AGENDA

ACI Committee 440 – FRP Reinforcement
Subcommittee G – Student Education

ACI Spring 2016 Convention
Milwaukee, WI

Sunday, April 17, 2016
10:00 – 11:30 AM
Room: C-203 E

1. Call to order
2. Approval of minutes from Kansas City, MO meeting
3. Rules changes for Detroit (Spring 2017) Competition
4. Distribution of Reinforcement Kits (Fall 2016)
5. Industry (FRP-RMC) Support for Future Competitions
6. Other business
7. Adjourn

MINUTES

ACI Committee 440 – FRP Reinforcement
Subcommittee G – Student Education

ACI Spring 2015 Convention
Kansas City, MO

Monday, April 13, 2015
1:30 – 3:00 PM
Room: M-Basie A

Attendees: S Gross (presiding), F de Caso, V Brown, S Steere, W Gold, J Fischer, C McClaskey, C Shield, J Busel, D Hutchison, X Seynave, H Rasheed, T Bradberry, C Crawford, R Al-Hammoud, P Sadeghian

1. The meeting was called to order at 1:30 PM.

2. Minutes of the March 24, 2014 meeting in Reno were approved, with the addition of "ACMA" prior to FRP-RMC in Item 5.

3. The Kansas City competition was held on Sunday April 12, 2015. Dr. Gross thanked subcommittee members Vicki Brown, Sam Steere, Jon Fischer, Carol Shield, Francisco de Caso, and Didier Hutchison for their hard work on Sunday to make the competition very successful. A total of 41 teams competed, with 24 teams in the Type 1 category (Straight Prismatic Beams) and 17 in the Type 2 (Other) category. The winners are identified below:

   Structure Type 1 Category
   1) Universidad Central del Ecuador (UCEVG)
   2) Escuela Politecnica Nacional (EPNEC)
   3) The University of Texas at Austin (TEXAS)

   Structure Type 2 Category
   1) Universidad de Cuenca (UCUEN)
   2) Universidad San Francisco de Quito (USFQA)
   3) Universidad Central del Ecuador (UCEMF)

   Five of the 41 teams were disqualified. Two teams did not make it to the competition on time due to travel delays, but were able to have their beams tested just prior to the testing machine being disassembled. One team had a rebar chair positioned within the clear span, and two teams used impermissible materials (epoxy?) to connect reinforcement together. There was also some confusion over reinforcement provided by one supplier, with certain teams receiving larger sized bars than intended. A few teams did not fill out the mix and cost sheet properly, resulting in unnecessary added costs for their design. Despite this, most felt that the revised mix-and-cost sheet and preliminary review of submitted sheets prior to the competition worked well.

4. The committee discussed potential adjustments to the next competition, which is planned for Detroit in Spring 2017. There was agreement that it would be difficult to handle more than 50 teams in future competitions. Mr. Steere suggested that specimens be tested immediately and

failed completely so as to avoid delays related to examining specimens at the end of the competition. Dr. de Caso suggested that students should be required to submit a poster with their specimen and that this should be part of the competition score. Mr. Hutchison suggested using a real-time scoring aspect, though Dr. Gross noted that this would require additional people to do the scoring in a real-time manner and would also impact the announcement of results at the student luncheon on the following day.

The most significant discussion was related to overhauling the distribution of reinforcing kits. Dr. Gross proposed that reinforcement be sent to a single person that can assemble complete student kits for distribution, rather than have each individual supplier send out kits to each student team. This would greatly simplify the process and avoid the confusion that existed with students receiving kits late or with the wrong bars during this competition cycle. Dr. Gross volunteered to do this for the next competition since the 2016 Fall Convention is being held in Philadelphia, where kits will need to be distributed to international teams. Dr. Gross further proposed that suppliers pay a fee to offset the costs associated with assembling and mailing the kits. There was also discussion about having a different fee structure for suppliers that are members of the ACMA FRP-RMC than for those that are not, so as to recognize the continuing contributions made by the members of the council over the history of the competition.

There was also discussion that a few rules changes or clarifications need to be made, specifically related to the use of "permitted" materials as bonding agents to aid the anchorage of reinforcement, the use of metallic bar supports, and clarification on dimensional tolerances.

Despite extensive discussion, no final decisions were made on either rules or logistics, and the topics will be discussed again at the next subcommittee meeting in Milwaukee (Spring 2016).

5. No other business was discussed.

6. The meeting was adjourned at 2:58 PM.

Recorded by Shawn P. Gross

APPROVED MINUTES

ACI Committee 440 – FRP Reinforcement
Subcommittee G – Student Education

ACI Spring 2014 Convention
Reno, NV

Monday, March 24, 2014
8:30 – 10:00 AM
Room: N-10

Attendees: S Gross (presiding), V Brown, C Steere, W Gold, J Fischer, C McClasky, J Tatar, Y Yomamoto, B Adkins, P Poudel, C Shield, J Busel, H Braverman, D Hutchison, X Seynave, R Gibson, T Hershberger

1. The meeting was called to order at 8:40 AM.
2. Minutes of the April 15, 2013 meeting in Minneapolis were approved as distributed.
3. Past competitions were discussed, and it was agreed that over several competitions, arches have dominated in the load-to-cost category while the beams have done better in the predictions category. An increase in penalties for non-rectangular and non-prismatic beams as previously proposed (Minneapolis) was discussed. Other ideas for keeping the competition creative were also discussed, including the addition of external reinforcement. At the conclusion of the discussion, it was agreed to rearrange the two categories (ACI provides awards for two categories) into "beam" and "arch" and present the awards in each category based on a combination of load/cost ratio and prediction accuracy. This will hopefully encourage students to try and be both structurally efficient and accurate in their predictions. External reinforcement may be considered for future competitions.
4. Preparation for Kansas City (Spring 2015) Competition (Sunday April 12, 2015) was discussed. It was agreed that proposed rules changes (based on Item 3 above) would be balloted by 440G this summer before the fall convention in Washington DC, so that rules could be forwarded to S801 for discussion at the fall convention. After the fall convention, Dr. Gross will work with S801 and the ACI Student Liaison to establish official dates for the competition. It was also agreed that kits would be distributed to international teams at the fall convention, as has been done in the past. Dr. Gross asked that any manufacturer interested in participating please contact him by the end of the summer to be part of the competition. He will then work with those suppliers on the logistics of getting reinforcement to international students in Washington. It was agreed that each manufacturer would provide 3 #3 bars instead of 2 #4 bars as has been done in the past.
5. Mr. Busel announced that the ACMA FRP-Rebar Manufacturers Council (FRP-RMC) is donating $500 toward the competition for supplies to be used on the day of the competition. Their support is of the competition is greatly appreciated and the competition would not be possible without their support.
6. The meeting was adjourned at 9:56 AM.

