RCSC Annual Meeting, Cleveland Ohio, IFI Headquarters

June 19th, 2009

Minutes

1. Introductions

Carter called the RCSC meeting to order at IFI headquarters 8:10 am. He made a general welcome to members and guests of the annual main meeting. There were a few noted changes to the agenda in the interest of timing and travel plans.

Carter thanked Joe Greenslade, of the IFI for making the meeting arrangements. Introductions were made around the room. Carter asked about departing arrangements to help identify further changes in the schedule. There were a total of 52 members present at the roll call.

Greenslade made a general housekeeping announcement with the plans for the day, and thanked Michelle Lightfoot for her help with the meeting arrangements.Larson made note of the membership list being passed around and asked that members and guests sign in.

2. Agenda approval

With the following changes; Item 10 Coordination was moved between items 6 and 7 on the agenda to facilitate the travel schedules of the item presenters. A Turnasure presentation was missed at the last meeting and Carter noted we would try to add it to the agenda time permitting. Carter asked for any other new items to add to agenda.

3. Approval of previous minutes

Carter called for a motion to accept the minutes of the main committee meeting from June, 2008, Toronto, Canada. There was a call for discussion and/or corrections to the 2008 minutes, none heard. Motion made that the minutes be accepted as written by Friel, second by Hundley. Unanimous.

4. Secretary/Treasurers Report

Larson gave a summary of finances including taxes, cash flow, and pending research payments that have been approved. Larson gave a summary of current membership status, at 74 members. Curven and Gialamas were accepted as new producer members. See attached membership breakdown. Carter called for a motion to accept the Secretary/Treasurer report. Motion by Friel, second by Hundley.

5. Nominating Committee Report

Greenslade and Vissat were eligible, nominated and were re-elected as directors. Nominating Committee Chairman Friel noted good vote return sufficient to carry the election. Carter called for a motion to accept the Nominating Committee report, motion by Deal, second by Hundley, unanimous. Carter noted that he would put together a revised Executive Committee membership history.

6. Election of Directors, as noted above.

7. Executive Committee Report.

Carter made note of the Executive Committee decision to appoint Hundley as new Producer representative as replacement of Hamilton. Additionally, the Executive Committee performed the following actions at the past two Executive Committee meeting, held in February and June;

Approved the Secretary/Treasurer report for the Fiscal Year
Approved new memberships
Authorized the preparation of the Income Tax return
Appointed a Nominating Committee
Reviewed the progress of all ongoing research projects
Approved research payments
Accepted the Nomination Committee report
Issued a ballot for the election of officers
Certified the Election results
Forwarded items to the Specification Committee
Appointed a new Executive Committee member with the passing of Roger Hamilton

8. Harrold Report on Spec Committee Ballot Results.

Harrold gave a summary of the individual ballot items that had negative votes in the recent ballot cycle. Details of the ballot comments and negatives can be found in the specification committee meeting minutes. Harrold noted the importance of stopping the ballot cycle in a timely manner, since the full council only meets once per year.

The by-law requirements are fairly strict and not supportive of a quick ballot cycle. Larson explained ballot requirements for voting and for finding negative voters non-persuasive.

A number of ballot negatives were withdrawn and a number of other negatives found non-persuasive by the group in attendance. The by-laws will require that the same negative votes be found non-persuasive by people who voted but did not attend the meeting. A new non-persuasive ballot would be sent out and the totals tabulated by Harrold for inclusion at the next specification committee meeting.

Harrold made comments about new ballot items accepted. And noted there were a number of in process ballot items that were not yet ready to go to ballot. Turn of nut rotation tolerance was approved by the group but ballot needs to be assembled.

Carter made a summary – A ballot will be coming out later in the year. We will try to reconcile the missing votes and get approved for the next version of the specification by the end of the year. We will have a new specification for publication by June. Anything not approved will be held over for the next ballot cycle.

9. Coordination Between RCSC and Other Standards

Carter mentioned the falling out of parallel of the RCSC specification with AISC. Efforts will be made to keep in better alignment moving forward. Kloiber gave presentation of TC6 work on slip critical connections. In 2003 there were some concerns with the use of oversized hole. OS holes have become very prevalent. Because of the concern there was an RCSC and TC6 meeting in Denver and the topic of reliability was discussed. W & W steel sponsored research. Grondin reviewed data and eliminated invalid data. Kliober stated the need to be on the same page moving forward. There was a general question and answer session after the presentation. TC6 will be meeting in the next week. What comes out of that goes into the next specification. Kloiber would like to see RCSC publish 2 years prior to the end of the AISC publication cycle.

Miazga discussed the need for a higher level of collaboration between all organizations. He agreed to take on the task of working toward keeping standards in parallel. CSA is collecting information for future standards improvement. Carter asked for a liaison group to compare AISC, CSA and RCSC processes and to issue a report and to perform a gap analysis. Task group to determine needs. Called for a comparison of committee members. Goal is to get RCSC out front. AISC Tide, Kloiber, Kruth, Schlafly. CSA Miazga, Birkemoe, Grondin.

10. Ricles Research committee report.

See attached

11. Brahimi research report. See Attached

Hydrogen embrittlement. Frank mentioned thread rolling after HT. Asked if this was a problem. Also - core to surface hardness disparity. Greenslade noted ISO has Vickers 30 range as maximum.

Birkemoe presentation. See Attached

Ongoing research presentation.

12. Meeting Location for 2010

Curven offered Vermont location. Greenslade offered Cleveland again. Brahimi offered Montreal, in combination with Infasco at McGill and a tour of a coating plant. Wallace offered transportation and location at The Old Tavern, distributed brochure. Modest subsidy available from Vermont. Factory tour of Applied plant, 5 miles away.

Carter called for more volunteers. Options were Cleveland, Montreal, Vermont. 24 votes for Vermont, 9 Montreal, 1 Cleveland. Applied Bolting will host 2010 meeting in Vermont.

13. Education Report.

McGormley reported on turn of nut method instructional sheet. Suggestion to incorporate in new revision. Tutorial idea for installation of bolts. $5000 commitment from committee for materials creation. Idea for 5 minute videos to post to web or you tube. Carted suggested formal proposal to Executive committee.

14. Greenslade Liaison Report.

Covered IFI ASME ASTM committee work. Copy Attached.

15. New Business

13. Motion to Adjourn

Made by Carter, 2nd by Schroeder.

Preliminary Agenda - RCSC Main Meeting

June 19th, 2009

1. Introductions – 8:00 AM
2. Approval of agenda
3. Approval of minutes of the June 2008 meeting
4. Secretary/Treasurer's report -- Larson
    a. Finances
    b. Membership
5. Nominating Committee report – Friel
6. Election of Directors
7. Executive Committee report – Carter
8. Specification Committee report -- Harrold
    a. Remaining ballot schedule for 2009 RCSC Specification
    b. Review of ballot items
    c. Resolution of non-persuasive findings
9. Other Committee reports
    a. Research – Ricles
    b. Education – McGormley
    c. Liaison – Greenslade
    d. Membership and Funding – Tide
10. Coordination between RCSC and other Standards Developers
    a. Need for coordination – Carter
    b. AISC activities and needs – Kloiber
    c. CSA activities and needs – Miazga
11. New Business
12. Location and Dates for 2010 Annual Meeting
13. Adjournment – 3:00 PM

