ATTACHMENT 5 – MANUFACTURER LITERATURE FROM POWER'S FASTENERS, INC. ON MAXIMUM TORQUE VALUES AND TORQUE RANGES FOR THE ADHESIVE ANCHORING SYSTEM

(3 pages)

51.5.4 Edge Distance for Adhesive Anchors

Edge Distance - Tension

For adhesive anchors loaded in tension, the following table lists the load reduction factor, Re, for each anchor diameter, d, based on the anchor center to edge distance. To obtain the maximum tension load, an edge distance of 6 anchor diameters (6d) should be used. The minimum recommended edge distance is 4 anchor diameters (4d) at which point the allowable working load for the adhesive resin should be reduced by 40%.

Anchor Size	Edge Distance, E (inches) Tension Only		
d	6d	5d	4d
1/4	1-1/2	1-1/4	1
3/8	2-1/4	1-7/8	1-1/2
1/2	3	2-1/2	2
5/8	3-3/4	3-1/8	2-1/2
3/4	4-1/2	3-3/8	3
7/8	5-1/4	4-3/8	3-1/2
1	6	5	4
1-1/4	7-1/2	6-1/4	5
1-3/8	8-1/4	6-7/8	5-1/2
1-1/2	9	7-1/2	6
Re	1.00	0.80	0.60

Edge Distance - Shear

The following table lists the load reduction factor, Re, for each anchor diameter,d, based on the anchor center to edge distance. To obtain the maximum shear load, an edge distance of 12 anchor diameters (12d) should be used. The minimum recommended edge distance is 4 anchor diameters (4d) at which point the allowable working load for the adhesive resin should be reduced by 50%.

Size	Edge Distance, E (inches) Shear Only									
d	12d	11d	10d	9d	8d	7d	6d	5d	4d	
1/4	3	2-3/4	2-1/2	2-1/4	2	1-3/4	1-1/2	1-1/4	1	
3/8	4-1/2	4-1/8	3-3/4	3-3/8	3	2-5/8	2-1/4	1-7/8	1-1/2	
1/2	6	5-1/2	5	4-1/2	4	3-1/2	3	2-1/2	2	
5/8	7-1/2	6-7/8	6-1/4	5-5/8	5	4-3/8	3-3/4	3-1/8	2-1/2	
3/4	8	8-1/4	7-1/2	6-3/4	6	5-1/4	4-1/2	3-3/4	3	
7/8	10-1/2	9-5/8	8-3/4	7-7/8	7	6-1/8	5-1/4	4-3/8	3-1/2	
1	12	11	10	9	8	7	6	5	4	
1-1/4	15	13-3/4	12-1/2	11-1/4	10	8-3/4	7-1/2	6-1/4	5	
1-3/8	16-1/2	15-1/8	13-3/4	12-3/8	11	9-5/8	8-1/4	6-7/8	5-1/2	
1-1/2	18	16-1/2	12-1/2	13-1/2	12	10-1/2	9	7-1/2	6	
Re	1.00	0.94	0.88	0.81	0.75	0.69	0.63	0.56	0.50	

51.5.5 Effect Of Elevated Temperature

The bond strength of the all adhesive type anchors is effected by elevated temperatures in the base material. As the temperature of the base material increases, the bond strength of the cured adhesive will decrease. Typically, the reduction in bond strength is based on testing conducted in concrete test samples maintained at a given temperature for a minimum of 24 hours before applying a test load. If the base material will be maintained at a constant elevated temperature, the allowable loads for the adhesive should be reduced accordingly.

During a fire, the actual behavior of an adhesive depends upon the heat dissipation inside the concrete. The rate of dissipation will vary depending upon the mix design along with the size and shape of the structural member. Normally, at depths beyond 3", the concrete heats up relatively slowly since only one face of a slab is actually exposed to a fire.

In addition to the heat dissipation within the base material, the transfer of heat into the adhesive by the anchor rod should be considered. One method of reducing the transfer of heat energy is to protect the fixture and the head of the anchor with a suitable coating. Stainless steel anchor rods typically have a low degree of heat transfer and may be used with some adhesives to provide an anchor which has a degree of fire resistance. Testing conducted with Type 316 stainless steel rods installed in normal weight concrete has shown that some adhesives can sustain a design load for at least 30 minutes when exposed to a temperature of 1500° F. Contact Powers *Rawl* for details.

51.5.6 Maximum Torque Values

A maximum torque value is listed for applications in which an adhesive anchor will be used to install a threaded rod. Although the application of torque is not necessary to achieve the published loads, in some cases it may be desirable to apply a clamping force to a fixture. The purpose of a maximum torque is to prevent over stressing of the adhesive bond. These values are based on testing in normal weight concrete at the standard embedment for capsule type adhesives and nine diameters of embedment for injection type adhesives. For specific applications, job site tests are recommended. As with mechanical anchors, preload relaxation should be expected due to creep within the concrete and in the adhesive. Refer to the section on Anchor Selection Guidelines for details.