Recorded by Shawn P. Gross

ACI FRP Composites Competition
Kansas City, MO (Sunday, April 12, 2015)
Structure Type 1 - OVERALL RESULTS

			R_1	R_2	R_3						
ID	Type	University	Cost-to-Load Ratio	Maximum Load Prediction Ratio	3.5 mm Deflection Prediction Ratio	Check Here if Disqualified	R_1 Rank	R_2 Rank	R_3 Rank	Ranking Points	Overall Rank
			$ per kN	%	%						
UCEVG	1	Universidad Central del Ecuador	0.242	32.6%	2.4%	OK	1	5	2	2.25	1
EPNEC	1	ESCUELA POLITÉCNICA NACIONAL	0.268	0.2%	43.6%	OK	2	1	10	3.75	2
TEXAS	1	The University of Texas at Austin	0.277	3.4%	42.2%	OK	3	3	9	4.50	3
NCSUR	1	North Carolina State University	0.419	0.8%	40.9%	OK	9	2	8	7.00	4
MAGIC	1	The University of Texas at Austin	0.324	114.2%	34.2%	OK	4	14	7	7.25	5
VALPO	1	Valparaiso University	0.422	47.0%	14.7%	OK	10	6	4	7.50	6
UMNDL	1	University of Minnesota Duluth	0.345	93.0%	109.0%	OK	5	13	15	9.50	7
UIUCh	1	University of Illinois at Urbana-Champaign	0.410	79.0%	76.4%	OK	8	10	12	9.50	8
UANLB	1	UNIVERSIDAD AUTONOMA DE NUEVO LEON	0.504	59.2%	5.0%	OK	13	9	3	9.50	9
PSUTB	1	Pittsburg State University	0.783	4.6%	32.0%	OK	15	4	6	10.00	10
UNAMA	1	UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO	0.381	133.6%	393.3%	OK	6	15	18	11.25	11
HAWGS	1	University of Arkansas	0.452	50.7%	152.6%	OK	11	7	16	11.25	12
NCSUW	1	North Carolina State University	0.501	90.5%	45.9%	OK	12	11	11	11.50	13
UMKCI	1	University of Missouri- Kansas City	0.393	321.4%	382.3%	OK	7	18	17	12.25	14
CSJSU	1	SAN JOSE STATE UNIVERSITY	0.824	260.3%	0.8%	OK	17	17	1	13.00	15
NINER	1	University of North Carolina at Charlotte	0.800	190.1%	14.8%	OK	16	16	5	13.25	16
AUACI	1	Auburn University	1.295	56.1%	89.1%	OK	19	8	13	14.75	17
NJITA	1	New Jersey Institute of Technology	2.355	92.6%	106.4%	OK	20	12	14	16.50	18
SIUEB	1	Southern Illinois University - Edwardsville	0.546	751.5%	1123.3%	OK	14	20	20	17.00	19
SIUEA	1	Southern Illinois University - Edwardsville	1.180	411.2%	794.5%	OK	18	19	19	18.50	20
BCITA	1	British Columbia Institute of Technology	0.397	106.3%	24.9%	DQ					
BCITB	1	British Columbia Institute of Technology	0.588	85.8%	74.6%	DQ					
DEVIL	1	Arizona State University	0.512	50.1%	148.9%	DQ					
FESAA	1	FES ARAGÓN UNAM	1.064	1582.8%	1841.0%	DQ					

Note: Only one team per university is eligible for a Top 3 Award.

ACI FRP Composites Competition
Kansas City, MO (Sunday, April 12, 2015)
Structure Type 1 - COST-TO-LOAD RATIO RESULTS

			R_1	R_2	R_3						
ID	Type	University	Cost-to-Load Ratio	Maximum Load Prediction Ratio	3.5 mm Deflection Prediction Ratio	Check Here if Disqualified	R_1 Rank	R_2 Rank	R_3 Rank	Ranking Points	Overall Rank
			$ per kN	%	%						
UCEVG	1	Universidad Central del Ecuador	0.242	32.6%	2.4%	OK	1	5	2	2.25	1
EPNEC	1	ESCUELA POLITÉCNICA NACIONAL	0.268	0.2%	43.6%	OK	2	1	10	3.75	2
TEXAS	1	The University of Texas at Austin	0.277	3.4%	42.2%	OK	3	3	9	4.50	3
MAGIC	1	The University of Texas at Austin	0.324	114.2%	34.2%	OK	4	14	7	7.25	5
UMNDL	1	University of Minnesota Duluth	0.345	93.0%	109.0%	OK	5	13	15	9.50	7
UNAMA	1	UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO	0.381	133.6%	393.3%	OK	6	15	18	11.25	11
UMKCI	1	University of Missouri- Kansas City	0.393	321.4%	382.3%	OK	7	18	17	12.25	14
UIUCh	1	University of Illinois at Urbana-Champaign	0.410	79.0%	76.4%	OK	8	10	12	9.50	8
NCSUR	1	North Carolina State University	0.419	0.8%	40.9%	OK	9	2	8	7.00	4
VALPO	1	Valparaiso University	0.422	47.0%	14.7%	OK	10	6	4	7.50	6
HAWGS	1	University of Arkansas	0.452	50.7%	152.6%	OK	11	7	16	11.25	12
NCSUW	1	North Carolina State University	0.501	90.5%	45.9%	OK	12	11	11	11.50	13
UANLB	1	UNIVERSIDAD AUTONOMA DE NUEVO LEON	0.504	59.2%	5.0%	OK	13	9	3	9.50	9
SIUEB	1	Southern Illinois University - Edwardsville	0.546	751.5%	1123.3%	OK	14	20	20	17.00	19
PSUTB	1	Pittsburg State University	0.783	4.6%	32.0%	OK	15	4	6	10.00	10
NINER	1	University of North Carolina at Charlotte	0.800	190.1%	14.8%	OK	16	16	5	13.25	16
CSJSU	1	SAN JOSE STATE UNIVERSITY	0.824	260.3%	0.8%	OK	17	17	1	13.00	15
SIUEA	1	Southern Illinois University - Edwardsville	1.180	411.2%	794.5%	OK	18	19	19	18.50	20
AUACI	1	Auburn University	1.295	56.1%	89.1%	OK	19	8	13	14.75	17
NJITA	1	New Jersey Institute of Technology	2.355	92.6%	106.4%	OK	20	12	14	16.50	18
BCITA	1	British Columbia Institute of Technology	0.397	106.3%	24.9%	DQ					
BCITB	1	British Columbia Institute of Technology	0.588	85.8%	74.6%	DQ					
DEVIL	1	Arizona State University	0.512	50.1%	148.9%	DQ					
FESAA	1	FES ARAGÓN UNAM	1.064	1582.8%	1841.0%	DQ					

ACI FRP Composites Competition
Kansas City, MO (Sunday, April 12, 2015)
Structure Type 1 - MAXIMUM LOAD PREDICTION RATIO RESULTS

