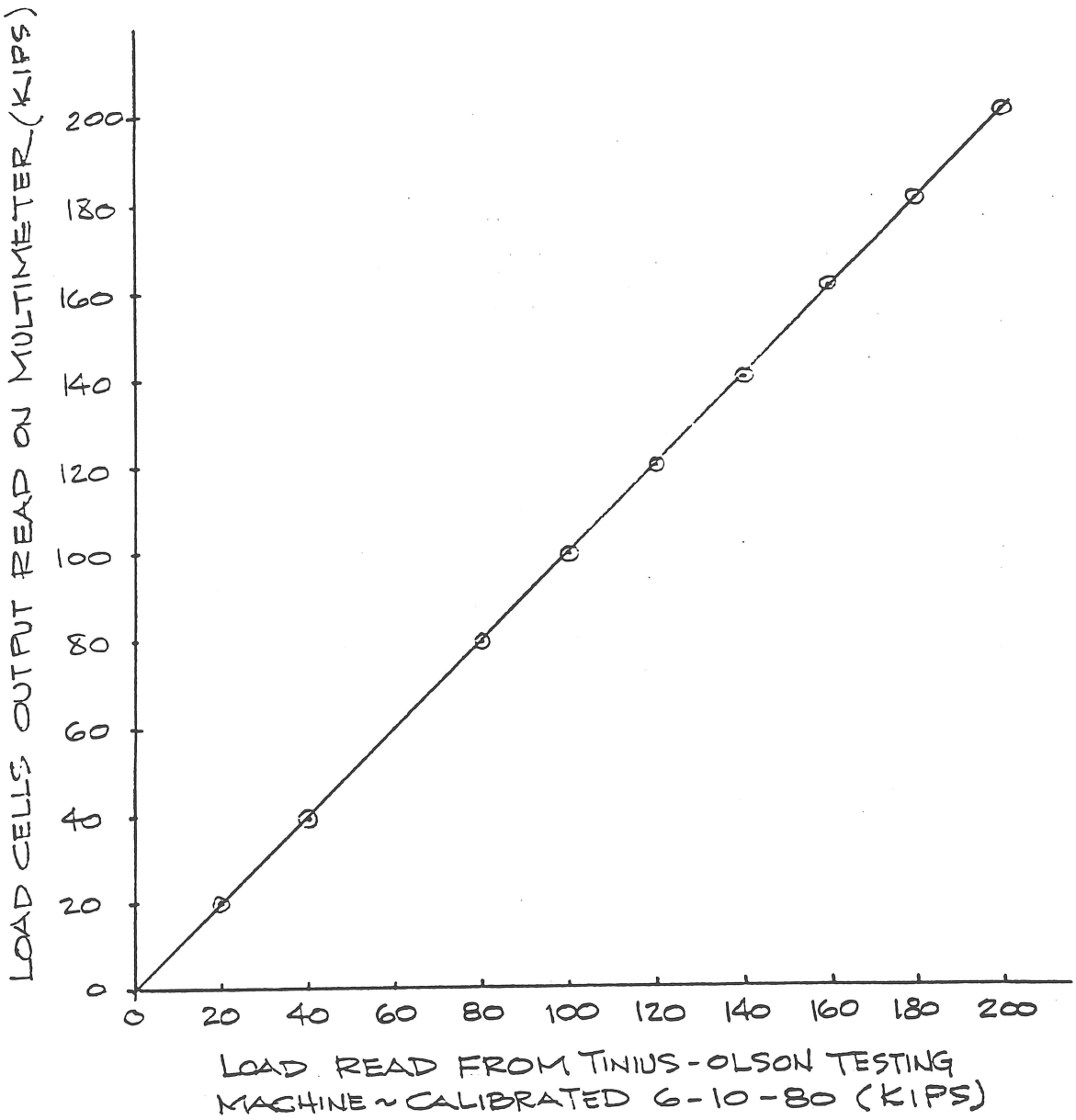
APPENDIX C

LOAD CELL CALIBRATION AND ORIGINAL DATA



CALIBRATION CURVE FOR LOAD CELLS

UNITED ENGINEERS CONTAINMENT LINER ANCHOR LOAD TEST

TEST SPECIMEN: SEABROOK T1
PEAK LOAD: 152 KIPS
f'c: 5,660 PSI (AVG. OF 3)
DIAL # 1 LOCATION: ON LINER PLATE TO VERIFY HORIZONAL DEFLECTION
DIAL # 2 LOCATION: ON CENTER OF BACK FACE OF BLOCK TO INDICATE BLOCK MOVEMENT
VISHAY-ELLIS CALIBRATION #: Z90

DATE: 10-16-80
WITNESSES: STETHEN, HALEY, CODLEY, BURNETTE, LONG, GALINIS, GRISETSKIE, KALAWADIA

MULTI-METER READING (VOLTS)	LVDT DEFL (IN)	LOAD (KIPS)	DIAL#1 (IN) x10^3	DIAL#2 (IN) x10^3
0.00	0.000	0.0	0	0
0.31	0.016	84.5	12	6
0.50	0.025	105.3	24	13
0.75	0.038	122.2	39	21
1.00	0.050	137.3	52	27
1.25	0.063	145.3	69	32
1.50	0.075	144.5	80	34
1.75	0.088	78.8	98	32
2.00	0.100	45.9	119	32
SHUT DOWN PUMP TO RESET LVDT				
1.21	0.061	0.0	67	30
1.75	0.088	28.1	98	32
2.00	0.100	36.5	115	32
2.25	0.113	38.7	131	32
2.50	0.125	38.6	146	32
2.75	0.138	38.9	160	32
3.00	0.150	38.7	173	32
3.25	0.163	36.4	189	32
SHUT DOWN PUMP TO RESET LVDT				
1.88	0.094	0.0	107	32
3.25	0.163	29.2	179	32
3.50	0.175	32.2	190	32

COMMENTS:

UNITED ENGINEERS CONTAINMENT LINER ANCHOR LOAD TEST

TEST SPECIMEN: SEABROOK T1
PEAK LOAD: 152 KIPS
f'c: _____ PSI
DIAL # 1 LOCATION: ON LINER PLATE TO VERIFY HORIZONAL DEFLECTION
DIAL # 2 LOCATION: ON CENTER OF BLANK FACE OF BLOCK TO INDICATE BLOCK MOVEMENT
VISHAY-ELLIS CALIBRATION #: 290

DATE: 10-16-80
WITNESSES: STETHEN, HALEY, COPLEY, BURDETTE, LONG, CALUNK, GRUSETSKIE, KALAWADIA

MULTI-METER READING (VOLTS)	LVDT DEFL (IN)	LOAD (KIPS)	DIAL#1 (IN) x10³	DIAL#2 (IN) x10³
3.75	0.188	35.2	204	32
4.00	0.200	35.4	222	32
4.25	0.213	35.8	237	32
4.50	0.225	35.1	248	33
4.75	0.238	35.0	263	33
5.00	0.250	35.4	275	33
5.25	0.263	34.2	289	33
SHUT DOWN PUMP TO DISCONNECT LVDT & DIAL #1				
2.73	0.137	0.00	145	33
———	———	28.4	———	33

COMMENTS:

	00	388
	00	392
	00	393
	00	397
	00	400
	00	398
	00	401
	00	386
	00	406
	00	393
	00	403
	00	385
	00	375
	00	345
1.80	- - - - - - - - - -	
	00	283
	00	250
	00	213
	00	172
1.30	00	111

RESET LVDT AT

HORIZONAL DEFL. OF 0.10"

	00	450
	00	559
	00	752
	00	886
	00	1313
	00	1415
	00	1497
	00	1495
	00	1477
	00	1452
	00	1394
	00	1354
	00	1325
	00	1296
	00	1253
	00	1165
	00	1071
	00	985
	00	892
	00	723
	00	445
BEGIN TEST →	00 -	000
	CHANNEL	LOAD (KIPS)