52.9 Performance Data

52.9.1 Ultimate Load Capacities for Installations Using Threaded Anchor Rod in Concrete

The following load capacities are the ultimate or failure load for the epoxy based on tests using high strength anchor rod. The capacity of the anchor rod itself should be taken into account in the design of any anchorage. The allowable load capacities for the epoxy and five types of anchor rod are described in the next section.

Anchor Size (inches)	Drill Dia. (inches)	Embed. Depth (inches)	Torque Range (ft-lbs.)	2,000 psi Concrete		4,000 psi Concrete		6,000 psi Concrete	
				Tension (lbs.)	Shear (lbs.)	Tension (lbs.)	Shear (lbs.)	Tension (lbs.)	Shear (lbs.)
1/4	5/16	1	5 - 10	1,400	2,465	1,600	2,465	2,210	2,465
1/4	5/16	2	5 - 10	2,370	2,465	2,950	2,465	4,420	2,465
1/4	5/16	3	5 - 10	3,860	2,465	4,470	2,465	6,240	2,465
3/8	7/16	1-1/2	10 - 20	3,010	6,480	4,780	6,480	5,560	6,480
3/8	7/16	2-1/4	10 - 20	4,515	6,480	6,695	6,480	7,840	6,480
3/8	7/16	3-3/8	10 - 20	7,770	6,480	9,085	6,480	11,260	6,480
3/8	7/16	4-1/2	10 - 20	9,330	6,480	11,340	6,480	13,680	6,480
1/2	9/16	2	20 - 40	5,120	11,120	7,885	11,120	8,755	11,120
1/2	9/16	3	20 - 40	7,680	11,120	11,365	11,120	12,630	11,120
1/2	9/16	4-1/2	20 - 40	11,515	11,120	17,435	11,120	18,460	11,120
1/2	9/16	6	20 - 40	15,535	11,120	19,700	11,120	23,265	11,120
5/8	3/4	2-1/2	50 - 90	8,520	17,650	9,960	17,650	12,910	17,650
5/8	3/4	3-3/4	50 - 90	12,780	17,650	15,845	17,650	19,360	17,650
5/8	3/4	5-5/8	50 - 90	19,170	17,650	30,175	17,650	32,040	17,650
5/8	3/4	7-1/2	50 - 90	25,560	17,650	31,605	17,650	38,720	17,650
3/4	7/8	3	100 - 160	9,910	29,250	10,345	29,250	14,290	29,250
3/4	7/8	4-1/2	100 - 160	17,860	29,250	18,550	29,250	24,670	29,250
3/4	7/8	6-3/4	100 - 160	26,790	29,250	38,935	29,250	40,590	29,250
3/4	7/8	9	100 - 160	35,720	29,250	44,475	29,250	52,130	29,250
7/8	1	3-1/2	180 - 200	15,860	36,065	18,930	36,065	22,330	36,065
7/8	1	5-1/4	180 - 200	23,765	36,065	34,010	36,065	36,010	36,065
7/8	1	7-7/8	180 - 200	35,650	36,065	42,385	36,065	52,030	36,065
7/8	1	10-1/2	180 - 200	47,530	36,065	63,560	36,065	71,890	36,065
1	1-1/8	4	250 - 300	20,455	53,135	25,495	53,135	30,990	53,135
1	1-1/8	6	250 - 300	30,630	53,135	38,510	53,135	42,550	53,135
1	1-1/8	9	250 - 300	46,025	53,135	59,555	53,135	67,430	53,135
1	1-1/8	12	250 - 300	61,365	53,135	80,605	53,135	92,975	53,135
1-1/4	1-3/8	5	350 - 600	31,010	83,450	40,785	83,450	46,980	83,450
1-1/4	1-3/8	7-1/2	350 - 600	46,510	83,450	61,180	83,450	70,475	83,450
1-1/4	1-3/8	11-1/4	350 - 600	69,770	83,450	91,765	83,450	105,710	83,450
1-1/4	1-3/8	15	350 - 600	93,025	83,450	122,355	83,450	140,950	83,450
1-3/8	1-1/2	5-1/2	350 - 600	37,100	97,460	48,800	97,460	56,215	97,460
1-3/8	1-1/2	8-1/4	350 - 600	55,650	97,460	73,200	97,460	84,320	97,460
1-3/8	1-1/2	12-3/8	350 - 600	83,480	97,460	109,800	97,460	126,480	97,460
1-3/8	1-1/2	16-1/2	350 - 600	111,300	97,460	146,395	97,460	168,640	97,460
1-1/2	1-5/8	6	350 - 600	43,740	112,780	57,530	112,780	66,270	112,780
1-1/2	1-5/8	9	350 - 600	65,605	112,780	86,295	112,780	99,405	112,780
1-1/2	1-5/8	13-1/2	350 - 600	98,410	112,780	129,440	112,780	149,105	112,780
1-1/2	1-5/8	18	350 - 600	131,215	112,780	172,585	112,780	182,810	112,780