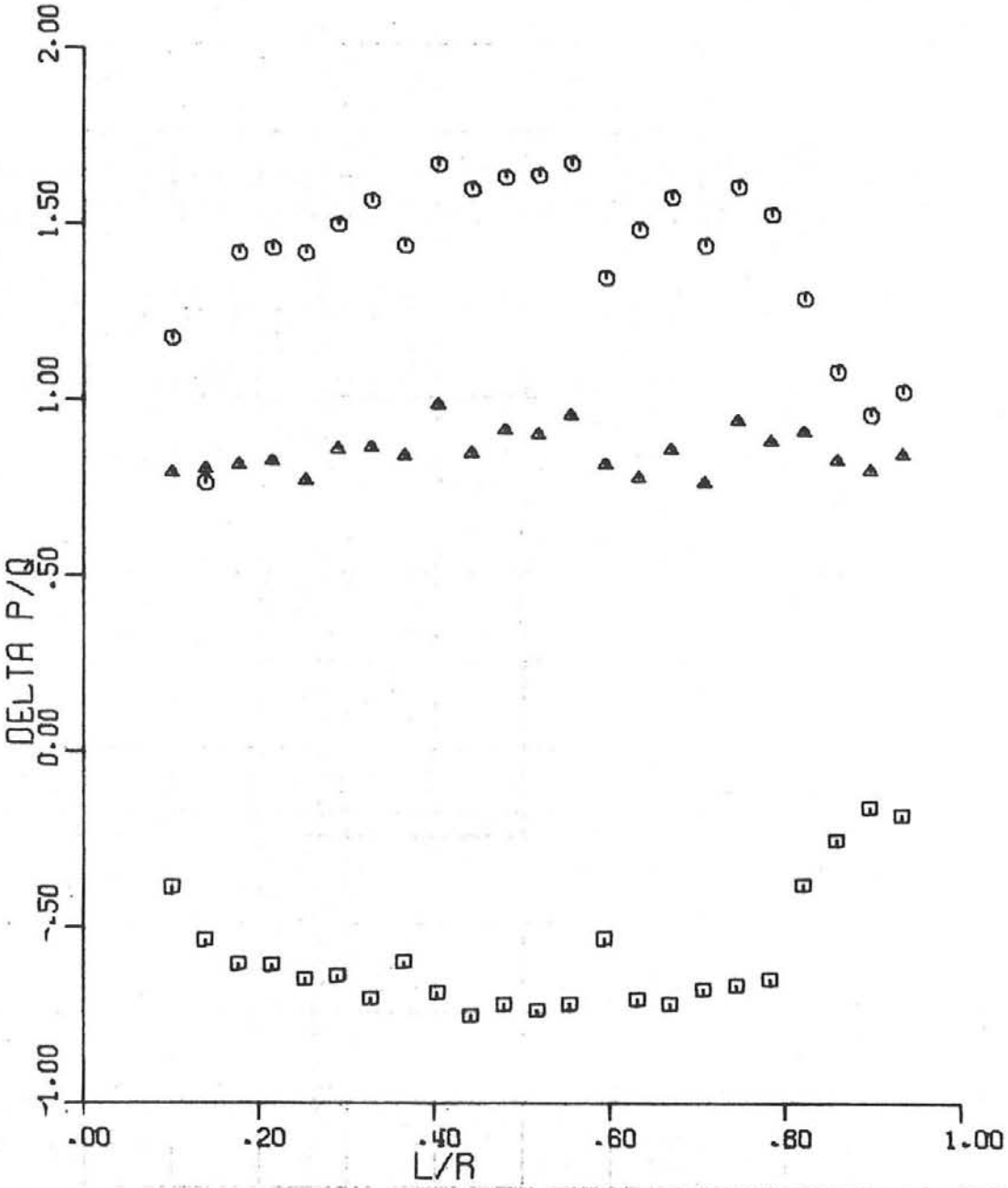
TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF




POINT 183 POROSITY= 30.00
Q= 199.80 SHROL= 1.50
CDOBAL= .5416 REEFL= 0.00
TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF
DELTA P/Q
2.00
1.50
1.00
.50
0.00
-.50
-1.00
.00
.20
.40
.60
.80
1.00
L/R

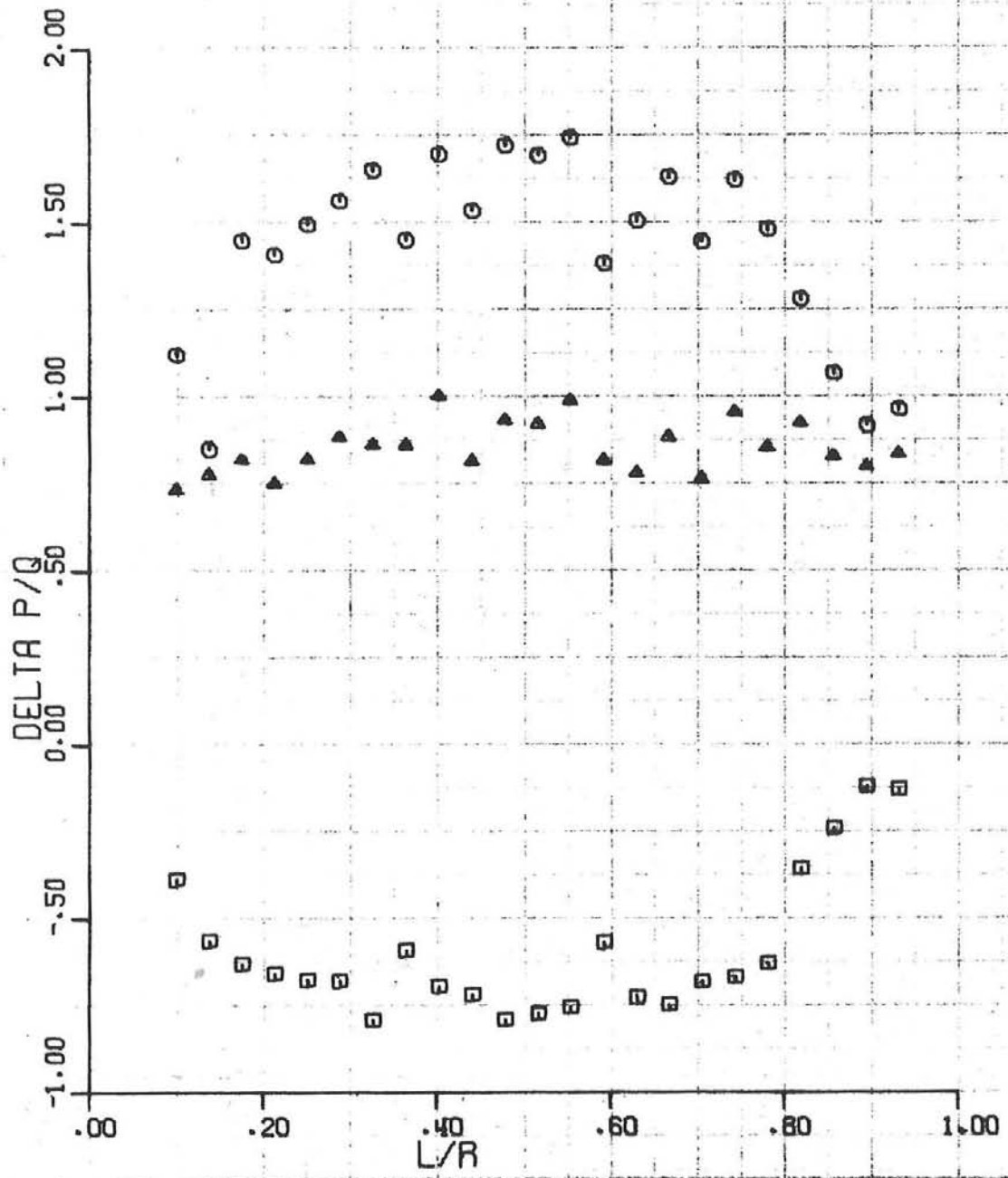
POINT 184 POROSITY= 30.00
Q= 304.36 SHRDL= 1.50
CDOBAL= .5531 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



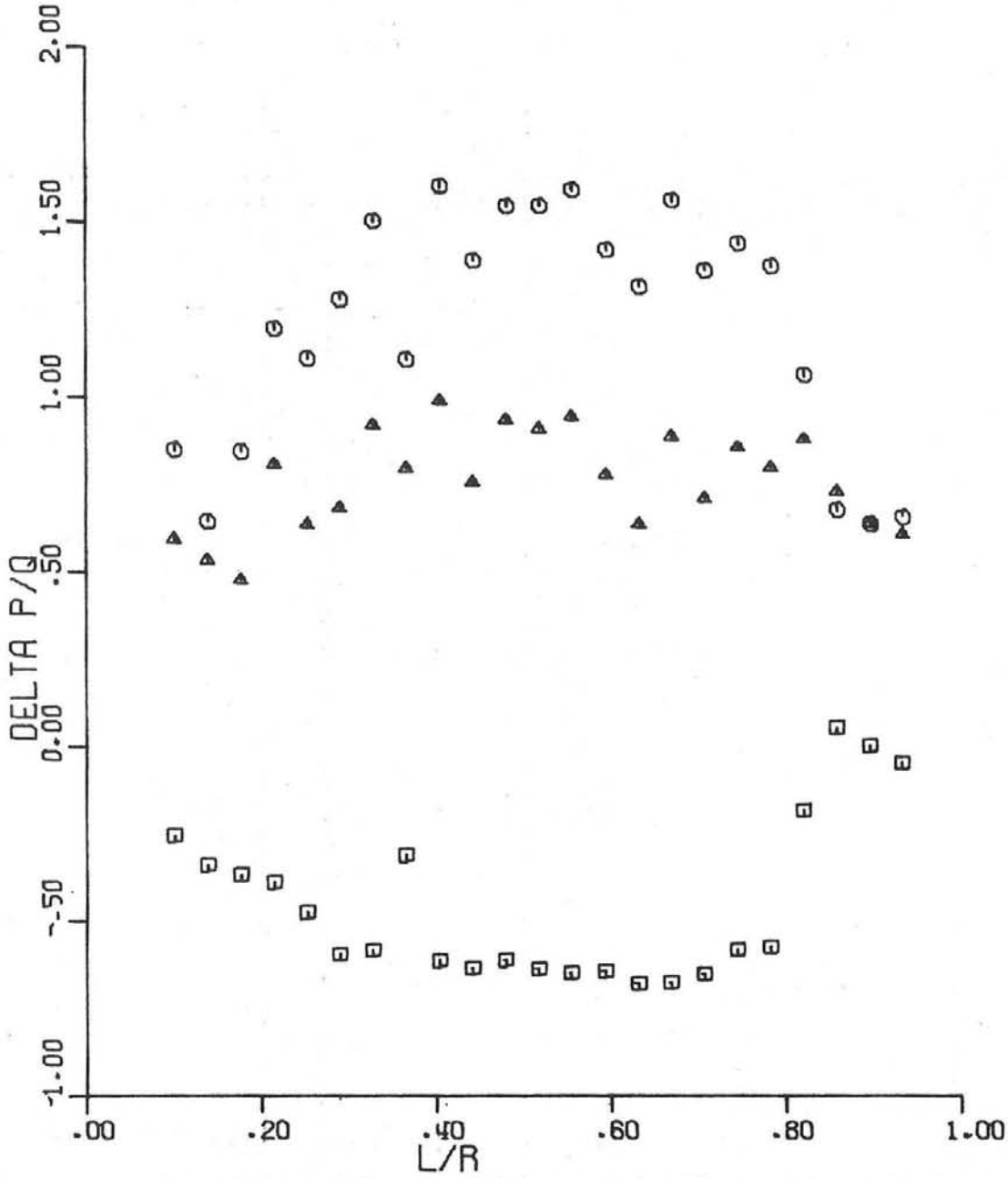
POINT 185 POROSITY= 30.00
Q=405.95 SHROL= 1.50
CDOBAL= .5637 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



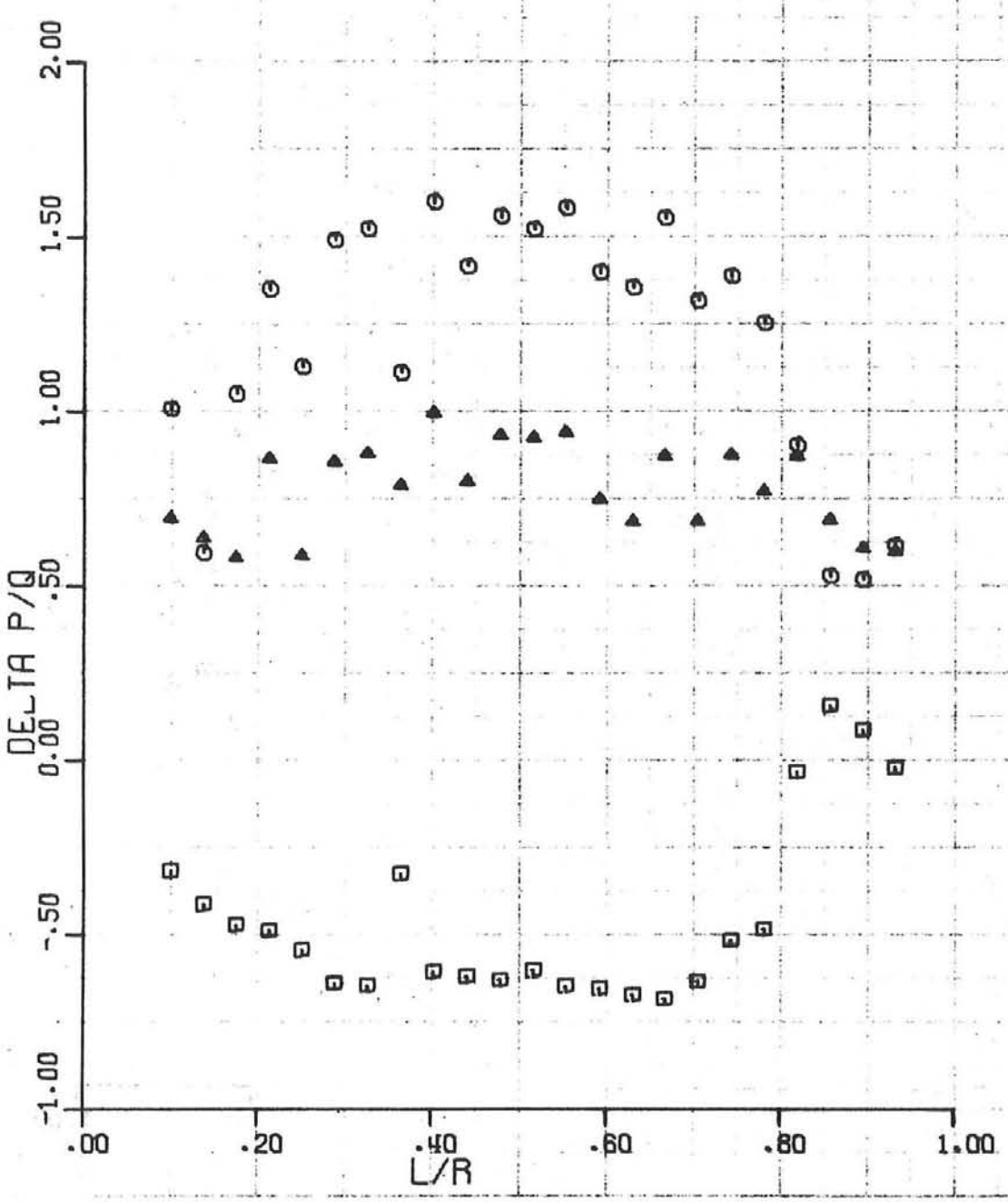
POINT 186 POROSITY= 30.00
Q= 75.84 SHRDL= 1.00
CDOBAL= .4394 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



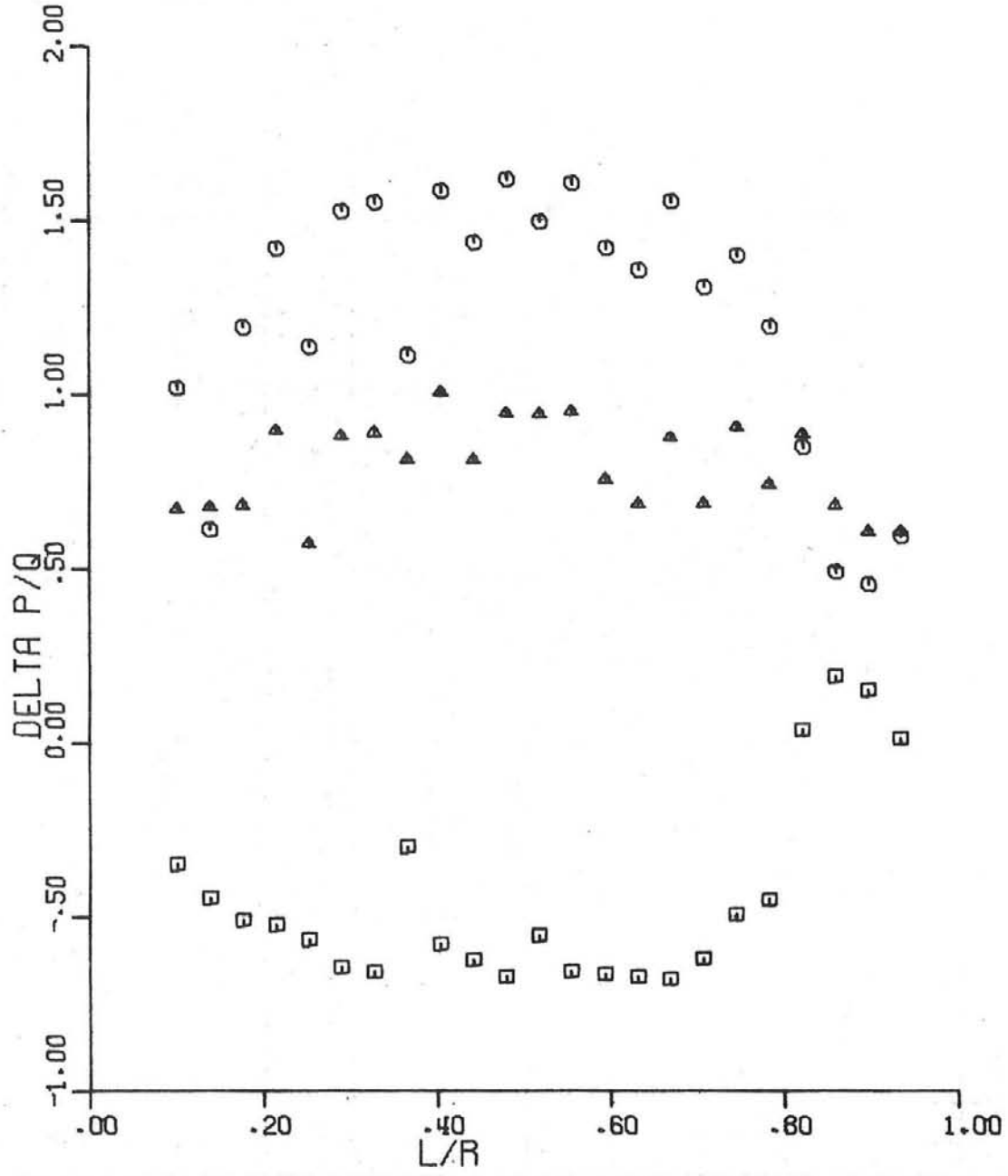
POINT 187 POROSITY= 30.00
Q= 201.89 SHROL= 1.00
CDOBAL= .4364 REEFL= 0.00

