THE LOCKDOWN Monster

George Mason University
2020 Concrete Canoe Design Paper

George Mason University
Concrete Canoe Team
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Fairfax, VA 22030

American Society of Civil Engineers
Concrete Canoe Committee
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Dear Concrete Canoe Committee, **January 03, 2021**

The George Mason University Concrete Canoe Team is writing this letter to certify that the proposed hull design, concrete mixture design, and reinforcement are in full compliance with the specifications outlined in the request for proposal. The team has reviewed and acknowledges the receipt of the Request for Information (RFI) Summary and certifies that the submissions comply with the RFI responses provided. The team also acknowledges that they have reviewed all relevant Material Technical Data Sheets (MTDS) and Safety Data Sheets (SDS) for the materials proposed for the construction of the canoe.

All of the members of the George Mason University Concrete Team listed below are registered participants and are qualified student members of the American Society of Civil Engineers and meet all of the eligibility requirements.

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Sincerely,

The George Mason University Concrete Canoe Team

1-6-21

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Executive Summary

The theme of the Lockdown Monster for the technical proposal was inspired by the biggest challenge faced this past year, the COVID-19 lockdown. George Mason University and many other universities switched from in-person classes to strictly online. Although this was necessary to contribute to reducing the spread of COVID-19, it was also very difficult for many students to sit in front of a screen for many consecutive hours. This challenge was something that most team members shared, and most students can relate to, and so it was decided to make this the theme. The monster shown in the cover page designed by the team artists was inspired by the Scottish myth, the Lochness Monster. George Mason University's school colors, yellow and green were used to represent the team shown on the sides of the canoe in the drawing.

For the 2020-2021 Concrete Canoe competition, the GMU ASCE Canoe team chose a canoe that would improve the aspects of the 2019-2020 competition. This year's hull design team chose to have the dimensions of the canoe at a height of 14.5 inches, a length of 255 inches, a width of 27 inches, thickness of 1 inch, and a weight of 246 pounds. Compared to last year's canoe, the length was changed from 240 inches to 255 inches in length to maximize efficiency. The goal of the structural analysis team was to evaluate where the canoe would potentially fail by analyzing the shear moment created in the canoe due to paddlers' weight, buoyancy force, self-weight of the canoe, and extra cargo load.

This year, the project managers focused on restructuring the leadership team and building the program for future years. The project managers planned months ahead and made sure to adhere to the project schedule. They also ensured the mix and mold design leads were well equipped to perform their tasks and met with them frequently to avoid mistakes from previous years.

The mix design team approached their starting point differently as they did not use a mix recipe from previous years. An extensive amount of research and testing of mixes was completed to create a new mix. The team studied mixtures from previous teams who were successful at the ASCE Concrete Canoe Competition to choose the components to test. The mix team was fortunate to have Vulcan Materials Company supply materials for batch testing. A set of mixes were lab tested based on calculated selections from past mixes and ASCE standards. ECS allowed the mix team to use one of their labs close to the George Mason campus. This allowed the team to conduct testing at the lab to determine the concrete properties for the final mix design shown in the table below.

Table #1: Concrete Properties

Concrete mixture type	OD / SSD Unit weight (pcf)	Compressive/Tensile Strength (PSI)
Structural mix	39.8/47.2	1470/366

The project construction team focused on consistency, quality, and time management. To make the design more precise, it was decided to have transactional pieces of the canoe mold professionally cut. This reduced human error and allowed greater precision in the professionally cut hull design. To control the quality of the construction of the canoe, different checks were put into place to ensure each step of the construction process was scrutinized and brought to the highest standards possible, given the circumstances of this year. The humidity chamber and professional cut of the mold as mentioned above were two new methods used this year to ensure the quality of the mold.

ASCE Student Chapter Profile

The GMU ASCE Student Chapter is a student-based and student-run professional development organization. The main goal is to enhance the knowledge of members by providing real-life experiences outside the typical classroom environment. This includes guest speaker meetings with professionals from the field, tours of job sites and companies found within the area, civil engineering-oriented competitions, and conferences among a variety of activities.

