

TABLE 1
LOAD INCREMENTS FOR DYNAMIC TESTS

$$--f_y = 105 \text{ ksi}--$$

A. Tensile Tests

No.	Stress	No. of Cycles	Maximum Loading (kips)		
			1/2" Dia.	5/8" Dia.	3/4" Dia.
1	0.50 f_y	7,000	7.46	11.87	17.54
2	0.60 f_y	2,000	8.95	14.24	21.04
3	0.70 f_y	2,000	10.44	16.61	24.55
4	0.80 f_y	2,000	11.93	18.98	28.06
5	0.90 f_y	2,000	13.42	21.36	31.56
6	1.00 f_y	2,000	14.91	23.73	35.07

B. Shear Test

No.	Stress	No. of Cycles	Maximum Loading (kips)		
			1/2" Dia.	5/8" Dia.	3/4" Dia.
1	0.35 f_y	7,000	5.22	8.31	12.27
2	0.42 f_y	2,000	6.26	9.97	14.73
3	0.49 f_y	2,000	7.31	11.63	17.18
4	0.56 f_y	2,000	8.35	13.29	19.64
5	0.63 f_y	2,000	9.39	14.95	22.09
6	0.70 f_y	2,000	10.44	16.61	24.55
7	0.77 f_y	2,000	11.48	18.27	27.00
8	0.84 f_y	2,000	12.50	19.93	29.46
9	0.91 f_y	2,000	13.54	21.59	31.91
10	0.98 f_y	2,000	14.61	23.26	34.37

TABLE 2
 TEST RESULTS FOR STATIC TENSION TESTS (UT)
 -- f_c' APPROXIMATELY 3,000 PSI--

Test No.	Bolt Dia. (In.)	Peak Load (kips)	Peak Stress (ksi)
1	1/2	16.7*	117.6
2	1/2	20.9	147.2
3	1/2	20.2	142.3
4	1/2	20.9	147.2
5	1/2	20.9	147.2
6	1/2	22.1	155.6
14	1/2	20.5	144.4
15	1/2	19.5*	137.3
AVG.	1/2	20.9	147.2
12	5/8	30.6	135.4
13	5/8	31.0	137.2
17	5/8	30.3	134.1
18	5/8	30.6	135.4
19	5/8	29.6	131.0
20	5/8	30.3	134.1
AVG.	5/8	30.4	134.5
7	3/4	46.6	139.5
8	3/4	46.3	138.6
9	3/4	44.5	133.2
10	3/4	47.7	142.8
11	3/4	46.6	139.5
16	3/4	45.9	137.4
AVG.	3/4	46.3	138.6

*Concrete block split due to insufficient edge distance (approximately 7-in.); test result omitted from average.

TABLE 3
TEST RESULTS FOR STATIC TENSION TESTS (TVA)

Test No.	Bolt Dia. (In.)	Peak Load (kips)	Peak Stress (kips)
1	1/2	19.22	135.4
2	1/2	20.47	144.2 ¹
3	1/2	20.10	141.5
4	1/2	20.10	141.5
AVG	1/2	19.97	140.7
5	5/8	30.45	134.7
6	5/8	29.33	129.8
7	5/8	29.83	132.0
8	5/8	30.45	134.7
AVG	5/8	30.02	132.8
9	3/4	44.02	131.8
10	3/4	45.31	135.7
11	3/4	46.60	139.5
12	3/4	44.02	131.8
AVG	3/4	44.99	134.7
13	1	72.00	118.8 ²
14	1	71.00	117.2 ²
15	1	82.00	135.3
16	1	81.00	133.7
AVG	1	81.5	134.5
17	1 1/4	148.2	148.2
18	1 1/4	137.3	137.3 ²
19	1 1/4	127.0	127.0
AVG	1 1/4	137.6	137.6

¹-Conical nut tore through sleeve, followed by shallow concrete cone failure

²-Test block split; result omitted from average

TABLE 4
 STATIC SHEAR TEST RESULTS FOR f'_c BETWEEN 5700 AND 6000 PSI (UT)