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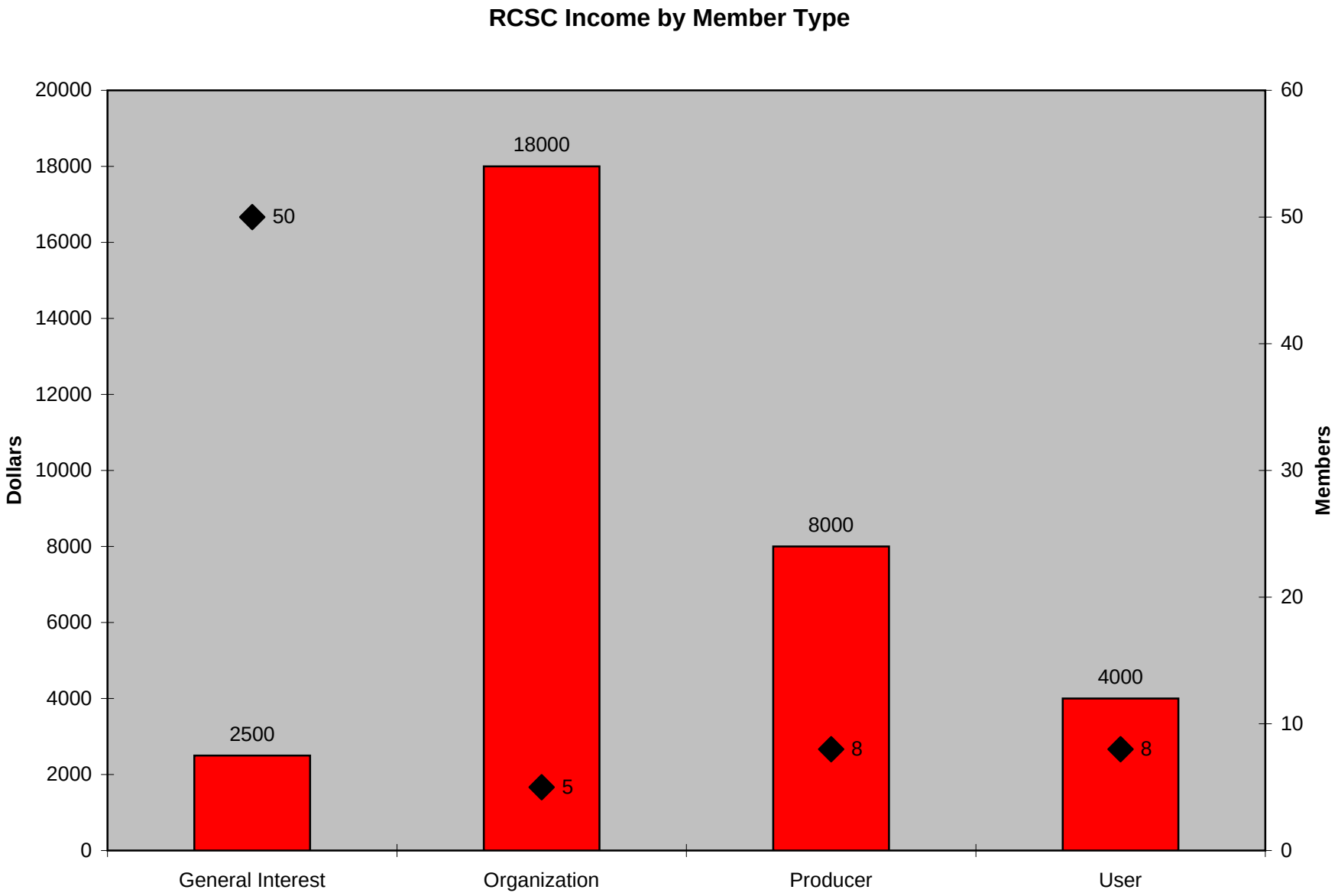
	Scott	Munter	Australian Steel Institute	General Interest	50.00
	Thomas M.	Murray	Virginia Tech	General Interest	50.00
	Gian A.	Rassati	University of Cincinnati	General Interest	50.00
	James M.	Ricles	Lehigh University - ATLSS Center	General Interest	50.00
	Thomas J.	Schlafly	AISC	General Interest	50.00
	Gerald E.	Schroeder		General Interest	50.00
	David F.	Sharp	GMS Engineers, LLP	General Interest	50.00
	Robert E.	Shaw Jr.	Steel Structures Technology Center	General Interest	50.00
	James A.	Swanson	University of Cincinnati	General Interest	50.00
	Arun A.	Syam	Australian Tube Mills	General Interest	50.00
	Thomas S.	Tarpy Jr.	Stanley D. Lindsey & Assoc.	General Interest	50.00
	William A.	Thornton	Cives Steel Company	General Interest	50.00

	Raymond H.R.	Tide	Wiss, Janney, Elstner Assoc.	General Interest	50.00
	Todd C.	Ude	Teng & Associates, Inc.	General Interest	50.00
	Floyd J.	Vissat	Washington Group International	General Interest	50.00
	Charles J.	Wilson	Consultant	General Interest	50.00
	Joseph A.	Yura	U of T Austin/Phil M. Ferguson Str. Eng. Lab.	General Interest	50.00
	William A.	Milek	Consultant	Life Member (1)	0.00
	Charles J.	Carter	AISC	Organization	10,000.00
	Helen	Chen	American Iron and Steel Institute	Organization	2,500.00
	Michael I.	Gilmor	Canadian Inst. of Steel Const.	Organization	1,000.00
	Joe	Greenslade	Industrial Fasteners, Inst.	Organization	3,000.00
	W. Lee	Shoemaker	Metal Bldg. Manufact Assoc.	Organization	1,500.00
new 08	John	Biel	Skidmore Wilhelm	Producer	1,000.00
new 09	Richard C.	Brown	TurnaSure LLC.	Producer	1,000.00
	Michael C.	Friel	Haydon Bolts, Inc.	Producer	1,000.00
	Charles E.	Hundley	Unytite, Inc.	Producer	1,000.00
	Chad M.	Larson	LeJeune Bolt Company	Producer	1,000.00
	Kenneth B.	Lohr	Lohr Fasteners	Producer	1,000.00
	Blane	Vines	Birmingham Fastener	Producer	1,000.00
	Wayne I.	Wallace	Applied Bolting Technology	Producer	1,000.00
	Dean G.	Droddy		User	500.00
	Allen J.	Harrold	BlueScope Building - North America	User	500.00
	James S.	Kennedy	Derr Gruenewald Const/Derr Steel Erection	User	500.00
	Lawrence	Kruth	Douglas Steel Fabricating Corp.	User	500.00
	Keith	Landwehr	Schuff Steel Company	User	500.00
	Bill R.	Lindley II	W & W Steel Company	User	500.00
	Curtis	Mayes	L.P.R. Construction	User	500.00


RCSC Income by Member Type
Dollars
Members
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
60
50
40
30
20
10
0
2500
18000
8000
4000
50
5
8
8
General Interest
Organization
Producer
User

RCSC Cash Projection

	2005	Paid	2006	Paid	2007	Paid	2008	Paid	2009	Paid	Planned
Grondin - Fatigue	$7,500	-$7,500									
Rassati - Ø Factors	$20,600	-$20,600									
Birkemoe - Old			$5,000	-$5,000							
Birkemoe - New			$10,000	-$10,000							
Rassati - Ø Factors			$20,667	-$20,667							
Dusicka - Fillers			$40,000	-$32,000							
Rassati - Ø Factors					$40,265	-$20,133					
Dusicka - Fillers - *2006*					$8,000	-$8,000					
Rassati - Ø Factors - 2007							$20,132	-$19,482			
Dusicka - Fillers - 2007							$40,000	-$20,000			
Dusicka - Fillers - 2007									$20,000		-$20,000
Dusicka - Fillers									$40,000		-$40,000
Birkemoe - New									$10,000		-$10,000
Birkemoe - New									$2,000		-$2,000
Brahimi									$10,000		-$10,000
Grondin - 3rd Edition									$12,000		-$12,000
Grondin - 3rd Edition									$6,000		-$6,000
Grondin - Fatigue - *2006*									$5,200		-$5,200
Income		$35,552		$35,934		$39,500		$35,287			$30,000
Research		$28,100		$67,667		$28,133		$39,482			$105,200
Expenses		$5,232		$3,590		$7,461		$3,820			$5,000
Balance		**$148,239**		**$112,916**		**$115,902**		**$107,887**	Balance		**$27,687**

RCSC Annual Financial Report

Fiscal Year 2008

Ending May 31st, 2009

Starting Balance - June 1st - 2008				**$115,901.80**
	From tax return FY2007			
Total Assets as of May 31st, 2009				
	Money Market		$80,861.63	
	Checking		$27,025.51	
	Certificate of Deposit		$0.00	
			$107,887.14	**$107,887.14**
	Net Increase (Decrease) in Assets FY2007 to 2008			**($8,014.66)**
Income	Research Contributions		$32,900.00	
	Meeting Expense Reimbursement		$1,691.13	
	Interest		$696.07	
	CD Interest		$0.00	
			$35,287.20	**$35,287.20**
Expenses	Research Payment	University of Cincinnati	($12,080.00)	
	Research Payment	PSU	($20,000.00)	
	Research Payment	University of Cincinnati	($7,401.85)	
	Bank Fee's		($103.34)	
	Travel Expenses		$0.00	
	Administrative Expense		($994.41)	
	Meeting Expense		($2,722.26)	
			($43,301.86)	**($43,301.86)**
	Income Less Expenses			**($8,014.66)**
Starting Balance - June 1st - 2008				**$115,901.80**
Income Less Expenses				**($8,014.66)**
Total Assets as of May 31st - 2009				**$107,887.14**

June 17, 2009

RCSC Research Council Structural Connections
Research Committee Report to Members of the RCSC

Research Committee Activities:

- Several documents have been completed and approved by the RCSC Executive Committee: RFP template; proposal review criteria document; requirements for contents of project progress and final reports.

Current Research Projects:

1. Gian Rassati - "Evaluation of the Current Resistance Factors for Bolted Connection Strength"
   - Project has been completed and the final report submitted to the RCSC Research Committee. The report has been approved and is available to the members of RCSC. (see http://www.boltcouncil.org/files/Current-Resistance-factor-report_final.pdf).
   - Final payment has been made to the University of Cincinnati.