The GMU ASCE Student Chapter, is currently composed of 140 members and strives to provide students with as much experience as possible. This includes professional development and experiential learning accumulated from events and projects.

A few key events and projects that the chapter is involved include the following:

GMU AISC Steel Bridge

On March 29 and 30 2019, The GMU ASCE student chapter, presided by Sarah Shay (*President-GMU ASCE Student Chapter*) and Andres Izquierdo (*Vice President-GMU ASCE Student Chapter*) hosted the Annual ASCE Virginias conference and the AISC steel bridge competition. The chapter has worked hard with their faculty advisors, Liza Durant (*Associate Dean Strategic Initiatives and Community Engagement*) and Doaa Bondok (*Assistant professor, CEIE Department*) to make this event a memorable one. Approximately 300 students, judges, faculty, and staff flock from 12 different Universities and Colleges in the region. The ASCE Virginias Conference provided several activities for civil engineering students to develop professionally and network through presenting papers and competing in several attractive competitions such as concrete canoe racing, multi-disciplinary competition, blue sky competition, and geotechnical competition and concrete Frisbee challenges.

GMU ASCE Competitions

On the banks of the Occoquan Reservoir in Fairfax County Virginia, in Fountainhead Regional Park, eight schools have competed in concrete canoe competition. On George Mason Campus, in Long & Kimmy Nguyen Building, various other competitions took place. Mason teams performed exceptionally at the competition, taking home a majority of the first-place trophies. Senior Mera Shabti secured George Mason’s second consecutive Hardy Cross Oratory Competition win with her innovative research on the “Development of a Methodology to Quantify the Effects of Wetlands on Erosion of Coastal Shorelines”. Mason students also triumphed in the Multidisciplinary, Marr Technical Paper, Geotechnical challenge, and the Blueskies competition.

Key Team Members

Senior Project Manager

Bridget Smith (Senior) and Karla Pineda (Senior)

The Senior Project Managers oversee the finances, budgets, and procurements of materials. They facilitate communication between team leads, organize and set the project schedule, and ensure deadlines are met. Additional responsibilities include establishing professional relationships with relevant companies to support the team. Support can be through material donations, design consultation, and/or use of lab space and equipment. In response to COVID-19, Senior Project Managers worked with various departments within the university to ensure the proper precautions and measures were taken to protect students during in person events.

Junior Project Manager

Rayan Elmisurati (Freshman)

The Junior Project Manager is an underclassman who assists the Senior Project Managers in their duties and provides familiarity with how the team is run from the project management point of view. This is a training position.

Project Safety and Quality Assurance Manager

Nikolas Hawley (Junior)

The Project Safety and QA/QC Manager works with university officials and team leads to establish a positive working relationship between them and the team regarding the scheduling and planning of in-person events. Additionally, the manager was responsible for conducting Silica Awareness Safety Training and collecting emergency contact sheets for all project members.

Hull Design Lead

Anagil Lobo (Senior)

The Hull Design Lead is responsible for overseeing the hull design process, which includes, but is not limited to overseeing and managing the Hull Design Subteam, coordinating with project management and other design leads, and meeting project deadlines. The Hull Design Subteam was specifically responsible for designing the proposed hull within a 3D modeling software, creating the CAD files used for the construction of the mold, and performing the hydrostatic, structural analysis, hull reinforcement, and the percent of the open area of the design.

Hull Design Lead Assistant

Camille Fulton (Freshman)

The Hull Design Lead Assistant (HDLA) assists in managing the Hull Design Subteam through recordkeeping and organization of members and work. This consists of taking attendance and notes for meetings, keeping track of who has been assigned each task, and when tasks are due. Additionally, the HDLA is responsible for research regarding which software will best meet the sub team's needs and lead the hydrostatic analysis of the hull design.

Mix Design Lead

Beverly Duran (Junior)

The Mix Design Lead oversees the design and testing of potential concrete mixes for the project's final design. She is responsible for coordinating and scheduling lab times at the non-university facility used by the team. The Mix Design Lead is also responsible for the determination of what materials to use, where they could be purchased, and how much of each material needs to be procured.

