Gus Sirakis

From: Skghosh@aol.com
Sent: Tuesday, May 01, 2007 4:40 PM
To: Gus Sirakis; DanE@bb.nyc.gov
Cc: sbhol@panynj.gov; ahmad.rahimian@wspcs.com; felix@stressteel.com
Subject: Re: Freedom Tower: 97 ksi Steel
Attachments: SASSpliceTestsMay1,2007.pdf

Dear Gus and Dan:

In regards to the report IS-06-16 "Bond Tests of High Strength SAS Threaded Bars", NCState is in the process of issuing a final version that will be dated May 2007. The attached table is from that report.

The difference between the numbers in the attached table and the corresponding numbers in the September 2006 draft is due almost entirely to one reason. The latest version calculates u sub aci using field-measured concrete cover for all splice beams. The September draft calculated u sub aci using the design cover. It was discovered after issuing the September draft that the as-built concrete cover in the beams varied from the design cover by 0.5 in. to 1 in. Since concrete cover is a primary factor controlling bond strength, the results for the splice beams were recalculated using the measured as-built cover in lieu of the design cover.

It should be noted that the 1.25 factor in Eq. 2 of AC 237 was put in there by me as an additional safety measure. Many would question whether this is strictly required by ACI 318. As should be clear from the attached table, this enhanced criterion was failed to be met in only five of the sixteen cases tested. It should be noted, however, that since both of the top bars were spliced at the same location in each test specimen, the splice length used, according to ACI 318, should have been 1.3 times the development length. The 1.3 factor was not used in the design and fabrication of the test specimens. This additional factor, if used, would doubtless have taken care of the "shortfalls" observed in the five cases. Thus I feel quite comfortable about the test results. You really need not feel any qualms about allowing lap splices with the Stressteel bars.

If I can clarify anything else, please do not hesitate to get un touch with me.

Thank you.

S. K. Ghosh

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Bar Size	Specimen Length (ft)	Specified Concrete Strength (psi)	Meaured Concrete Strength (psi)	Transverse Reinforcement	Actual Splice (l_s) (in)	ACI Splice (l_{daci}) (in)	Measured Steel Stress (ksi)	u_{test} (psi)	u_{aci} (psi)
No. 9 db = 1.125"	22	6000	6300	none	64	75	105	461	452
			6300	min	60	69	100	469	494
			6300	min	60	69	105	492	494
			6300	2xmin	56	64	99	497	535
		12000	9400	none	46	62	110	673	552
			10100	min	43	55	111	726	625
			10100	min	43	55	113	739	625
			9400	2xmin	40	52	112	788	654
No. 20 db = 2.5"	48	6000	6000	none	235	277	88	234	273
			6000	min	207	239	109	329	317
			7700	min	207	211	108	326	359
			8400	2xmin	185	177	112	378	428
		12000	11300	none	166	215	94	354	353
			11100	min	146	185	105	449	410
			10300	min	146	185	105	449	410
			10100	2xmin	131	162	107	510	467

Equation 2 per ICC	**Equation 3**	**% of fy**
% of u_{aci} (ICC)	% of Uaci (ACI)	% of yield
102%	128%	108%
95%	119%	103%
100%	125%	108%
93%	116%	102%
122%	152%	113%
116%	145%	114%
118%	148%	116%
120%	151%	115%
86%	107%	91%
104%	130%	112%
91%	113%	111%
88%	111%	115%
100%	125%	97%
110%	137%	108%
110%	137%	108%
109%	137%	110%

$$u_{test} \geq u_{aci}$$

Equation 2 (ICC requirement)

$$\frac{f_s d_b}{4 l_s} \geq \frac{1.25 f_y d_b}{4 l_{d,aci}}$$

$$u_{test} \geq u_{aci}$$

Equation 3 (ACI prediction)

$$\frac{f_s d_b}{4 l_s} > \frac{f_y d_b}{4 l_{d,act}}$$