2. Grondin – "Fatigue Resistance of High Strength Bolts in Tension"
   - Completion and submittal of final report is pending (he has been asked several times).
   - No research project presentation to be made at the 2009 RCSC Annual Meeting (Professor Grondin will not attend the meeting).
   - Project progress report – none received from Professor Grondin.

3. Birkemoe – "Delayed Installation of ASTM F1852 Fasteners – 2nd Phase"
   - There has been a request from the University of Toronto for a letter from the RCSC. The University of Toronto stated that, "*It should indicate the total extension amount, the revised payout of the remaining amount and an extension of the concluding date to the end of this year*." Jim Ricles has asked the University of Toronto to provide a draft of the letter in order that all items are included in order to expedite the process. No draft letter has been received. The University of Toronto needs payment of the second installment of the extension ($6,000 plus an additional increment based on the declining value of the US$ to Canadian currency). Professor Birkemoe states, "*I thought the acceptance of the interim report would be all that was necessary to receive second installment and the supplement that was approved at your executive meeting last year.* " See attachment for additional correspondence.
   - Project progress report – to be given in conjunction with a research presentation at the 2009 Annual Meeting.
4. Dusicka- "Effect of Fillers on Steel Girder Field Splice Performance"
   - Professor Dusicka will not attend the 2009 RCSC Annual Meeting.
   - Project progress report – see attached.

5. Brahimi – "Hydrogen Embrittlement of Steel Fasteners"
    - Project progress report – see attached.
    - There has been a request for a supplement. The request has been delayed: slow in sending to Jim Ricles the request; issue with final report and final payment (see attached e-mail).
    - Research project presentation to be made at the 2009 RCSC Annual Meeting.

Development of RFP:

- Last year there was discussion of the development of an RFP related to the topic of rotation capacity of bolted connections.
    - Research project involving testing.
    - RFP will be posted on web site and RCSC members notified.
    - No date has been established for the release of the RFP.
    -

Research Committee:

- The Research Committee will meet during the 2009 Annual Meeting
    - To solicit research ideas that can be included among potential topics in a future RFP by the RCSC.
    - Consider sponsoring technical session at future ASCE Structures Congresses (2011) related to RCSC research (3 to 4 papers to be included).

Submitted by
J. Ricles, Chairman of the RCSC Research Committee
June 17, 2009

June 17, 2009

Progress Report
Professor Grondin – "Fatigue Resistance of High Strength Bolts in Tension"

Progress report requested. None received.

Progress Report
Supplement for Professor Birkemoe – "Delayed Installation of ASTM F1852 Fasteners – 2nd Phase"

-------- Original Message --------
Subject: Delayed Installation of F1852
Date: Mon, 15 Jun 2009 21:55:38 -0400
From: Peter C Birkemoe <pete.birkemoe@utoronto.ca>
To: 'James M. Ricles' <jmr5@Lehigh.EDU>
CC: 'Chad Larson' <CLarson@lejeunebolt.com>

Jim

I met with Ms. Tammy Chan our university administrator of external contracts. As I mentioned to you before, she is new to this project but has all of the previous correspondence regarding funding by the RCSC. The recent U of T reorganization has the following address for her:

Tammy Y. Chan
Research Contracts Officer
Industry Liaison Office, The Innovations Group
Office of the Vice-President, Research
University of Toronto
Suite 320, 101 College Street
MaRS Centre, Heritage Building
Toronto, ON M5G 1L7
CANADA

Tel: (416) 946-0601
Fax: (416) 978-5821

The original project funding for the period of 2003-06 was fully paid and completed except that some of the parametric work was expanded in the proposed extension. The extension to the project proposal was funded at $20000 US and was to be paid in increments of $10000 startup, $6000 interim and $4000 final reporting. The startup is the only payment received thus far and was converted to Canadian funds when received. An interim report was submitted prior to the 2007 meeting and results were presented at that last meeting in Cleveland by Vladimir Maleev.

I have no indication, other than a note from Rex Owen last year, that the report interim report had been accepted and that the $6000 payment and that an additional one time increment would be received based

on a declining value of the US$ to the Canadian. Although she has no indication of this communication, she will send an invoice for $6000 to Chad and I assume that the one time increment will be included as well with an acknowledgment for the record. A $4000 invoice will be sent after a final report on the entire project (authored by all participants) is submitted and that will be accomplished before the end of this year. Ms. Tammy Chan agreed to send a summary letter to this effect to bring the project records up to date.

The student, H. Akhlagh-Nejat presented the final phase of the work in a summary of results from his work on the expansion of the reduced temperature effect and has re-submitted a revised thesis this week. I will incorporate his final conclusions in the summary that you requested for presentation at the meeting later this week in Cleveland.

If you have further questions, I will see you in Cleveland. I intend to arrive at the hotel in mid afternoon Wednesday and will be leaving the after the meeting on Friday afternoon.

Regards,
Pete

P. C. Birkemoe, P.Eng.
Professor Emeritus
Department of Civil Engineering
University of Toronto
Tel. (416) 978-5908 Fax (416) 978-6813
Home Office (416) 232-2330
pete.birkemoe@utoronto.ca

June 17, 2009

Progress Report
Professor Birkemoe – "Delayed Installation of ASTM F1852 Fasteners – 2nd Phase"

To be presented by Professor Birkemoe during the Annual Meeting.

June 17, 2009

Progress Report
Professor Dusicka- "Effect of Fillers on Steel Girder Field Splice Performance"

infraStructure Testing & Applied Research (iSTAR) Laboratory
Department of Civil and Environmental Engineering
Portland State University
P.O. Box 751, Portland, OR, 97207-0751

EFFECT OF FILLERS ON STEEL PLATE GIRDER SPLICE CONNECTIONS
PHASE 2 – GIRDER EXPERIMENTS

by

Peter Dusicka, Ph.D., P.E., Assistant Professor
and
Cole Smith, Research Assistant

May 2009

EXECUTIVE SUMMARY

Phase 1 of the research focused on component tests utilizing symmetrically bolted high strength steel plates subjected to axial tension with fillers up to 2 in. Among other results and observations, the experimental results have shown a level of conservatism in the existing design strength equations when extrapolated to thick fillers. The ultimate strength reduction attributed to fillers was shown not to continuously decrease, but instead have a limit and a rebound to near original strength as a function of increasing filler thickness, unless multi-ply fillers were used. The slip values in the assembly tests were found to be lower than expected for Class B surface finish and trends were noted regarding slip resistance decrease with the presence of filler. Phase 2 of the research is aimed to further expand the experimental database with focus on large scale flexure tests that utilize steel plate girders with fillers to more closely reflect a girder splice connection.

Prior to the large-scale girder tests, controlled slip tests were done to investigate the lower than expected slip coefficient in the assembly tests. Tests between HPS70W plate faying surfaces indicated similar values of slip coefficient to those observed in the assembly tests. These lower values may be attributed to the surface treatment applied or in the affect of the surface treatment on HPS70W grade steel.

The large-scale girder test setup was designed to utilize four point bending with a 27.5 ft span in order to develop a tensile force in a flange bolted connection with fillers between the two girders. The test setup conditions are intended to more closely resemble a girder connection and differ from the assembly tests in terms of the load application and the utilization of unsymmetrical filler. The intent for the girders is for partial re-use by connecting the girders together for the destructive tests and then cutting the used ends off in order to achieve relative economy while obtaining numerous data points. Since the girder dimensions do not change in the test, developed fillers are used on one end and of the connection and undeveloped on the other in order to achieve the different filler thickness combinations. Although the largest of the considered fillers thicknesses is unlikely to occur in a girder situation, the 2 in filler thickness was included to remain complementary to the assembly tests.

The girders had been fabricated along with the test setup fixtures, which had now been installed in the laboratory. The testing had started, with the first batch of tests consisting of oversize hole connections with fillers up to 1 in. In the next three months, over 16 different test setups are planned to be completed. The initial results from the tests indicate strength trends similar to those observed in the assembly tests. Although the failure was designed to occur in the bolts, the failure bends the splice plates such that no re-use of the splices is possible as originally intended. The girder faying surface was grit blasted by a different steel girder fabricator, yet the preliminary results indicate slip coefficients with low values that are similar to the observations in the assembly tests. Further controlled slip tests are therefore planed to investigate if these lower slip values are due to the use of HPS70W grade steel.