Key Team Members

Mix Design Lead Assistant

Adam Alamin (Senior)

The Mix Design Lead Assistant assists the Mix Design Lead in their duties and is responsible for coordinating and delegating write-ups pertaining to the mix design process.

Mold Design Lead

Musanna Nasher (Junior)

The Mold Design Lead is responsible for designing how the hull will be constructed and overseeing the construction phase of the project. Additionally, this lead coordinates with the Hull Design Lead to ensure the design is constructible and is responsible for ensuring the construction plan is within budget as well as which materials and tools will be required for the process.

Chief Project Editor and Social Media Director

Camila Renjel (Sophomore)

The Chief Project Editor is responsible for the formatting and final editing of the project technical proposal. Roles and responsibilities include, but not limited to, collecting design processes from each of the design leads, compiling project steps and stages into a professional technical report, ensuring proper grammar and correct spelling throughout the paper, and ensuring the paper meets all the requirements listed in the Request for Proposals.

As Social Media Director, this role is responsible for maintaining and updating the project's LinkedIn and Instagram accounts, as well as creating and posting promotional or marketing material.

PROJECT MANAGEMENT

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VISUAL AND CREATIVE DESIGNERS
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CAMILLE FULTON, FR.
IVAN RAMOS, JR.

Hull Design

This year's hull bottom was chosen by the team to be a rounded V and the hull sides to be flared. The reason for the bottom being a rounded V is to reduce drag and increase maneuverability. The rounded bottom helps with speed and efficiency in the water. The flat and arched styles both improve turning but tend to be slower when adding people and gear to the canoe.

The hull siding this year was chosen to be flared as mentioned above. The flared sidings provide increased final stability and a dry side hull profile. It also allows for a narrower waterline which increases the speed and efficiency when in water. Unfortunately, when it comes to paddling the comfort and efficiency it is reduced. Once the pandemic is no longer a threat, the team hopes to race. The two other styles that were not chosen were straight and tumblehome. Straight was not chosen as it is more acceptable to drag and with a deep hull it would be difficult to paddle. The tumblehome was not chosen as it tends to reduce the final stability of the hull and water is more likely to curve up the hull side adding water weight onto the canoe. This directly affects the speed and overall movement of the canoe. This semester the team mainly focused on the boat's speed and the reduction of drag. With the rounded V bottom and flared sides, it accomplished the goal which is further explained in the structural analysis.

It was decided to not have a fully rockered canoe. The lesser amount of rockers were done to increase the hull speed which would also increase the maneuverability of the boat. This would be consistent with the idea of the canoe.

Hydrostatics

The hydrostatic and stability tests were conducted using two programs: Orca3D and DelftShip. DelftShip performed the open area calculations and Orca3D tested the stability.

The hull thickness was one inch and all the calculations for the tests were shown in either DelftShip or Orca3D. The design length was 21.250 feet with a design beam of 3.7 feet and design draft of 0.5 of a foot. The maximum beam length was 3.612 feet, the midship location was 10.625 feet at a relative water density of 1.0250. The mean shell thickness was found to be 0.083 feet. Using conditions demonstrated in Figure 2, the tests determined the displacement weight, sinkage, trim, and center of buoyancy and flotation. The hull form coefficients, sectional parameters, stability, waterplane values, volumetric values and waterline dimensions were also determined. The initial stability for transverse metacentric height was 2.236 feet and the longitudinal metacentric height was 55.342 feet. The sectional areas data collected is shown in *Construction Drawings & Specifications* which showed how the cross sections change throughout the canoe.

Figure 1: Orca 3D Render

Figure 2: Test Conditions Report

Condition Summary

Load Condition Parameters

Condition	Weight / Sinkage	LCG / Trim	TCG / Heel	VCG (ft)
Condition 1	250.000 kgf	9.987 ft	0.000 deg	0.777887139107612

Resulting Model Attitude and Hydrostatic Properties

Condition	Sinkage (ft)	Trim(deg)	Heel(deg)	Ax(m^2)
Condition 1	-15.717	11.397	0.000	0.00

Condition	Displacement Weight (kgf)	LCB(ft)	TCB(ft)	VCB(ft)	Wet Area (m^2)
Condition 1	250.003	-17.746	0.000	138.357	221.131