TEST 80-26
SEABROOK T1

	00	284

DISCONNECT LVDT

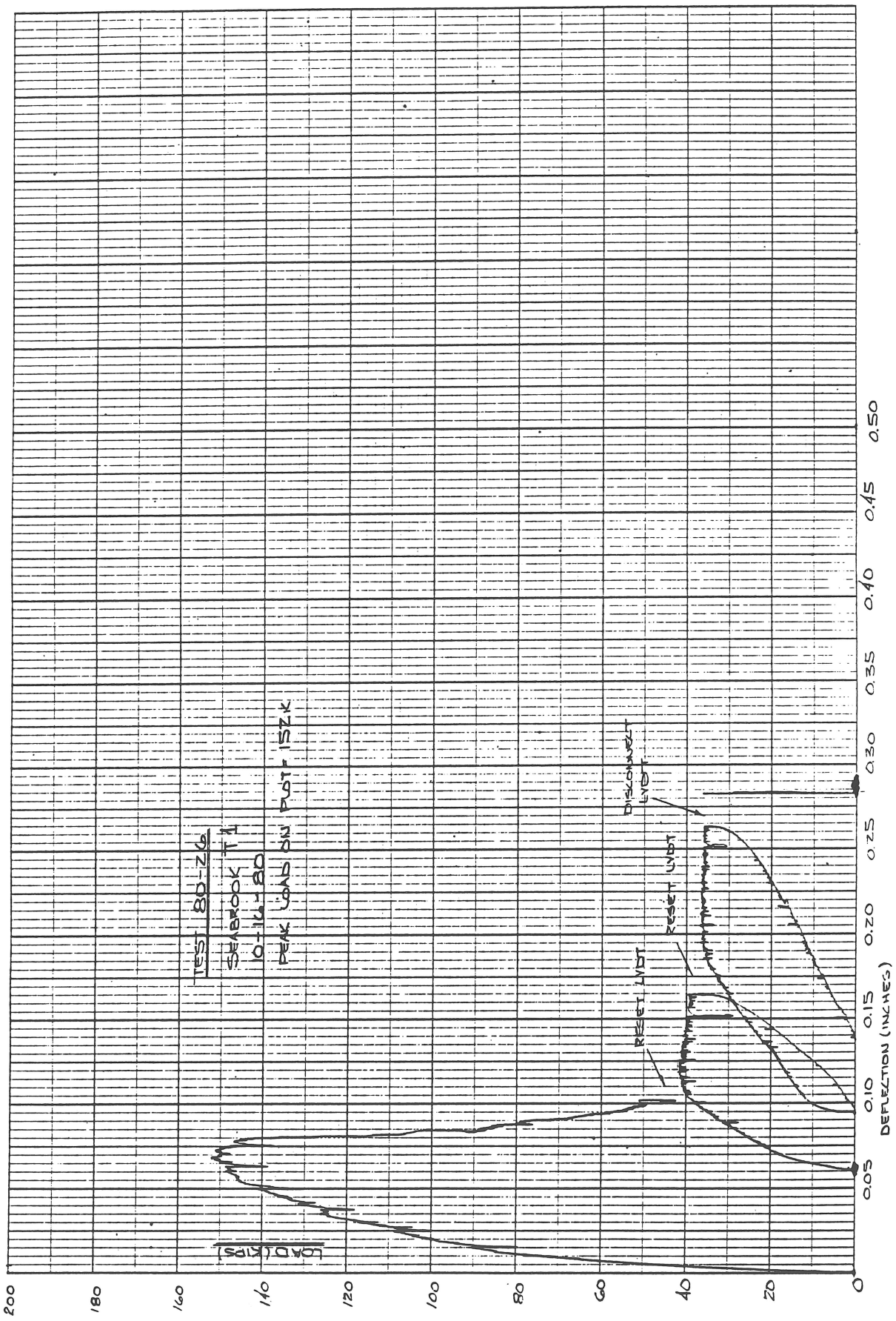
AT HORIZONAL DEFL. OF

0.263"

	00	355
	00	352
	00	354
	00	357
	00	355
	00	356
	00	359
	00	357
	00	356
	00	359
	00	360
	00	360
	00	353
	00	355
	00	358
	00	341
	00	341
	00	326
	00	313
	00	300
	00	285
	00	278
	00	262
	00	243
	00	230
	00	216
	00	190
	00	181
	00	167
	00	154
	00	140
	00	126
	00	102
1.90	00	049

RESET LVDT AT

HORIZONAL DEFL. OF 0.163"


TEST 80-26
SEABROOK T1
0-11-80
PEAK LOAD ON PUT - 152K
DISCONNECT LVDT
RESET LVDT
RESET LVDT
LOAD (KIPS)
DEFLECTION (INCHES)
200
180
160
140
120
100
80
60
40
20
0
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50

UNITED ENGINEERS CONTAINMENT LINER ANCHOR LOAD TEST

1 OF 1

TEST SPECIMEN: SEABROOK T2
PEAK LOAD: 156 KIPS
f'c: PSI
DIAL # 1 LOCATION: SLIGHTLY ABOVE LVDT PROBE TO VERIFY HORIZONAL DEFLECTION
DIAL # 2 LOCATION: 7" FROM BACK FACE MOUNTED ON SIDE FACE TO INDICATE ROTATION
VISHAY-ELLIS CALIBRATION #: 290

DATE: 10-20-80
WITNESSES: STETHEM, HALEY, HAYES, COBLEY, BURDETTE AND HOLBROOK

TEST 80-Z6

MULTI-METER READING (VOLTS)	LVDT DEFL (IN)	LOAD (KIPS)	DIAL#1 (IN) x10^{3}	DIAL#2 (IN) x10^{3}
0.00	0.000	0.0	0	0
0.25	0.013	7.48	13	3
0.50	0.025	118.0	26	9
0.75	0.038	137.1	39	13
1.00	0.050	148.0	52	19
1.25	0.063	153.7	66	25
1.50	0.075	62.9	80	5
1.75	0.088	39.9	97	5
2.00	0.100	37.7	113	4
2.50	0.125	36.9	145	4
3.00	0.150	34.8	175	4
3.50	0.175	34.1	203	4
4.00	0.200	34.3	231	4
4.50	0.225	34.1	259	4
5.00	0.250	34.0	288	4
6.00	0.300	28.2	344	4
7.00	0.350	18.9	403	4
8.00	0.400	20.2	458	4
9.00	0.450	20.6	515	4
9.96	0.498	19.7	569	4
6.18	0.309	0.0	369	2

COMMENTS:
PUMP SHUT DOWN TO DISCONNECT LVDT AND DIAL#1

DEFL. (INCH)	CHANNEL	LOAD (KIPS)
	00	341
	00	345
	00	346
	00	337
	00	345
0.20	00	343
	00	334
	00	343
	00	345
	00	348
	00	341
	00	352
	00	350
	00	349
	00	351
0.15	00	348
	00	359
	00	360
	00	358
	00	355
	00	369
	00	365
	00	369
	00	375
	00	352
0.10	00	378
	00	378
	00	398
	00	435
	00	517
	00	629
	00	1529
	00	1520
	00	1542
	00	1511
0.05	00	1475
	00	1443
	00	1377
	00	1339
	00	1252
	00	1180
	00	1050
	00	896
	00	683
	00	376
0.00	00	000

EST 80-26

SEABROOK TZ

PEAK LOAD ON PLOT=156K

PEAK LOAD ON TAPE=154.2K

10-20-80

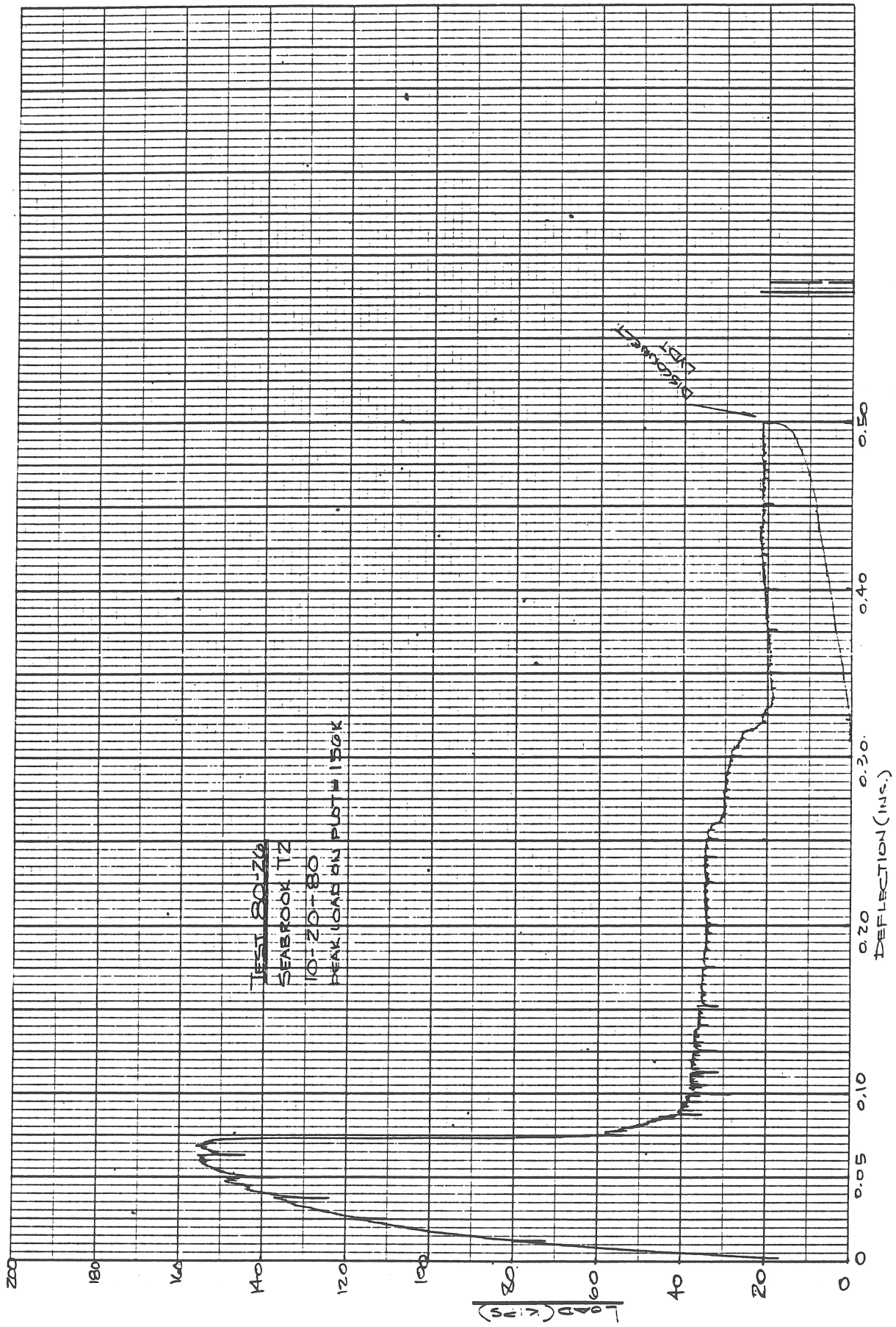
0.50	00	202
	00	212
	00	212
	00	213
	00	204
	00	210
	00	209
	00	211
	00	210
	00	213
0.45	00	206
	00	209
	00	211
	00	218
	00	209
	00	214
	00	203
	00	210
	00	209
	00	210
0.40	00	202
	00	206
	00	203
	00	202
	00	199
	00	199
	00	196
	00	195
	00	192
	00	189
0.35	00	189
	00	187
	00	188
	00	186
	00	191
	00	210
	00	213
	00	247
	00	263
	00	277
0.30	00	282
	00	288
	00	296
	00	296
	00	297
	00	302
	00	301
	00	304
	00	315
	00	337
0.25	00	340
	00	344
	00	347

