UF ACI – Concrete Canoe Competition Project



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University of Florida



About the Concrete Canoe Competition

 The ASCE (<u>American Society of Civil Engineers</u>) National Concrete Canoe Competition (NCCC) provides students with a practical application of the engineering principles they learn in the classroom, along with important team and project management skills they will need in their careers. The event challenges the students' knowledge, creativity and stamina, while showcasing the versatility and durability of concrete as a building material.

Excerpt from article on Concrete Canoe on Wikipedia https://en.wikipedia.org/wiki/Concrete_canoe

ASCE NATIONAL CONCRETE CANOE COMPETITION





Each year, a team of undergraduate student design leads and volunteers work at the University of Florida to design and construct a concrete canoe for the ASCE regional and national competitions.



Research and Development

- Development of rule-compliant mortar designs
 - ASTM C330 Aggregate Requirement
 - Specified documentation of ingredients
- Design parameters
 - Workable for hand placement
 - Lightweight for buoyancy
 - Structural at 7 days
- Over 40 trial batches conducted over a 6-month testing program





The Design Process



- Preliminary Research
 - Academic knowledge and faculty
 - Industry contacts
- Focus on aggregate optimization
 - Reduce concrete unit weight
 - Improve strengths to reduce required cement content
- MathCAD integration for QC on mix designs

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Bardan L Commentaria II			Specific Gravity		1	1 414		270		To	Total Amount of	
Portland Cement Type IL			3.06		1	1.414		270		cemen	cementitious materials	
Slag Cement			2.8	3	1	529		270			<u>540</u> lb/yd [*] c/cm ratio	
			2.0.	5		1.525		270			0.5	
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Component		Sp	Specific Gravity			Volume (ft3)		Amount of	lume) (lb/yd³)			
Polypropylene Micro-Fibers			.91		(0.05		3.0		Total .	Total Amount of Fibers 3 lb/yd ³	
				AG	GREG/	ATES						
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Aggregates	0	C330		16)	SGOD	SG _{SSD}		OD	S	SD	Volume (ft ³)	
Riverlite ESC		Yes	25.	.14	1.01	1.26	13	4.644	16	8.494	2.143	
Poraver® 1.0-2.0mm		No	20	.00	0.38	0.46	6	6.118	79	.342	2.795	
Poraver® 0.5-1.0mm		No	20.	.00	0.41	0.50	2	1.446	25	.735	0.831	
Poraver® 0.25-0.5mm		No		.00	0.57	0.73	6	8.215	87	.315	1.912	
Poraver® 0.1-0.3mm	No		35.	.00	0.66	0.89	3	6.468	49	.232	0.892	
				AD	MIXTU	RES						
Admixture	lb/ga	ı	Dos (fl. oz.	age / cwt)	% Solids		Amount of Water in Admixture (lb/yd3)					
ADVA® 600	8.9		10.	10.00 40		0.00	2.25					
ZYLA® 310	9.1	9.1		1.45		35.00		0.362		To	Total Water from	
V-MAR® 3	8.5	8.5		4.56		65.00		0.572		Admixtures, ∑w _{admx} 5.12 lb/yd ³		
DAREX®AEA	8.5		5.7	5.72 5.		.80	1.933					
SOLIDS (LAT	EX, DY	ÆS,	POWI	DERE	D ADM	IXTUR	ES, Al	ND MINI	ERAL	FILLER	as)	
Component		Sp	oecific (Gravity	Volu	ume (ft ³)		Amou	nt (ma	ss/volume) (lb/yd ³)	
\$38 Glass Microspheres			0.38			9.45		224.08		Total Solids from		
Increte [®] Pigment			4.86			0.14		43.2		Admixtures 267.28 lb/xd ³		
		_		1	WATE	R				-		
					Amo	unt (mass	/volum	e) (lb/yd ³)		1	Volume (ft ³)	
Water, lb/yd3				w: 2				.00		4.76		
Total Free Water from All Aggregates, lb/yd ³			_			$\sum w_{true}$: -82.265						
Total Water from All Admixtures, lb/yd3							$\sum w_{advar}$: 5.119					
Batch Water, lb/yd3				Whatch: 374.146								
	DENSI	TIES	S, AIR	CON	TENT	, RATIO	OS AN	D SLUM	ſP			
			cm	1	fibers	aggre	gates	solid	s	water	Total	
Mass of Concrete, M, (lb)		3	40		3	3 410.		118 267.28		297.00	∑M: 1517.4	
Absolute Volume of Concrete, V, (ft ³)		2	2.943		0.053	0.053 8.5		9.592		4.76	$\sum V: 25.92$	
Theoretical Density, T, $(-\sum M / \sum V)$ 58		58.5	542 lb/ft ³		Air Con	Air Content $[=(T-D)/T \times 100\%]$			4.1%			
Measured Density, D 56		56.2	.2 lb/ft ³ 5		Slump,	Slump, Slump flow			4.5 in.			
water/cement ratio, w/c:		1.	1.1		water/c	water/cementitious material ratio, w/cm:				.55		

CONSTRUCTION

Pour Day

- Concrete production / placement
- High student volunteer

involvement (30+)

- Management and teamwork skills
- Mortar carbon fiber composite









 Table 2: Free Floatin' Mixture Properties

Property	Core	External	Aesthetic
Wet Unit Weight (pcf)	56.3	56.2	58.0
Oven-Dry (OD) Unit Weight (pcf)	<mark>45</mark>	<mark>43</mark>	<mark>51</mark>
7-day Compressive Strength (psi)	<mark>2400</mark>	<mark>2050</mark>	<mark>1500</mark>
7-day Tensile Strength (psi)	143	92	102
-day Composite Flexural Strength (psi)	722	N/A	
Air Content (%)	4.1	4.1	1.9



Table





Table 1: Free Floatin' Specifications				
Name	Free Floatin'			
Weight	<mark>160 lbs.</mark>			
Primary Colors	Maroon, Gray, Black, White			
Primary Reinforcement	Kevlar [®] woven carbon fiber			
Secondary Reinforcement	Polypropylene Micro- Fibers			
Maximum Length	<mark>21.8 ft.</mark>			
Maximum Width	2.10 ft.			
Average Thickness	1⁄2 in.			
Maximum Depth	1.15 ft.			

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ASCE Southeast Regional Conference





Concrete Canoe Southeast Regional Competition
Knoxville, TN March 28th-31st, 2019
25 schools competed in Concrete Canoe.
Each school was judged in 4 categories:

- Design Paper
- Presentation
- Final Product Display
- Race

UF won 1st in all 4 categories and moved forward towards Nationals in Melbourne, FL in June 2019!





National Concrete Canoe Competition

Concrete Canoe National Competition Melbourne, FL June 6th-8th, 2019

• 20+ schools worldwide

Awards:

- Oral presentation 1st
- Design Paper 1st
- Final Product 2nd

UFCC 1st Place Overall Champions!

COMPETITION RESULTS

CONGRATULATIONS TO THE UNIVERSITY OF FLORIDA – WINNER OF THE 2019 ASCE NATIONAL CONCRETE CANOE COMPETITION





Lessons Learned



- Take pride in technicality
- Prioritize your team and its members
- Think outside the box



Success is more than a trophy

Starting ACI at University of Florida



We were last active in 2013.

How can we move forward as a new student chapter?



Thank You!