Figure 17 illustrates that μ values for the first 6 girder tests remained relatively constant for changes in filler sizes, which resemble the trends observed for oversized holes in Phase 1. And the values calculated for the coefficient of slip compare closely to the slip coefficient values calculated from Phase 1. Despite the consistency, these values were lower than the expected values for Class B surface. Since the surface treatment was conducted at a different and more experienced facility and since the controlled slip tests on the assembly steel revealed similarly low values of slip coefficient, it may be possible that these values can be attributed to the steel grade (A709 HPS 70W). Additional controlled slip tests are planned to investigate this possibility by subjected A709 Gr50 as well as A709 HPS 70W steel grades to the same surface finish and testing them based on the RSCS controlled slip test recommendations.

6.0 UPCOMING ACTIVITIES

The fabrication of the large scale tests had been initially slowed down by the boom in steel fabrication and then again by the complementary bust in that initially the fabricator that we are working could not fit us in the schedule and then it was hard for them to provide reduced cost fabrication at a later stage. Nonetheless, the specimens have now been fabricated and the test setup installed in the laboratory. Over the next three months, the testing of the planed 16 different test setups will be completed. Of particular interest is the effect of multi-ply filler consisting of a thick filler and a complementary 0.25 in filler, which is likely to be more representative of erection conditions as opposed to the multi-ply fillers in Phase 1 that conservatively consisted of numerous 0.25 in fillers to make up the total thickness. Following the girder tests, the data will be reduced and compared to the Phase 1 tests and those conducted at Illinois on the simulated wide flange truss connection in compression.

7.0 REFERENCES

Dusicka, P. and Lewis, G. "Effect of Fillers on Steel Girder Field Splice Performance Year 1 Progress Report," Research Council on Structural Connection, Department of Civil and Environmental Engineering, Portland State University, Portland, OR, 2007.

RCSC (2001) "Guide to Design Criteria for Bolted and Riveted Joints", by Kulak, G.L., Fisher J.W., and Struik, J.H.A., Second Edition, Research Council on Structural Connections, Chicago, IL.

Wallaert, J.J., Fisher, J.W. (1965). "Shear Strength of High-Strength Bolts", Journal of the Structural Division, Vol. 91, No. ST3., American Society of Civil Engineers.

Yura, J.A., Hansen, M.A. and Frank, K.H (1982), "Bolted Splice Connections with Undeveloped Fillers", Journal of the Structural Division, Vol. 108, No. ST12, American Society of Civil Engineers

8.0 APPENDIX

Table 1: Test matrix for girder splice experiment.

Test	Holes Used	Filler 1 1/8" Flange	Thickness 1 3/4" Flange	Holes
1*	Inner Flange	No Filler Plate U (East)	No Filler Plate D (West)	Oversize
2	Outer Flange	7/8" D (East)	1/4" U (West)	Oversize
3**	Inner Flange	No Filler Plate U (East)	No Filler Plate D (West)	Oversize
4	Outer Flange	5/8" U (West)	No Filler Plate D (East)	Oversize
5	Inner Flange	1" U	3/8" D	Oversize
6	Outer Flange	1" U	3/8" D	Oversize
7	Inner Flange	2" U	1 3/8" D	Oversize
8	Outer Flange	2" U	2 3/8" D	Oversize
9*	Inner Flange	No Filler Plate U (East)	No Filler Plate D (West)	Standard
10	Outer Flange	7/8" D (East)	1/4" U (West)	Standard
11**	Inner Flange	No Filler Plate U (East)	No Filler Plate D (West)	Standard
12	Outer Flange	5/8" U (West)	No Filler Plate D (East)	Standard
13	Inner Flange	1" U	3/8" D	Standard
14	Outer Flange	1" U	3/8" D	Standard
15	Inner Flange	2" U	1 3/8" D	Standard
16	Outer Flange	2" U	1 3/8" D	Standard
17	Inner Flange	2 x 5/16" U	No Filler Plate	Standard
18	Outer Flange	2 x 5/16" U	No Filler Plate	Standard
19	Inner Flange	4 x 1/4" U	3/8" D	Standard
20	Outer Flange	4 x 1/4" U	3/8" D	Standard
21	Inner Flange	1/4" + 3/4" U	3/8" D	Standard
22	Outer Flange	1/4" + 3/4" U	3/8" D	Standard
23	Inner Flange	1/4" + 1 3/4" U	1 3/8" D	Standard
24	Outer Flange	1/4" + 1 3/4" U	2 3/8" D	Standard
25	Inner Flange	7/8" D	1/4" U	Standard
26	Outer Flange	7/8" D	1/4" U	Standard
27	Inner Flange	5/8" U	No Filler Plate	Standard
28	Outer Flange	5/8" U	No Filler Plate	Standard
29	Inner Flange	7/8" D	1/4" U	Standard
30	Outer Flange	7/8" D	1/4" U	Standard
31	Inner Flange	5/8" U	No Filler Plate	Standard
32	Outer Flange	5/8" U	No Filler Plate	Standard

* = 1.125” flange connected to 1.125” flange.
** = 1.75” flange connected to 1.75” flange.
= Tests that have been completed

June 17, 2009

Progress Report
Professor Brahimi – "Hydrogen Embrittlement of Steel Fasteners"

HYDROGEN EMBRITTLEMENT OF STEEL FASTENERS

Advisory Committee Meeting – 6
Summary Report

DATE: **Friday, November 21, 2008**
LOCATION: **Boeing, St. Louis, MO**

PRESIDING: **Prof. Stephen Yue**
PROJECT MANAGER: **Salim Brahimi**

ATTENDANCE

Prof. Stephen Yue – McGill University
Salim Brahimi – IBECA Technologies / McGill University
Steve Gaydos – Boeing
Ed Babcock – Boeing
Louie Tran – Boeing
Joe Osborne – Boeing
James Jennings – US Navy
Baohong Cao – Ifastgroupe
Dr. Louis Raymond – LRA Research

Conference Call / Web Attendance

Joe Greenslade – IFI
Roger Hamilton – RCSC / Nucor Fasteners
Charles Wilson – Consultant
Sriraman Rajagopalan – McGill University

Absent

David McCrindle, CFI
Don Snyder, AESF
Prof. Jerzy Szpunar, McGill University

CALL TO ORDER

The meeting was called to order at 9:00 A.M.

INTRODUCTIONS

Salim Brahimi welcomed the attendees and thanked Steve Gaydos for his hospitality in hosting the meeting.

Charles Wilson, Roger Hamilton, Joe Greenslade and Sriraman Rajagopalan were in attendance by web/teleconference

Messages of regret were received from Messrs. McCrindle (CFI), Prof. Szpunar (McGill).

APPROVAL OF AGENDA AND MEETING MINUTES

The minutes from the March 27, 2008, web meeting were not distributed prior to the meeting.

STATUS REVIEW

Personnel

The project team members remain as follows:

Prof. Stephen Yue: Principle Investigator
Professor Jerzy Szpunar: Co-investigator
Salim Brahimi: Project Manager and PhD Student
Sriraman Rajagopalan: PhD Student

Overview – coating process qualification

- ***Phase 1*** – Qualification of a large number of industrial fastener plating/coating processes using ASTM F1940 methodology was completed in 2007. Following submission of the thesis in late 2007, Salim Brahimi was granted a Master degree in May 2008. Two papers based on this portion of the research were presented at the 2008 conference of metallurgists (COM 2008) in Winnipeg, Manitoba. One of the two papers will be published in the July 2009 edition of Canadian Metallurgical Quarterly (CMQ).

- ***Phase 2***:

    - Microstructural characterization of coatings – A first round characterization of three coatings, Electroplated Zn (acid chloride), Electroplated Zn-Ni (alkaline), and hot dip galvanized zinc has been completed. The characterization methods comprised:
        - Scanning electron microscopy (SEM) ➔ surface morphology and defect characterization
        - X-ray diffraction ➔ coating structure, phase and texture
        - Energy dispersive spectrometry (EDS) ➔ composition analysis
        - Electron backscattered diffractometry (EBSD) ➔ grain size and texture

    - Electrochemical permeation studies – an electrochemical permeation cell was constructed using a borrowed potentiostat. After overcoming methodological and technical obstacles, initial experiments were successfully conducted to measure the rate of hydrogen diffusion through Electroplated Zn, and Zn-Ni. This initial work confirmed the feasibility and scientific value of the test method for investigating the hydrogen permeability of coating systems. Based on this success two dedicated potentiostats were purchased to conduct the permeation studies of coating systems on a full time basis.

    - Thermal desorption spectrometry (TDS) – the TDS unit was successfully used to conduct a series of experiments on the three above mentioned coating systems. The results revealed important information regarding effects of up-quenching during the hot dip zinc process, trapped vs. mobile hydrogen, and the permeability of the Boeing Zn/Ni coating.

Overview – material sensitivity investigation

- Fast fracture (FF) testing and ISL testing in air and at -1.2V imposed potential has been completed for the following quench and tempered steels: 5140, 8640, 4042 , 10B38, at 35, 39, 44, and 53 HRC.
- Fast fracture testing and ISL testing in air has been completed for 4340 (Vac) at 35, 39, 44, and 53 HRC. ISL Testing at -1.2V will be completed by the end of 2008.