			R_1	R_2	R_3						
ID	Type	University	Cost-to-Load Ratio	Maximum Load Prediction Ratio	3.5 mm Deflection Prediction Ratio	Check Here if Disqualified	R_1 Rank	R_2 Rank	R_3 Rank	Ranking Points	Overall Rank
			$ per kN	%	%						
EPNEC	1	ESCUELA POLITÉCNICA NACIONAL	0.268	0.2%	43.6%	OK	2	1	10	3.75	2
NCSUR	1	North Carolina State University	0.419	0.8%	40.9%	OK	9	2	8	7.00	4
TEXAS	1	The University of Texas at Austin	0.277	3.4%	42.2%	OK	3	3	9	4.50	3
PSUTB	1	Pittsburg State University	0.783	4.6%	32.0%	OK	15	4	6	10.00	10
UCEVG	1	Universidad Central del Ecuador	0.242	32.6%	2.4%	OK	1	5	2	2.25	1
VALPO	1	Valparaiso University	0.422	47.0%	14.7%	OK	10	6	4	7.50	6
HAWGS	1	University of Arkansas	0.452	50.7%	152.6%	OK	11	7	16	11.25	12
AUACI	1	Auburn University	1.295	56.1%	89.1%	OK	19	8	13	14.75	17
UANLB	1	UNIVERSIDAD AUTONOMA DE NUEVO LEON	0.504	59.2%	5.0%	OK	13	9	3	9.50	9
UIUCh	1	University of Illinois at Urbana-Champaign	0.410	79.0%	76.4%	OK	8	10	12	9.50	8
NCSUW	1	North Carolina State University	0.501	90.5%	45.9%	OK	12	11	11	11.50	13
NJITA	1	New Jersey Institute of Technology	2.355	92.6%	106.4%	OK	20	12	14	16.50	18
UMNDL	1	University of Minnesota Duluth	0.345	93.0%	109.0%	OK	5	13	15	9.50	7
MAGIC	1	The University of Texas at Austin	0.324	114.2%	34.2%	OK	4	14	7	7.25	5
UNAMA	1	UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO	0.381	133.6%	393.3%	OK	6	15	18	11.25	11
NINER	1	University of North Carolina at Charlotte	0.800	190.1%	14.8%	OK	16	16	5	13.25	16
CSJSU	1	SAN JOSE STATE UNIVERSITY	0.824	260.3%	0.8%	OK	17	17	1	13.00	15
UMKCI	1	University of Missouri- Kansas City	0.393	321.4%	382.3%	OK	7	18	17	12.25	14
SIUEA	1	Southern Illinois University - Edwardsville	1.180	411.2%	794.5%	OK	18	19	19	18.50	20
SIUEB	1	Southern Illinois University - Edwardsville	0.546	751.5%	1123.3%	OK	14	20	20	17.00	19
BCITA	1	British Columbia Institute of Technology	0.397	106.3%	24.9%	DQ					
BCITB	1	British Columbia Institute of Technology	0.588	85.8%	74.6%	DQ					
DEVIL	1	Arizona State University	0.512	50.1%	148.9%	DQ					
FESAA	1	FES ARAGÓN UNAM	1.064	1582.8%	1841.0%	DQ					

ACI FRP Composites Competition
Kansas City, MO (Sunday, April 12, 2015)
Structure Type 1 - 3.5mm DEFLECTION PREDICTION RATIO RESULTS

			R_1	R_2	R_3						
ID	Type	University	Cost-to-Load Ratio	Maximum Load Prediction Ratio	3.5 mm Deflection Prediction Ratio	Check Here if Disqualified	R_1 Rank	R_2 Rank	R_3 Rank	Ranking Points	Overall Rank
			$ per kN	%	%						
CSJSU	1	SAN JOSE STATE UNIVERSITY	0.824	260.3%	0.8%	OK	17	17	1	13.00	15
UCEVG	1	Universidad Central del Ecuador	0.242	32.6%	2.4%	OK	1	5	2	2.25	1
UANLB	1	UNIVERSIDAD AUTONOMA DE NUEVO LEON	0.504	59.2%	5.0%	OK	13	9	3	9.50	9
VALPO	1	Valparaiso University	0.422	47.0%	14.7%	OK	10	6	4	7.50	6
NINER	1	University of North Carolina at Charlotte	0.800	190.1%	14.8%	OK	16	16	5	13.25	16
PSUTB	1	Pittsburg State University	0.783	4.6%	32.0%	OK	15	4	6	10.00	10
MAGIC	1	The University of Texas at Austin	0.324	114.2%	34.2%	OK	4	14	7	7.25	5
NCSUR	1	North Carolina State University	0.419	0.8%	40.9%	OK	9	2	8	7.00	4
TEXAS	1	The University of Texas at Austin	0.277	3.4%	42.2%	OK	3	3	9	4.50	3
EPNEC	1	ESCUELA POLITÉCNICA NACIONAL	0.268	0.2%	43.6%	OK	2	1	10	3.75	2
NCSUW	1	North Carolina State University	0.501	90.5%	45.9%	OK	12	11	11	11.50	13
UIUCh	1	University of Illinois at Urbana-Champaign	0.410	79.0%	76.4%	OK	8	10	12	9.50	8
AUACI	1	Auburn University	1.295	56.1%	89.1%	OK	19	8	13	14.75	17
NJITA	1	New Jersey Institute of Technology	2.355	92.6%	106.4%	OK	20	12	14	16.50	18
UMNDL	1	University of Minnesota Duluth	0.345	93.0%	109.0%	OK	5	13	15	9.50	7
HAWGS	1	University of Arkansas	0.452	50.7%	152.6%	OK	11	7	16	11.25	12
UMKCI	1	University of Missouri- Kansas City	0.393	321.4%	382.3%	OK	7	18	17	12.25	14
UNAMA	1	UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO	0.381	133.6%	393.3%	OK	6	15	18	11.25	11
SIUEA	1	Southern Illinois University - Edwardsville	1.180	411.2%	794.5%	OK	18	19	19	18.50	20
SIUEB	1	Southern Illinois University - Edwardsville	0.546	751.5%	1123.3%	OK	14	20	20	17.00	19
BCITA	1	British Columbia Institute of Technology	0.397	106.3%	24.9%	DQ					
BCITB	1	British Columbia Institute of Technology	0.588	85.8%	74.6%	DQ					
DEVIL	1	Arizona State University	0.512	50.1%	148.9%	DQ					
FESAA	1	FES ARAGÓN UNAM	1.064	1582.8%	1841.0%	DQ					

ACI FRP Composites Competition
Kansas City, MO (Sunday, April 12, 2015)
Structure Type 2 - OVERALL RESULTS

			R_1	R_2	R_3						
ID	Type	University	Cost-to-Load Ratio	Maximum Load Prediction Ratio	3.5 mm Deflection Prediction Ratio	Check Here if Disqualified	R_1 Rank	R_2 Rank	R_3 Rank	Ranking Points	Overall Rank
			$ per kN	%	%						
UCUEN	2	Universidad de Cuenca	0.085	12.8%	91.4%	OK	1	3	10	3.75	1
UCUEC	2	UNIVERSIDAD DE CUENCA	0.090	24.3%	26.8%	OK	3	5	4	3.75	2
USFQA	2	Universidad San Francisco de Quito	0.094	11.3%	52.6%	OK	4	2	8	4.50	3
UCEMF	2	Universidad Central del Ecuador	0.086	65.7%	112.3%	OK	2	9	12	6.25	4
USFQB	2	Universidad San Francisco de Quito	0.116	16.3%	104.5%	OK	5	4	11	6.25	5
SherB	2	Université de Sherbrooke	0.118	42.7%	27.8%	OK	6	8	5	6.25	6
EPNIC	2	ESCUELA POLITÉCNICA NACIONAL	0.128	28.8%	33.5%	OK	7	6	7	6.75	7
MSTAA	2	Missouri University of Science and Technology	0.183	38.6%	14.4%	OK	10	7	2	7.25	8
MSTBB	2	Missouri University of Science and Technology	0.271	6.5%	31.3%	OK	11	1	6	7.25	9
UANLA	2	UNIVERSIDAD AUTÓNOMA DE NUEVO LEÓN	0.305	66.3%	3.6%	OK	12	10	1	8.75	10
SherA	2	University of Sherbrooke	0.153	81.6%	145.7%	OK	9	12	13	10.75	11
UMNDU	2	University of Minnesota Duluth	0.135	262.8%	1197.1%	OK	8	14	16	11.50	12
ULMMR	2	University of Louisiana at Lafayette	0.686	67.7%	19.8%	OK	16	11	3	11.50	13
ZSTCQ	2	University of Windsor	0.356	154.9%	161.5%	OK	13	13	14	13.25	14
ZNMLE	2	University of Windsor	0.663	469.8%	90.4%	OK	15	16	9	13.75	15
UNAMB	2	UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO	0.551	391.8%	549.9%	OK	14	15	15	14.50	16
FESAB	2	FES ARAGÓN UNAM	0.833	1016.7%	770.4%	DQ					

Note: Only one team per university is eligible for a Top 3 Award.