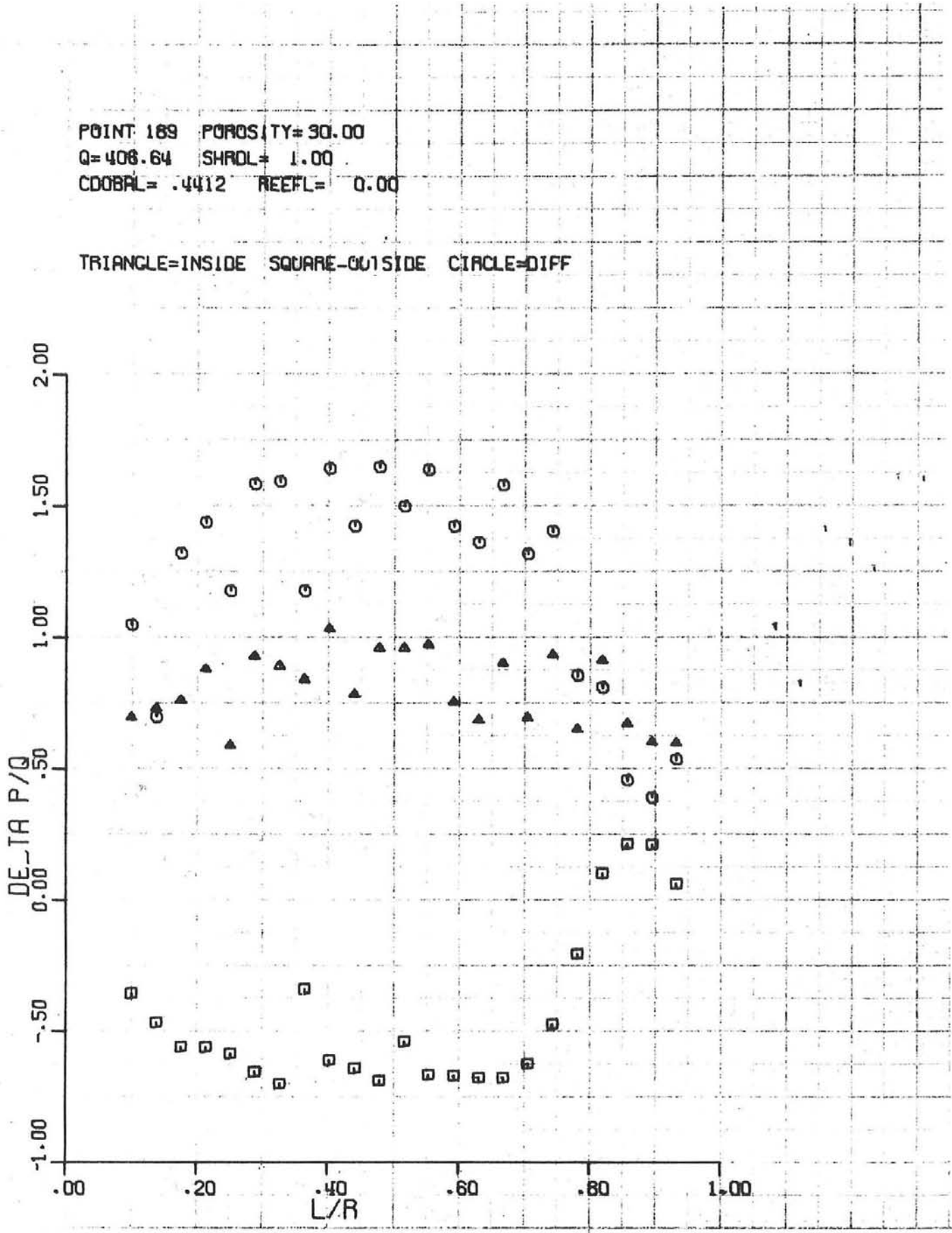
TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



POINT 188 POROSITY= 30.00
Q= 304.79 SHROL= 1.00
CDOBAL= .4392 REEFL= 0.00

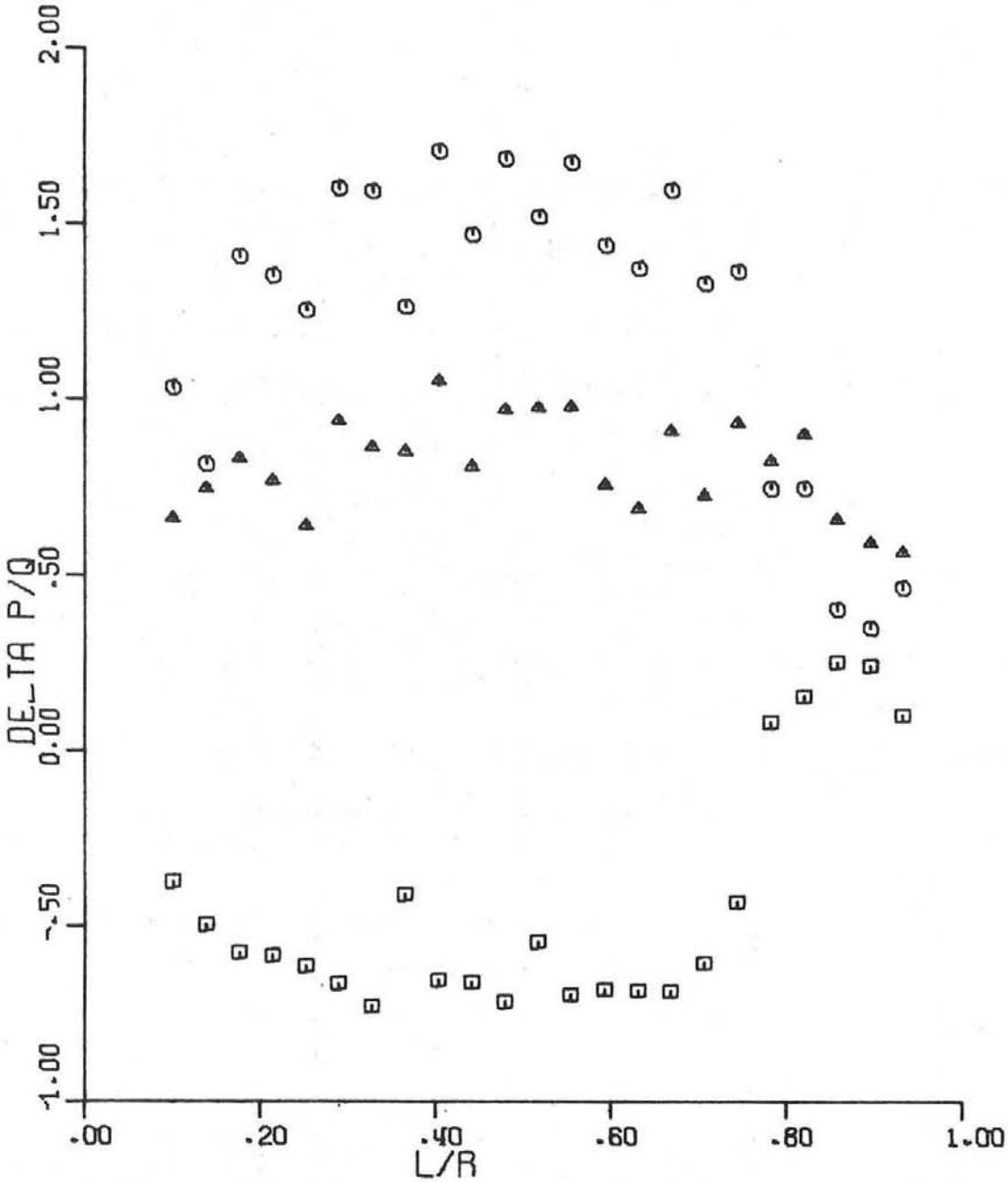
TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF




POINT 169 POROSITY= 30.00
Q= 408.64 SHROL= 1.00
CDOBAL= .4412 REEFL= 0.00
TRIANGLE=INSIDE SQUARE-OUTSIDE CIRCLE=DIFF
DE_TA P/Q
2.00
1.50
1.00
.50
0.00
-.50
-1.00
.00
.20
.40
.60
.80
1.00
L/R

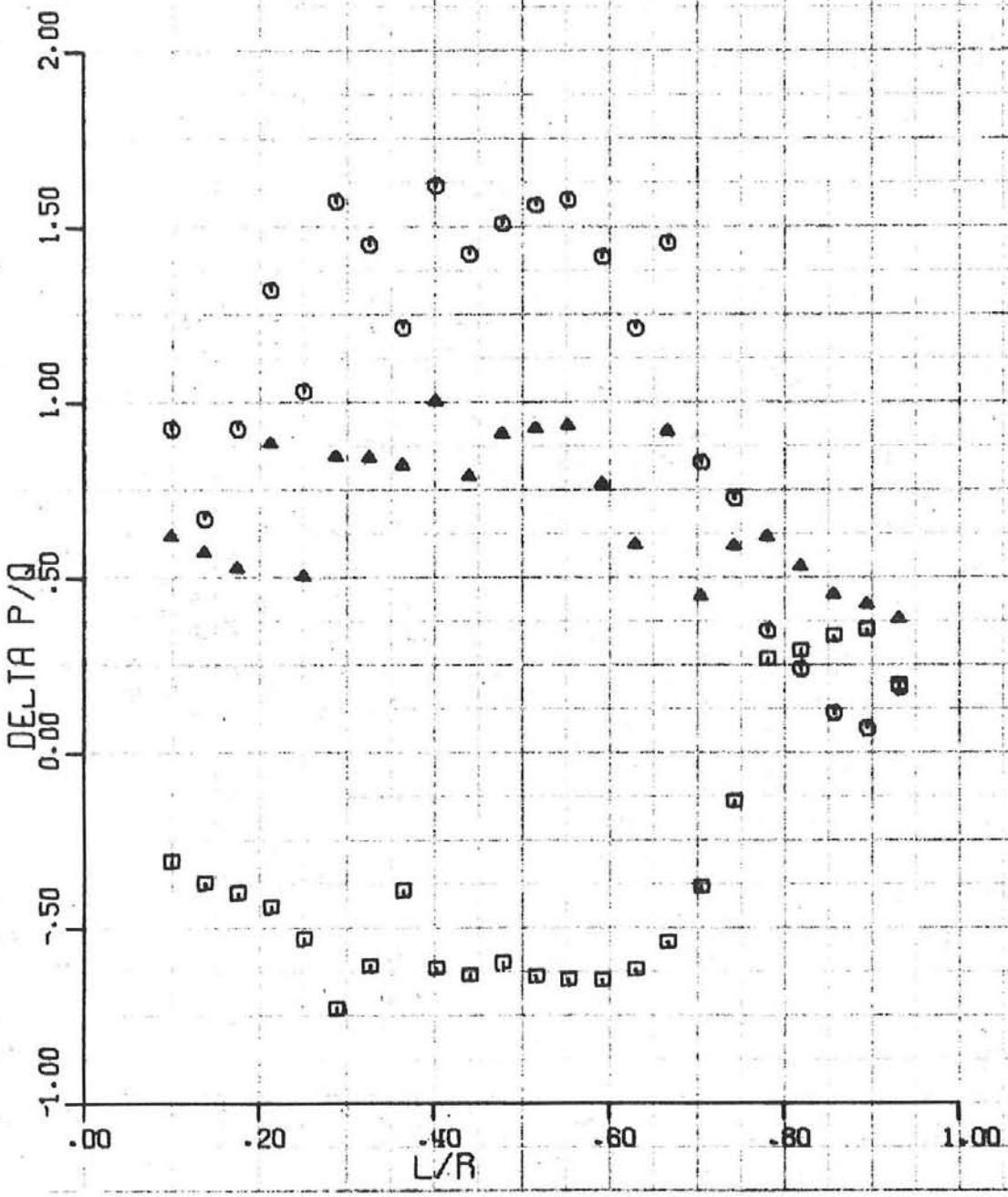
POINT 190 POROSITY= 30.00
Q= 506.00 SHRDL= 1.00
CDOBAL= .4425 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



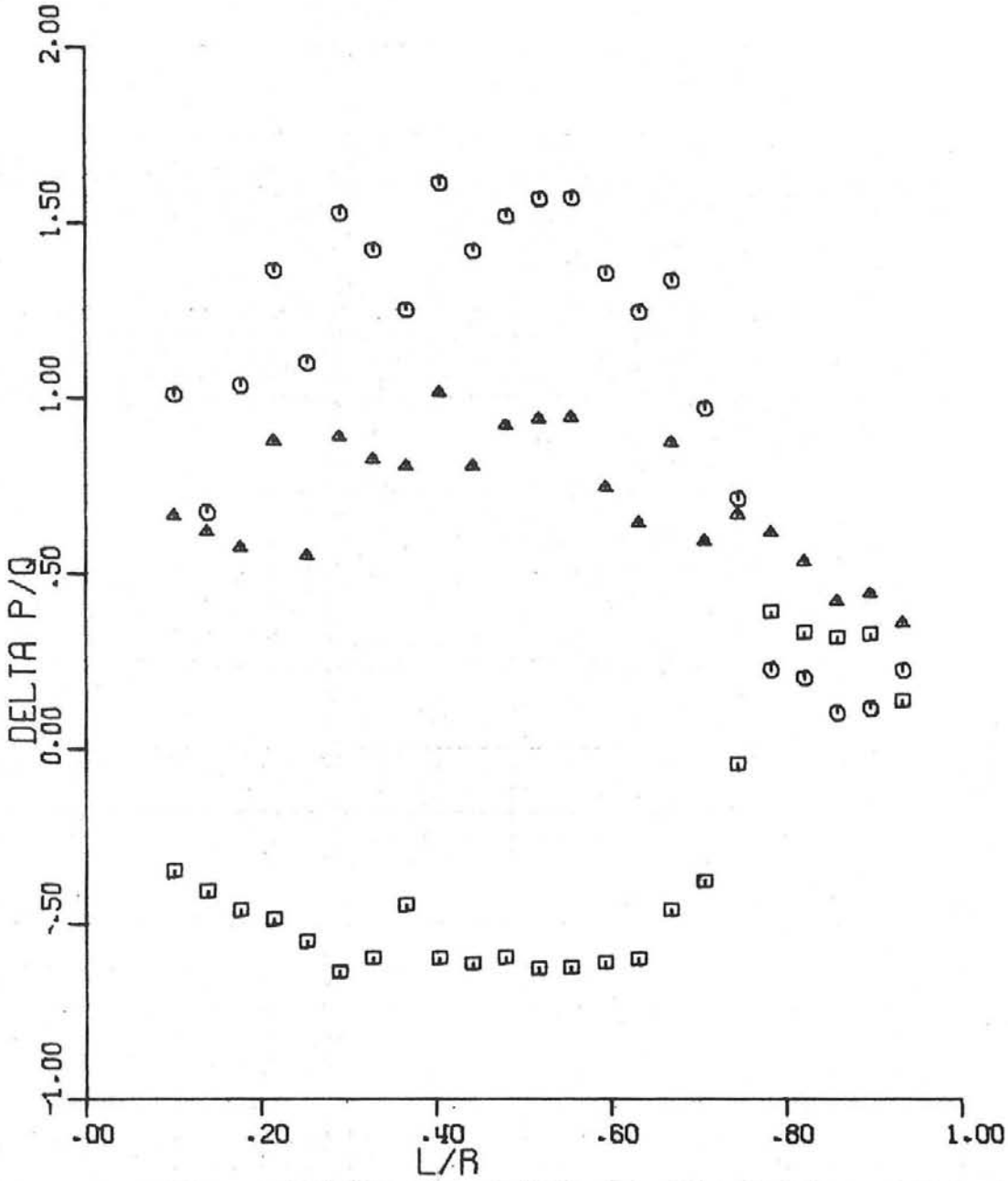
POINT 191 POROSITY= 30.00
Q-76.27 SHRDL= 1.00
CDOBAL= .3367 REEFL= 57.00

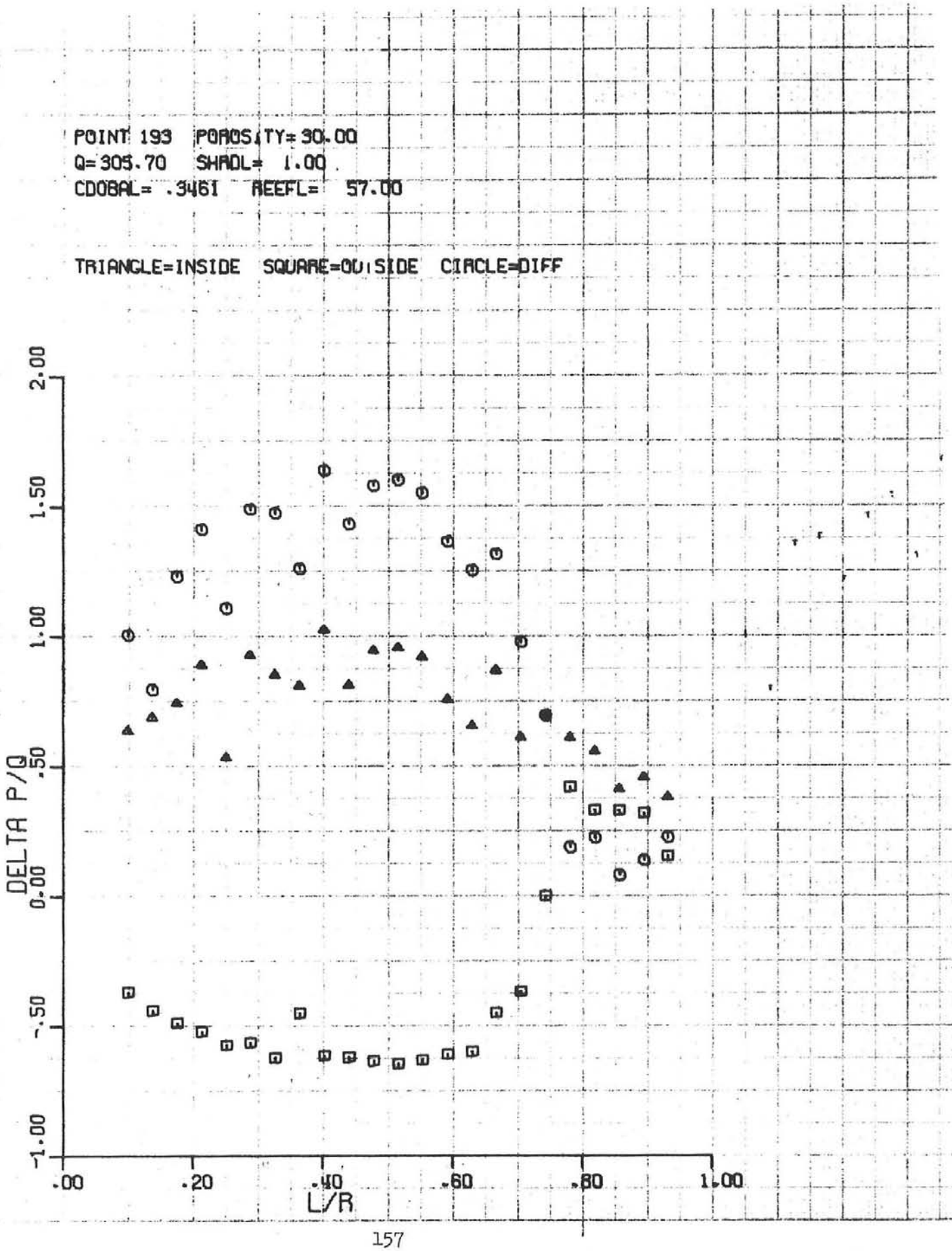
TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