END TEST

	00	033
	00	006
	00	194
	00	217
INTERMITTENT	00	191
LOAD READINGS	00	181
	00	170
	00	161
	00	155
	00	119
	00	053

DISCONNECT LVDT #1

DIAL #1


TEST 80-Z6
SEABROOK T2
10-20-80
PEAK LOAD ON PLOT 156K
LOAD (KIPS)
DEFLECTION (INS.)
0
0.05
0.10
0.20
0.30
0.40
0.50
20
40
60
80
100
120
140
160
180
200

UNITED ENGINEERS CONTAINMENT LINER ANCHOR LOAD TEST

TEST SPECIMEN: SEABROOK T3
PEAK LOAD: 144 KIPS
f'c: PSI
DIAL # 1 LOCATION: 1.5 IN. ABOVE LVDT PROBE TO VERIFY HORIZONAL DEFL 14" FROM T
DIAL # 2 LOCATION: 7" FROM BACK FACE MOUNTED ON SIDE FACE TO INDICATE ROTATION
VISHAY-ELLIS CALIBRATION #: 290

DATE: 10-24-80
WITNESSES: STETHEN, HAVEY HAYES, CODLEY, HOLBROOK, & BURDETTE
DIAL #3 LOCATION: 6 IN BEHIND T TO MEASURE PLATE LIFT-UP

TEST 80-26

MULTI-METER READING (VOLTS)	LVDT DEFL (IN)	LOAD (KIPS)	DIAL#1 (IN) x10^3	DIAL#2 (IN) x10^3	DIAL#3 (IN) x10^3
0.00	0.000	0.0	0	0	0
0.25	0.013	76.6	13	0	16
0.50	0.025	106.9	27	1	39
0.75	0.038	128.3	40	2	69
1.00	0.050	141.3	53	3	102
1.25	0.063	85.3	65	1	240 @ PEAK 290 ABRUPT 310 @ 1.25
1.50	0.075	67.0	82	0	297
1.75	0.088	35.0	92	0	428
2.00	0.100	39.7	105	0	505
2.50	0.125	39.4	133	0	629
3.00	0.150	39.0	160	0	745
3.50	0.175	38.6	186	0	855
4.00	0.200	38.2	213	0	DISCONNECT
5.00	0.250	31.6	268	2	—
6.00	0.300	32.1	322	2	—
7.00	0.350	26.0	375	0	—
8.00	0.400	25.8	429	0	—
9.00	0.450	25.5	482	0	—
9.96	0.500	22.8	534	0	—
6.37	0.319	0.0	365	0	—

BURDETTE ADDED ON LATE

COMMENTS:

DEFL (INCH)	CHANNEL	LOAD (KIPS)
	00	354
	00	357
	00	365
	00	375
DISCONNECT DIAL# 3	00	381
0.20	00	382
	00	385
	00	387
	00	387
	00	388
	00	386
	00	386
	00	389
	00	391
	00	387
0.15	00	390
	00	394
	00	396
	00	397
	00	396
	00	394
	00	392
	00	387
	00	391
	00	397
0.101	00	392
0.10	00	397
	00	389
	00	370
	00	326
	00	257
	00	090
	00	751
	00	822
	00	1404
	00	1438
0.05	00	1413
	00	1372
	00	130
	00	1257
	00	1177
	00	1069
	00	973
	00	839
	00	692
	00	460
0.00	00	000

TEST 80-26
SEABROOK T3
PEAK LOAD ON PLOT = 143K
PEAK LOAD ON TAPE = 143.8

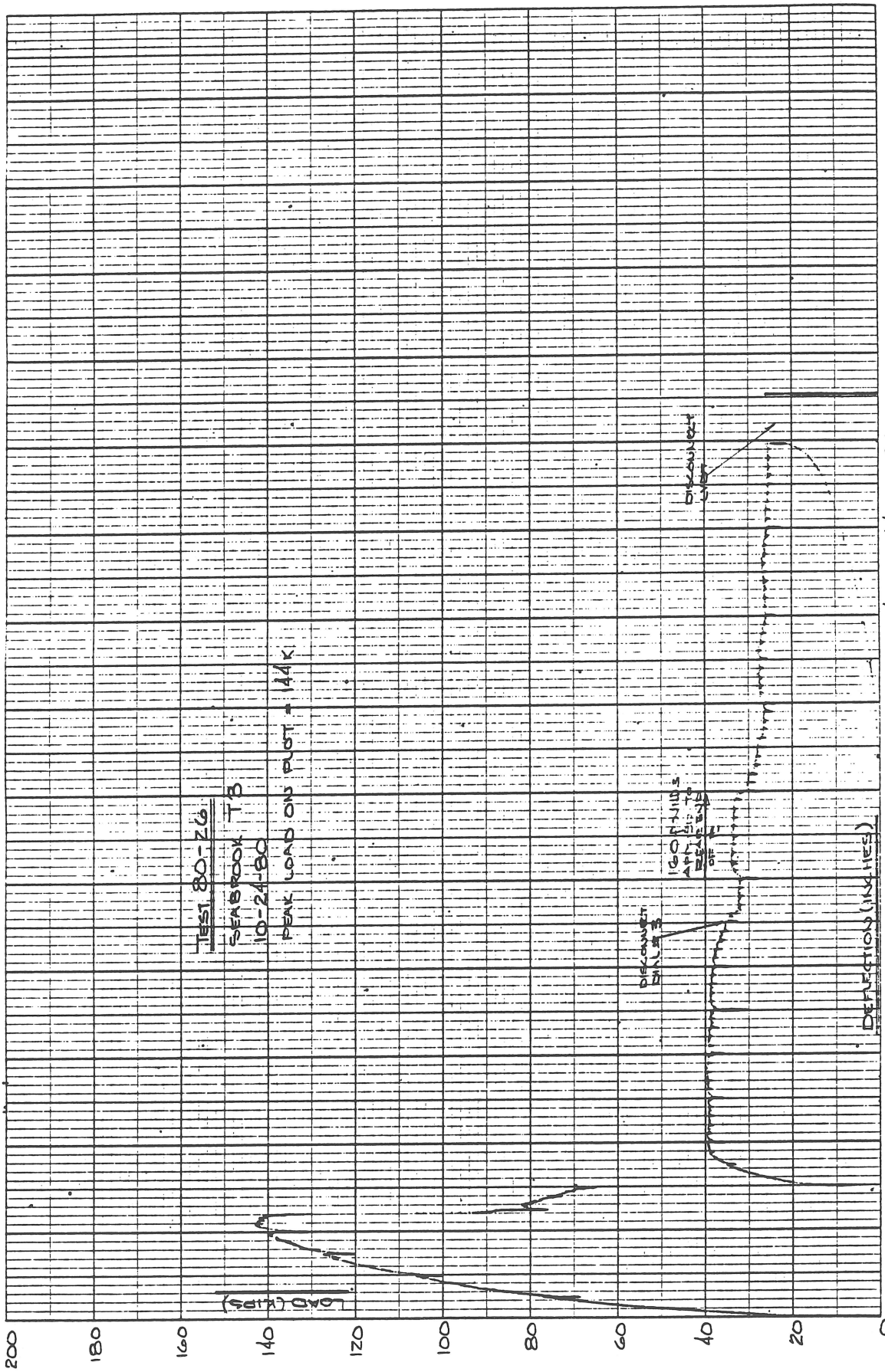
DEFL (INCH)	CHANNEL	LOAD (KIPS)
0.50	00	249
	00	250
	00	252
	00	252
	00	252
	00	253
	00	252
	00	255
	00	256
	00	254
0.45	00	255
	00	258
	00	261
	00	262
	00	262
	00	262
	00	256
	00	258
	00	257
	00	260
0.40	00	258
	00	263
	00	265
	00	269
	00	275
	00	272
	00	271
	00	270
	00	266
	00	272
0.35	00	260
	00	262
	00	262
	00	265
	00	270
	00	278
	00	278
	00	282
	00	286
	00	290
0.30	00	321
	00	331
	00	332
	00	333
	00	337
	00	335
	00	336
	00	337
	00	332
	00	330
0.25	00	316
	00	321
	00	324