Condition	Awp(m^2)	LCF(ft)	TCF(ft)	VCF(ft)
Condition 1	5.066	-18.234	0.000	-19.708

Condition	BMt(ft)	BMl(ft)	GMt(ft)	GMl(ft)
Condition 1	-45.388	7.106	94.959	147.452

Condition	Cb	Cp	Cwp	Cx	Cws	Cvp
Condition 1	0.001	0.000	0.277	0.000	367.680	0.004

Structural Analysis

The structural analysis was implemented using STAAD.Pro. The canoe was modeled as a beam with two pins at 40% and 60% of the total length. The team's analysis took into consideration the loads represented in the figure below, which shows the combination of loads two cases evaluated.

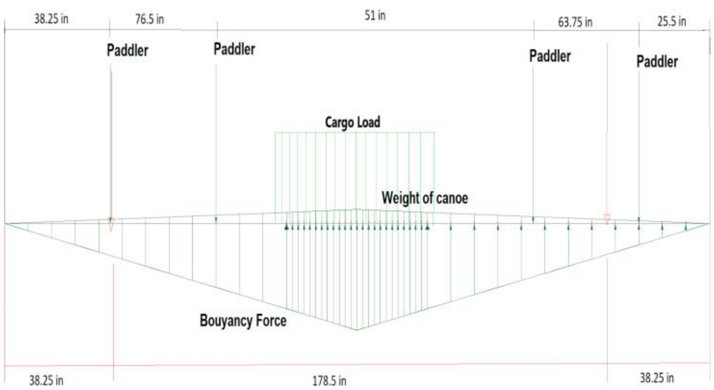


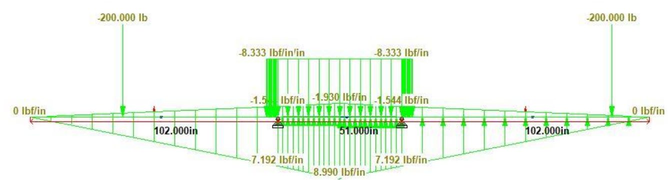
Figure 3: Schematic loads in analysis

Additionally, a cross-section was analyzed to calculate the maximum tensile and compressive forces to find the cracking moment and ultimate bending moment. These results were compared to the compressive stress coming from the mix compressive test of 1470 psi divided by a factor of 1.5 of safety resulted in 980 psi. This confirmed that the calculated maximum stress of 63.060 psi was less than actual stress, therefore it passed the test. AutoCAD (2021) was used to create a cross-sectional area of the hull design in order to analyze stresses within the canoe Bulkheads were not included in the total weight calculation since they made up such a small fraction of the weight. Using the loading computations and cross-section dimensions the maximum shear, moment, compressive and tensile stresses were determined. The diagrams above were analyzed and drawn using STAAD.PRO.

Case 1

Two paddlers and a cargo load of 500 pounds that was placed at 97.5 inches from the bow on a 60 inches distance represented as uniform distributed load of 8.333 pound per inch at the center of the canoe. The weight of the canoe 246 lb is represented as a triangular distributed load since the weight is more focused at the center of the canoe rather than at the ends. The buoyancy force was also assumed as a triangular distributed load. To be conservative all paddlers were modeled as point loads of 200 pounds for both females and males. The location of these weights were: 38.25 inches at 15% and 216.75 inches at 85% from the bow. The figure below shows a representation of case 1.

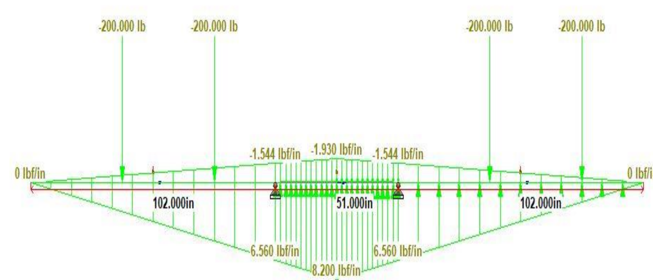
Figure 4: Case 1



Case 2

Case two, four paddlers of 200 pounds each were placed as load points along the length of the beam, the first paddler located at 38.25 inches at 15% of the length of the canoe, the second one located at 76.5 inches at 30%, the third paddler located at 191.25 inches at 75% and the fourth paddler located at 229.5 inches at 90%. Similar to case one, the weight of the canoe and the buoyancy force were represented as triangular uniform loads. The buoyancy force was slightly smaller than the first case because there was no cargo load included. The figure below shows a representation of case 2.