ACI FRP Composites Competition
Kansas City, MO (Sunday, April 12, 2015)
Structure Type 2 - COST-TO-LOAD RATIO RESULTS

			R_1	R_2	R_3						
ID	Type	University	Cost-to-Load Ratio	Maximum Load Prediction Ratio	3.5 mm Deflection Prediction Ratio	Check Here if Disqualified	R_1 Rank	R_2 Rank	R_3 Rank	Ranking Points	Overall Rank
			$ per kN	%	%						
UCUEN	2	Universidad de Cuenca	0.085	12.8%	91.4%	OK	1	3	10	3.75	1
UCEMF	2	Universidad Central del Ecuador	0.086	65.7%	112.3%	OK	2	9	12	6.25	4
UCUEC	2	UNIVERSIDAD DE CUENCA	0.090	24.3%	26.8%	OK	3	5	4	3.75	2
USFQA	2	Universidad San Francisco de Quito	0.094	11.3%	52.6%	OK	4	2	8	4.50	3
USFQB	2	Universidad San Francisco de Quito	0.116	16.3%	104.5%	OK	5	4	11	6.25	5
SherB	2	Université de Sherbrooke	0.118	42.7%	27.8%	OK	6	8	5	6.25	6
EPNIC	2	ESCUELA POLITÉCNICA NACIONAL	0.128	28.8%	33.5%	OK	7	6	7	6.75	7
UMNDU	2	University of Minnesota Duluth	0.135	262.8%	1197.1%	OK	8	14	16	11.50	12
SherA	2	University of Sherbrooke	0.153	81.6%	145.7%	OK	9	12	13	10.75	11
MSTAA	2	Missouri University of Science and Technology	0.183	38.6%	14.4%	OK	10	7	2	7.25	8
MSTBB	2	Missouri University of Science and Technology	0.271	6.5%	31.3%	OK	11	1	6	7.25	9
UANLA	2	UNIVERSIDAD AUTÓNOMA DE NUEVO LEÓN	0.305	66.3%	3.6%	OK	12	10	1	8.75	10
ZSTCQ	2	University of Windsor	0.356	154.9%	161.5%	OK	13	13	14	13.25	14
UNAMB	2	UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO	0.551	391.8%	549.9%	OK	14	15	15	14.50	16
ZNMLE	2	University of Windsor	0.663	469.8%	90.4%	OK	15	16	9	13.75	15
ULMMR	2	University of Louisiana at Lafayette	0.686	67.7%	19.8%	OK	16	11	3	11.50	13
FESAB	2	FES ARAGÓN UNAM	0.833	1016.7%	770.4%	DQ					

ACI FRP Composites Competition
Kansas City, MO (Sunday, April 12, 2015)
Structure Type 2 - MAXIMUM LOAD PREDICTION RATIO RESULTS

			R_1	R_2	R_3						
ID	Type	University	Cost-to-Load Ratio	Maximum Load Prediction Ratio	3.5 mm Deflection Prediction Ratio	Check Here if Disqualified	R_1 Rank	R_2 Rank	R_3 Rank	Ranking Points	Overall Rank
			$ per kN	%	%						
MSTBB	2	Missouri University of Science and Technology	0.271	6.5%	31.3%	OK	11	1	6	7.25	9
USFQA	2	Universidad San Francisco de Quito	0.094	11.3%	52.6%	OK	4	2	8	4.50	3
UCUEN	2	Universidad de Cuenca	0.085	12.8%	91.4%	OK	1	3	10	3.75	1
USFQB	2	Universidad San Francisco de Quito	0.116	16.3%	104.5%	OK	5	4	11	6.25	5
UCUEC	2	UNIVERSIDAD DE CUENCA	0.090	24.3%	26.8%	OK	3	5	4	3.75	2
EPNIC	2	ESCUELA POLITÉCNICA NACIONAL	0.128	28.8%	33.5%	OK	7	6	7	6.75	7
MSTAA	2	Missouri University of Science and Technology	0.183	38.6%	14.4%	OK	10	7	2	7.25	8
SherB	2	Université de Sherbrooke	0.118	42.7%	27.8%	OK	6	8	5	6.25	6
UCEMF	2	Universidad Central del Ecuador	0.086	65.7%	112.3%	OK	2	9	12	6.25	4
UANLA	2	UNIVERSIDAD AUTÓNOMA DE NUEVO LEÓN	0.305	66.3%	3.6%	OK	12	10	1	8.75	10
ULMMR	2	University of Louisiana at Lafayette	0.686	67.7%	19.8%	OK	16	11	3	11.50	13
SherA	2	University of Sherbrooke	0.153	81.6%	145.7%	OK	9	12	13	10.75	11
ZSTCQ	2	University of Windsor	0.356	154.9%	161.5%	OK	13	13	14	13.25	14
UMNDU	2	University of Minnesota Duluth	0.135	262.8%	1197.1%	OK	8	14	16	11.50	12
UNAMB	2	UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO	0.551	391.8%	549.9%	OK	14	15	15	14.50	16
ZNMLE	2	University of Windsor	0.663	469.8%	90.4%	OK	15	16	9	13.75	15
FESAB	2	FES ARAGÓN UNAM	0.833	1016.7%	770.4%	DQ					

ACI FRP Composites Competition
Kansas City, MO (Sunday, April 12, 2015)
Structure Type 2 - 3.5mm DEFLECTION PREDICTION RATIO RESULTS

			R_1	R_2	R_3						
ID	Type	University	Cost-to-Load Ratio	Maximum Load Prediction Ratio	3.5 mm Deflection Prediction Ratio	Check Here if Disqualified	R_1 Rank	R_2 Rank	R_3 Rank	Ranking Points	Overall Rank
			$ per kN	%	%						
UANLA	2	UNIVERSIDAD AUTÓNOMA DE NUEVO LEÓN	0.305	66.3%	3.6%	OK	12	10	1	8.75	10
MSTAA	2	Missouri University of Science and Technology	0.183	38.6%	14.4%	OK	10	7	2	7.25	8
ULMMR	2	University of Louisiana at Lafayette	0.686	67.7%	19.8%	OK	16	11	3	11.50	13
UCUEC	2	UNIVERSIDAD DE CUENCA	0.090	24.3%	26.8%	OK	3	5	4	3.75	2
SherB	2	Université de Sherbrooke	0.118	42.7%	27.8%	OK	6	8	5	6.25	6
MSTBB	2	Missouri University of Science and Technology	0.271	6.5%	31.3%	OK	11	1	6	7.25	9
EPNIC	2	ESCUELA POLITÉCNICA NACIONAL	0.128	28.8%	33.5%	OK	7	6	7	6.75	7
USFQA	2	Universidad San Francisco de Quito	0.094	11.3%	52.6%	OK	4	2	8	4.50	3
ZNMLE	2	University of Windsor	0.663	469.8%	90.4%	OK	15	16	9	13.75	15
UCUEN	2	Universidad de Cuenca	0.085	12.8%	91.4%	OK	1	3	10	3.75	1
USFQB	2	Universidad San Francisco de Quito	0.116	16.3%	104.5%	OK	5	4	11	6.25	5
UCEMF	2	Universidad Central del Ecuador	0.086	65.7%	112.3%	OK	2	9	12	6.25	4
SherA	2	University of Sherbrooke	0.153	81.6%	145.7%	OK	9	12	13	10.75	11
ZSTCQ	2	University of Windsor	0.356	154.9%	161.5%	OK	13	13	14	13.25	14
UNAMB	2	UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO	0.551	391.8%	549.9%	OK	14	15	15	14.50	16
UMNDU	2	University of Minnesota Duluth	0.135	262.8%	1197.1%	OK	8	14	16	11.50	12
FESAB	2	FES ARAGÓN UNAM	0.833	1016.7%	770.4%	DQ					