- The test methodology includes hardness measurement of all test specimens tested in fast fracture mode for the purpose of correlating hardness and fracture strength for all materials.
- Preliminary microstructural examination of the materials is being conducted concurrently with the ISL testing. This will be followed by material characterization.

Project Extension

This research project officially began in February 2006 and is funded for three years until the spring of 2009. With the leadership of Boeing and the renewed support of sponsors, the funding is being extended for an additional two years, until 2011 to accommodate an expanded scope of investigation.

DELIVERABLES AND NEXT MEETING

- The committee members will receive:
  - Meeting report
  - Copy of the presentation slides
  - July 2008 update report
  - Article manuscripts

- A workshop on the effects of coatings on the structural integrity of fasteners is being organized by committee F16.96 (Bolting Technology) on May 20, 2009 in Vancouver, Canada in conjunction with the ASTM May committee week. Salim Brahimi and Sriraman Rajagopalan will both present talks at this venue.

- The next meeting will be held at McGill University in Montreal, in late August or early September, 2009.

ADJOURNMENT: 1:00 P.M.

Respectfully submitted,

Salim Brahimi Eng.

Attachments

Request for Supplement from Brahimi – "Hydrogen Embrittlement of Steel Fasteners"

-------- Original Message --------
Subject: RE: Request for Supplement RCSC funds
Date: Tue, 9 Jun 2009 11:57:44 -0400
From: Salim Brahimi <salim.brahimi@ibeca.ca>
Reply-To: <salim.brahimi@ibeca.ca>
Organization: IBECA Technologies Corp.
To: 'James M. Ricles' <jmr5@lehigh.edu>
CC: 'Chad Larson' <CLarson@lejeunebolt.com>
References: <498C8A84.2090803@lehigh.edu>
<!&!AAAAAAAAAAAYAAAAAAAAAE33UNYNX7tOtloObIUFMxfCgAAAEAAAAO0LN+vR5kFGniskwqgTEyEBAAAAAA==@ibeca.ca>
<4A29597F.7010701@lehigh.edu>

Jim,

I plan to attend the RCSC meeting. However, my travel schedule has been in flux, which is why I haven't been able to finalize my travel arrangements, I will do so this week. I will be happy to make a presentation at the meeting. I may have one of the PhD students along for the presentation.

Please find attached a copy of the minutes from the last advisory committee meeting. Roger (RIP) was in attendance via conference call. It is still a reasonably accurate update.

Regarding the question of the final report, I simply want to make it clear that RCSC will receive a summary report once the project reaches the end. A couple of theses and scientific publications will naturally follow, and will be presented to RCSC. However, these should not be considered as deliverables to RCSC. Otherwise, the final payment will be held up unnecessarily.

Regards,

Salim Brahimi ing.
IBECA Technologies Corp. | 4 Parkside Place | Montreal, QC H3H 1A8 | Canada

Tel: +01.514.944.3358 | Fax: +01.514.935.8918 | Salim.Brahimi@ibeca.ca | www.ibeca.ca

-----Original Message-----
From: James M. Ricles [mailto:jmr5@Lehigh.EDU]
Sent: June 5, 2009 13:45
To: salim.brahimi@ibeca.ca
Subject: Re: Request for Supplement RCSC funds

Dear Salim:
I am preparing the letter for funding, and have a question. It concerns the final report. It is not clear in your second statement under payment plan concerns as to how the RCSC can determine whether the scope of work funded by the RCSC has been completed. Can you provide a brief outline

in which you can assign part of the scope of work that is to be covered by RCSC funds. This will make it a lot easier for the RCSC to say the work funded by the RCSC has been completed and issue final payment when the time comes (it will significantly expedite the final report review).

Thanks,
Jim

Salim Brahimi wrote:
>
> Dear Jim,
>
> Please find attached a copy of the scope and detail for the project
> extension. The document is essentially what we have submitted to NSERC
> and focuses on the "*_additional_*" elements of the investigation. It
> does not elaborate on work that is still underway as part of the
> original scope. I apologize for the delay in sending this. I needed to
> respond to administrative requirements by Boeing to secure their
> portion of the additional funds, which involved the inclusion of the
> tribocorrosion study. Please let me know if you have any questions.
>
> Regarding the Advisory Committee, we will continue to hold our semi
> annual meetings. I am in regular contact with Joe. I also plan to
> regularly attend the RCSC annual meetings where I can provide
> technical presentations and or updates as needed.
>
> As far as the payment plan is concerned:
>
> 1. Does RCSC require to be invoiced for each installment before paying
> CFI, or is this simply a requirement for the last installment?
>
> 2. Regarding the final report for payment of the last installment,
> what I would consider "final" in terms of deliverables are theses,
> publications, talks, etc. However, from an administrative point of
> view, a final report will be submitted that reflects progress up to
> the stopping point for the bulk of investigation. The final
> deliverables will naturally take a bit longer. I bring this up to
> ensure that CFI will be able to meet its payment commitments to McGill.
>
> Once again I would like to thank you and the RCSC executive for your
> support.
>
> Regards,
>
> Salim
>
> Salim Brahimi ing.
>
> IBECA Technologies Corp. | 4 Parkside Place | Montreal, QC H3H 1A8 |
> Canada
>
> Tel: +01.514.944.3358 | Fax: +01.514.935.8918 | Salim.Brahimi@ibeca.ca
> | www.ibeca.ca
>
> -----Original Message-----
> From: James M. Ricles [mailto:jmr5@Lehigh.EDU]
> Sent: February 6, 2009 14:08
> To: Salim Brahimi
> Cc: Carter, Charlie; Joe Greenslade
> Subject: Request for Supplement RCSC funds
>
> Dear Salim:
>
> The RCSC Executive Committee is favorably considering your request for

> $10,000 of supplemental funds to continue your project. We feel that you
> have made good progress and that the industry will greatly benefit from
> your research results.

> In order for the Executive Committee to authorize the funds I will need
> from you a brief proposal. The proposal should include the following:
>
> (1) title of the research; (2) objectives; (3 scope of work; (4)
> expected deliverables; (5) schedule. I also want to be sure that you
> have, and will continue to have a industry advisory panel (I believe
> that you do have a industry advisory panel, since Roger Hamilton had
> been sending me minutes of your meetings with the panel and progress on
> your research). With the unfortunately passing of Roger Hamilton, Joe
> Greenslade from the Executive Committee has volunteered to be the
> liaison member from the Exe. Committee for your project.

> For you information, we are thinking of a payment plan with three
> installments:
>
> - Provide $5000 of funds upon receipt and approval of a proposal that
> summarizes exactly what is to be done with the RCSC $10000 over the
> two years.
>
> - Jan 2010: upon receipt and approval of a progress report, fund
> additional $3500 (the RCSC should be invoiced when the progress report
> is submitted). Approval is based on whether satisfactory progress on
> the work as described in the proposal has been achieved.
>
> - 2010: upon receipt and approval of the final report, pay the final
> $1500 (the RCSC should be invoiced when the progress report is
> submitted). Approval is based on whether the work as described in the
> proposal has been completed.
>
> Please send this proposal to me as soon as possible. I have been given
> the authority by the Exe. Committee to act upon your request, and
> therefore the process will be significantly expedited.
>
> Sincerely,
>
> Jim Ricles
>
> --
>
> James M. Ricles, Ph.D. PE.
>
> Bruce G. Johnston Professor of Structural Engineering,
> Director - Lehigh RTMD NEES Equipment Site
> Deputy Director - ATLSS Engineering Research Center
> Lehigh University
> 117 ATLSS Drive, H Building
> Bethlehem, PA 18015-4729
> Tel: 610-758-6252
> Fax: 610-758-5902
> e-mail: jmr5@lehigh.edu
> web page: http://www3.lehigh.edu/engineering/cee/contacts/ricles.asp

HYDROGEN EMBRITTLEMENT OF STEEL FASTENERS

Advisory Committee Meeting – 6
Summary Report

DATE: **Friday, November 21, 2008**
LOCATION: **Boeing, St. Louis, MO**

PRESIDING: **Prof. Stephen Yue**
PROJECT MANAGER: **Salim Brahimi**

ATTENDANCE

Prof. Stephen Yue – McGill University
Salim Brahimi – IBECA Technologies / McGill University
Steve Gaydos – Boeing
Ed Babcock – Boeing
Louie Tran – Boeing
Joe Osborne – Boeing
James Jennings – US Navy
Baohong Cao – Ifastgroupe
Dr. Louis Raymond – LRA Research

Conference Call / Web Attendance

Joe Greenslade – IFI
Roger Hamilton – RCSC / Nucor Fasteners
Charles Wilson – Consultant
Sriraman Rajagopalan – McGill University

Absent

David McCrindle, CFI
Don Snyder, AESF
Prof. Jerzy Szpunar, McGill University

CALL TO ORDER

The meeting was called to order at 9:00 A.M.