23.3

END TEST

	CHANNEL	LOAD (KIPS)
	00	000
	00	007
	00	046
	00	043
	00	016
	00	005
	00	128
	00	092
	00	142
	00	136
	00	127
	00	181
INTERMITTENT LOAD READINGS	00	166
	00	172
	00	158
	00	138
	00	112
	00	074
	00	249
	00	252
	00	238
	00	241
	00	235
	00	194
	00	140
	00	100
	00	065
	00	042
	00	023
	00	009

DISCONNECT LVDT


TEST 80-26
SEABROOK T-B
10-24-80
PEAK LOAD ON PLOT = 144 K
DISCONNECT
DISCONNECT
190 K LBS APPLIED TO BEAM END
LOAD (K LBS)
DEFLECTION (INCHES)
200
180
160
140
120
100
80
60
40
20
0
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50

UNITED ENGINEERS CONTAINMENT LINER ANCHOR LOAD TEST

TEST SPECIMEN: STUDS 1
PEAK LOAD: 51 KIPS
f'c: PSI
DIAL # I LOCATION: 1.5 IN ABOVE LVDT PROBE TO VERIFY HORIZONAL DEFL. 14" FROM STUDS
DIAL # 2 LOCATION: 7" FROM BACK FACE MOUNTED ON SIDE FACE TO INDICATE ROTATION
VISHAY-ELLIS CALIBRATION #: Z90

DATE: 11-7-80
WITNESSES: STETHEN, HOLBROOK, CANNON, BURDETTE, FUNK, PERRY

DIAL#3 LOCATION: 5 IN BEHIND STUDS TO MEASURE PLATE

TEST 80-Z6

MULTI-METER READING (VOLTS)	LVDT DEFL (IN)	LOAD (KIPS)	DIAL#I (IN) x10 3	DIAL#2 (IN) x10 3	DIAL#3 (IN) x10 3
0.00	0.000	0.0	0	—	0
0.25	0.013	15.5	12	—	8
0.50	0.025	28.7	24	—	18
0.75	0.038	36.3	37	—	28
1.00	0.050	39.4	50	—	36
1.25	0.063	41.2	63	—	43
1.50	0.075	42.4	76	—	49
1.75	0.088	43.0	90	—	53
2.00	0.100	43.7	104	—	58
2.50	0.125	44.0	129	—	65
3.00	0.150	44.9	155	—	72
4.00	0.200	46.3	207	—	84
5.00	0.250	46.9	258	—	92
6.00	0.300	49.1	310	—	100
7.00	0.350	50.0	362	—	103
8.00	0.400	0.0	FAILURE OF 1 STUD (RIGHT STUD)		ONLY
9.00	0.450	26.2	—	—	—
9.95	0.500	24.0	—	—	—
9.59	0.480	0.0	—	—	—
1/2" MAXIMUM TRAVEL REACHED, LOAD REMAINING (SEE DIAL)				STUD TO	

COMMENTS:

DEFL (IN)	CHANNEL	LOAD (KIPS)
	00	465
	00	469
	00	469
	00	468
0.20	00	463
	00	465
	00	467
	00	460
	00	460
	00	456
	00	446
	00	451
	00	449
	00	453
0.15	00	449
	00	453
	00	447
	00	447
	00	446
	00	440
	00	442
	00	436
	00	441
	00	434
0.10	00	437
	00	435
	00	428
	00	430
	00	429
	00	424
	00	420
	00	416
	00	408
	00	400
0.05	00	388
	00	383
	00	369
	00	362
	00	318
	00	287
	00	196
	00	161
	00	143
	00	101
0.0	00	000

TEST 80-26
STUDS 1

PEAK LOAD ON PLOT = 51.5K
PEAK LOAD ON TAPE = 50.9K

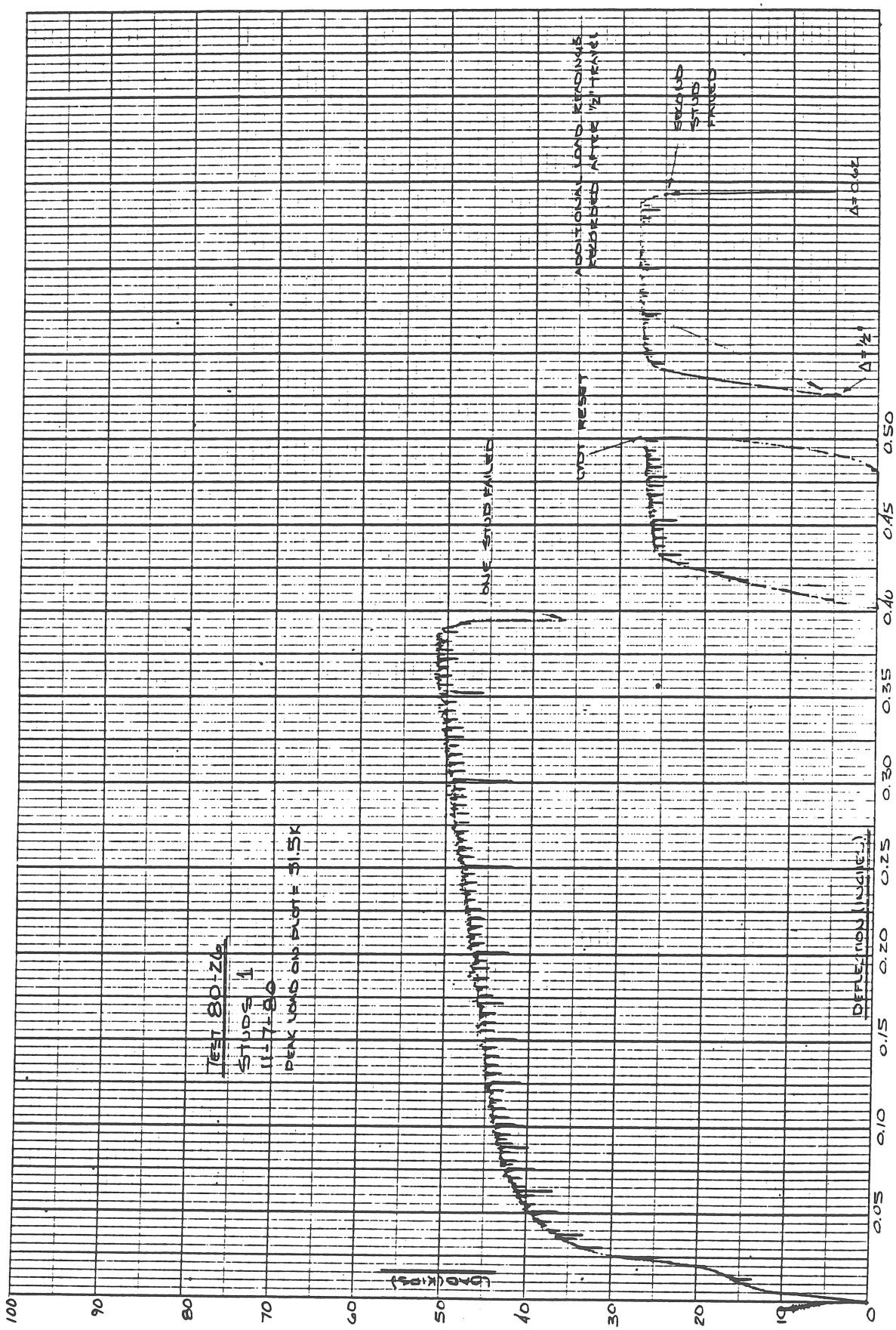
	00	262
	00	264
0.45	00	260
	00	262
	00	260
	00	256
	00	255
	00	251
	00	230
	00	193
	00	161
	00	108
0.40	00	052