POINT 192 POROSITY= 30.00
Q= 204.26 SHRDL= 1.00
CDOBAL= .3412 REEFL= 57.00

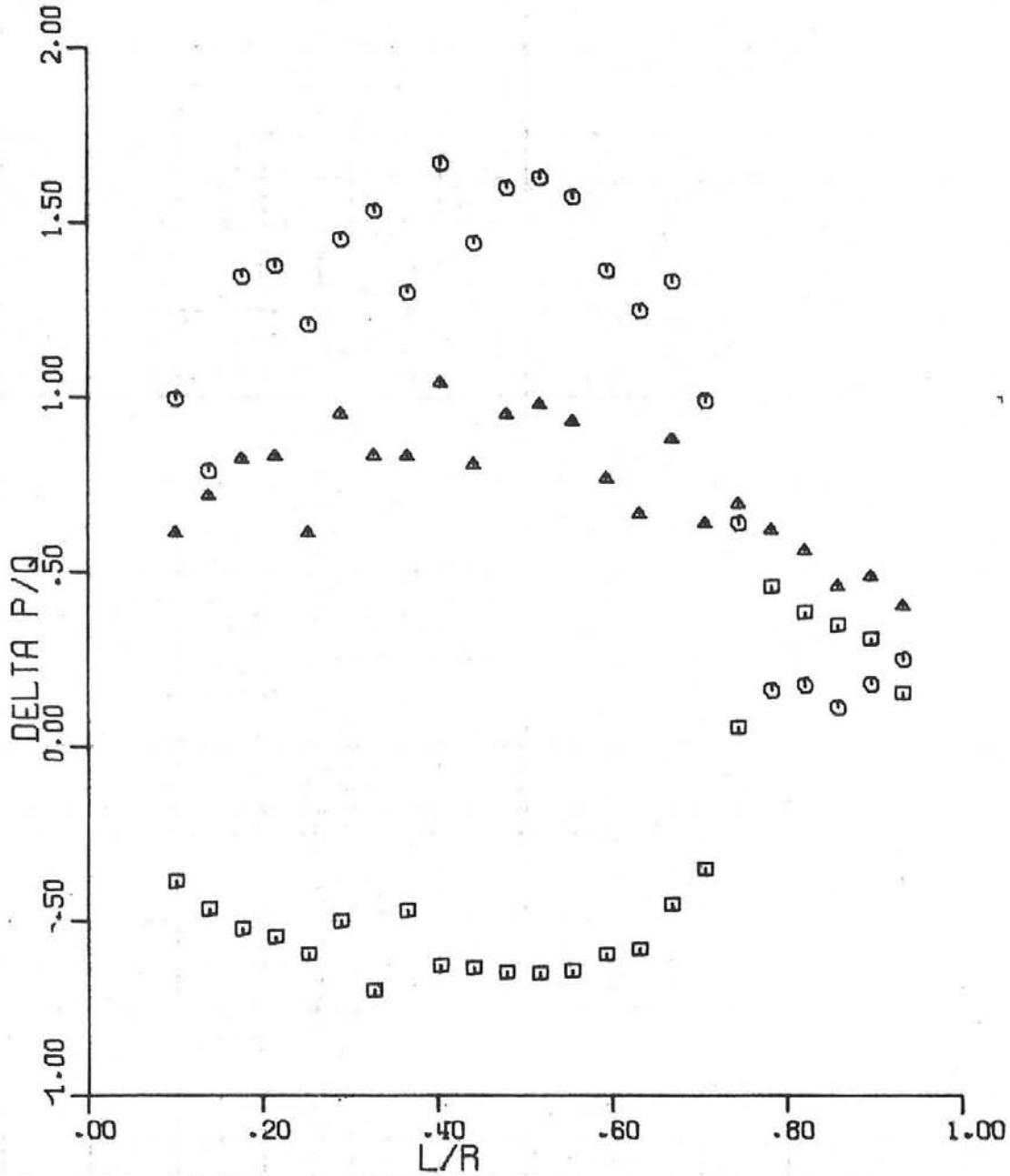
TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF




POINT 193 POROSITY= 30.00
Q= 305.70 SHADL= 1.00
CDOBAL= .3461 REEFL= 57.00
TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF
DELTA P/Q
2.00
1.50
1.00
.50
0.00
-.50
-1.00
.00
.20
.40
.60
.80
1.00
L/R

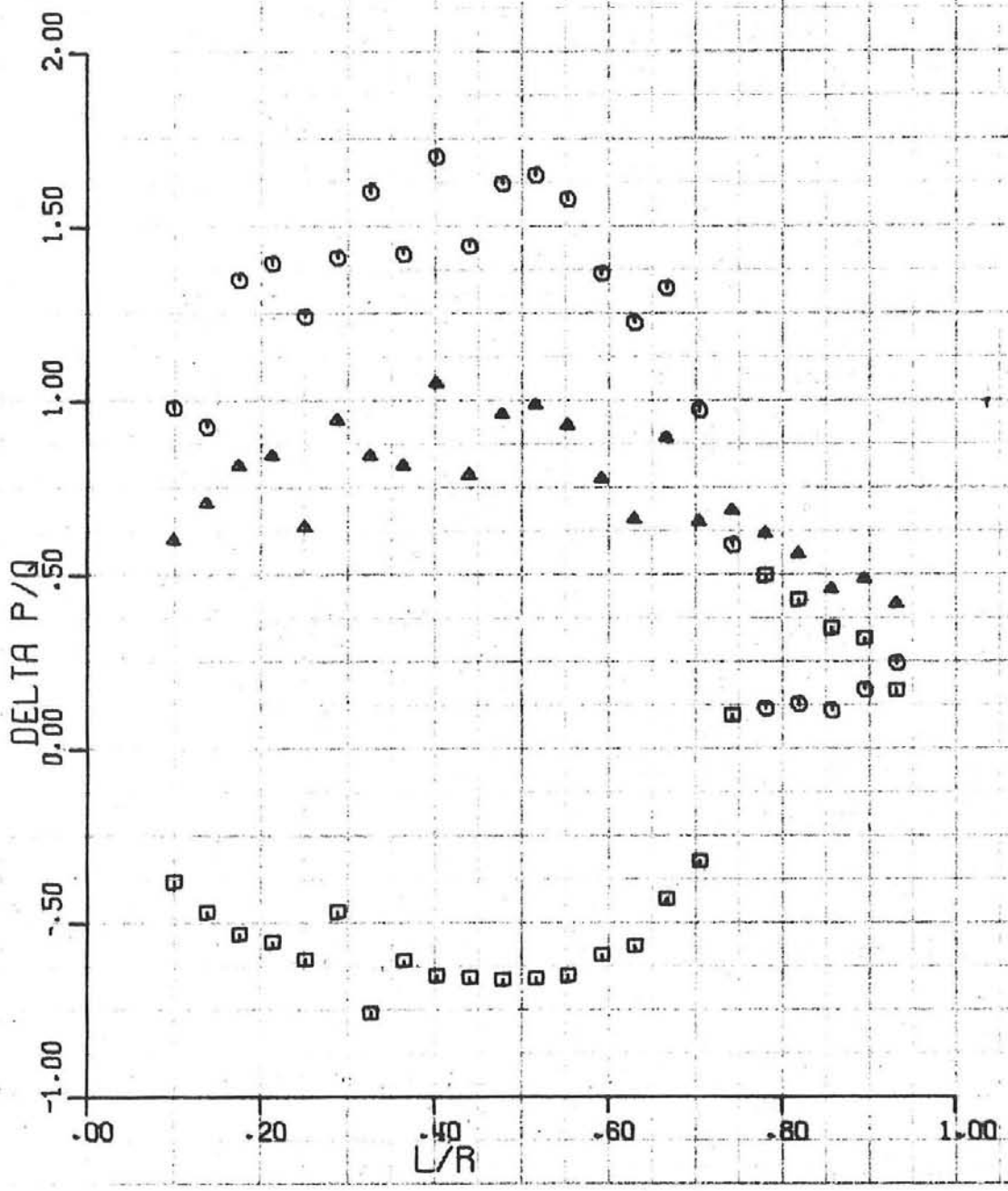
POINT 194 POROSITY= 30.00
Q= 407.28 SHRDL= 1.00
CDOBAL= .3502 REEFL= 57.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



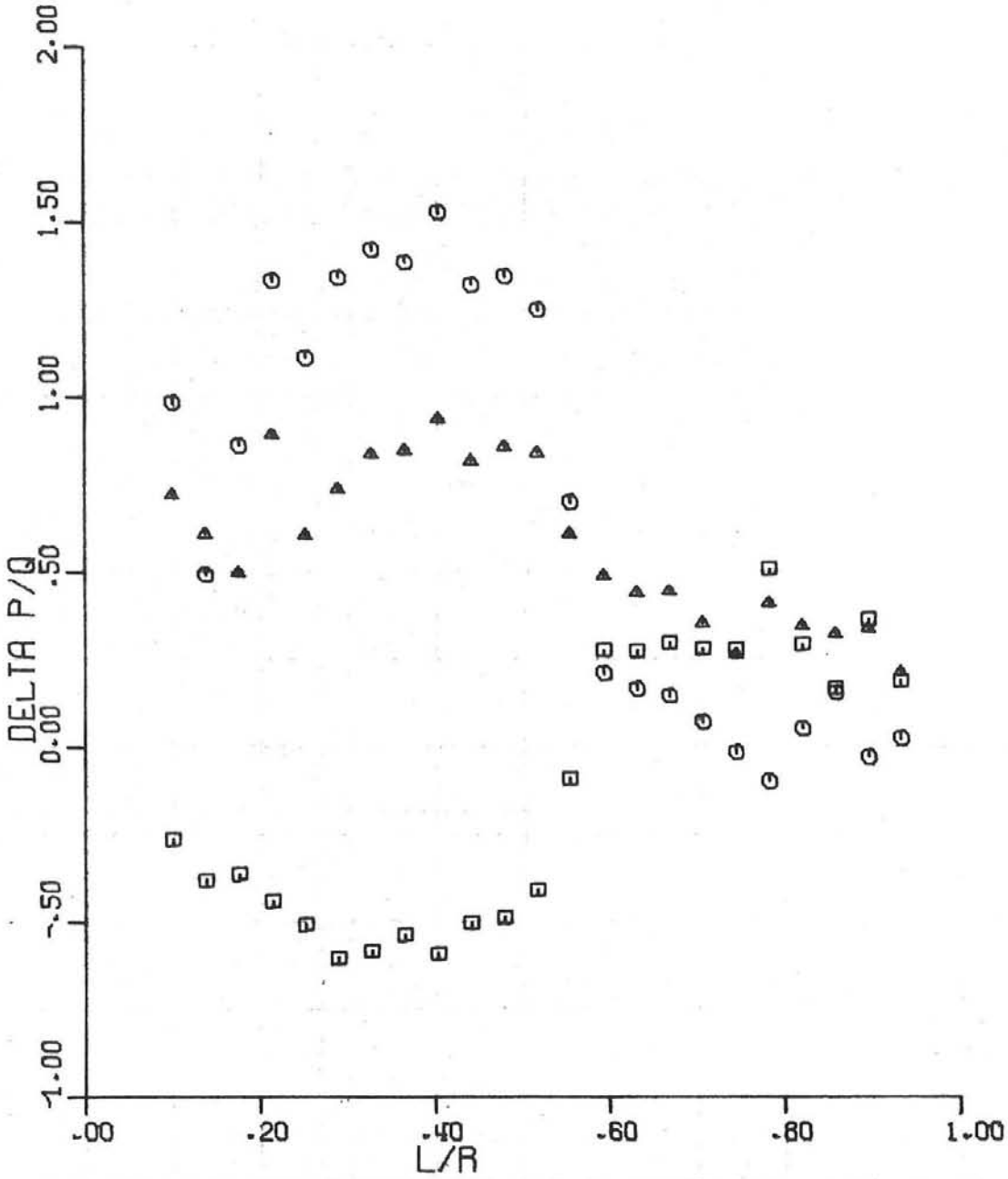
POINT 195 POROSITY= 30.00
Q=506.93 SHROL= 1.00
CDOBAL= .3534 REEFL= 57.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



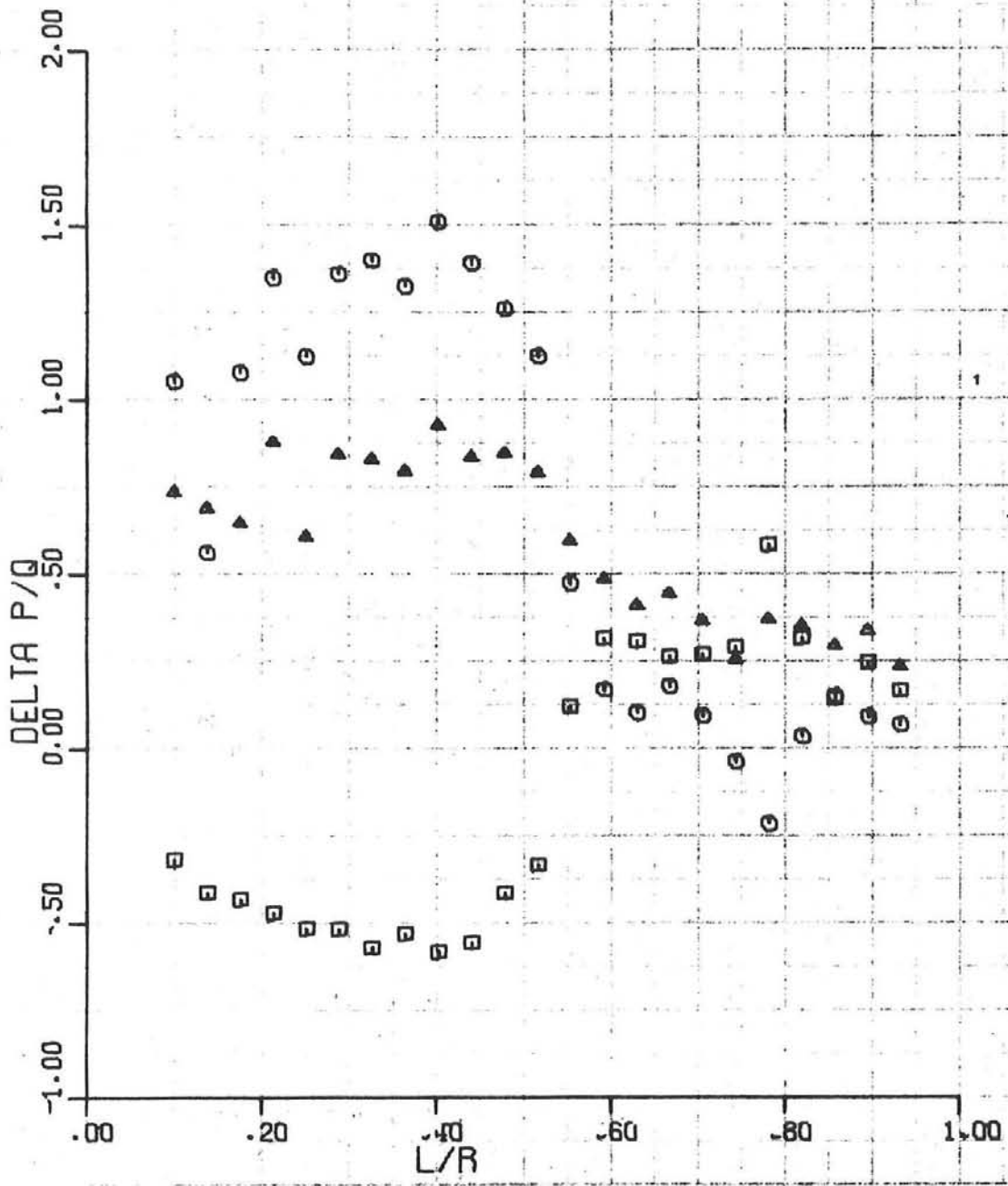
POINT 196 POROSITY= 30.00
Q= 75.37 SHRDL= 1.00
CDOBAL= .2016 REEFL= 38.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



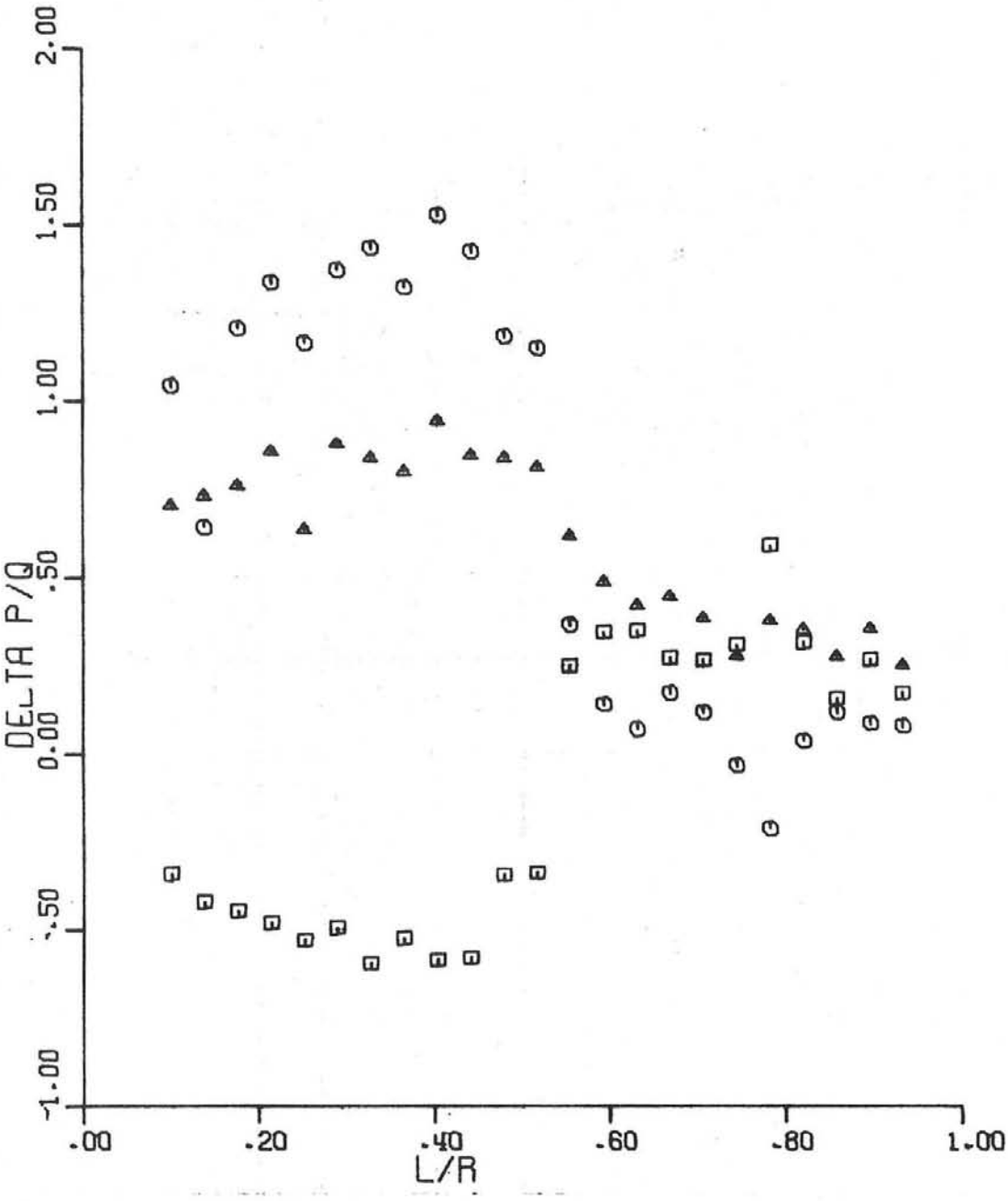
POINT 197 POROSITY= 30.00
Q= 205.07 SHROL= 1.00
CDOBAL= .1978 REEFL= 38.00