Test No.	Bolt Dia. (In.)	Peak Load (kips)	Peak Stress (ksi)
1	1/2	12.8	90.1
2	1/2	13.7	96.5
3	1/2	15.7	110.6
4	1/2	12.6	88.7
5	1/2	14.7	103.5
6	1/2	14.4	101.4
7	1/2	13.0	91.5
8	1/2	13.3	93.7
9	1/2	13.3	93.7
AVG.	1/2	13.7	96.5
10	5/8	18.6	82.3
11	5/8	19.2	85.0
12	5/8	21.0	92.9
13	5/8	18.8	83.2
14	5/8	20.4	90.3
15	5/8	19.7	87.2
16	5/8	20.2	89.4
17	5/8	20.7	91.6
18	5/8	19.1	84.5
AVG.	5/8	19.7	87.2
19	3/4	29.1	87.1
20	3/4	30.0	89.8
21	3/4	30.2	90.4
22	3/4	31.2	93.4
23	3/4	29.3	87.7
24	3/4	31.2	93.4
AVG.	3/4	30.2	90.3

TABLE 5
STATIC SHEAR TEST RESULTS FOR f'_c BETWEEN 3,000 AND 4,100 PSI (UT)

Test No.	Bolt Dia. (In.)	Peak Load (kips)	Peak Stress (ksi)
9	1/2	18.4	129.6
10	1/2	16.6	116.9
12	1/2	16.6	116.9
13	1/2	14.4	101.4
19	1/2	13.6	95.8
24	1/2	18.5	130.3
25	1/2	18.8	132.4
26	1/2	16.0	112.7
27	1/2	18.4	129.6
AVG.	1/2	16.8	118.4
1	5/8	22.8	100.9
2	5/8	23.2	102.7
3	5/8	19.2	85.0
4	5/8	20.0	88.5
7	5/8	20.8	92.0
15	5/8	20.6	91.2
17	5/8	19.4	85.8
22	5/8	20.0	88.5
23	5/8	19.4	85.8
AVG.	5/8	20.6	91.2
5	3/4	34.8	104.2
6	3/4	37.0	110.8
8	3/4	31.6	94.6
11	3/4	28.8	86.2
14	3/4	31.2	93.4
16	3/4	30.8	92.2
18	3/4	32.0	95.8
20	3/4	32.0	95.8
21	3/4	32.4	97.0
AVG.	3/4	32.3	96.7

TABLE 6

TEST RESULTS FOR DYNAMIC TENSION TESTS (UT)

-- f'_c BETWEEN 3,300 AND 3,800 PSI EXCEPTFOR TESTS WITH * WHICH HAD f'_c BETWEEN 5,500 AND 6,000--

Test No.	Bolt Dia. (In.)	Peak Load (kips)	Peak Stress (ksi)	No. Cycles at Peak Load
1	1/2	14.91	105	2,000
5	1/2	22.2 ¹	156	0
6	1/2	21.5 ¹	151	0
7	1/2	14.91	105	110
1*	1/2	17.0	120	110
2	5/8	23.73	105	1,350
3	5/8	23.73	105	750
4	5/8	29.4 ²	130	0
2*	5/8	23.0 ³	102	1,000
3*	5/8	22.0 ⁴	97	1,200
8	3/4	48.0 ⁵	105	0
9	3/4	42.3 ⁵	105	0
10	3/4	35.07	105	880
11	3/4	35.07	105	1,820
12	3/4	31.56	94	1,480
4*	3/4	47.0 ⁶	141	0
5*	3/4	38.5 ⁷	115	0

Notes:

¹After 2,000 cycles at 14.91 kips, bolt failed under a static load of 22.2 kips in Test 5 and 21.5 kips in Test 6.

²After 2,000 cycles at 23.73 kips, bolt failed under a static load of 29.4 kips.

³Bolt was cycled 7,000 times at 13.0 kips, 2,000 at 18.0, 2000 at 22.0, and 1,000 at 23.0 kips when failure occurred.

⁴Bolt was cycled 7,000 times at 13.0 kips, 2,000 at 18.0, and 1,200 at 22.0 kips when failure occurred.