ACI FRP Composites Competition - Registration is closed

Objectives

These are the challenges in this competition:

- Design, construct, and test a concrete structure reinforced with fiber-reinforced polymer (FRP) reinforcement to achieve the lowest cost-load ratio. Cost is defined as the calculated batch cost for concrete materials and chemical admixtures plus the cost of the FRP used to reinforce the structure; adjusted for forming costs for more complicated geometries and reduced by credits given for implementation of sustainable design concepts.
- Predict the ultimate load.
- Predict the load that will result in a piston deflection of 3.5 mm (0.14 in.).
- **Registration opens January 1, 2015**. Comply with the contest rules. The completed **Advance Registration Form is due March 8, 2015.** The Official Mix and Cost Form, and a diagram showing placement and dimensions of all FRP reinforcing materials must be received by March 29, 2015 11:59 p.m.

Prizes

Prizes will be awarded in the following manner:

- First, Second, and Third Prizes will be awarded to the teams in each of two structure type categories (TYPE 1 and TYPE 2), using the evaluation process defined in Paragraph 5. First Prize will be awarded $750, with $500 for Second Prize and $250 for Third Prize.
- Each school shall be eligible for only one prize in each structure type category.
- First-, Second-, and Third-place entries will also be awarded a certificate of recognition, recognition on ACI's website, and will be recognized in *Concrete International* magazine if space allows.

Rules

Read more.

1. THE STUDENT TEAM

1.1. Each team must have a supervising faculty advisor who will see that the student team complies with the rules of the competition. The faculty member is permitted to advise more than one team..

1.2. Each team must consist of not more than five students currently enrolled in an undergraduate program at any college or university worldwide. Undergraduate students on cooperative or internship work assignment are eligible to compete. All members of a given team must be from the same school. A student may not be a member of more than one team.

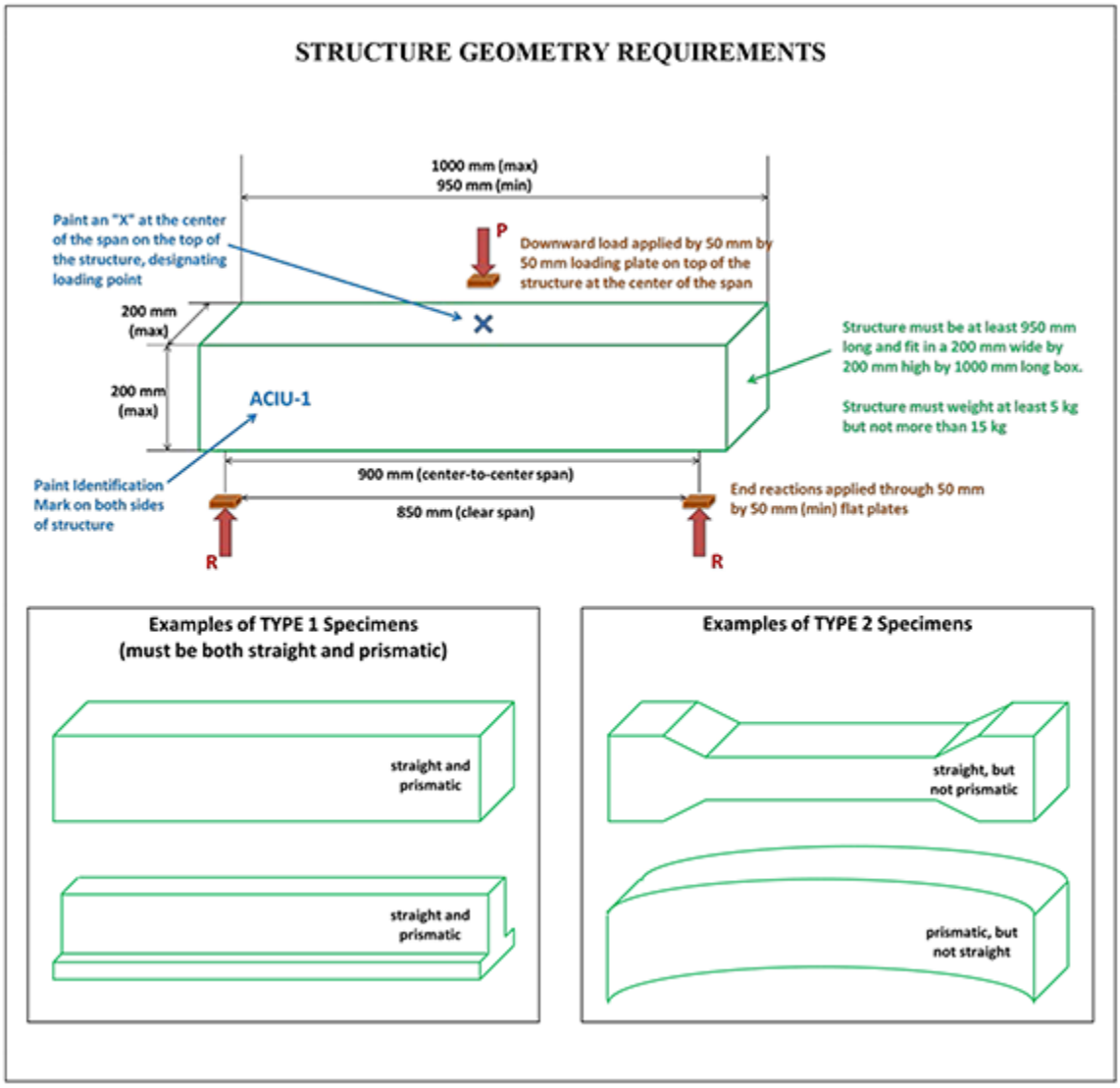
1.3. It is strongly recommended that at least one individual (faculty advisor or student team member) be designated to represent each team and be present during testing of the structure at the time and location specified for this competition. Participation by additional team members is both permitted and encouraged.

1.4. Each team must complete and submit the **Advance Registration Form - Due March 8, 2015,** the Official

Mix and Cost Form, and a diagram showing placement and dimensions of all FRP reinforcing materials by March 29, 2015 11:59 p.m.

1.5. Each school will be permitted to send no more than two teams to the competition. The first two properly completed applications (Advance Registration Form, and Official Mix and Cost Form with reinforcement diagram) will be accepted as that school's entries. Additional teams will only be accepted if an earlier entry from the same school withdraws from the competition.