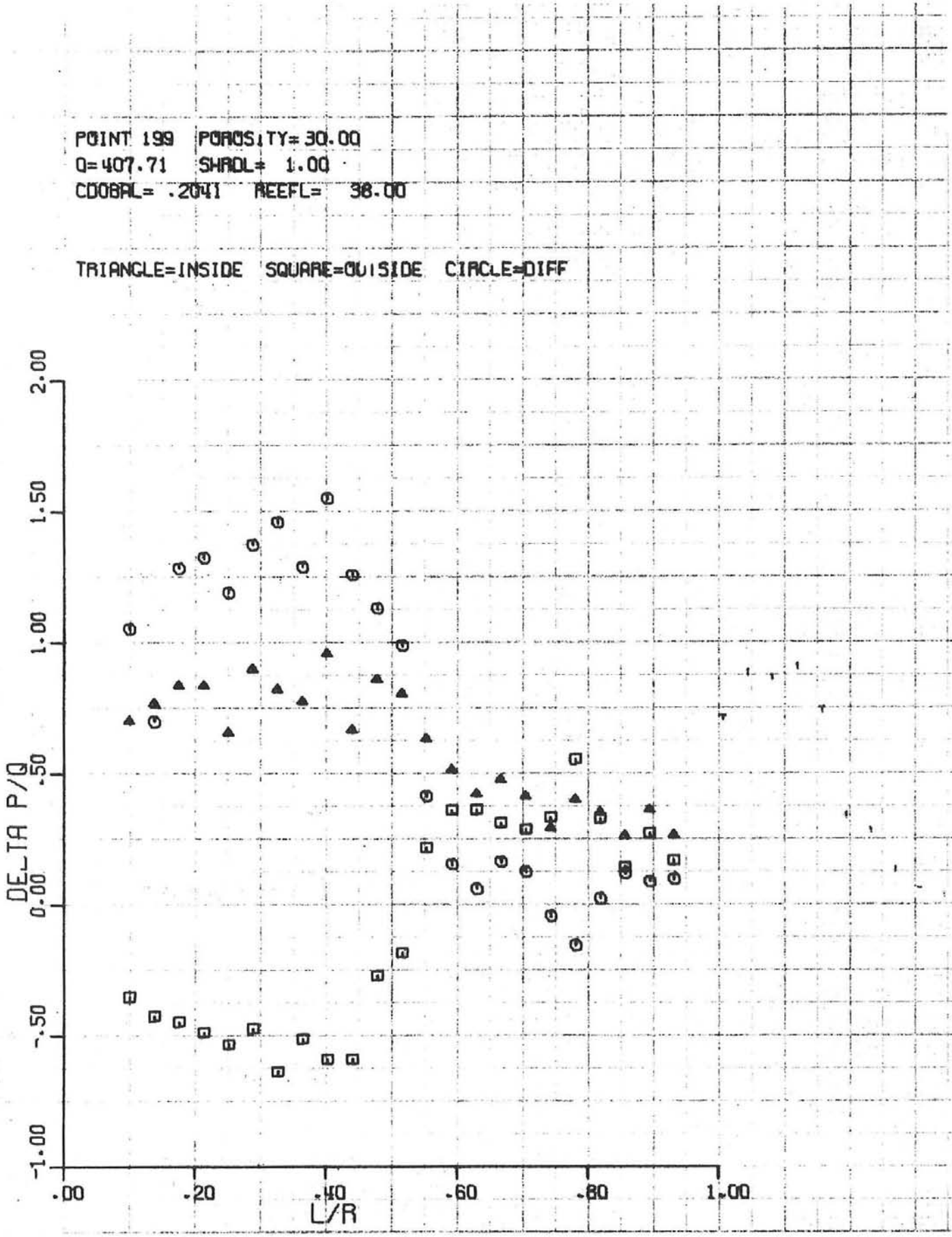
TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



POINT 198 POROSITY= 30.00
Q= 306.59 SHRDL= 1.00
CDOBAL= .2005 REEFL= 38.00

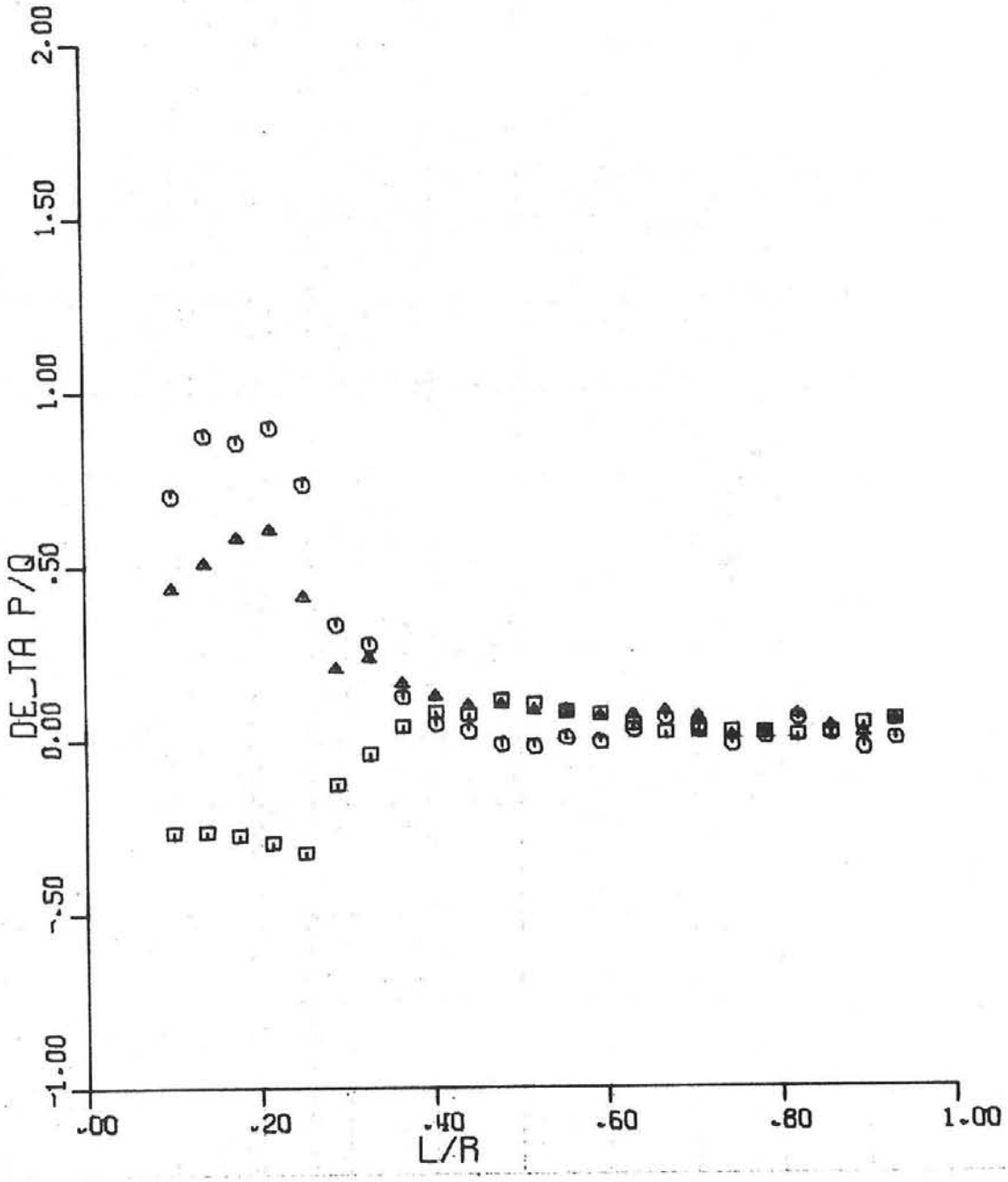
TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF




POINT 199 POROSITY= 30.00
Q=407.71 SHROL= 1.00
CDOBAL= .2041 REEFL= 38.00
TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF
DELTA P/Q
2.00
1.50
1.00
.50
0.00
-.50
-1.00
.00
.20
.40
.60
.80
1.00
L/R

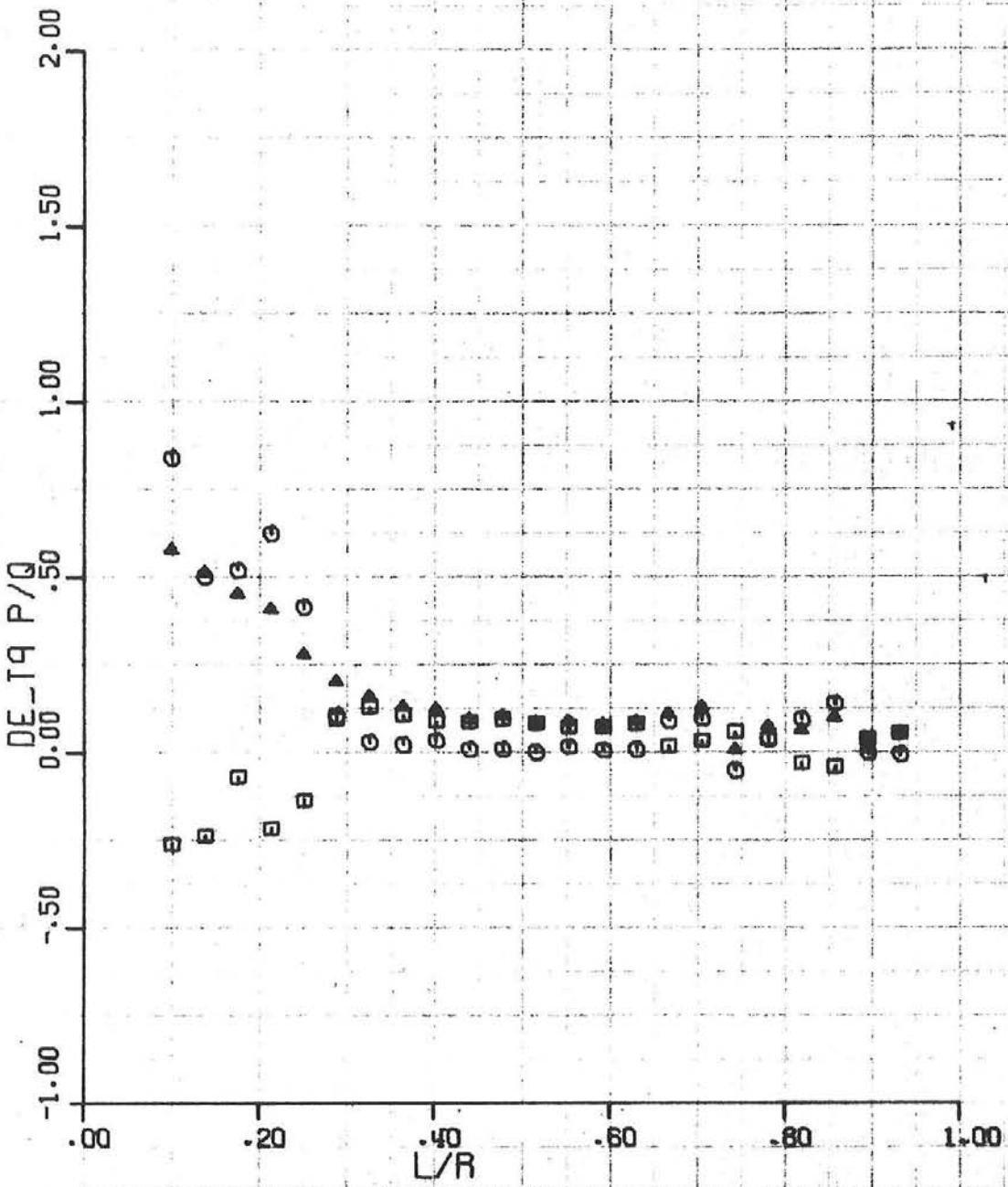
POINT 200 POROSITY= 30.00
Q= 75.83 SHADL= 1.00
CDOBAL= .0563 REEFL= 19.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



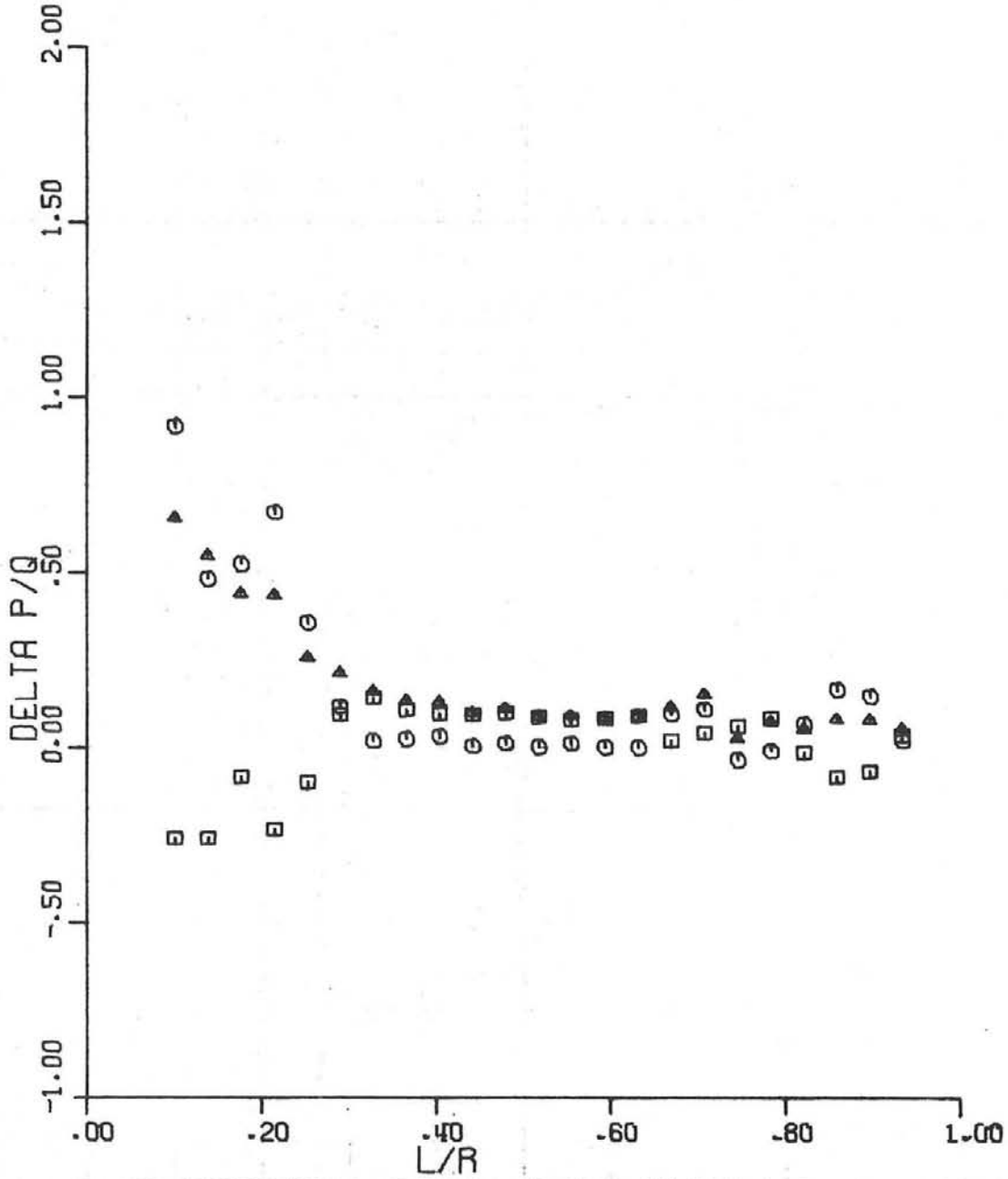
POINT 201 POROSITY= 30.00
Q= 206.88 SHROL= 1.00
CDOBAL= .0551 RLEFL= 19.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



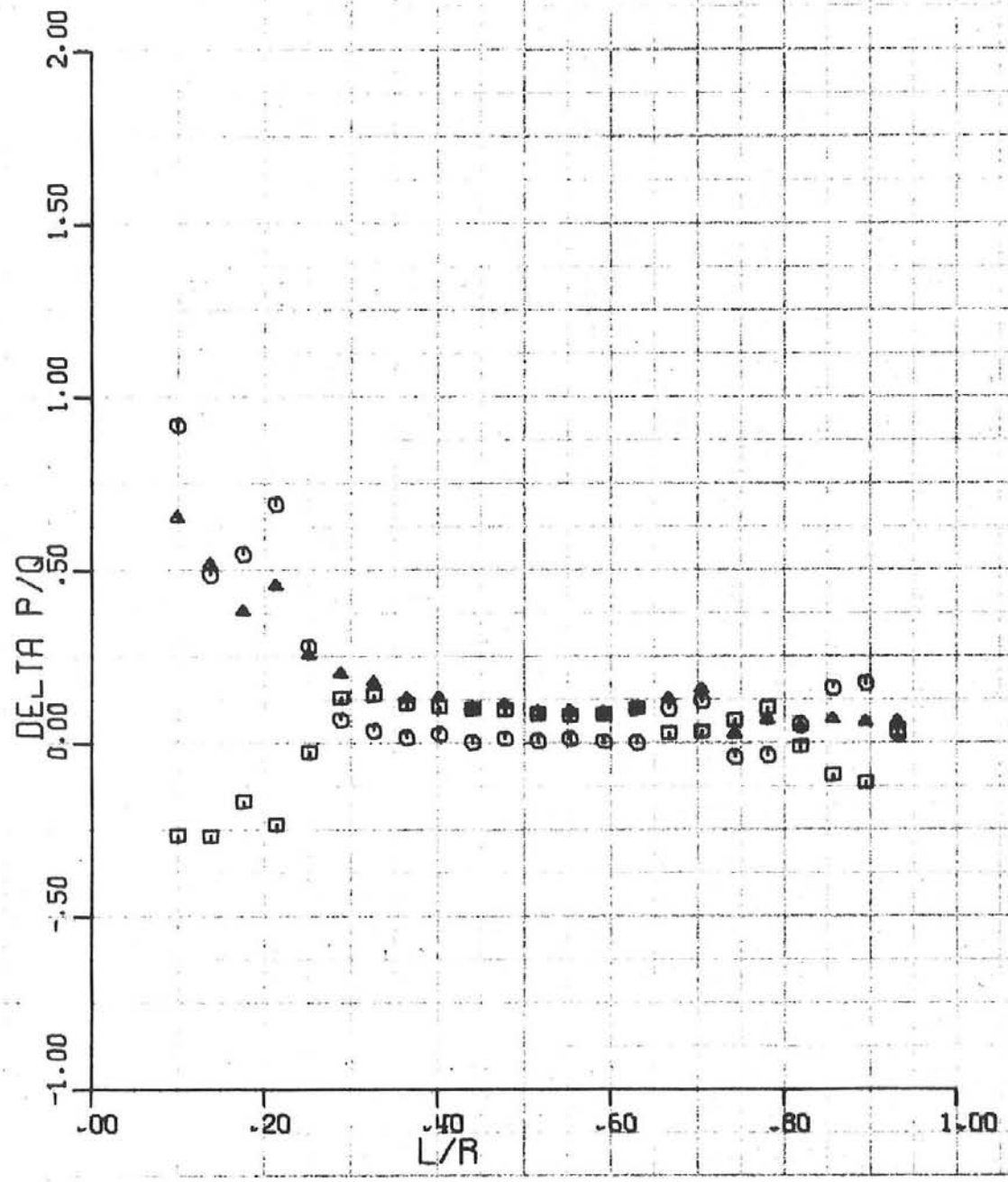
POINT 202 POROSITY= 30.00
Q= 306.81 SHRDL= 1.00
CDOBAL= .0540 REEFL= 19.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