RIGHT STUD FAILED
CONTINUE LOADING

	00	486
	00	504
	00	504
	00	506
	00	503
	00	509
	00	507
	00	502
0.35	00	500
	00	504
	00	500
	00	503
	00	498
	00	496
	00	493
	00	492
	00	487
	00	494
0.30	00	491
	00	485
	00	489
	00	489
	00	485
	00	484
	00	485
	00	483
	00	485
	00	483
0.25	00	469
	00	477
	00	475
	00	474

MAXIMUM TRAVEL OFF 1/2"

00	240
00	265
00	262
00	262
00	259
00	266
00	263


TEST 80-24
STUDS 1
111-7-80
PEAK LOAD ON PLOT = 31.5K
ONE STUD FAILED
LVDT RESET
ADDITIONAL LOAD APPLIED AFTER ½" TRAVEL
SECOND STUD FAILED
Δ=0.02"
Δ=½"
LOAD (Kips)
DEFLECTION (Inches)
0
10
20
30
40
50
60
70
80
90
100
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50

UNITED ENGINEERS CONTAINMENT LINER ANCHOR LOAD TEST

TEST SPECIMEN: STUDS 2
PEAK LOAD: 54.8 KIPS
f'c: PSI
DIAL # 1 LOCATION: 1.5 IN ABOVE LVDT PROBE TO VERIFY HORIZONAL DEF. 14 IN FROM STUDS
DIAL # 2 LOCATION: 7 IN FROM BACK FACE MOUNTED ON SIDE FACE TO INDICATE ROTATION
VISHAY-ELLIS CALIBRATION #: 290

DATE: 11-21-80
WITNESSES: STETHEN, BURDETTE, P. HAYES, T. HAYES, FUNK, PERRY, COOLEY
DIAL #3 LOCATION: 3 IN BEHIND STUDS TO MEASURE PLATE UPLIFT

TEST 80-26

MULTI-METER READING (VOLTS)	LVDT DEFL (IN)	LOAD (KIPS)	DIAL#1 (IN) x10 3	DIAL#2 (IN) x10 3	DIAL#3 (IN) x10 3
0.00	0.000	0.0	0	0	0
0.25	0.013	24.2	12	0	9
0.50	0.025	29.8	24	0	17
0.75	0.038	34.6	37	0	25
1.00	0.050	37.9	50	0	32
1.25	0.063	38.3	64	0	39
2.00	0.100	41.6	103	0	52
3.00	0.150	42.8	155	0	65
4.00	0.200	44.0	208	0	77
5.00	0.250	44.2	260	0	83
6.00	0.300	46.4	312	0	88
7.00	0.350	47.6	364	0	92
8.00	0.400	49.7	416	0	95
9.00	0.450	49.7	468	0	96
9.96	0.500	48.8	518	0	99
9.14	0.457	0.0	—	—	—
RESET LVDT, CONTINUE TEST (SEE PLOT)					

COMMENTS:

DEFL (IN)	CHANNEL	LOAD (KIP)
	00	507
	00	507
	00	508
	00	502
	00	505
	00	502
0.45	00	497
	00	483
	00	493
	00	490
	00	493
	00	494
	00	497
	00	490
	00	494
	00	492
0.40	00	481
	00	490
	00	488
	00	485
	00	484
	00	481
	00	473
	00	481
	00	480
	00	476
0.35	00	476
	00	477
	00	474
	00	471
	00	470
	00	473
	00	467
	00	467
	00	464
	00	457
0.30	00	464
	00	459
	00	463
	00	461
	00	450
	00	456
	00	459
	00	454
	00	458
	00	453
0.25	00	43
	00	450
	00	452
	00	451
	00	450
	00	448
	00	446
	00	449
	00	433
	00	446
0.20	00	440
	00	441
	00	435
	00	442
	00	438
	00	435
	00	439
	00	438
	00	434
	00	432
0.15	00	428
	00	434
	00	429
	00	431
	00	428
	00	425
	00	426
	00	428
	00	419
	00	417
0.10	00	416
	00	415
	00	415
	00	.407
	00	405
	00	401
	00	401
	00	397
	00	386
	00	383
0.05	00	379
	00	373
	00	359
	00	347
	00	323
	00	298
	00	301
	00	286
	00	240
	00	155
0.00	00 -	000

TEST 80-26

PEAK LOAD ON PLOT = 54.8K

PEAK LOAD ON TAPE = 54.2K

11-21-80

	00	033
	00 -	001

ONE STUD FAILED, DISCONNECT PLOTTER & TAKE RANDOM LOAD READINGS OF FINAL STUD

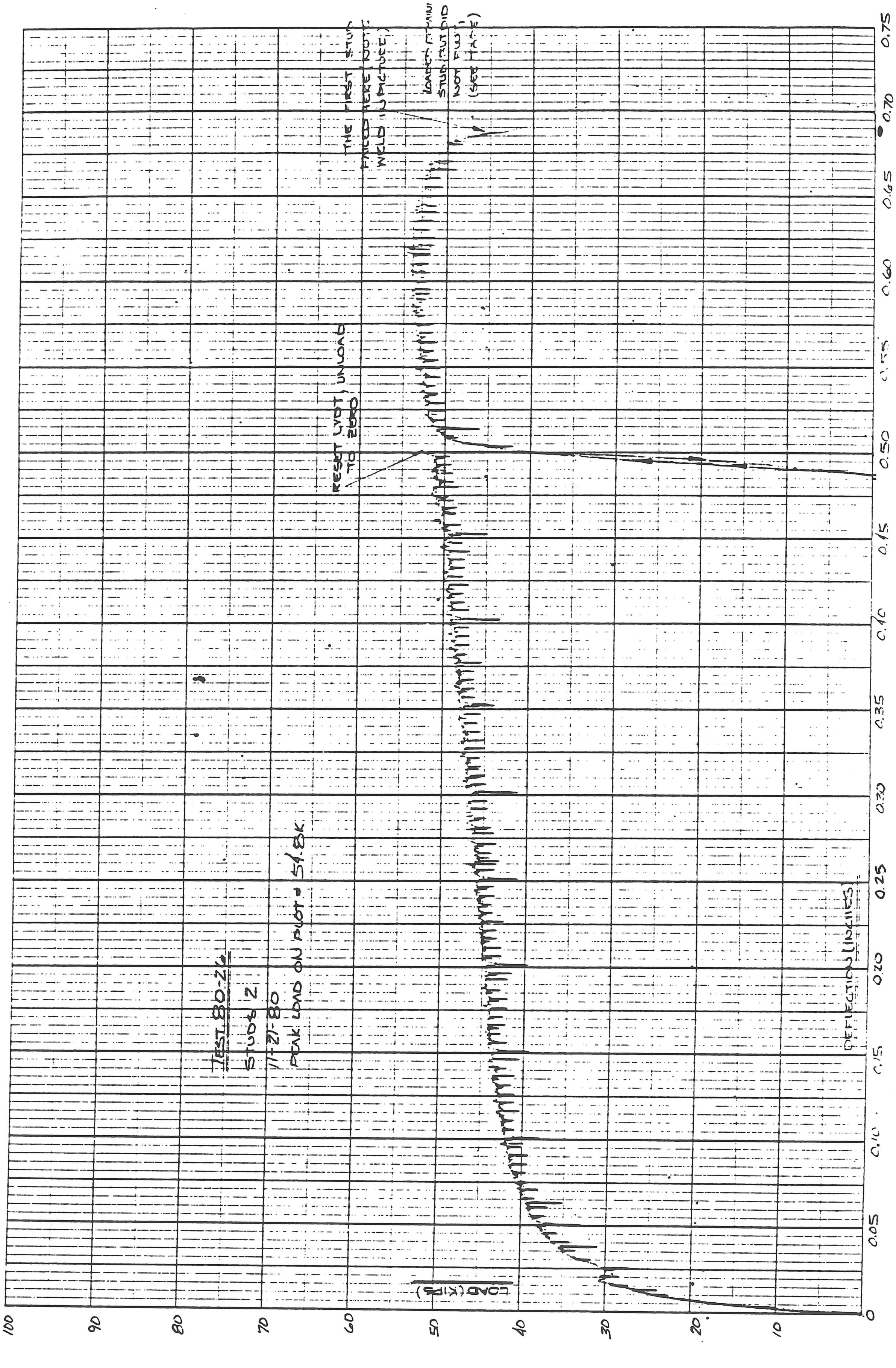
0.68	00	468
	00	496
	00	507
	00	511
	00	520
	00	521
0.65	00	528
	00	519
	00	531
	00	529
	00	538
	00	531
	00	542
	00	539
	00	540
	00	532
0.60	00	539
	00	534
	00	540
	00	535
	00	535
	00	533
	00	536
	00	531
	00	535
	00	526
0.55	00	515
	00	512
	00	524
	00	519
	00	519
	00	518
	00	518
	00	514
	00	502
	00	500
0.50	00	424