⁵After 2,000 cycles at 35.07 kips, bolt failed under a static load of 48.0 kips in Test 8 and 42.3 kips in Test 9.

⁶Bolt was cycled 7,000 times at 19.3 kips and failed under a static load of 47.0 kips.

⁷Bolt was cycled 7,000 times at 19.3 kips, 2,000 at 26.0, 1,000 at 32.0, and failed under a static load of 38.5 kips.

TABLE 7
 TEST RESULTS FOR DYNAMIC SHEAR TESTS (UT)
 -- f'_c BETWEEN 3,000 PSI AND 3,800 PSI--

Test No.	Bolt Dia. (In.)	Peak Load (kips)	Peak Stress (ksi)	No. Cycles at Peak Load
1	1/2	12.50	88.0	1,650
2	1/2	13.54	95.4	1,275
3	1/2	13.54	95.4	900
4	1/2	13.54	95.4	0
5	1/2	13.54	95.4	0
6	5/8	18.27	80.8	600
7	5/8	16.61	73.5	400
8	5/8	16.61	73.5	975
9	5/8	19.93	88.2	40
10	5/8	21.59	95.5	20
11	3/4	29.46	88.2	800
12	3/4	27.00	80.8	0
13	3/4	29.46	88.2	0
14	3/4	27.00	80.8	190
15	3/4	24.55	73.5	675