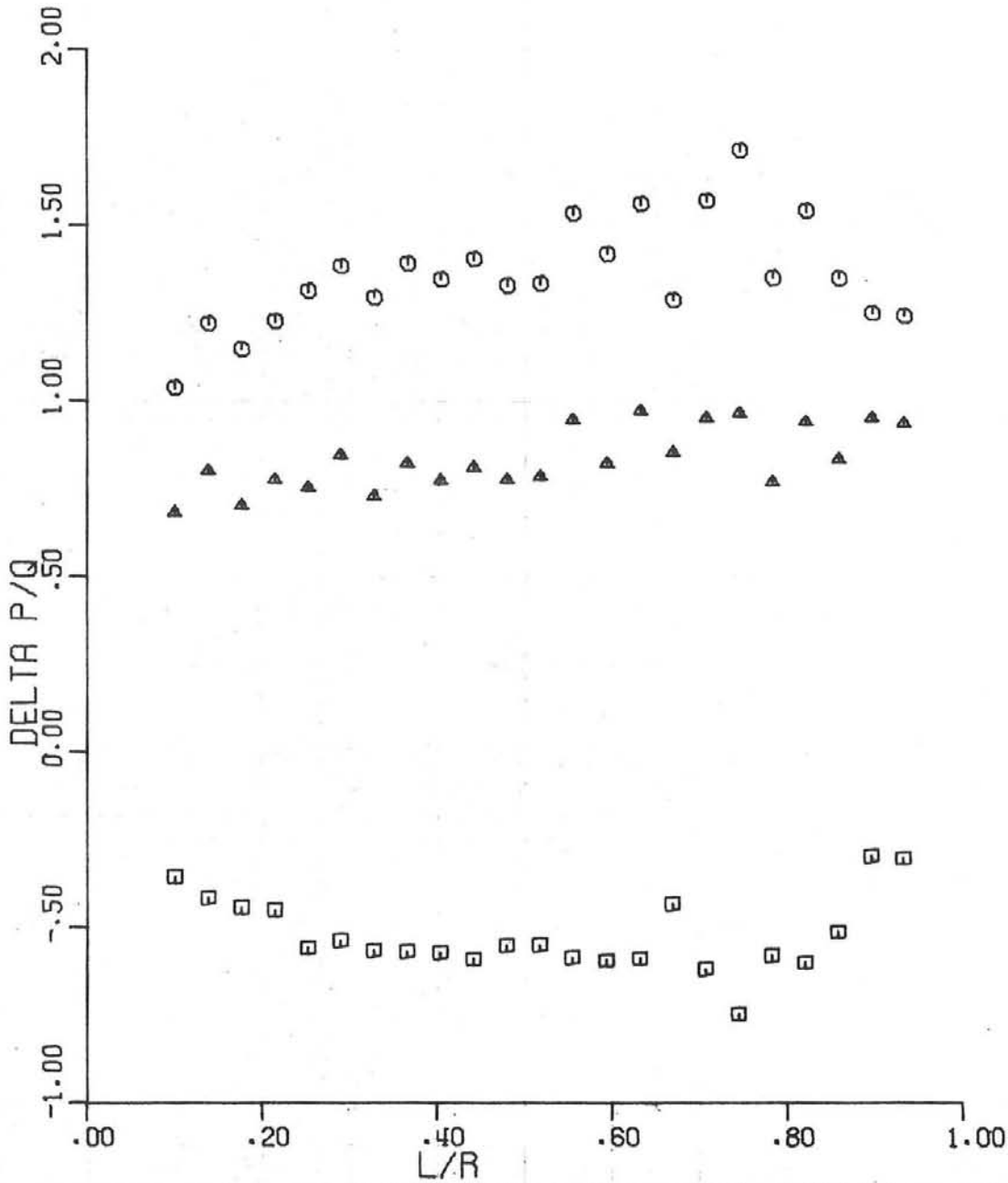
POINT 203 POROSITY= 30.00
Q= 412.62 SHADL= 1.00
COOBAL= .0534 REEFL= 19.00

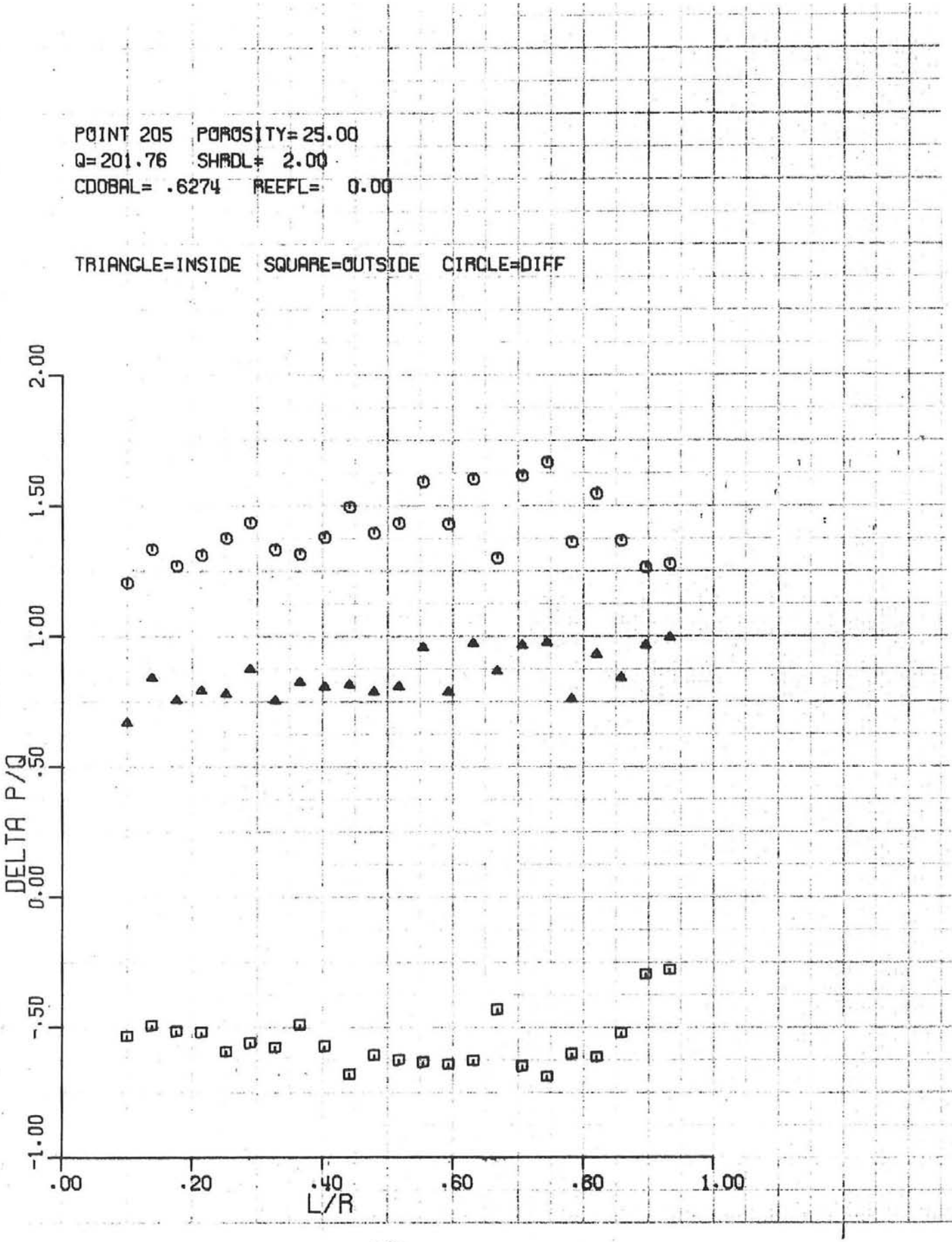
TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



POINT 204 POROSITY= 25.00
Q= 73.77 SHRDL= 2.00
CDOBAL= .5989 REEFL= 0.00

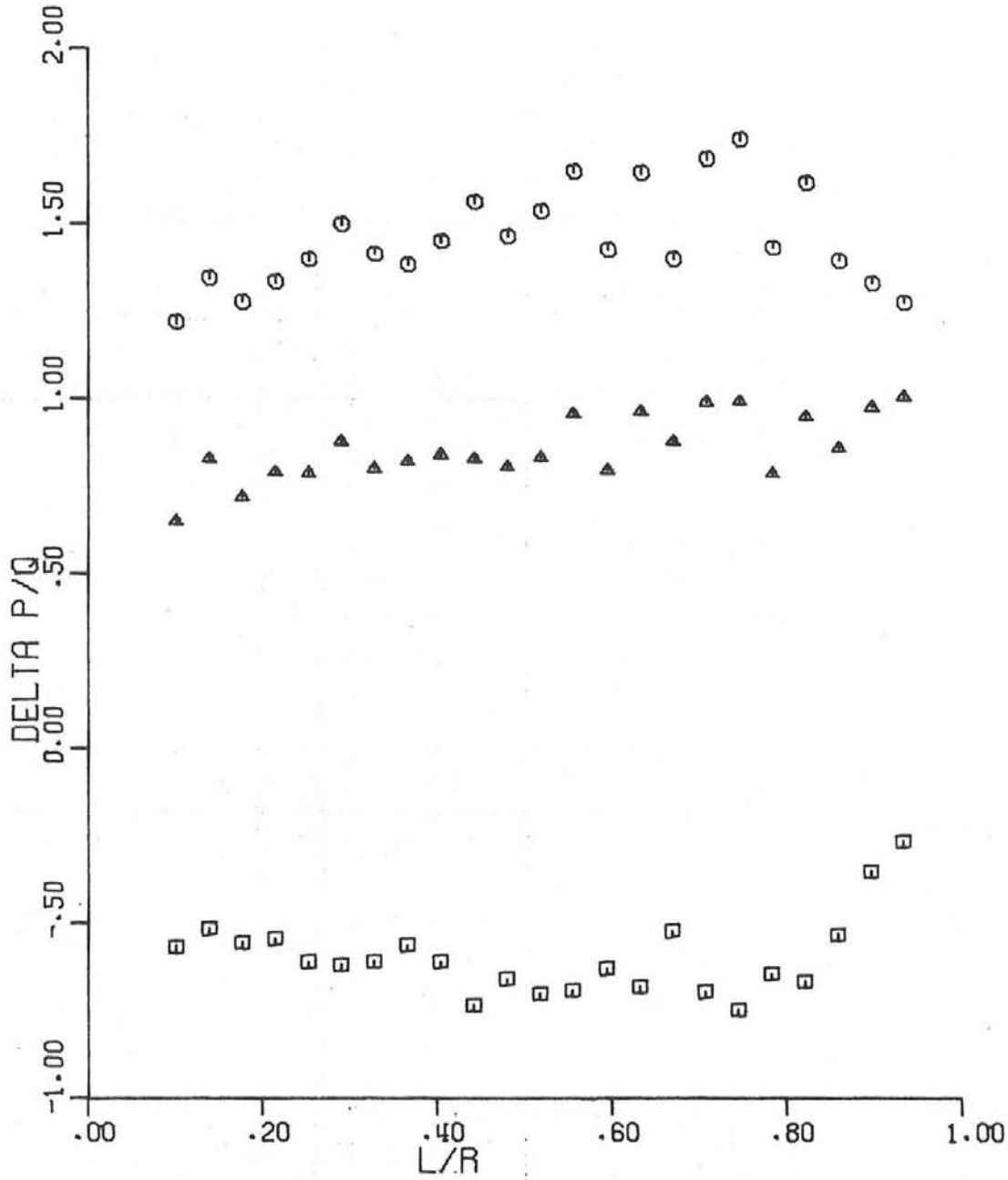
TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF




POINT 205 POROSITY= 25.00
Q= 201.76 SHRDL= 2.00
CDOBAL= .6274 REEFL= 0.00
TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF
DELTA P/Q
2.00
1.50
1.00
.50
0.00
-.50
-1.00
.00
.20
.40
.60
.80
1.00
L/R

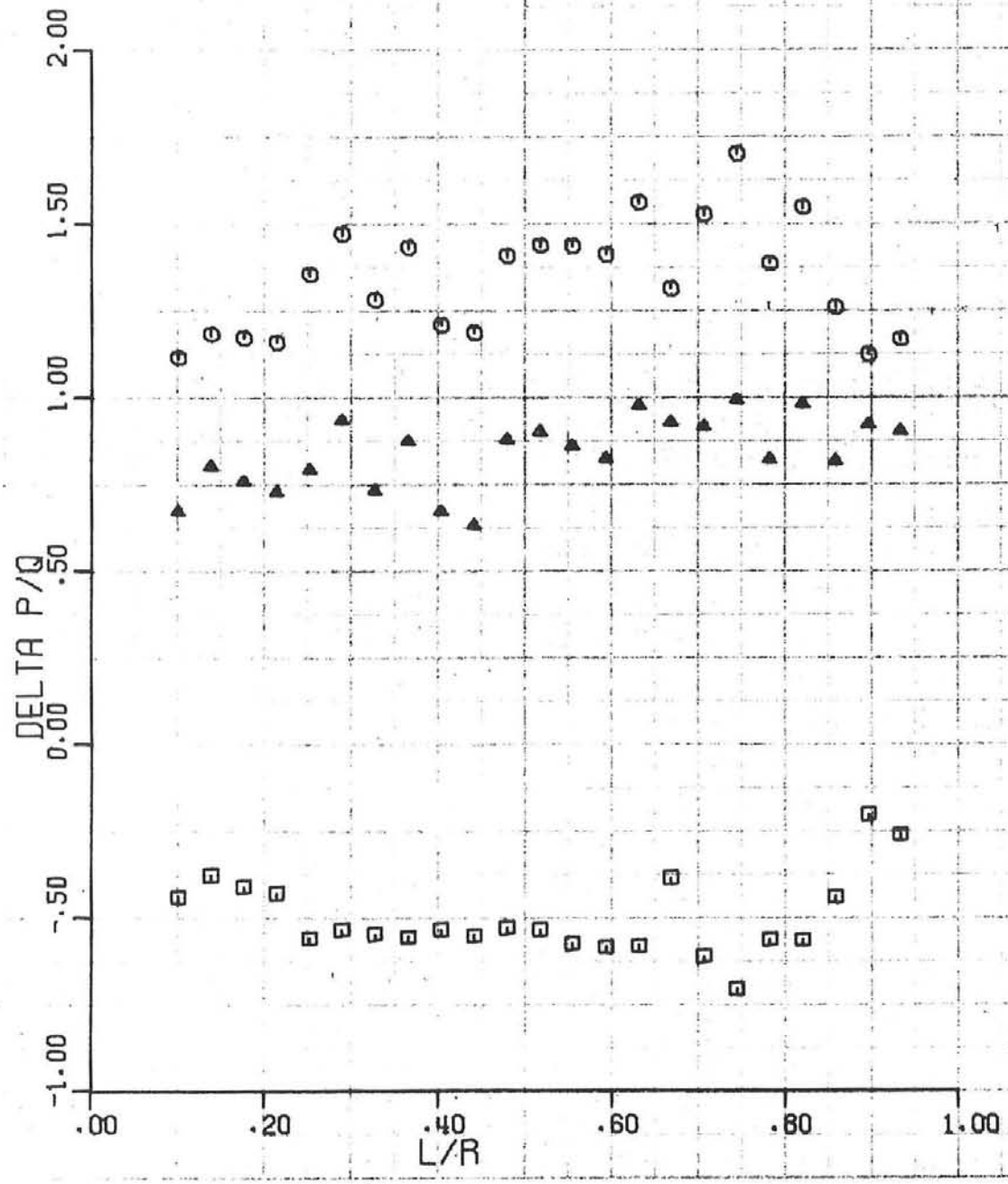
POINT 206 POROSITY= 25.00
Q= 302.57 SHRDL= 2.00
CDOBAL= .6476 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



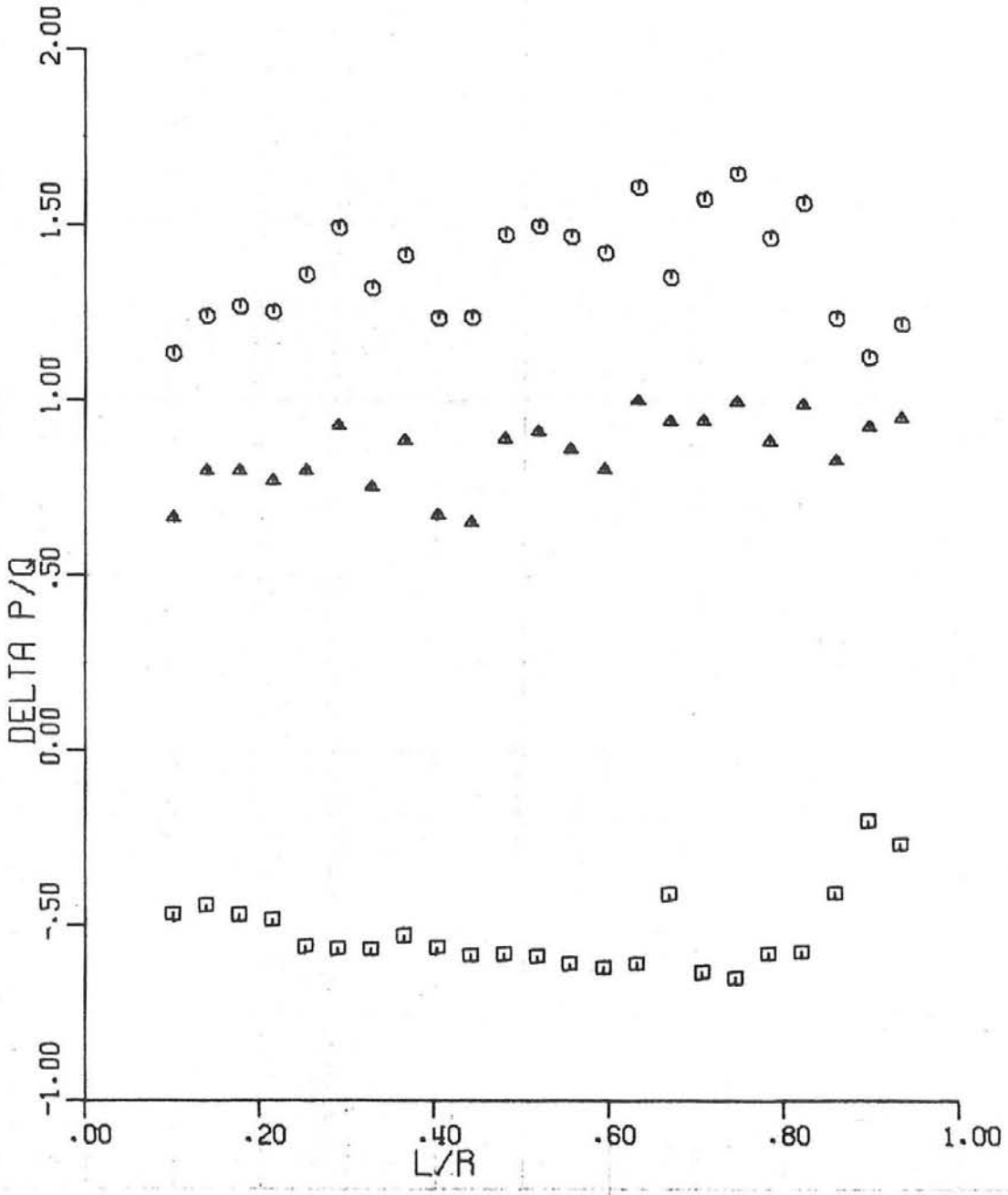
POINT 208 POROSITY= 25.00
Q= 77.10 SHRDL= 1.50
CDOBAL= .5742 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



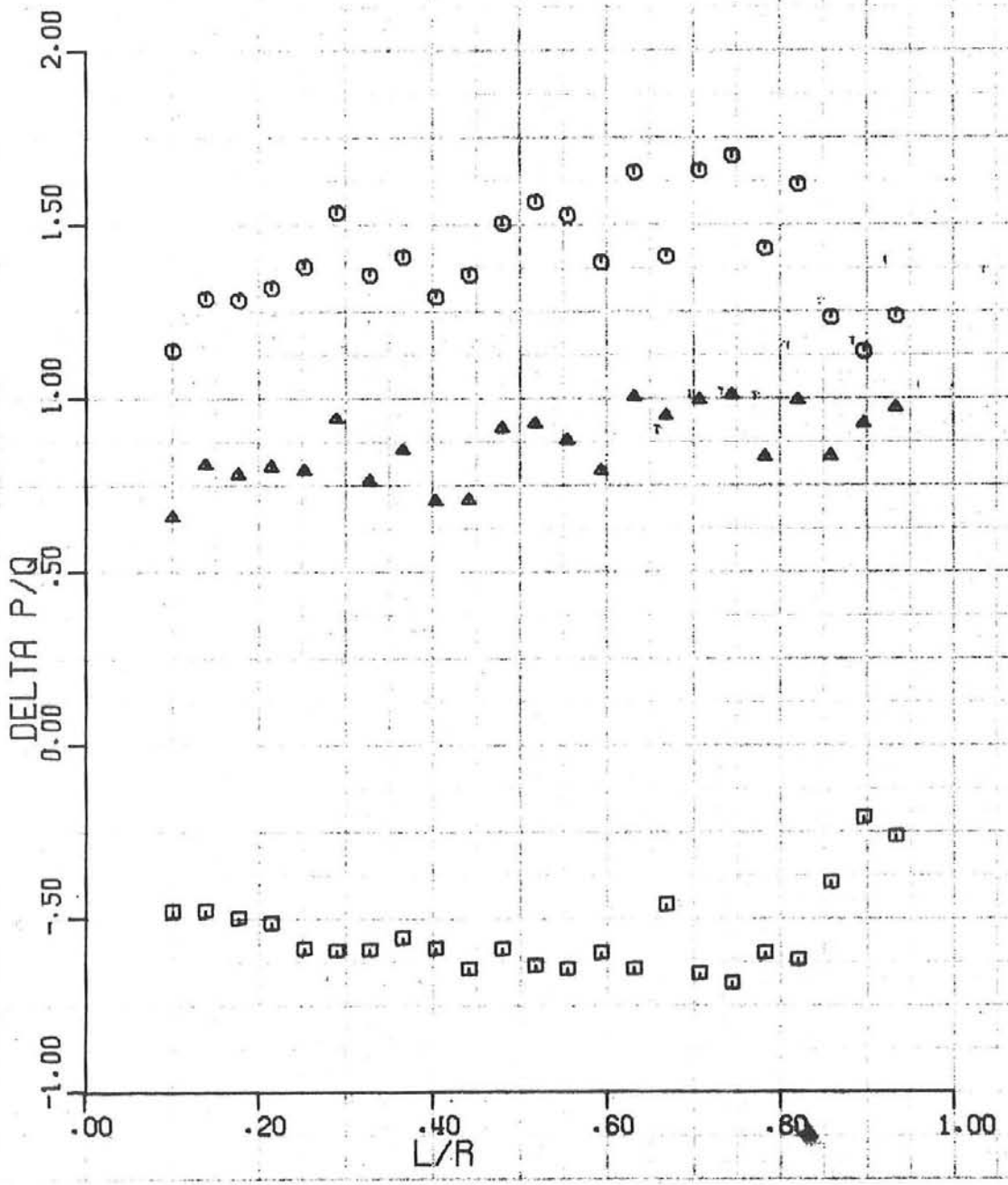
POINT 209 POROSITY= 25.00
Q= 202.52 SHRDL= 1.50
CDOBAL= .5911 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