RESET LVDT & CONTINUE LOADING

0.50	00	488
	00	509
	00	514
	00	512

SECOND STUD FAILED, END TEST

00 -	002
00	280
00	275
00	284
00	287
00	288
00	283
00	286
00	286
00	287
00	286
00	282
00	282
00	279
00	279
00	276
00	268
00	239
00	204
00	164
00	116
00	070


TEST 80-26
STUDS 2
11-21-80
PEAK LOAD ON PLOT = 54.8K
RESET LVDT, UNLOAD TO ZERO
DEFLECTION (INCHES)
LOAD (KIPS)
0
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.60
0.65
0.70
0.75
10
20
30
40
50
60
70
80
90
100

UNITED ENGINEERS CONTAINMENT LINER ANCHOR LOAD TEST

TEST SPECIMEN: STUDS 3
PEAK LOAD: 52.5 KIPS
f'c: PSI
DIAL # 1 LOCATION: 1.5 IN ABOVE LVDT PROBE TO INDICATE HORIZONAL DEFLECTION OF PLATE
DIAL # 2 LOCATION: 7 IN FROM THE BACK FACE OF BLOCK TO INDICATE ROTATION
VISHAY-ELLIS CALIBRATION #: Z90

DATE: 12-2-80
WITNESSES: STETHEN, HALEY, COREY, BURDETTE, T. HAYES, GAUNT
DIAL#3 LOCATION: 3½ IN BEHIND STUDS TO MEASURE PLATE UPLIFT

TEST 80-Z6

MULTI-METER READING (VOLTS)	LVDT DEFL (IN)	LOAD. (KIPS)	DIAL#1 (IN) x10^{-3}	DIAL#2 (IN) x10^{-3}	DIAL#3 (IN) x10^{-3}
0.00	0.000	0.0	0	0	0
0.25	0.013	15.7	12	0	5
0.50	0.025	29.9	24	0	17
0.75	0.038	37.9	36	0	27
1.00	0.050	39.7	50	0	38
1.25	0.063	40.6	62	0	46
1.50	0.075	42.7	76	0	52
2.00	0.100	43.8	102	0	61
3.00	0.150	45.9	154	0	77
4.00	0.200	47.1	207	0	93
5.00	0.250	48.4	258	0	104
6.00	0.300	49.6	311	0	115
7.00	0.350	50.0	361	0	125
8.00	0.400	50.9	415	0	130
9.00	0.450	50.3	466	0	135
ONE STUD FAILED, RESET LVDT, DISCONNECT DIAL # 1					
6.30	0.550	24.1	———	2	132
7.30	0.600	SECOND STUD FAILED			
*NOTE: BOTH STUDS FAILED OUTSIDE THE WELD REGION					

COMMENTS:

	00	504
	00	513
	00	505
	00	507
	00	511
	00	510
	00	512
0.45	00	503
	00	498
	00	508
	00	507
	00	508
	00	496
	00	506
	00	506
	00	510
	00	512
0.40	00	509
	00	508
	00	516
	00	515
	00	513
	00	513
	00	511
	00	510
	00	505
	00	514
0.35	00	500
	00	502
	00	507
	00	505
	00	502
	00	505
	00	503
	00	500
	00	497
	00	501
0.30	00	496
	00	497
	00	492
	00	494
	00	495
	00	497
	00	489
	00	487
	00	488
	00	497
0.25	00	484
	00	483
	00	480
	00	473
	00	480
	00	476
	00	478
	00	473
	00	473
	00	470
0.20	00	471
	00	468
	00	471
	00	468
	00	468
	00	464
	00	463
	00	462
	00	459
	00	462
0.15	00	459
	00	453
	00	448
	00	449
	00	452
	00	449
	00	448
	00	447
	00	436
	00	444
0.10	00	438
	00	439
	00	436
	00	435
	00	432
	00	427
	00	427
	00	418
	00	413
	00	411
0.05	00	397
	00	390
	00	380
	00	365
	00	334
	00	299
	00	267
	00	214
	00	129
	00	088
0.0	00	000

DEFL. (IN) | CHANNEL | LOAD (KIPS)

TEST 80-26

PEAK LOAD ON PLOT = 52.5 K
PEAK LOAD ON TAPE = 51.6K

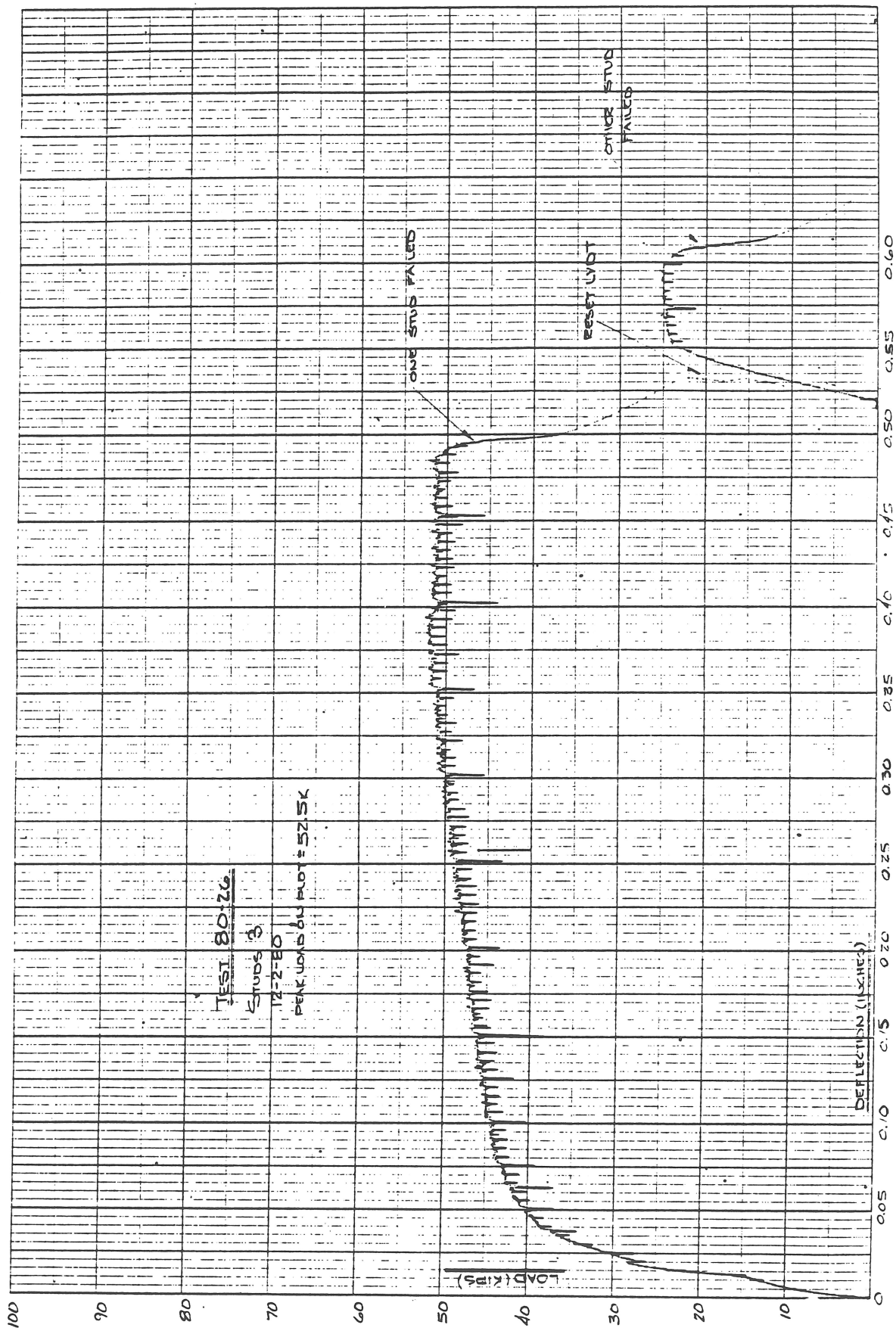
STUDS 3
17-7-80

SECOND STUD FAILED, END TEST

0.585	00	214
	00	237
	00	244
	00	245
	00	245
	00	246
	00	245
0.55	00	241
	00	241
	00	243
	00	241
	00	238
	00	219
	00	191
	00	157
	00	109
	00	067
0.50	00	025