2. THE MATERIALS AND THE STRUCTURE GEOMETRY



2.1. **Structure Type:** A structure will be classified as a TYPE 1 structure if it is a straight prismatic beam; that is, its cross section is prismatic and the centroid of the cross section (based on the gross concrete cross section) does not vary along the span. A TYPE 1 structure may have a rectangular or non-rectangular cross section; however, if the cross section is non-rectangular then a Complex Formwork cost adjustment will be applied as specified in Paragraph 4.3. Any structure that does not meet the requirements for TYPE 1 will be designated as

a TYPE 2 structure. Any TYPE 2 structure that is non-rectangular in cross section and or nonprismatic along the span will have a Complex Formwork cost adjustment applied as specified in paragraph 4.3. Examples of TYPE 1 and TYPE 2 structures are shown in the Structure Geometry Requirements Diagram.

2.2. **Structure Size:** Regardless of whether the structure is classified as TYPE 1 or TYPE 2, the structure must fit into a 200 mm (7.87 in.) wide by 200 mm (7.87 in.) high by 1000 mm (39.4 in.) long box. The structure's overall length may not be less than 950 mm (37.4 in.) nor more than 1000 mm (39.4 in.), including any protruding reinforcement. The structure must be able to be placed on supports and loaded as shown in the Structure Geometry Requirements Diagram.

2.3. **Structure Markings:** At the center of the structure, a large "X" shall be painted on the upper surface where the concentrated load will be applied. In addition, student teams must select an identification mark (for example, the school initials followed by the numeral 1 for team #1 or 2 for team #2), which must be marked so as to be clearly visible on both sides of the structure. Teams may also apply decals of their school logo and/or decorate their entry with felt-tip markers to improve its appearance, if desired. No other markings or surface treatment shall be permitted.

2.4. **Structure Weight:** Total structure weight must be between 5 kg (11.0 lb) and 15 kg (33.1 lb).

2.5. **Structure Materials**

2.5.1. Use only materials listed in the Official Mix and Cost worksheet.

2.5.2. The cementitious materials shall consist of any combination of portland cement meeting ASTM C150, or blended cement meeting ASTM C595 or ASTM C1157. Supplementary cementitious materials that may also be used include slag cement ("slag") meeting ASTM C989, fly ash meeting ASTM C618, and/or silica fume meeting ASTM C1240.

2.5.3. Any type of nonmetallic aggregate may be used.

2.5.4. Chemical admixtures meeting ASTM C260, C494, or C1017 are allowed. Epoxies and other polymers, glue, and binders may NOT be used.

2.5.5. Teams must provide the measured weights of all materials used in the concrete batch prepared to cast their competition structure, as specified on the Official Mix and Cost Form.

2.5.6. Every eligible student team submitting the Advance Registration Form will receive an FRP reinforcing materials kit from the manufacturers supplying FRP for the competition. FRP reinforcing materials supplied for the competition are listed in the Official Mix and Cost Worksheet. The FRP reinforcing materials supplied for the competition, along with the manufacturers' data sheets on engineering properties, will be shipped to the U.S. or Canadian address specified on the Advance Registration Form. Due to difficulties in shipping to countries outside the United States and Canada, all teams must provide a shipping address in the United States or Canada. Schools/student teams are responsible for arranging for trans-shipment from the U.S. or Canadian address they provide.

2.5.7. A student team may use any combination of the FRP reinforcing materials supplied for the competition in their structure, but the competition structure must be fabricated with at least one (1) full piece of the FRP reinforcing materials supplied for the competition. The FRP reinforcing material may be cut in any manner. Other reinforcing materials not supplied in the FRP reinforcing materials kit are not allowed. The FRP reinforcing materials may not be prestressed. Mechanical anchorages, if used, must be made from the FRP reinforcing materials supplied for the competition. Students may experiment with the supplied FRP materials.

2.5.8. Students and advisors, in return for receiving the FRP reinforcing materials free of charge, must agree to only use the FRP reinforcing materials supplied to them for purposes directly related to the competition. Failure to comply with the requirement prohibiting the use of FRP reinforcing materials supplied for the competition in other projects will disqualify the student team from the competition and may also disqualify the faculty advisor from participation in future competitions. Should faculty advisors desire to use these types of reinforcements in other projects, they are encouraged to directly contact the manufacturers.

2.6. **Structure Construction:**

2.6.1. Curing shall be at atmospheric pressure, and the curing temperature must not exceed the boiling point of water at atmospheric temperature.

2.6.2. No structure shall be more than 56 days old at the time of the test.

2.6.3. Reinforcing support wires and/or chairs are not permitted in the 850 mm clear span. Any manner of bar support may be used outside the clear span, as long as the bar support does not act to enhance the behavior of the structure, such as by anchoring the bar in the concrete; these bar supports are NOT included in the total cost. Mechanical anchorages, if used, must be made from the materials provided, as specified in paragraph 2.5.7 and ARE included in the total cost.

2.7. **Submissions:**

2.7.1. Teams must submit a 75 x 150 mm (3 x 6 in.) cylinder placed from the same concrete batch as that used to place the competition structure. The cylinder MUST be identified with the same structure identification mark and MUST be submitted with the structure on the day of the competition. The cylinder will be used by ACI as required by the judges to confirm materials used. Teams failing to submit the required cylinder will be disqualified from the competition.

2.7.2. Teams must also provide a diagram showing placement and dimensions of all FRP reinforcing materials used. The diagram must include the structure identification mark and must be submitted along with the Official Mix and Cost Form by the date specified on the competition website. Teams are encouraged to prepare an 11 x 17 in. poster with their school name and logo, their structure identification mark, and the names of student team members and faculty advisor to be displayed with their structure at the competition.

2.7.3. Entries not meeting the specified requirements may be tested if time permits but will not be eligible for prizes. MODIFICATION OF ENTRIES SHALL NOT BE PERMITTED AT THE COMPETITION SITE.

3. THE TESTING PROCESS:

3.1. Entries will be weighed and measured, and those judged acceptable by the FRP Competition Committee will be positioned in the testing apparatus, which will apply a midspan concentrated load by means of a

pivoting load plate. The center-to-center span is 900 mm (35.4 in.) and reaction forces are through bearing surfaces measuring not less than 50 mm (2 sq in.) by 50 mm (2 sq in.) and providing no restraint against rotation at the ends of the structure.

3.2. Once seated in the testing apparatus, a seating load of approximately 0.25 kN (56 lb) will be applied and recorded. Additional load will be applied until the structure fails or is loaded to the test fixture's capacity of 67 kN (15,000 lb). In lieu of obvious physical signs of failure, after initial cracking, failure will be assumed to have occurred when total load on the structure has decreased to 75% of the maximum load achieved by that structure. The loading rate will be determined by adjusting the cylinder's manual speed setting so that the manual speed valve is closed hand-tight. This setting will correspond to a piston movement of approximately 2.5 mm/minute, but may be affected by the stiffness of the structure. Deflection will be measured as the movement of the loading piston, which is assumed to correspond to deflection of the structure at the loading plate.

3.3. The maximum load achieved (P_{ult}) will be recorded as the maximum load prior to failure or 67 kN (15,000 lb), whichever is smaller, without deduction of the seating load.
3.4. The load corresponding to a deflection of 3.5 mm (0.14 in.) will also be recorded. To arrive at the load corresponding to this deflection ($P_{3.5}$), the measured load will be reduced by the 0.25 kN (56 lb) seating load (for which no deflection was measured). If a structure fails to reach a deflection of 3.5 mm (0.14 in.) prior to failing or reaching the test fixture’s capacity of 67 kN (15,000 lb), ($P_{3.5}$) will be taken as the maximum load achieved (as specified in Paragraph 3.3) less the seating load of 0.25 kN (56 lb).