Figure 4: Case 2



Development and Testing

Many concrete canoe teams have implemented water reducers to try and increase the slump without adding an excessive amount of water. The team initially used a high range water reducer that was producing what was referred to as a 'pancake,' the mix that contained the high range water reducer liquified the mix more. Since the high range water reducer was failing, the mix team looked for other options. Sika AEA 14, a water reducer that provided much better results for increased slump. Using Sika AEA 14 further refined the mixing progress as it made the mix stronger and more stable. The next obstacle was to figure out the specific aggregates to be used and the amount of each type required.

After research and checking on availability, it was found that Perlite was the best option for the aggregate. Perlite was thought ideal to use in the mix, as it is a lightweight aggregate that can be easily obtained, as well as offers a very high compressive and flexural strength. During the early mix designs it was found that an estimated 2-6% of the mix would need to be made up of perlite. By this stage a slump of roughly 3 inches was produced. This test is a standard for ASTM C143: the team recommended test for slump. To further refine the team's, mix the team looked into quantities of cementitious materials.

Table #2: Cementitious Materials

Volume percentages of total cementitious material	
Portland Cement	42%
Hess Pozz	31%
Fly Ash Class F	21%
Silica Fumes	6%

Table #3: Aggregate Properties

Aggregate Properties				
Aggregate	Label size	Particle size	Specific gravity	Absorption
Hess grade 7	xsmall	0.6 - 2.38 mm	1.88	14%
Hess grade 10	small	0.6 - 4.75 mm	1.83	15%
Hess grade 5	coarse	0.06 - 2.0 mm	1.88	14%
perlite	-	0.42 - 4.74 mm	0.39	79%

The team utilized Portland cement ASTM C150, Slag cement grade 100 ASTM C989, Fly ash class F and ASTM C1240 Silica Fume all as the cementitious materials. Through experimentation and multiple mixes, the team concluded the best mix based on slump was 10.1% portland cement, 23.09% slag, 13.6% fly ash, 9.9% silica fume, 0.01% fiber force, 4.7% pumice ⅛, 12% pumice sand course, 2.7% perlite, 0.16% Sika AEA 14 in, 0.04% Sika SRA 75, and 23.7% water. This mix provided a 2-inch slump which was considered a good start. Slag cement was effective in achieving a low slump, but it has a high density which decreased overall load capacity, therefore, was not the ideal mix. While testing mixes, the team gained valuable information about materials. Using CSA instead of Portland Cement was explored, but CSA was found to be more difficult to work with, more expensive, and harder to obtain as opposed to Portland Cement. Those factors influenced the team to use Portland Cement. The mix team leads studied different mixes and found 25 pounds to be the goal weight for the mixes tested. Using pumice ⅛ +fines aggregate, pumice sand coarse aggregate, portland cement, slag cement, class F fly ash, silica fume, less than a pound of perlite (since it is very lightweight), air entrainment, shrinkage reducing liquid admixture, and nearly 7 pounds of water; a 2-inch slump was achieved.

Fly ash class F was switched out for ultra-hess pozzolan as the final change to the mix. This produced a final and most minimum slump of 1.25 inches.

Getting the cured cylinders to float was a big obstacle for the team at first. The first three cylinders were each approximately 1.85 pounds and were each cured for 28 days. The next four were all approximately 2.3 pounds and were cured for 31 days each. The longer the cure made the concrete stronger, but it did not improve the mix's buoyancy. Because the team's workspace was outside, they struggled to make the mixes due to low temperatures. Concrete must attain 500 psi of strength before freezing. Working in the cold, the team decided to use a cement accelerator to obtain a faster cure time. The cement accelerator also decreased the risk of the concrete getting damaged from frost damage.