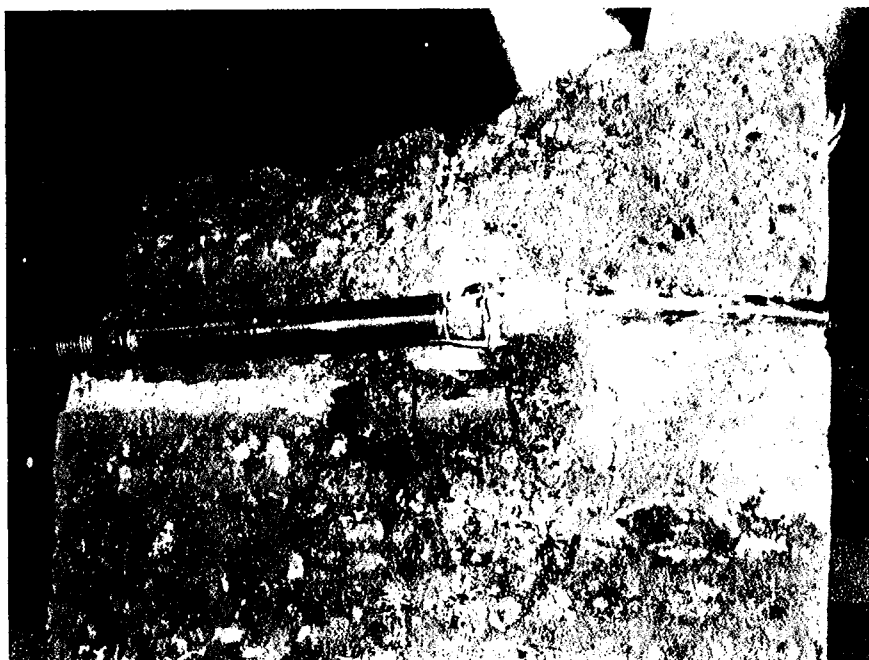


Fig. 1--Undercut anchor

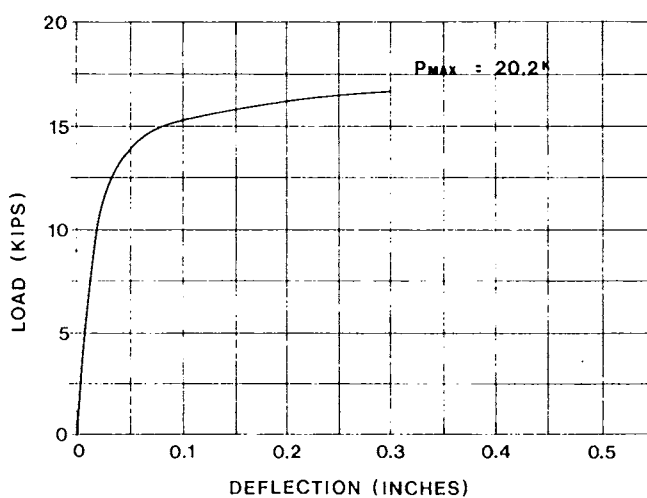


Fig. 2--Load-deflection curve for 1/2 inch diameter anchor in tension

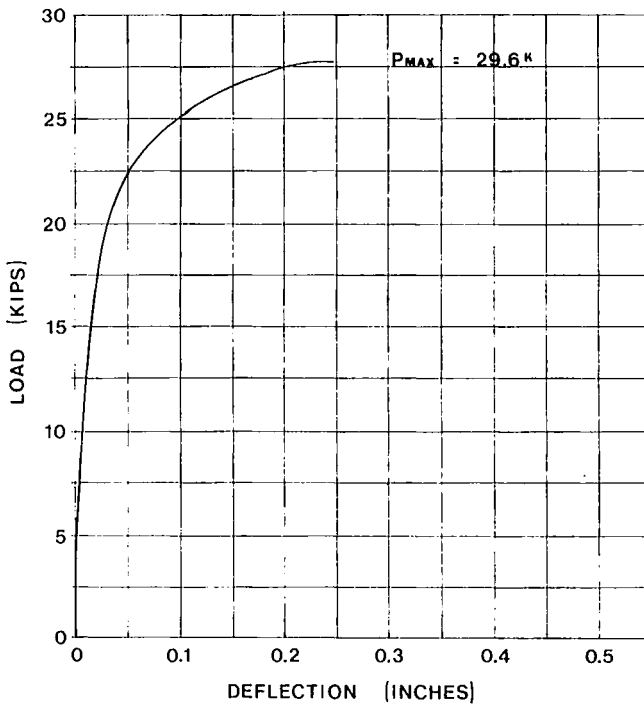


Fig. 3--Load-deflection curve for 5/8 inch diameter anchor in tension

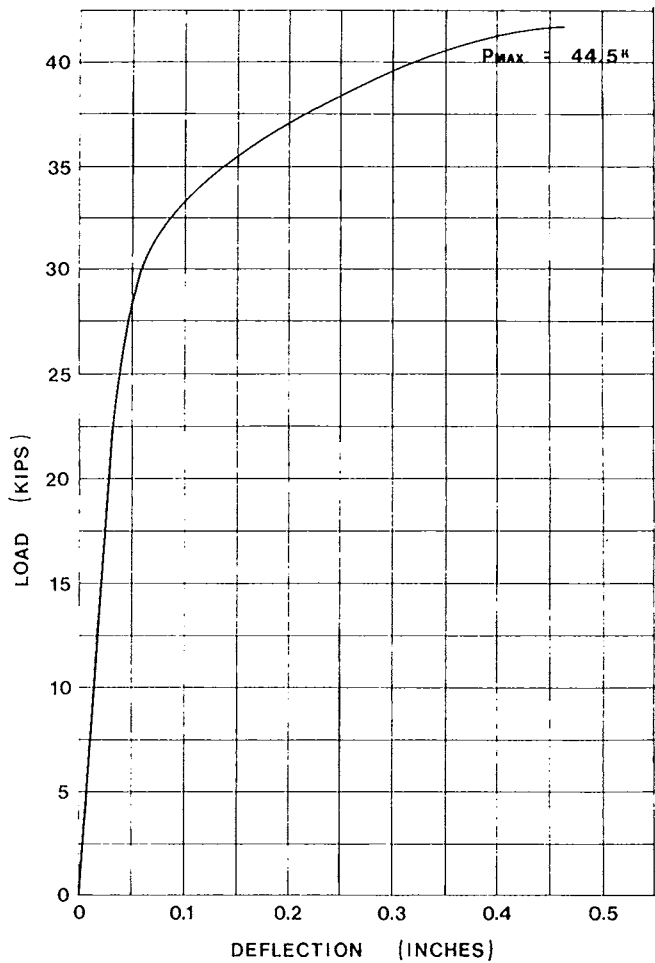


Fig. 4--Load-deflection curve for 3/4 inch diameter anchor in tension