INTRODUCTIONS

Salim Brahimi welcomed the attendees and thanked Steve Gaydos for his hospitality in hosting the meeting.

Charles Wilson, Roger Hamilton, Joe Greenslade and Sriraman Rajagopalan were in attendance by web/teleconference

Messages of regret were received from Messrs. McCrindle (CFI), Prof. Szpunar (McGill).

APPROVAL OF AGENDA AND MEETING MINUTES

The minutes from the March 27, 2008, web meeting were not distributed prior to the meeting.

STATUS REVIEW

Personnel

The project team members remain as follows:

Prof. Stephen Yue: Principle Investigator
Professor Jerzy Szpunar: Co-investigator
Salim Brahimi: Project Manager and PhD Student
Sriraman Rajagopalan: PhD Student

Overview – coating process qualification

- ***Phase 1*** – Qualification of a large number of industrial fastener plating/coating processes using ASTM F1940 methodology was completed in 2007. Following submission of the thesis in late 2007, Salim Brahimi was granted a Master degree in May 2008. Two papers based on this portion of the research were presented at the 2008 conference of metallurgists (COM 2008) in Winnipeg, Manitoba. One of the two papers will be published in the July 2009 edition of Canadian Metallurgical Quarterly (CMQ).

- ***Phase 2***:

    - Microstructural characterization of coatings – A first round characterization of three coatings, Electroplated Zn (acid chloride), Electroplated Zn-Ni (alkaline), and hot dip galvanized zinc has been completed. The characterization methods comprised:
        - Scanning electron microscopy (SEM) ➔ surface morphology and defect characterization
        - X-ray diffraction ➔ coating structure, phase and texture
        - Energy dispersive spectrometry (EDS) ➔ composition analysis
        - Electron backscattered diffractometry (EBSD) ➔ grain size and texture

    - Electrochemical permeation studies – an electrochemical permeation cell was constructed using a borrowed potentiostat. After overcoming methodological and technical obstacles, initial experiments were successfully conducted to measure the rate of hydrogen diffusion through Electroplated Zn, and Zn-Ni. This initial work confirmed the feasibility and scientific value of the test method for investigating the hydrogen permeability of coating systems. Based on this success two dedicated potentiostats were purchased to conduct the permeation studies of coating systems on a full time basis.

    - Thermal desorption spectrometry (TDS) – the TDS unit was successfully used to conduct a series of experiments on the three above mentioned coating systems. The results revealed important information regarding effects of up-quenching during the hot dip zinc process, trapped vs. mobile hydrogen, and the permeability of the Boeing Zn/Ni coating.

Overview – material sensitivity investigation

- Fast fracture (FF) testing and ISL testing in air and at -1.2V imposed potential has been completed for the following quench and tempered steels: 5140, 8640, 4042 , 10B38, at 35, 39, 44, and 53 HRC.
- Fast fracture testing and ISL testing in air has been completed for 4340 (Vac) at 35, 39, 44, and 53 HRC. ISL Testing at -1.2V will be completed by the end of 2008.

- The test methodology includes hardness measurement of all test specimens tested in fast fracture mode for the purpose of correlating hardness and fracture strength for all materials.
- Preliminary microstructural examination of the materials is being conducted concurrently with the ISL testing. This will be followed by material characterization.

Project Extension

This research project officially began in February 2006 and is funded for three years until the spring of 2009. With the leadership of Boeing and the renewed support of sponsors, the funding is being extended for an additional two years, until 2011 to accommodate an expanded scope of investigation.

DELIVERABLES AND NEXT MEETING

- The committee members will receive:
  - Meeting report
  - Copy of the presentation slides
  - July 2008 update report
  - Article manuscripts

- A workshop on the effects of coatings on the structural integrity of fasteners is being organized by committee F16.96 (Bolting Technology) on May 20, 2009 in Vancouver, Canada in conjunction with the ASTM May committee week. Salim Brahimi and Sriraman Rajagopalan will both present talks at this venue.

- The next meeting will be held at McGill University in Montreal, in late August or early September, 2009.

ADJOURNMENT: 1:00 P.M.

Respectfully submitted,

Salim Brahimi Eng.

Attachments

2007 RCSC Annual Meeting – Cleveland, OH

Installation Characteristics of Twist-off Type, Tension Control Structural Bolt-Nut-Washer Assemblies

V.V. Maleev
P.C. Birkemoe

2005 Presentation

- Research objectives
- Method of pretension evaluation for ASTM F1852 TC bolt
- Laboratory bolt stiffness calibration
- Pretension results from moisture, temperature and delayed installation tests
- Conclusions & recommendations

RESEARCH OBJECTIVES

ASTM F1852 TC Bolt – Installation Behaviour

- Extreme thread friction condition
- Exposure during tensioning delays
- Temperature
- Moisture
- Reinstallation

BOLT STIFFNESS CALIBRATION

Laboratory Calibration Setup

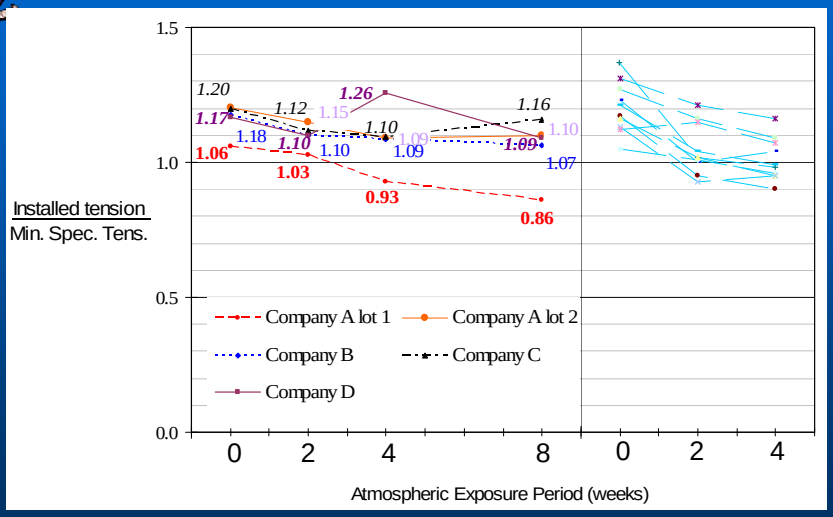
S-W CALIBRATOR / (VERIFICATION)

Typical Specimen (2005)

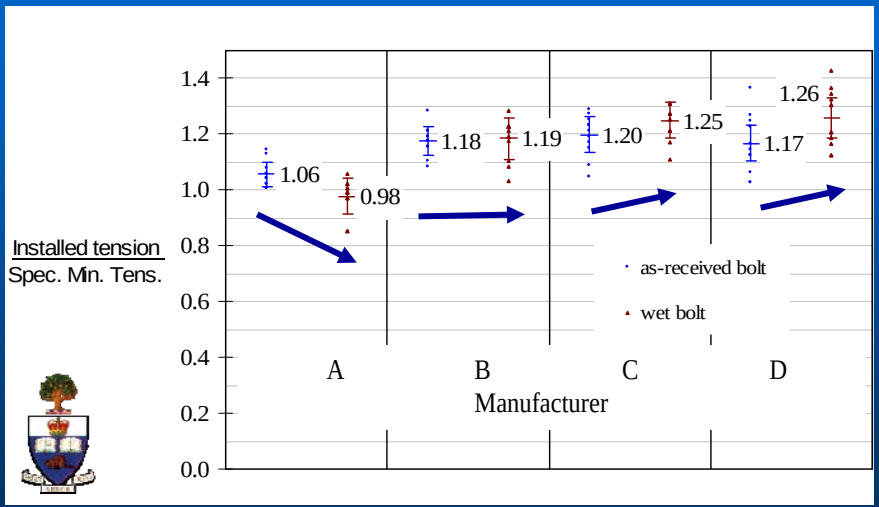
as-received sample

weathered sample on roof
Galbraith Building, Toronto

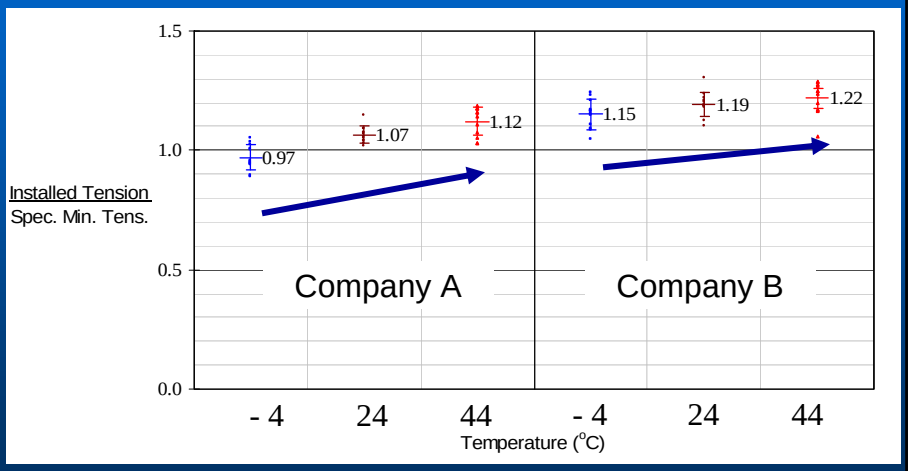
INSTALLATION DELAY EFFECT



WET EFFECT (soaked)