Reinforcement

It was found during the research phase that fibers could be incorporated into the mix, serving as a secondary reinforcement. The fibers help make the concrete stronger by not allowing it to break even when tiny cracks form. The fibers hold the concrete together, they are randomly oriented, therefore they cannot be placed in the exact direction they are needed in. As a result, using these can cause difficulty. The team used monofilament polypropylene microfibers in the first tested mixes, but later decided the fiber reinforcement should be taken out since the strands were too long and stuck out of the concrete.

While doing research about silica fume particles, the team found that it made the slump go down dramatically by 20%-40%. Since it is a small particle it improved the strength of the concrete. Silica fume particles provide secondary reinforcement to the concrete mix.

The primary reinforcing material in the mix was steel hardware cloth. The mesh was made up of about 0.25 square inch gaps.

The team chose the hardware cloth as the most economically conscious choice in order to make sure the team was able to stay within the budget. Enough steel hardware cloth was available from last year's project, which reduced the cost.

The final mix included the following constituents:

Table #4: Final Mix

Mix materials	Intended Use	ASTM
Portland Cement	Cementing reaction	C150
Fly Ash Class F	provide strength	C618
Hess Pozz Cement	works well with pumice aggregates	C618
Silica Fume	provide strength	C1240
Pumice	Strong lightweight aggregate	C330
Perlite	lightweight aggregate	C330
Mono Poly microfibers	Reduce plastic shrinkage cracking	C1116
HRWR	Reduce water content	C494
SRA	Prevent early cracking	C494
Accelerator	Quicker curing time	C494
Air Entrainment	Cause air bubbles and improve workability	C260
Sealing compound		C309
water	cause reaction	-
Green dye	Canoe Aesthetics	C979

Construction

Foam Material Selection

The team decided to build the canoe mold with a high-density extruded polystyrene (XPS) foam with a psi of 25. The compression force was taken into account when making this choice as it was needed to be high enough to withstand the concrete that would be poured on top. Since XPS has a low cost, it was possible to have it professionally cut. Having the transactional pieces of the canoe cut by a professional was estimated to improve the consistency of the canoe in order to achieve precision in meeting the decision specifications.

Foam Construction

In constructing the canoe, the foam pieces were dry fitted to ensure both the keel and gunwale of the boat were correctly aligned. Once the dry fit was visually inspected for quality, it was transferred to the casting table to be fully assembled. Assembly started with dry fitting the pieces again, then separating the bulkheads from the main body of the canoe mold. This was done as the bulkheads would be casted into the concrete. The spray adhesive used for adhering the foam pieces was recommended by the provider. The adhesive worked by corroding the surface of the foam pieces then binding them together. The three pieces of the mold: two bulkheads and the main body, were adhered together. The next step was to sand the pieces of the mold to smooth out the transitions from one transactional foam piece to the next. In this process sandpaper of different grits was used to smooth out frays in the mold. Two sections of the mold were found to not transition as smoothly and a way to make the transition smoother was needed. The transition was corrected by mixing wood glue with the foam shavings to create a paste that could be applied on the mold.

Tarping the mold came next, excluding the bulkheads, this involved laying three different sections of tarp to account for the curving of the keel. The tarp was held in place by using a staple gun, then waterproof tape was used to ensure no concrete leaked through the tarp. Once the tarping was completed the tarp was brushed with a releasing oil to ensure the mold releases from the concrete cleanly.

Methodology of Mixing and Placement of the Concrete and Reinforcement & Layering Scheme

Next came the placing of the concrete and the reinforcement. The first step was to place a ½-inch layer of concrete over the entire canoe including the bulkheads, this was checked throughout the process by inserting a dowel with ½-inch increments marked on it to ensure consistency throughout the placing of the first layer of concrete. Then the reinforcement was added, this year it was decided to use chicken wire as the reinforcement layer in between the concrete, the chicken wire was shaped to dimensions of the canoe prior to being placed over the first layer of concrete. Finally, once the initial layer of concrete and the chicken wire had been put in place the next ½-inch layer of concrete was added on top, this was then smoothed.