4. STRUCTURE COST:

4.1. The Final Cost (**COST**) will be calculated as the sum of the material cost for the individual materials used to produce each entry times the Complex Formwork and Sustainability Credit Multipliers, as specified in the Official Mix and Cost Worksheet.
4.2. The cost for FRP reinforcing materials will be calculated on a per-piece basis and will NOT be prorated when less than the full piece of an FRP reinforcement is used. (For example, an entry that uses one complete piece of FRP reinforcement as required by Paragraph 2.5.7 and a part of another piece of FRP reinforcement as permitted by Paragraph 2.5.7 would be assigned the material cost associated with two full pieces of FRP reinforcing materials.)

4.3. Complex Formwork Multipliers will be assigned to account for the additional costs of more involved cross sections. Complex Formwork Multipliers will be applied to only the concrete material costs. Multipliers will be assigned for the following geometries:

4.3.1. If the cross section is nonrectangular, a multiplier of 1.1 will be applied to the concrete material costs;

4.3.2. If the cross section is nonprismatic (i.e. varies in the clear span), a multiplier of 1.1 will be applied to the concrete material costs;

4.4. Sustainability credits will be granted for reduction in cement content and for use of recycled supplementary cementitious materials (SCMs). The Sustainability Credit Multiplier will be applied to both the concrete and the FRP material costs. The Sustainability Credit Multiplier will be calculated by subtracting the

sum of the sustainability credits awarded from 100%. Sustainability Credits will be awarded for implementation of the following sustainable design concepts:

4.4.1. If the measured batch weight of cement (in lb or kg) is less than 15% of the total batch weight (in lb or kg) of all concrete materials, as reported on the Mix and Cost Form worksheet, a 1% sustainability credit will be awarded;

4.4.2. If the measured batch weight of cement (in lb or kg) is less than 10% of the total batch weight (in lb or kg) of all concrete materials, as reported on the Mix and Cost Form worksheet, an additional 1% sustainability credit will be awarded;

4.4.3. If the measured batch weight of cement (in lb or kg) is less than 5% of the total batch weight (in lb or kg) of all concrete materials, as reported on the Mix and Cost Form worksheet, an additional 1% sustainability credit will be awarded;

4.4.4. If the measured batch weight (in lb or kg) of fly ash is more than 20% of the sum of the measured batch weights (in lb or kg) of all cementitious materials (including cement, fly ash, slag cement [slag], and silica fume), as reported on the Mix and Cost Form worksheet, a 1% sustainability credit will be awarded;

4.4.5. If the measured batch weight (in lb or kg) of fly ash is more than 30% of the sum of the measured batch weights (in lb or kg) of all cementitious materials (including cement, fly ash, slag, and silica fume), as reported on the Mix and Cost Form worksheet, an additional 1% sustainability credit will be awarded;

4.4.6. If the measured batch weight (in lb or kg) of fly ash is more than 40% of the sum of the measured batch weights (in lb or kg) of all cementitious materials (including cement, fly ash, slag, and silica fume), as reported on the Mix and Cost Form worksheet, an additional 1% sustainability credit will be awarded;

4.4.7. If the measured batch weight (in lb or kg) of slag cement (slag) is more than 20% of the sum of the measured batch weights (in lb or kg) of all cementitious materials (including cement, fly ash, slag, and silica fume), as reported on the Mix and Cost Form worksheet, a 1% sustainability credit will be awarded;

4.4.8. If the measured batch weight (in lb or kg) of slag is more than 35% of the sum of the measured batch weights (in lb or kg) of all cementitious materials (including cement, fly ash, slag, and silica fume), as reported on the Mix and Cost Form worksheet, an additional 1% sustainability credit will be awarded;

4.4.9. If the measured batch weight (in lb or kg) of slag is more than 50% of the sum of the measured batch weights (in lb or kg) of all cementitious materials (including cement, fly ash, slag, and silica fume), as reported on the Mix and Cost Form worksheet, an additional 1% sustainability credit will be awarded;

4.4.10. If the measured batch weight (in lb or kg) of silica fume is more than 5% of the sum of the measured batch weights (in lb or kg) of all cementitious materials (including cement, fly ash, slag, and silica fume), as reported on the Mix and Cost Form worksheet, a 1% sustainability credit will be awarded;

4.4.11. If the measured batch weight (in lb or kg) of silica fume is more than 10% of the sum of the measured batch weights (in lb or kg) of all cementitious materials (including cement, fly ash, slag, and silica fume), as reported on the Mix and Cost Form worksheet, an additional 1% sustainability credit will be awarded.

5. THE EVALUATION PROCESS:

5.1. The Cost-Load Ratio (R_1) will be calculated as the Final Cost of the structure, as defined in Paragraph 4, divided by the maximum load achieved (P_{ult}), as defined in Paragraph 3.3.
$R_1 = \text{COST} / P_{ult,measured}$

5.2. The Maximum Load Prediction Ratio (R_2) will be calculated as the absolute value of the percent difference between predicted and measured values for P_{ult} as follows:
$R_2 = 100\%*\text{ABS}[(Pult_{,predicted} - Pult_{,measured}) / Pult_{,measured}]$

5.3. The 3.5 mm Deflection Load Prediction Ratio (R_3) will be calculated as the absolute value of the percent difference between predicted and measured values for $P_{3.5}$ as follows:
$R_3 = 100\%*\text{ABS}[(P_{3.5,}predicted - P_{3.5,}measured) / P_{3.5,}measured]$

5.4. Teams will be ranked in ascending order in each of three categories based on the Ratios defined in paragraphs 5.1 to 5.3. For example, the team with the lowest Cost-Load Ratio will be ranked 1, the team with the second-lowest ratio will be ranked 2, etc. Teams will be ranked separately in each structure type category (TYPE 1 and TYPE 2) for each of the three ratios.

5.5. A team's final ranking points will be determined by multiplying its ranking in the Cost-Load Ratio by 0.50 and the ranking in each of the other two categories by 0.25. For example, a team finishing third in the Cost-Load Ratio, second in the Maximum Load Prediction Ratio, and seventh in the 3.5 mm Deflection Load Prediction Ratio would receive 3.75 ranking points, computed as follows: [(0.50*3)+(0.25*2)+(0.25*7)=3.75]. Ties will be broken by the ranking in the Cost-Load Ratio category.

5.6. Within each structure type category (TYPE 1 and TYPE 2), the team with the lowest final ranking points will be declared the winner, and all other groups will be ranked based on final ranking points in ascending order. Each school shall be eligible for only one prize in each structure type category.

6. TIME AND LOCATION FOR TESTING AND COMPLIANCE WITH RULES:

6.1. The competition will be held in conjunction with The Concrete Convention and Exposition in Kansas City, MO, on Sunday April 12, 2015, beginning at 10:30 a.m. All entries must be delivered to the competition area in person by 10:30 a.m. the morning of the competition. The entry does not have to be delivered by a team member.