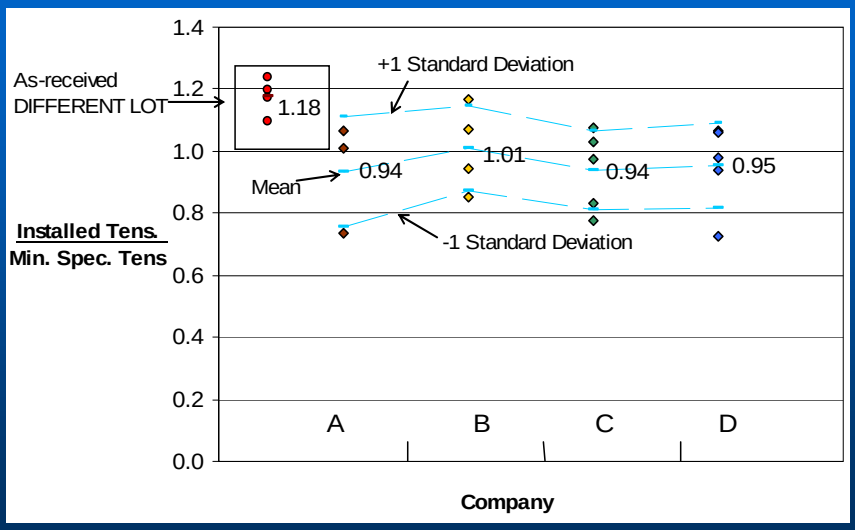


TEMPERATURE EFFECT (during installation)



Field Measurement (prep and release)

Field Results - One Site - 2005



Examination after removal

2006-07 RESEARCH OBJECTIVES

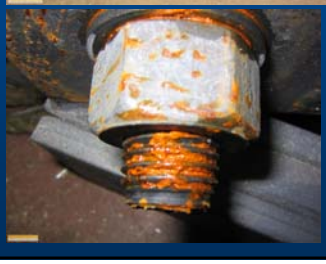
- Continued delayed installation testing
- Further investigation of the moisture effects
- Extreme cold temperature tests
- Further testing with the tension calibrator for verification of weathered assemblies

2006-07 TESTING PROGRAM

- Similar laboratory setup
- 7/8” x 3” bolts were tested from four manufacturers
- Environmental chamber was introduced at -20° C (-4° F) and used for cold tests
- Moist room introduced with 100% RH used for the wet installation tests