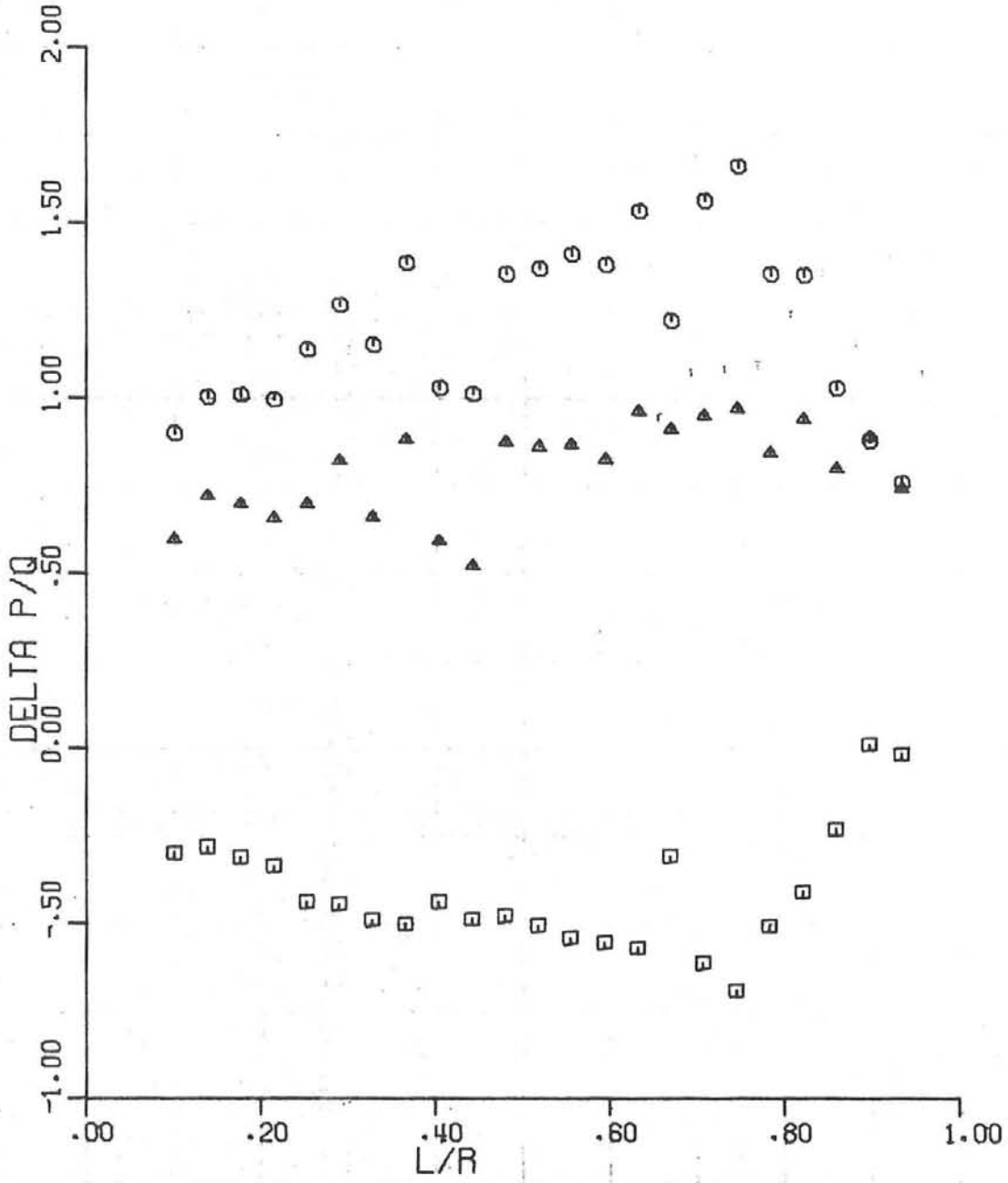
POINT 210 POROSITY= 25.00
Q= 301.49 SHRDL= 1.50
CDOBAL= .6067 REEFL= 0.00

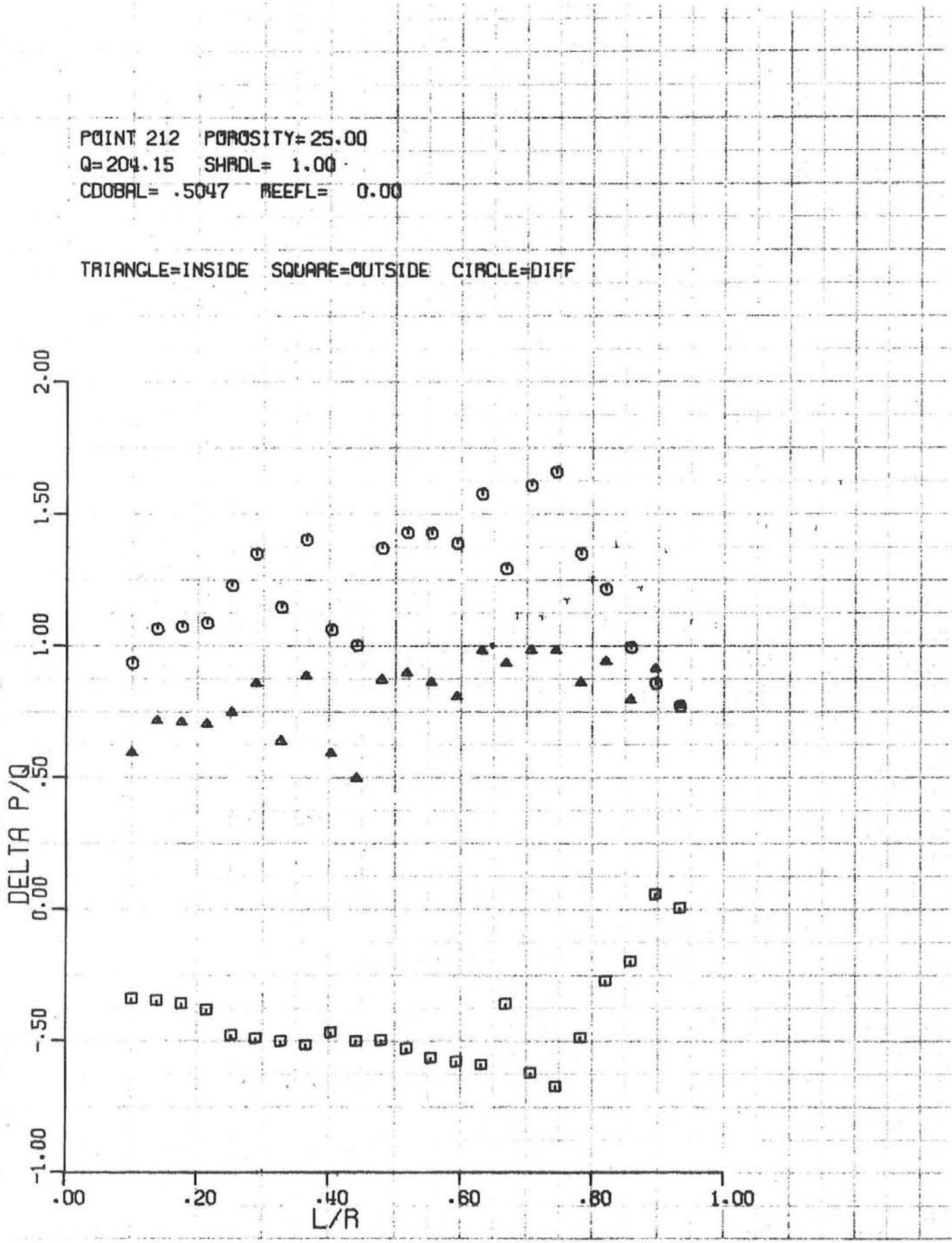
TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



POINT 211 POROSITY= 25.00
Q= 77.15 SHRDL= 1.00
CDOBAL= .4920 REEFL= 0.00

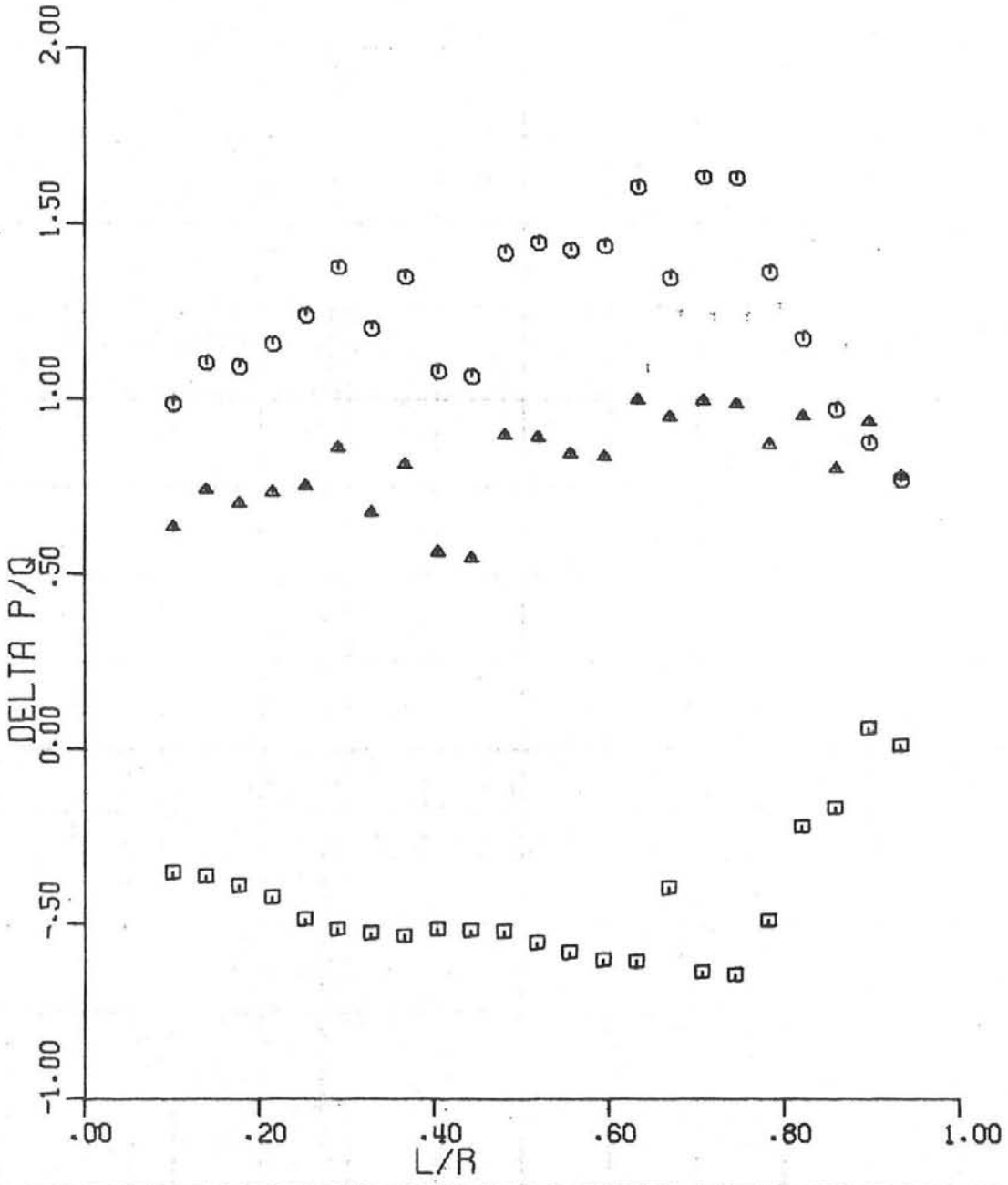
TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF




POINT 212 POROSITY= 25.00
Q= 204.15 SHRDL= 1.00
CDOBAL= .5047 REEFL= 0.00
TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF
DELTA P/Q
2.00
1.50
1.00
.50
0.00
-.50
-1.00
.00
.20
.40
.60
.80
1.00
L/R

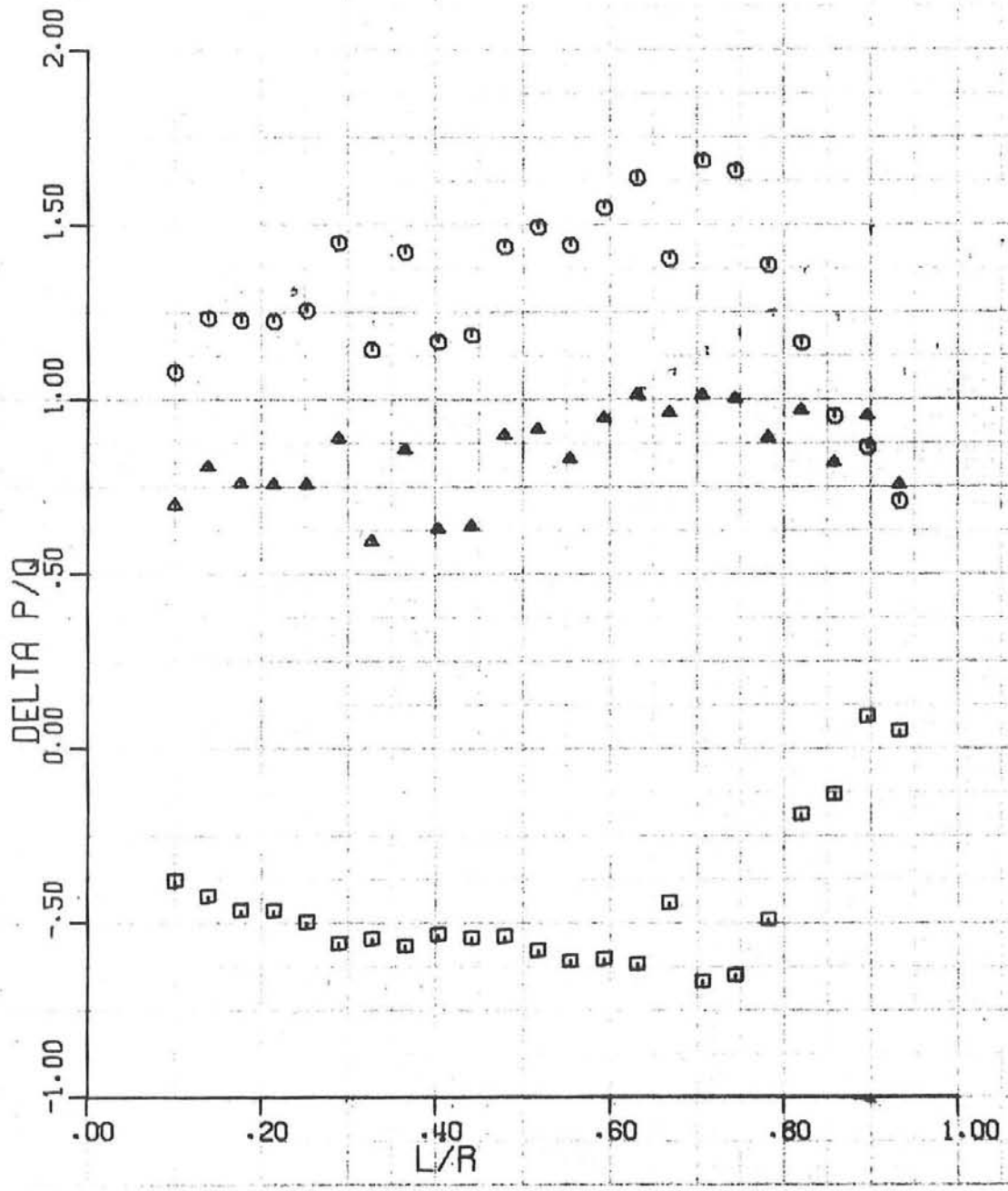
POINT 213 POROSITY= 25.00
Q= 303.22 SHROL= 1.00
CDOBAL= .5130 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



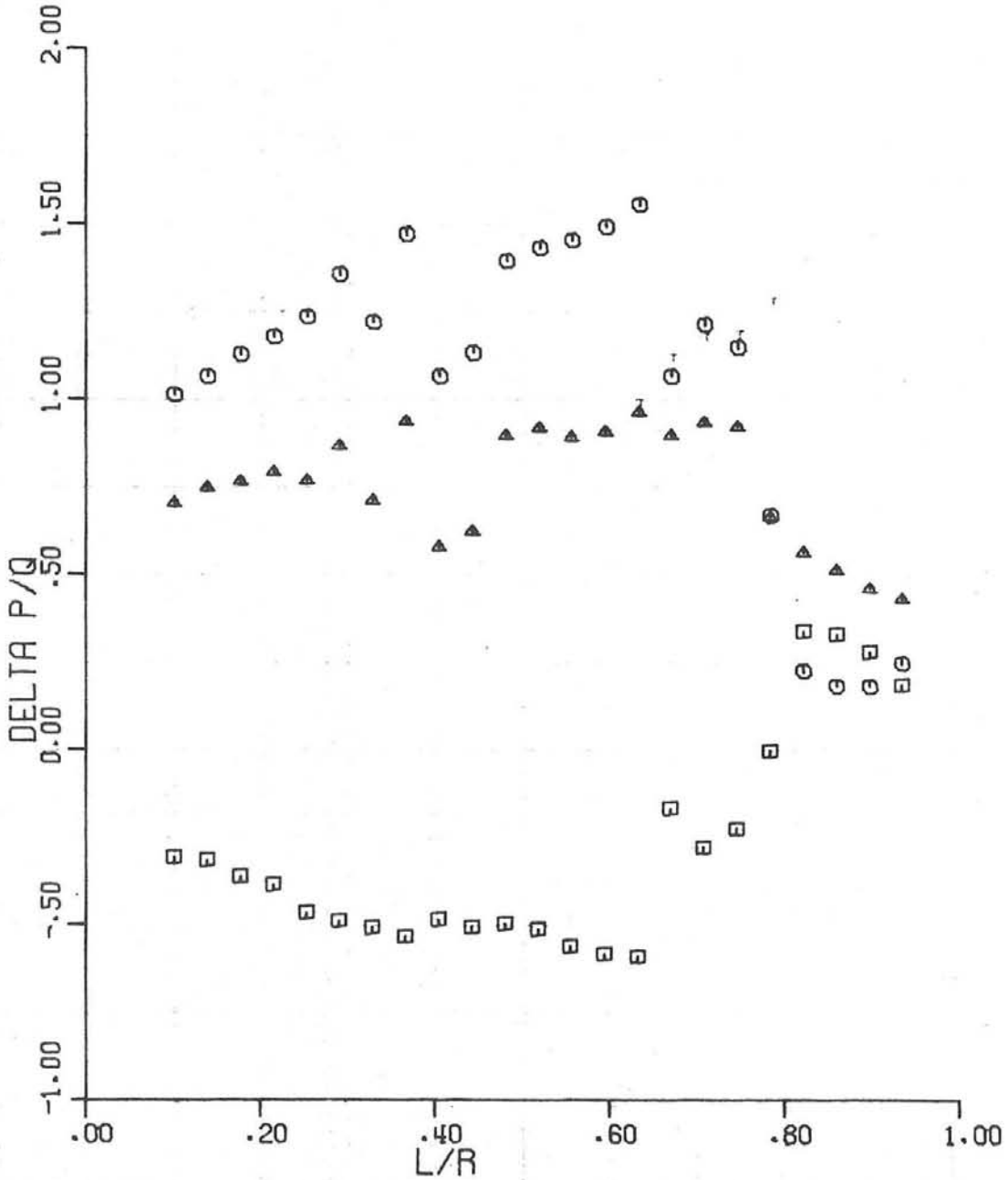
POINT 214 POROSITY= 25.00
Q= 404.19 SHRDL= 1.00
CDOBAL= .5221 REEFL= 0.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