ONE STUD FAILED, RESET LVDT, REMOVE DIAL # 1

0.495	00 -	000
	00	487


TEST 80-26
3 STUDS
12-2-80
PEAK LOAD ON PLOT = 52.5K
ONE STUD FAILED
RESET LVDT
OTHER STUD FAILED
LOAD (KIPS)
DEFLECTION (INCHES)
100
90
80
70
60
50
40
30
20
10
0
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60

CONTAINMENT LINER ANCHOR LOAD TEST
FABRICATION OF SPECIMENS
SEABROOK PROJECT

Date: April 7, 1981

Prepared by: Branko Galunic
B. Galunic

Containment Liner Anchor Load Test
Fabrication of Specimens
Seabrook Project

1. INTRODUCTION

The containment structure at the Seabrook Nuclear Project is a right vertical cylinder having an inside radius of 140 feet and wall thickness of 4'-6", and it has a hemispherical dome which is 3'-6" thick. At the base is a 10 foot thick mat. It is designed to resist the pressure from the most severe break in a reactor coolant pipe. In order to meet the leak tightness requirements of the vessel, a steel liner plate is installed over the inside surface of the concrete. The liner is generally 3/8 inch thick in the cylindrical portion and is thickened to 3/4 inches in the penetration areas near the base. The liner in the dome has a uniform thickness of 1/2 inch and it is 1/4 inch thick on top of the mat. It is anchored to the concrete shell by embedded structural tees and studs welded to the liner plate. Headed studs are only used on the 3/4 inch plates in the penetration area. The tees are used in all other regions.

The purpose of these tests is to define a load-deflection curve for the anchors which can be used in the analysis of the liner/anchor system. The liner strains and anchor displacements must meet the requirements of the ASME Section III Division 2 Code.

2. MATERIALS

2.1 Tees

The tees are made from SA36 steel. They were rolled in Japan and accordingly have metric dimensions. The tee WT 100x100 corresponds very closely

with the American WT 4x7.5 (3.94 in. vs 4.0 in. flange width).

2.2 Studs

The stud material conforms to ASTM Specification A-108 Grade 1018. The yield stress is approximately 50 ksi and the ultimate strength is approximately 60 ksi.

2.3 Liner Plate

The liner plate is made from SA 516 Grade 60 steel (Specification 9763.006 15-1). The plate was cut so that the tensile load on the plate during the test is applied in the direction of rolling. The plate thickness used for all tests, including the studs, was 3/8 inch. In the containment structure the studs are welded to a 3/4 inch plate. It is expected that the thinner plate used in the test will permit larger rotations of the anchor in the vicinity of the plate causing larger stresses in the concrete and thereby conservative results.

2.4 Concrete

All concrete was mixed in accordance with PSNH Specification 9763.006 69-7 and 9763-69-3. The design strength was 4000 psi. The concrete mix is the same as used in the containment structure. An air-entraining and retarding admixture was used. The concrete was Atlantic Type II and the coarse aggregate conforms to ASTM C-67.

2.5 Reinforcement

The concrete is reinforced with rebar that conforms to ASTM A615 Grade 60 Specifications.

3. DESIGN OF SPECIMENS

The dimensions of the specimens, the reinforcement and pertinent details are shown in the drawing LT-1. The overall size of the specimens and the length and taper of the liner were based on the dimensional limitations of the testing equipment. The reinforcement served two purposes. It first provided a confinement of the concrete and prevented cracking that could occur during transportation and other handling. Also, additional rebar were placed on the side of the tees away from the load application. The purpose of these bars was to prevent overall cracking of the specimen when the test load is applied. They are intended to eliminate failure modes that might occur due to the physical limitations of the test specimen. Any cracking of the free vertical surfaces would not be representative of what could occur in the actual structure which is continuous. The length of the tee specimens was held to 12 inches, to minimize the effect of the free edge.

These problems are not expected to occur when studs are used because the failure will be localized to a small area. The same overall dimensions were used for simplicity of fabrication.

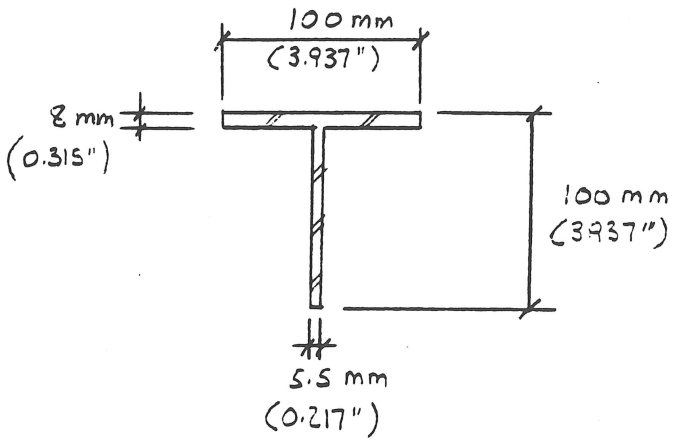
4. POURING PROCEDURE

The test block forms were fabricated at the Seabrook site. The liner formed one side of the form as is the case in the containment structure. The tees were oriented vertically during the pouring operation. Before the concrete was poured a thin coating of WD-40 was sprayed on the liner to eliminate bond between the liner and concrete. Concrete was mixed at the Site Batch Plant and brought to the test area by trucks. The concrete was placed into the forms by a pump truck to simulate actual field placement conditions.

Each specimen was fabricated in three lifts. After each lift a vibrator was used to consolidate the concrete and eliminate voids. Two different trucks were used. Twelve cylinders were taken from each truck. In addition, six cylinders were made for each specimen. These were stored on site in a controlled environment curing room. Three were broken on the day of the test of the specimen. At the end of the pour the top of the concrete surface was troweled to a smooth finish. A chemical curing compound was applied to the exposed surface to seal in moisture and thereby replace water curing.

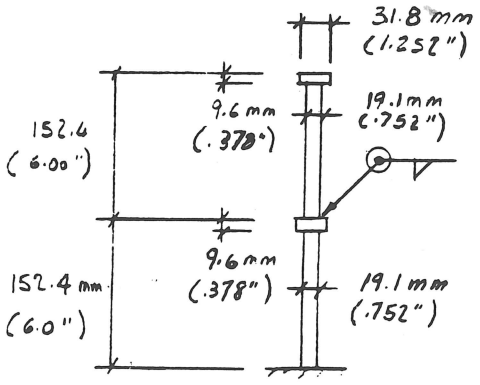
5. TRANSPORTATION

The specimens were transported to Knoxville, Tennessee on two flatbed trucks 14 days after fabrication. Five day cylinder breaks indicated a strength of 3550 psi.



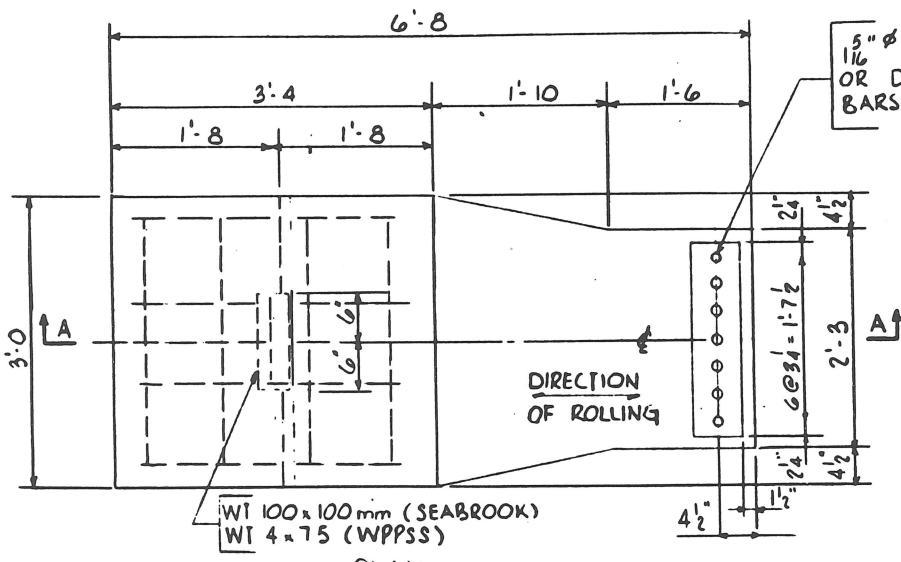
TEE SECTION

FIGURE 1.