6.2. A panel of judges will be appointed by the FRP Competition Committee. Interpretations and decisions made by the judges will be final, and appeals will not be considered. ACI reserves the right to perform a detailed examination and check all entries for compliance with the competition rules. Due to the complexity of this task, the examination may be done after the competition, if needed. If the examination shows that a team

did not follow the rules, the team, their advisor, and all of his/her teams will be disqualified. ACI Committee S801 will further document recommendations to disallow the team, their advisor, and/or school/university from participation in future ACI competitions and submit this to the Student and Young Professional Activities Committee.

CONTACT INFORMATION

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FRP Competition Questions

Q: After casting our structure, we realized that it was a little bit longer than permitted by the rules and a little bit heavier. Are we allowed to saw cut our specimen to make it conform to the rules?

A: Yes, the specimen may be saw-cut after casting if necessary to achieve dimensions and weight that conform to the rules.

Q: How do we distinguish between the different reinforcement manufacturers' bars, and what are the material properties of each?

A: Please see the "Reinforcement Identification Guide and Product Datasheets" link posted on the competition website.

Q: Can a student team submit an entry in both the Type 1 and Type 2 structure categories?

A: No. Each student team may only submit an entry in one category. If there are two student teams from a university, each team may independently decide which structure type category in which to submit an entry. Both teams may submit a Type 1 structure, or both teams may submit a Type 2 structure, or the two teams may submit in different categories. Note that if the two teams submit structures in the same category, they will be competing directly against one another, and only the higher finishing team will be awarded a prize because each school is eligible for only one prize in each structure type category.

Q: Could you clarify the amount of material that will be sent to the recipients for the competition?

A: Student teams should expect to receive six total sets of three No. 3 (3/8 in. [9 mm] diameter) bars or the equivalent from five fiber-reinforced polymer (FRP) manufacturers, as well as a small amount of FRP grid from a sixth manufacturer. Not all the reinforcement will arrive at the same time, as the manufacturers may ship separately.

Q: If I do not have enough materials from the original kit, will I have the opportunity to get more materials to complete the final specimen for competition?

A: No. Each student team will only be sent one complete set of materials.

Q: I see that an electronic copy of the Official Mix and Cost Form is due March 29 and that a hard copy is due April 12. Do the two have to exactly match in terms of predicted loads?

A: The predictions must match exactly. Student teams are not permitted to adjust their predictions after the March 29 deadline. Should they do so, the prediction values submitted on March 29 will be used for determining the prediction discrepancy.

Q: The three cylinders and the slump test that are listed on the Official Mix and Cost Form aren't mentioned in the official rules or any other page of the submittals. Is it a requirement to perform these tests?

A: All requested information on the Official Mix and Cost Form must be provided, so you will need to perform a slump test and break three cylinders for 7-day strength. A fourth cylinder must also be produced and brought to the competition along with the structure.

Q: Is our batch weight used for cost determination based on how much material we used to produce our specimen or is it based on our mixture design for (1 cubic yard or 1 cubic meter)?

A: Neither. Costs are determined based on the entire batch weight of the concrete volume used for casting the structure. More specifically, this includes the concrete for the structure, the slump test, four cylinders, and any "extra" concrete that is left over after placing. You must pay for all concrete that you batch with your competition beam. For example, if you typically batch for 30% losses, you will need to pay for that concrete.

Q: We only have 4 x 8 in. (100 x 200 mm) and 6 x 12 in. (150 x 300 mm) cylinders in our lab. May we use one of these sizes for the competition or is it mandatory to use 3 x 6 in. (75 x 150 mm) cylinders?

A: For the cylinder that is brought to the competition, student teams may substitute a 4 x 8 in. (100 x 200 mm) cylinder for the 3 x 6 in. (75 x 150 mm) cylinder size specified in the rules. For the three cylinders used for evaluation of 7-day compressive strength, any larger size cylinder may be used provided that the cylinder has a height:diameter ratio of 2:1.

Q: Can we use capping for the concrete cylinders?

A: You may cap the cylinders you test for 7-day strength, but the cylinder that is brought to the competition should not be capped.

Q: Can we reuse the concrete for the slump test in one of our cylinders? This would save on cost.

A: Yes, reusing the slump test concrete in the cylinders or structure is permitted, should teams choose to do so.

Q: On the diagram, it says that the end reactions are applied through flat plates that are at least 2 x 2 in. (50 x 50 mm). The design that we are working with won't work with plates that size. The wording makes it seem like bigger plates are a possibility.

A: The beams must be able to be tested with plates any size from 2 x 2 in. (50 x 50 mm) on up. Designs that do not meet this requirement may not be able to be tested at the competition. It is the team's responsibility to ensure that their beam can be safely tested with end reactions applied through flat plates that may be as small as 2 x 2 in. (50 x 50 mm).

Q: Of what material will the reaction points be composed of when the structure is tested?

A: Steel.

Q: What is the length of one piece of GFRP rebar given for competition?

A: All reinforcement is 39 in. (990 mm) in length.

Q: May we use a mixture of reinforcing bars and/or fiber mesh for the competition?

A: Different types of FRP may be used in the same structure, as long as the only reinforcing materials used are from the FRP reinforcing materials kits and all materials used are reported on the Official Mix and Cost form.

Q: Is the FRP allowed to show?

A: FRP may be exposed in the structure.

Q: What cannot be done to the reinforcement bars, or what are the limitations on the manipulation of the bars?

A: The only limitation on manipulation of the bars or grids per the rules is that you are not permitted to prestress the reinforcement.

Q: Can the FRP surface be roughened to increase or decrease the bond strength?

A: Yes, the rules permit this.

Q: Are you able to bend the FRP bars in any way to create a hook at the end of the bar? Can the bars be melted?

A: You should research the materials prior to doing anything to the bars and grids other than cutting them, as it is possible that activities such as heating may destroy material properties. Also keep in mind the stress-strain characteristics of these materials that are linear elastic to failure–or in other words, the bars will not yield.

Q: What constitutes "mechanical anchorage" of FRP bars?

A: "Mechanical anchorage" is the use of any type of mechanical device (such as end plate) to anchor the bar, other than relying on the bond between the concrete and reinforcement.

Q: Are we permitted to use metal wires or similar items such as paper clips to locate the FRP inside the beam?

A: Yes, but the bar supports must be located outside the clear span and must not act to enhance the behavior of the structure, such as by anchoring the bar in the concrete.

Q: Is bending the grid in the corners of the structure permitted?

A: Yes.

Q: Do glass fibers qualify as aggregate?

A: No, glass fibers do not qualify as aggregate. Fiber-reinforced concrete (a concrete mixture with short fibers, no matter what the type) is not permitted.

Q: Is Micron 3 allowed?

A: Only materials listed on the Official Mix and Cost worksheet are allowed. Although Micron 3 may meet requirements of ASTM C618, it is not fly ash meeting ASTM C618 so it would not be allowed.

Q: Is the use of lightweight core permitted for the structure?

A: It depends on what you consider a "lightweight core" to be. If you mean a core of lightweight concrete, then yes, that is permitted. But if the lightweight core is made of any material other than concrete, it would not be permitted.

Q: As far as type of cross section, we read the rules for competition several times and we did not find anything saying that we are not allowed to do a hollow section, so just to make sure, are we allowed to have a hollow section for our beam? And if yes, are we able to use something like a pipe to create the hollow or is there any restriction on what we use to make the hollow happen in our beam?

A: A hollow section is permitted by the rules; however, nothing used to create the void may permanently be left attached to the member. The final structure must be comprised of concrete and FRP reinforcement.