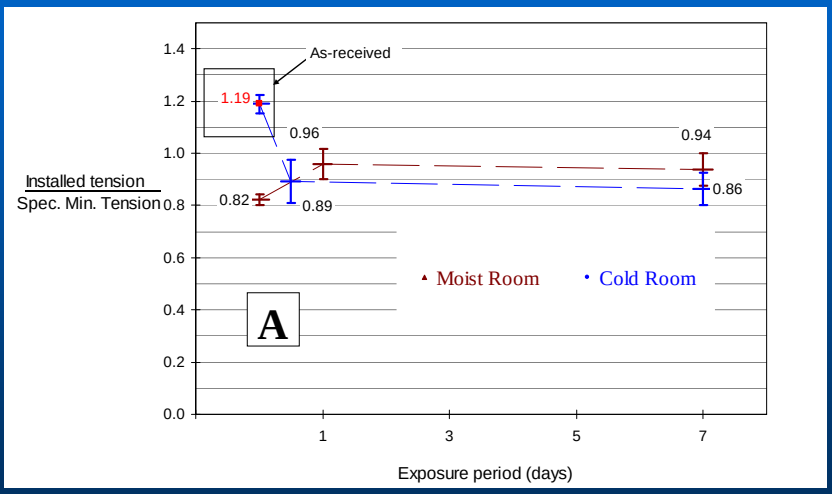
WET AND TEMPERATURE EFFECTS

Moist Room

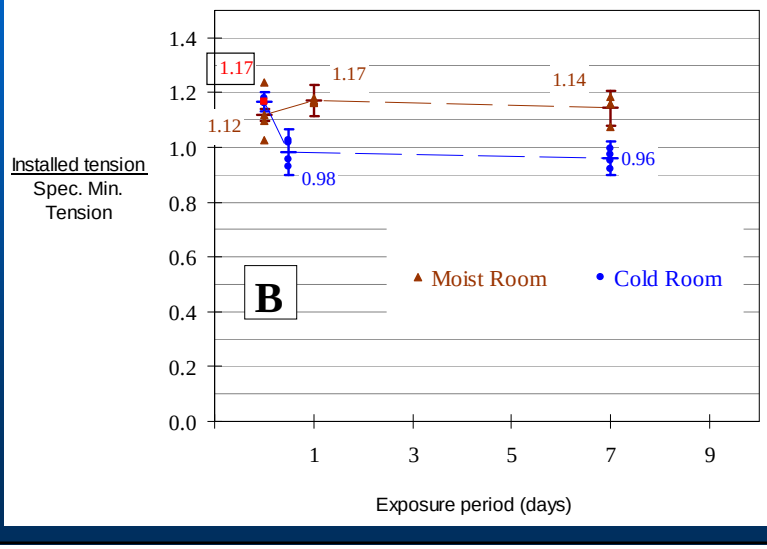


Cold Room

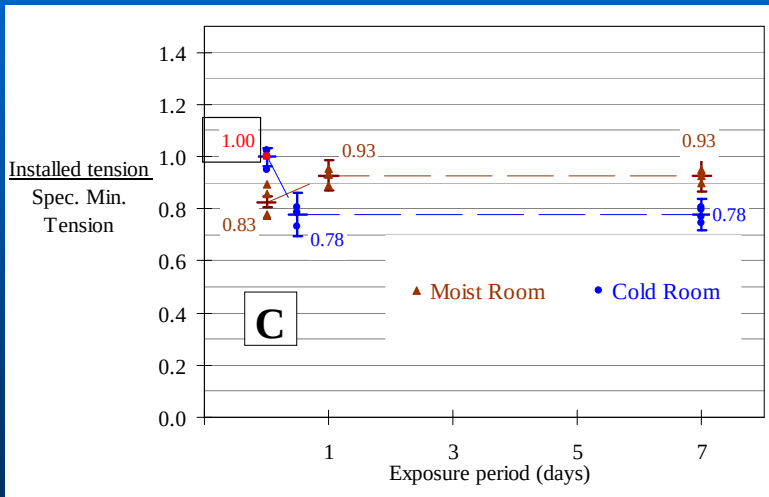
WET AND TEMPERATURE EFFECTS



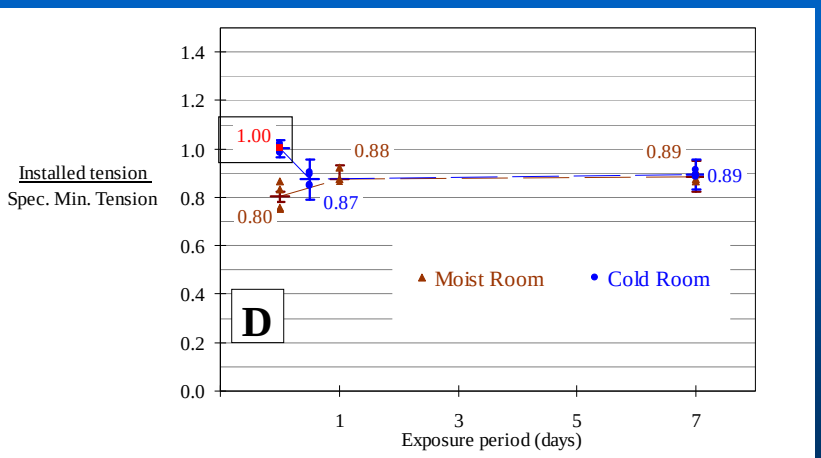
WET AND TEMPERATURE EFFECTS



WET AND TEMPERATURE EFFECTS



WET AND TEMPERATURE EFFECTS

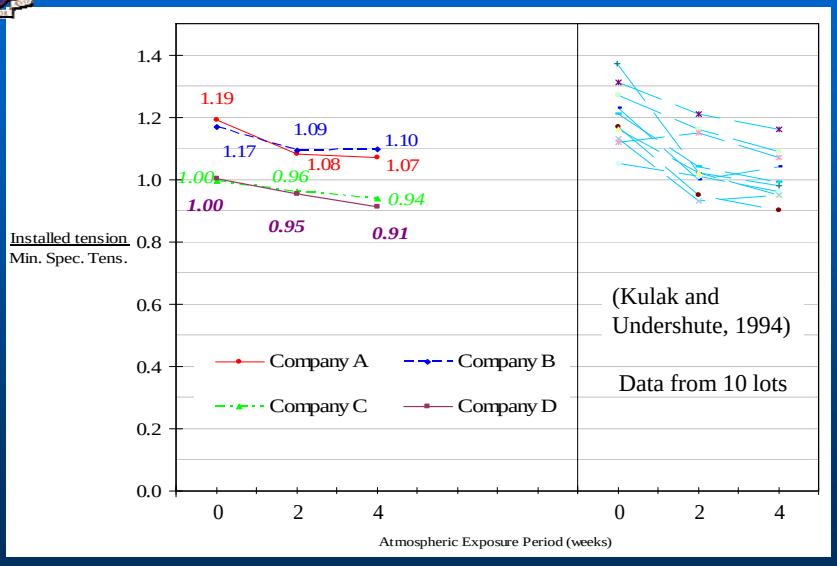


DELAYED INSTALLATION EFFECTS

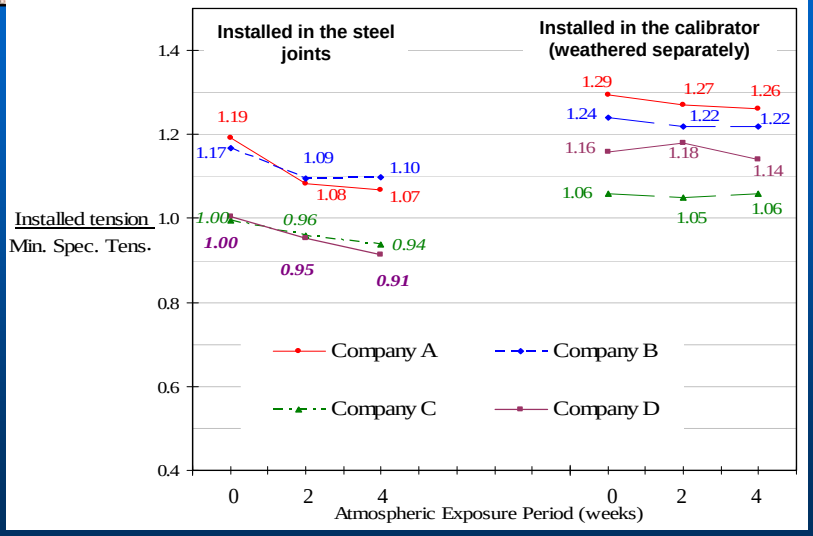
DELAYED INSTALLATION EFFECTS

Weathered Separately Weathered in the Steel Joints

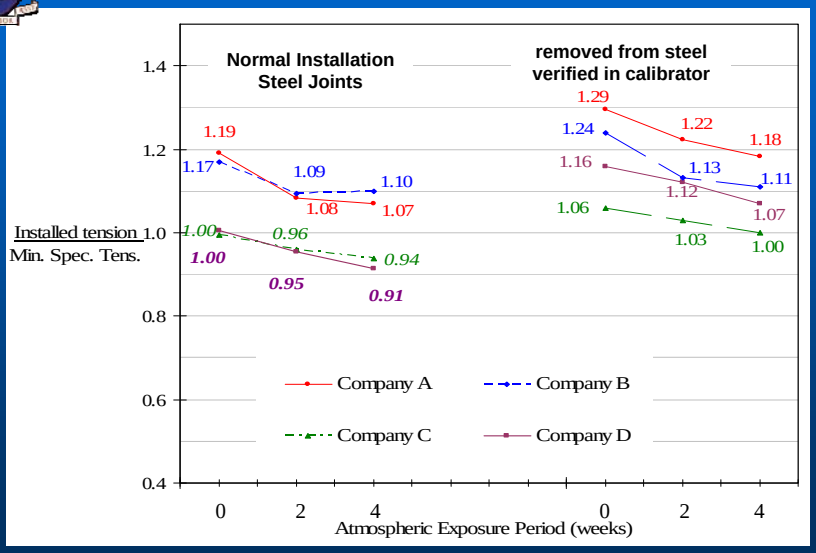
DELAYED INSTALLATION EFFECTS



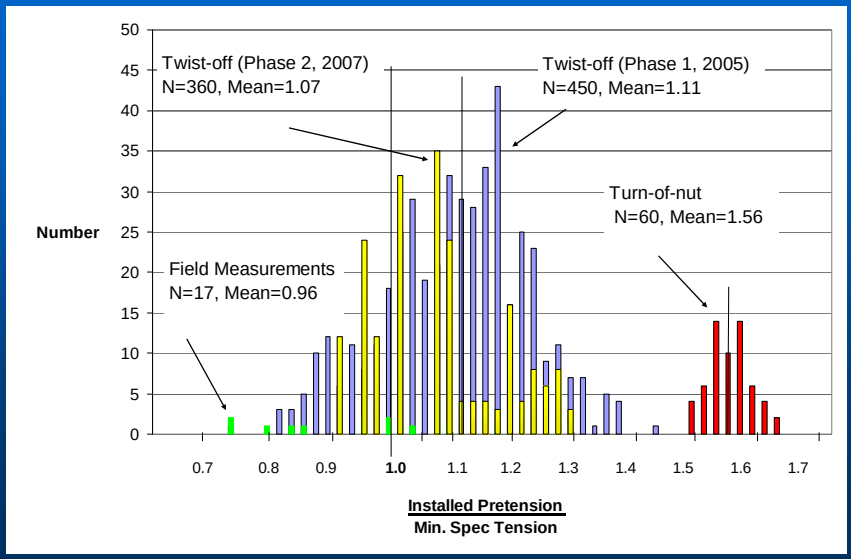
DELAYED INSTALLATION EFFECTS



DELAYED INSTALLATION EFFECTS



All TC BOLTS: Simulation vs Field vs Reinstall



Primary Results – Executive Summary - 1/2

- All bolt assemblies met specifications.
- The average pretension for as-received TC bolts in simulated joints = 1.09 x Min Req'd. Tens.
  1.15 for Phase 1
- The universally adverse parameter in a delayed installation exposure was SEVERE COLD. All assemblies installed at a temperature of -20° C failed to reach the Min. Spec. Tension.
- The presence of moisture at installation was the next most significant parameter affecting all bolts. Assemblies from three of the four manufacturers did not meet the min. spec. tension in the moisture tests performed.

Primary Results – Executive Summary – 2/2

- The quality or nature of the lubricant appears to be crucial to the installed tension. The visibly/tactilely greasy lubricant showed more deterioration during both the cold temperature and moisture tests.
- Assemblies weathered in the steel joints and tested in the calibrator consistently achieved lower pretensions than did the same assemblies weathered separately. The installations in steel joints showed a similar trend.
- Field test results showed similar levels of tension to those obtained in the laboratory simulations. Average pretensions corresponded very well to those obtained by the simulated delayed installation tests.

Observations

The Tension Calibrator ("…a hydraulic device that indicates the pretension that is developed in a bolt that is installed in it.") as applied in field situations appears to not perform adequately for PRE-INSTALLATION VERIFICATION when used in accordance with the current specification.

Assemblies experience higher rates of deterioration in steelwork when **assembled to snug tight.** In contrast, the visible corrosion of the parts exposed openly exceeded that of the assembled ones.

Assemblies installed in the calibrator achieve higher pretensions than those in the steelwork. This variation appears to be related to the stiffness of the device and friction conditions at the calibrator/washer interface.

RECOMMENDATIONS –a short list

- Revise the Specification to have bolts removed from the steelwork for verification.
- Revise the Specification for TC bolts to be required to reach 1.1? times the minimum required tension in the as-received condition and modify the current pre-installation verification requirements.
- Add cautionary notes in the commentary about the requirements for cold weather verification and installation.
- Include the “wet” condition as part of the verification requirements.

ACKNOWLEDGEMENTS

- Research Council on Structural Connections
- CISC Member Fabricators
- Natural Sciences and Engineering Research Council of Canada
- Department of Civil Engineering; University of Toronto
- RCSC Member Companies; Suppliers and Manufacturers