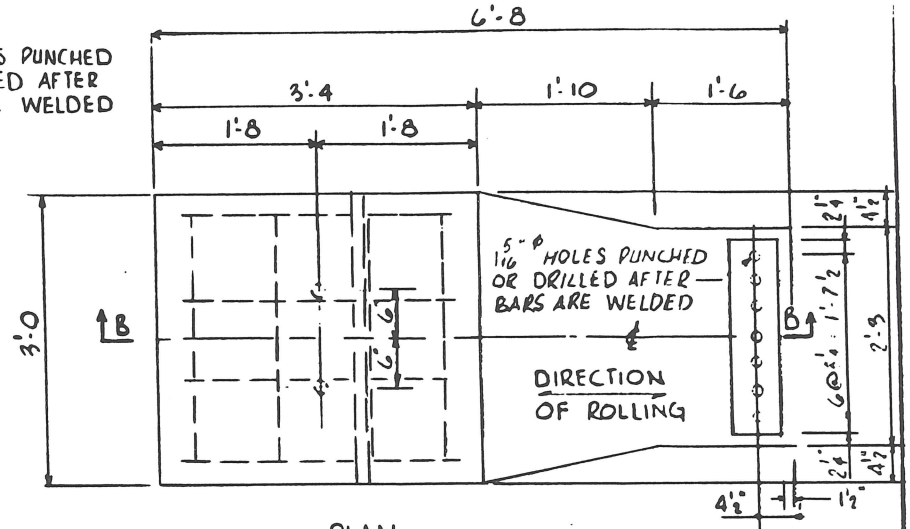


STUD DETAIL

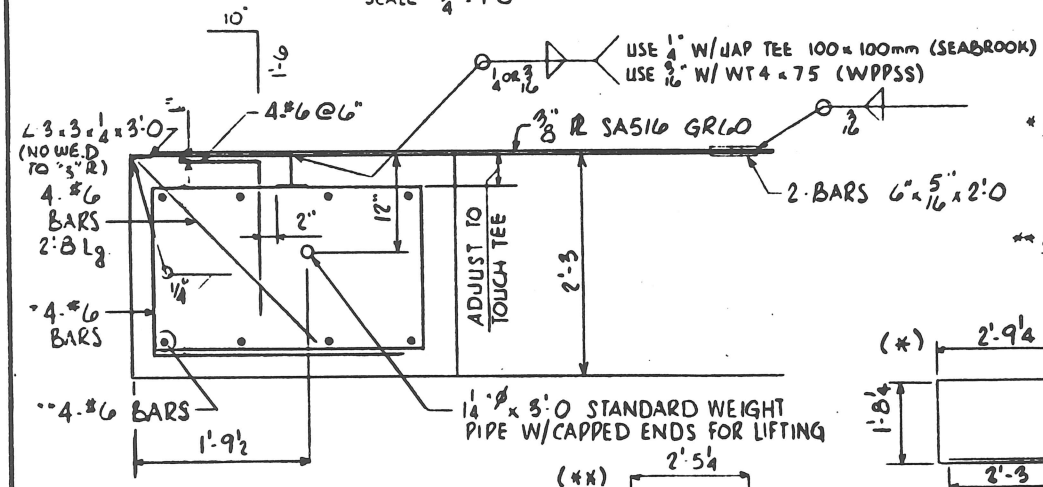
FIGURE 2



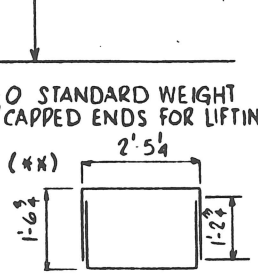
PLAN
FIGURE # 1
SPECIMEN FOR TESTING TEES
SCALE: 3/4" = 1'-0

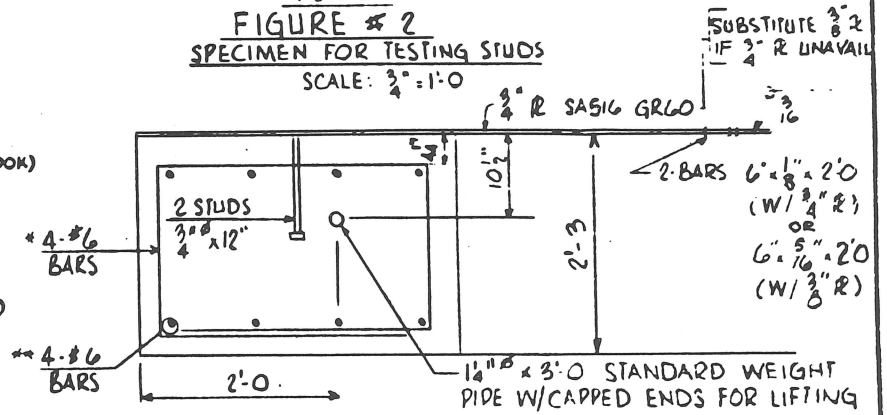


PLAN
FIGURE # 2
SPECIMEN FOR TESTING STUDS
SCALE: 3/4" = 1'-0



SECTION A-A
SCALE: 3/4" = 1'-0





SECTION B-B
SCALE: 3/4" = 1'-0

ENGINEER	DATE
STATE REG.	NO.

LINER ANCHOR TEST SPECIMENS

united engineers

LT-1

REV. NO	DATE	DESCRIPTION	ENGR	SUP ENG
	7-2-80	ISSUED FOR CONSTRUCTION	CTM	
	5-12-80		B.G.	
	5-1-80	FIRST ISSUE	B.G.	

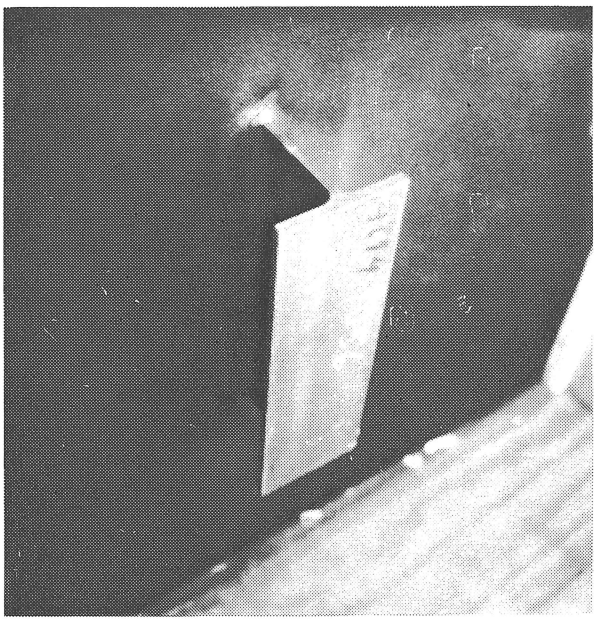


Plate 1: Close-up of tee welded to liner plate

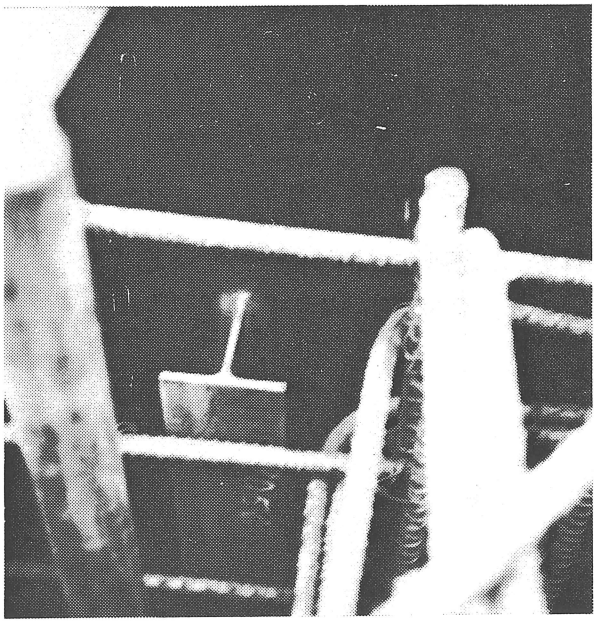


Plate 2: Reinforcing cage and tee

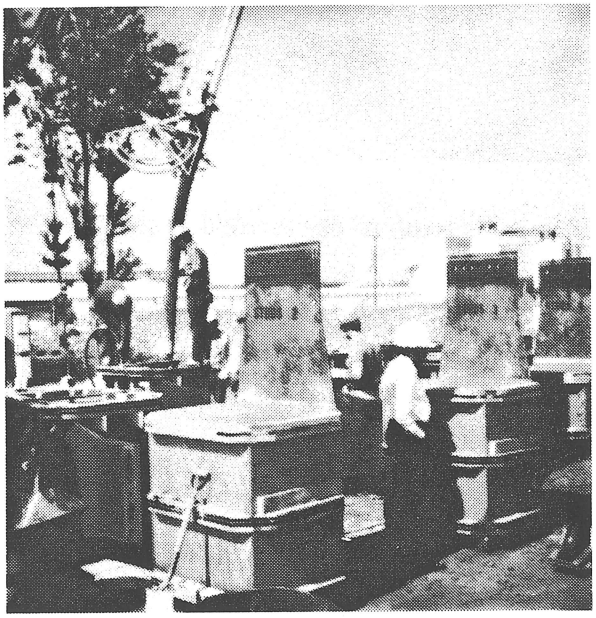


Plate 3: Finished specimens at end of pouring operation

APPENDIX 3H

(Deleted in Amendment 53)