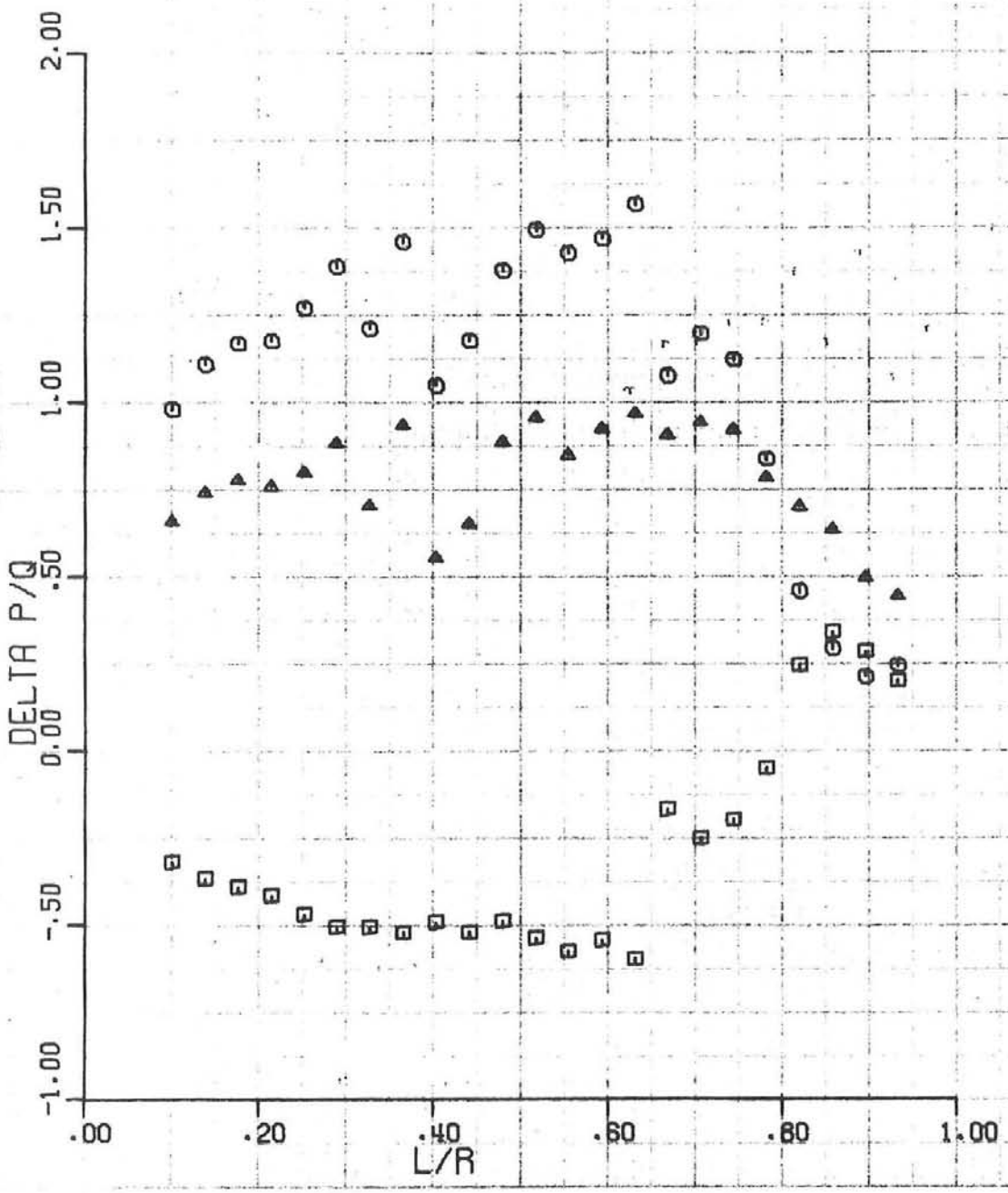
POINT 215 POROSITY= 25.00
Q= 77.86 SHRDL= 1.00
CDOBAL= .3683 REEFL= 57.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



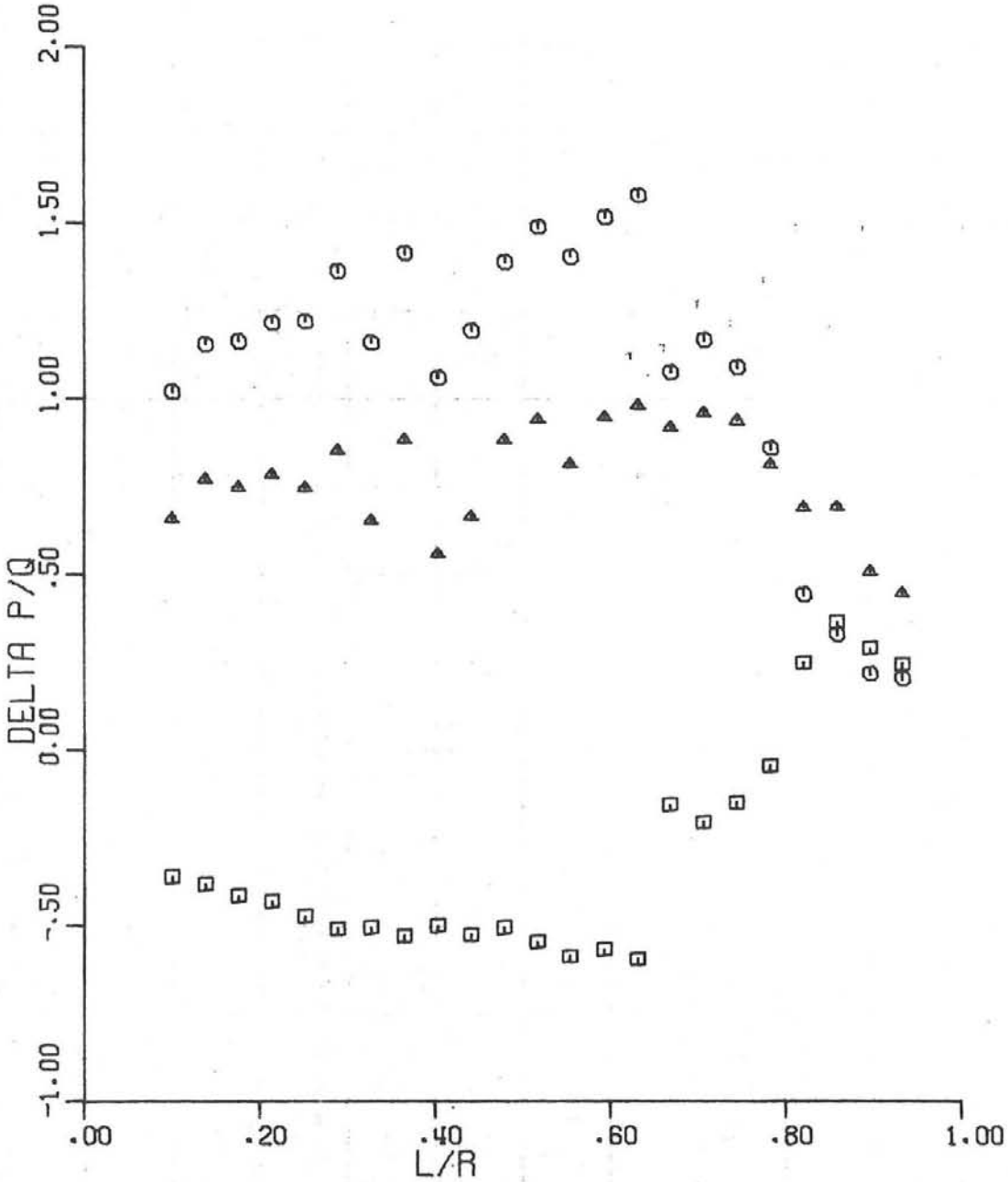
POINT 216 POROSITY= 25.00
Q= 206.83 SHRDL= 1.00
CDOBAL= .3787 REEFL= 57.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



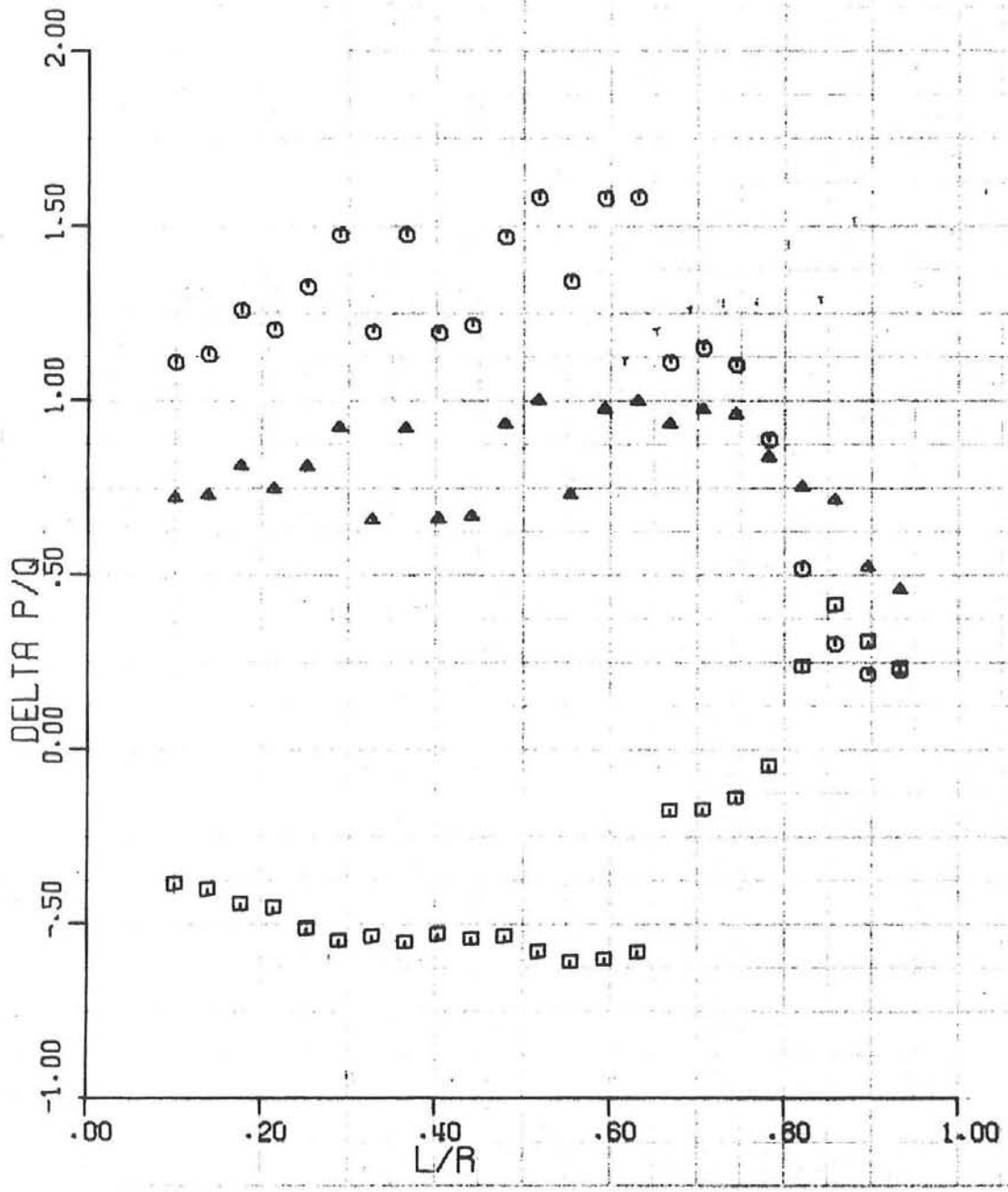
POINT 217 POROSITY= 25.00
Q= 303.09 SHRDL= 1.00
CDOBAL= .3849 REEFL= 57.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



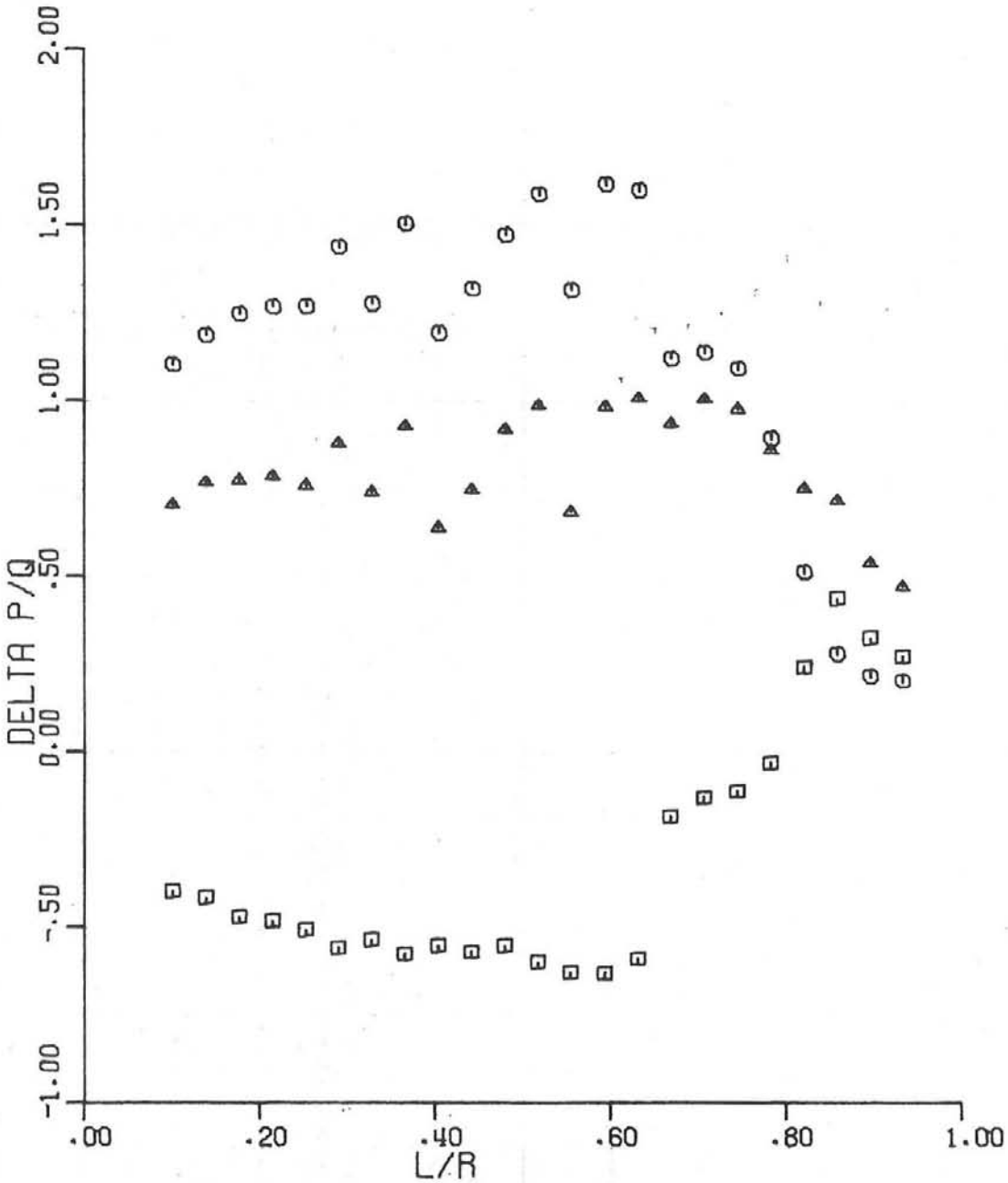
POINT 218 POROSITY= 25.00
Q= 404.70 SHRDL= 1.00
CDOBAL= .3931 REEFL= 57.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



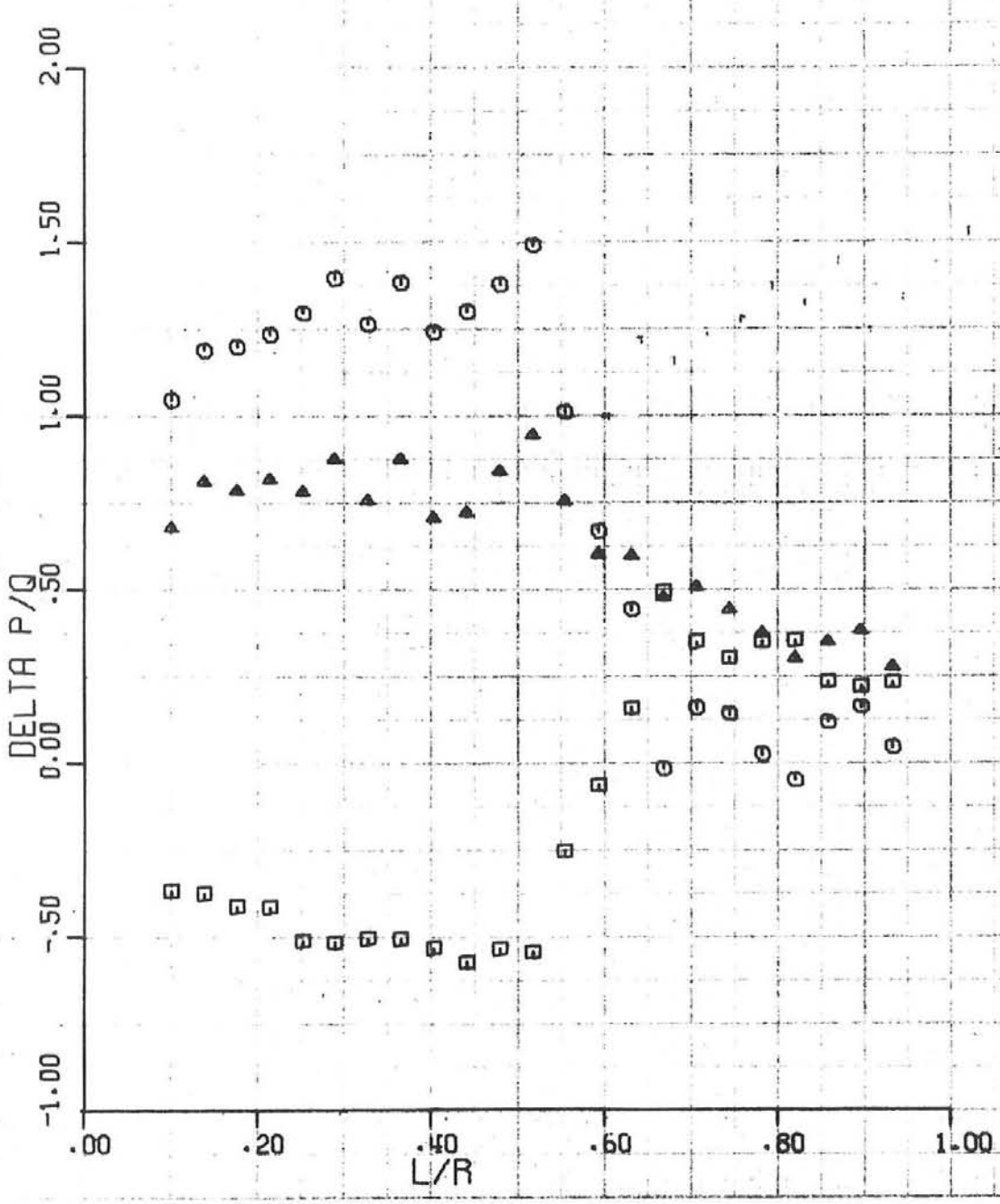
POINT 219 POROSITY= 25.00
Q= 504.47 SHRDL= 1.00
CDOBAL= .4013 REEFL= 57.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



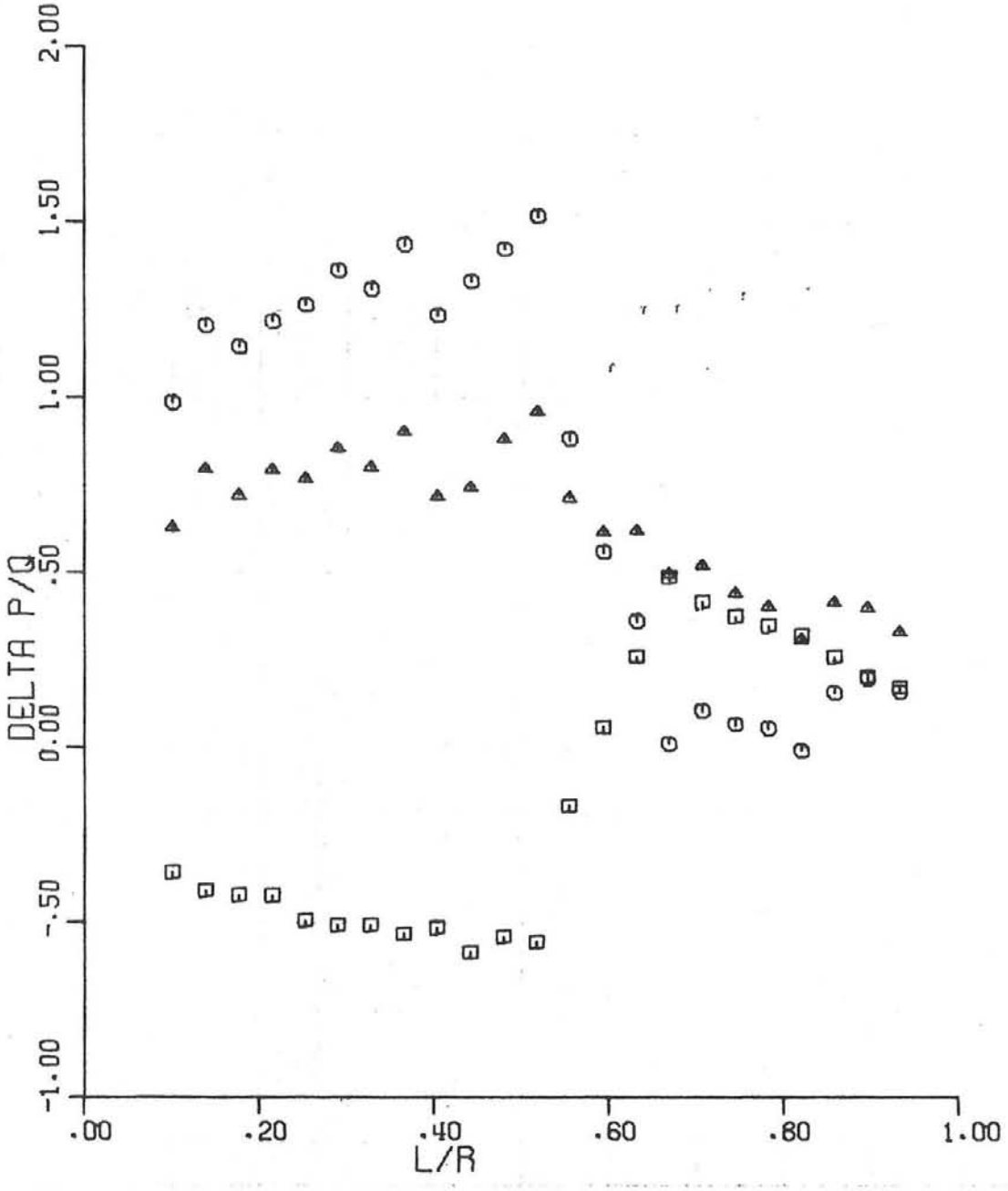
POINT 220 POROSITY= 25.00
Q= 75.68 SHRDL= 1.00
CDOBAL- .2352 REEFL= 38.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



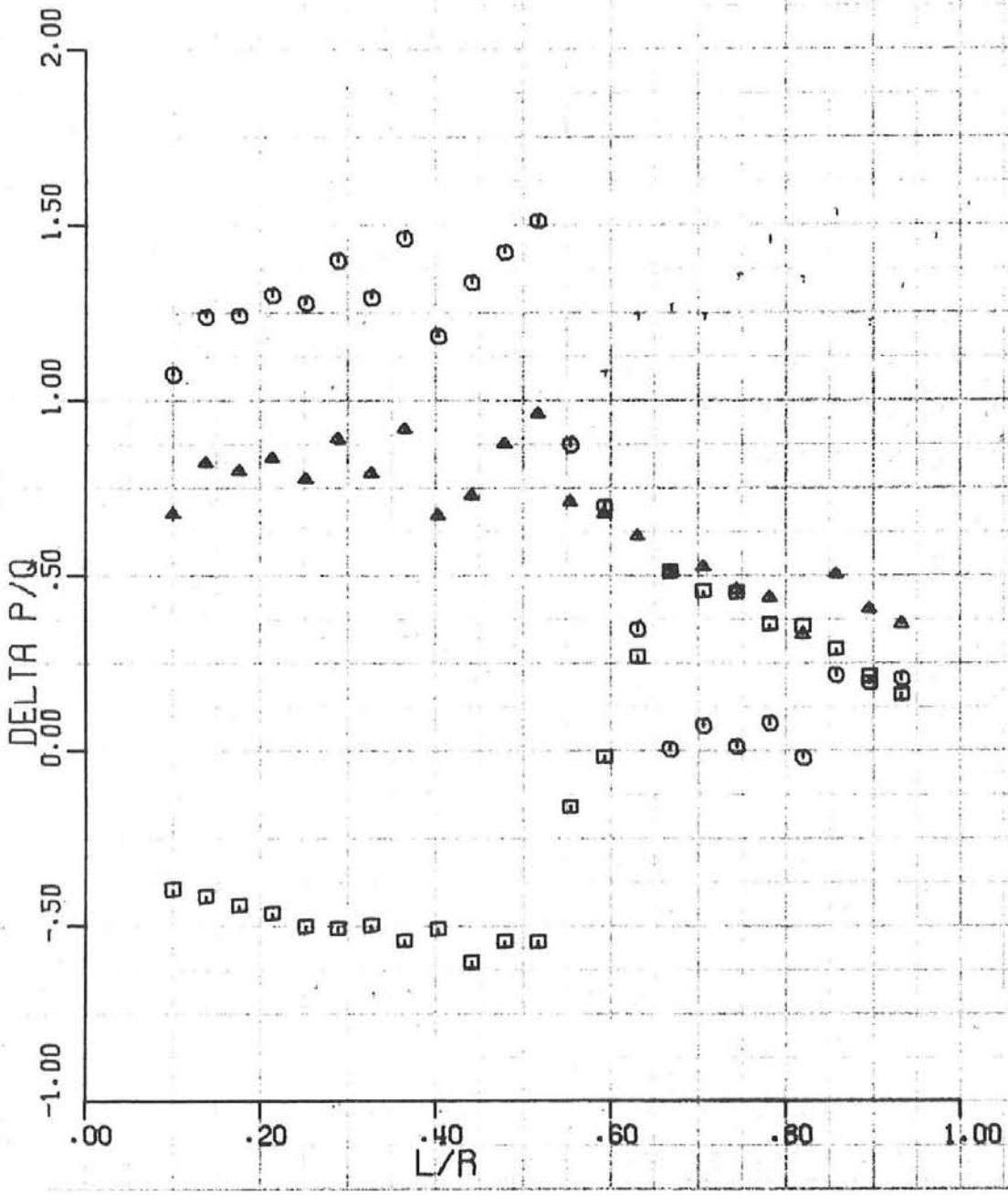
POINT 221 POROSITY= 25.00
Q= 201.84 SHRDL= 1.00
CDOBAL= .2355 REEFL= 38.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



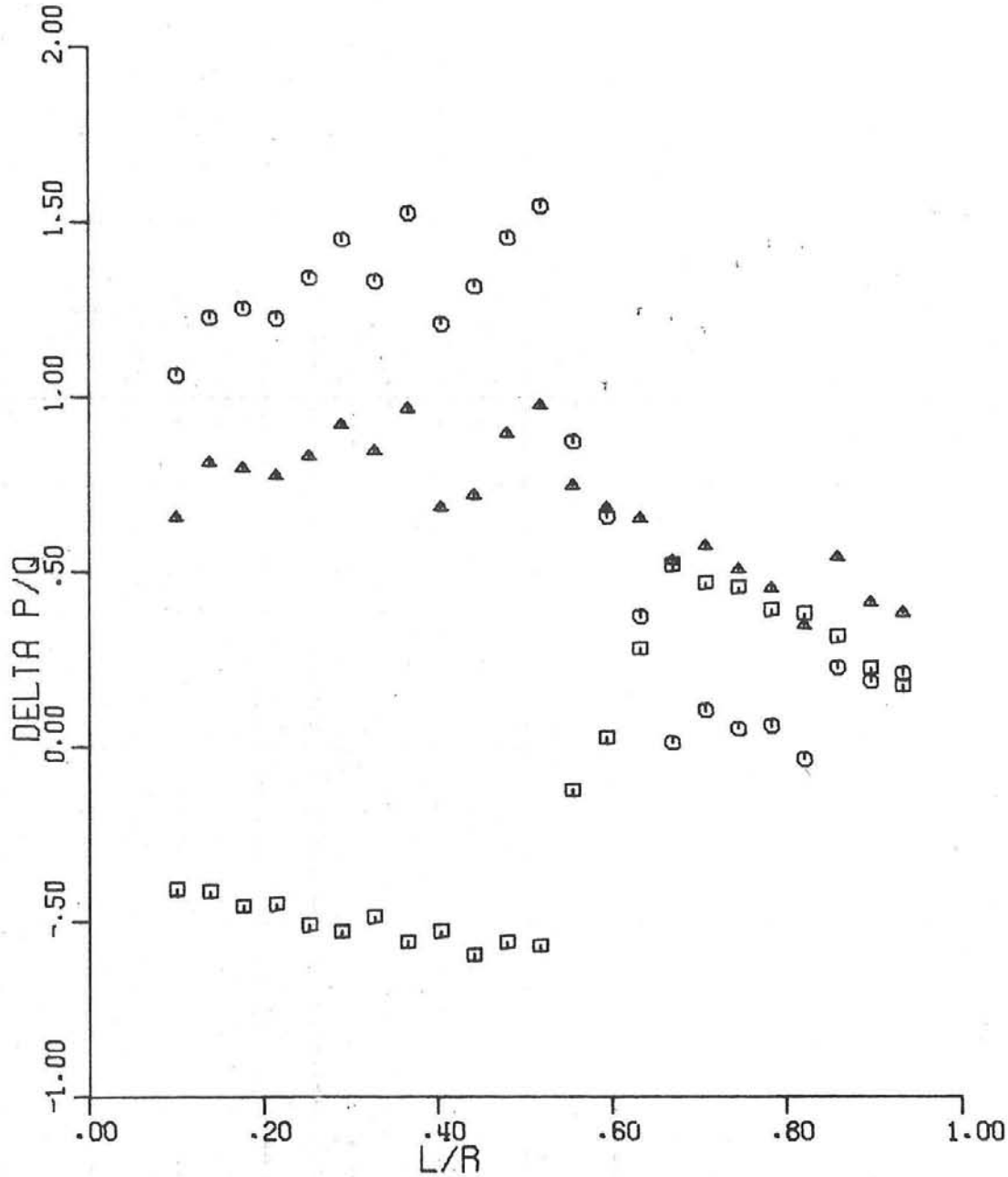
POINT 222 POROSITY= 25.00
Q- 300.54 SHRDL= 1.00
CDOBAL- .2397 REEFL- 38.00

TRIANGLE-INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



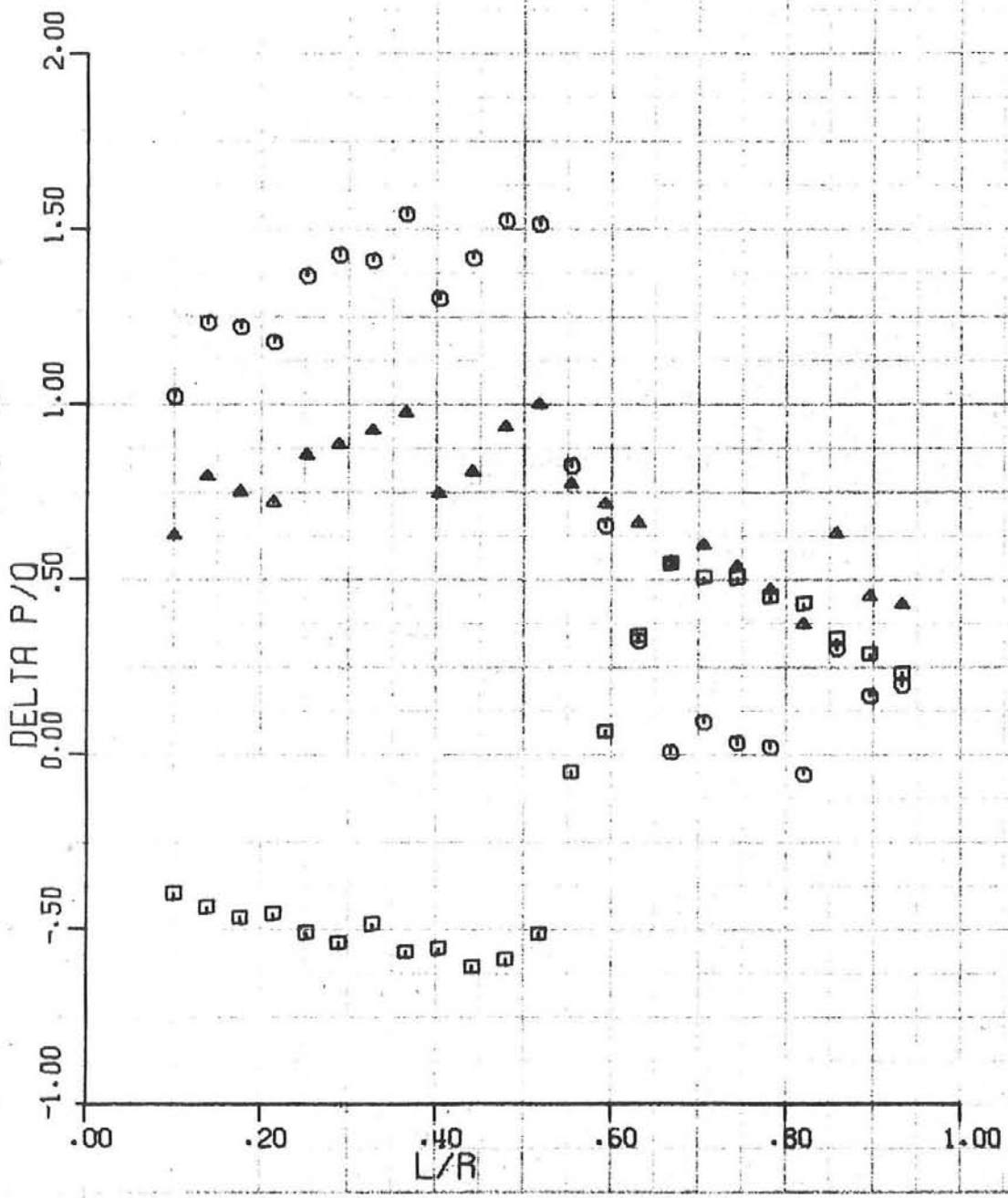
POINT 223 POROSITY= 25.00
Q=400.89 SHRDL= 1.00
CDOBAL= .2440 REEFL= 38.00

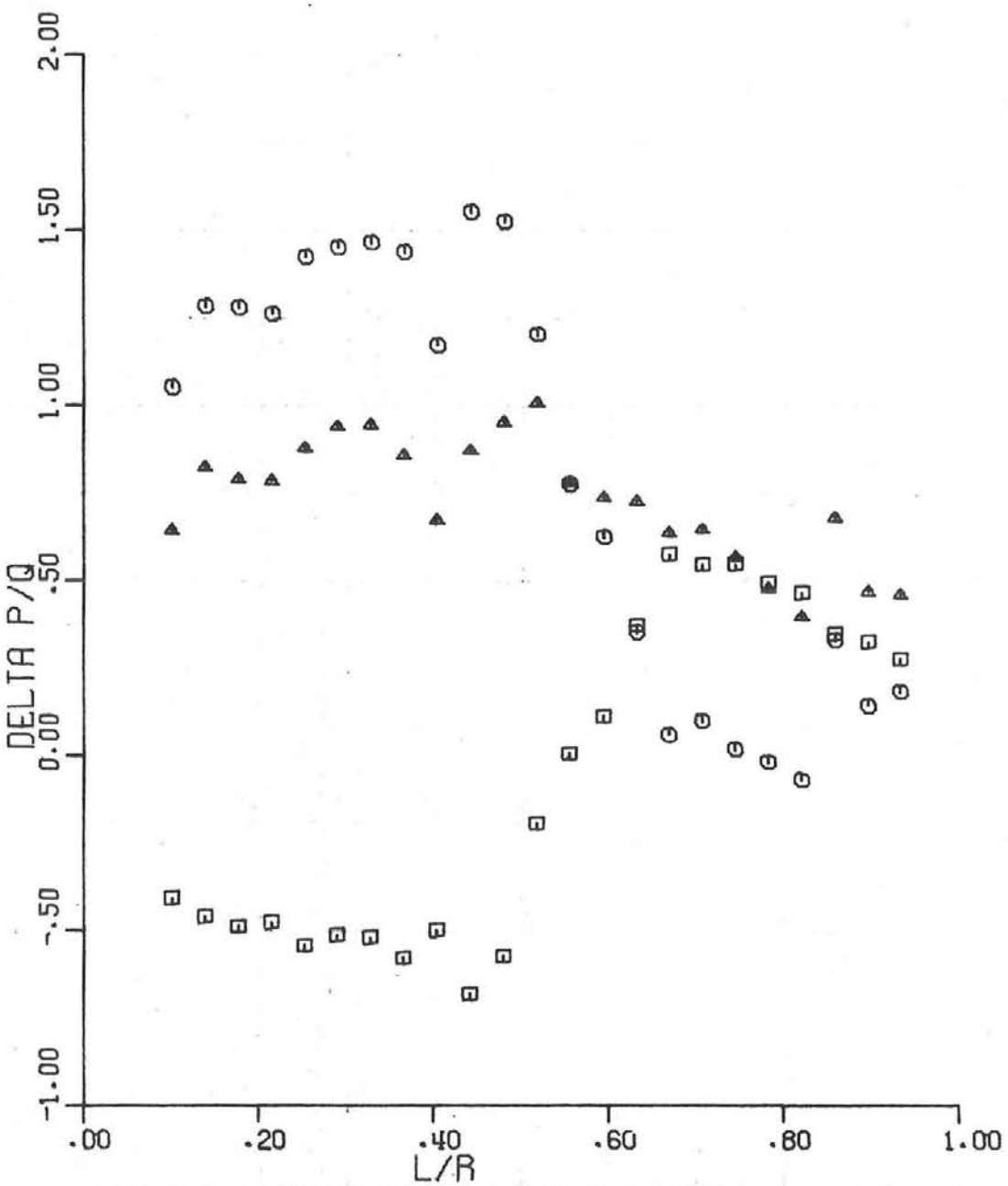
TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



POINT 224 POROSITY=25.00
Q=512.75 SHRDL= 1.00
CDOBAL= .2491 REEFL= 38.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF



POINT 225 POROSITY= 25.00
Q= 602.46 SHRDL= 1.00
CDOBAL= .2552 REEFL= 38.00

TRIANGLE=INSIDE SQUARE=OUTSIDE CIRCLE=DIFF