Curing

The curing process started with the building of a humidity chamber, this was constructed with the use of PVC pipes and fittings. The frame was made big enough so that it would be able to fit over the canoe and be placed on the table, the next step was to then zap tie a low-pressure misting system to the frame as well as placing various wood blocks under the casting table to create a slight slope to one end. Once the frame and the misting system was attached the frame was then placed on top of the table and over the canoe. A tarp was then placed over the frame and taped down to ensure the canoe was enclosed and an opening was made in the front of the frame to help funnel out and remove the water.

The excess water would then be funneled into a cooler with a hose attached which would irrigate the water outside.

Mold Removal

Last year's canoe team used cooking oil as a release agent, but it was found that even though it was a more affordable alternative, it did not work well with the foam that was used. This year, the mold design team researched other alternatives and chose to use SAKRETE Form Release Oil. This is a mineral oil and is a petroleum distillate based concrete form release agent. This oil contains lubricity modifiers and surface wetting agents, so it allows for forms to be removed easier than with other release agents. When the team assembled the mold, it was initially attached in two sections, but the adhesive chosen corroded the foam so ultimately some pieces had to be reattached and the mold was put together in four sections. To remove the foam from the mold, the canoe was flipped right side up and placed on the display stands. Once the canoe was flipped the foam was removed in the four sections by carefully lifting each section. Each section came out in a matter of seconds and there was no chipping away at the foam to remove it compared to last year.

Figure 5: Mold Removal

Concrete Finishing

The finishing processes will consist of using varying grits of sandpaper on the exterior of the canoe, a small amount of sanding may be needed on the interior of the canoe to address any imperfections from the tarp. The sanding process helps produce the desired smoothness, texture, and remove any imperfections from the casting processes. The first stages of sanding will include very low grit sandpaper to help quickly remove large imperfections in the canoe, the final stages of sand will implement very high grit sandpaper to create the smoothest surface we can on the canoe which will result in a lower friction when in the water. The final step in the finishing process will consist of painting on three coats of a penetrating water-based sealant which will not only create a waterproof surface but also protect from abrasions on the canoe.

Aesthetics

For aesthetics of the canoe, we plan on using brown pigments. We will press forms into the exterior sides of the canoe to give it a wood paneling look. The indents of the paneling will be filled in with a slightly darker mix to ensure that the outline of each panel sticks out.

Improvements

Some improvements that can be noted for future reference are sticking to hard deadlines, stricter quality checks, and communication. A major improvement that can be made is sticking to deadlines. This is important especially due to the circumstances of this year, sticking to deadlines ensures that each part of the project has the adequate amount of time it needs to be done properly and with the care and attention it needs. Quality checks ensure that the work being done is up to standards that are required. Finally, communication is another major improvement that can be made, given the circumstances this year communication is something that made or broke the project. With proper communication we can make sure that every member is informed of what is going on and any changes that may have come about.

Project Management; Scope, Schedule, and Fee

In previous years, all leadership had the title of captain. This year, the project managers decided to restructure the leadership roles. These positions included two Project Managers, a Jr. Project Manager, Mix Design Lead, Mix Design Lead Assistant, Hull Design Lead, Hull Design Lead Assistant, Mold Design Lead, Project Safety and Quality Control Manager, and a Social Media Director and Chief Project Editor. The project managers decided to include a jr. project management role so that they could learn the ropes of how to manage the whole team and what it takes to be a project manager. This was done so that this person could be prepared for next year's competition and to allow the project to start at an earlier date in order to prevent falling behind. The selection of the leads was based on previous leadership and hands-on engineering experience. Each applicant was required to fill out an application and submit a resume for review. In order to maintain the project schedule, the leadership team met on a bi-weekly schedule to go over updates and important information that was needed from team to team.

Due to COVID-19, the project managers created a Discord Server in order to ease communication for the team. This server provided both text channels as well as voice channels to conduct meetings. The server allowed the project managers to stay informed about what each team was doing since they had access to each individual team communication channel. Communication was strictly done through Discord for leaders as well as for sub-team members to prevent losing time by reaching out to a person individually. Furthermore, all team management documents, finances, research information, CAD files, etc. were kept in the team's Google Drive. This allowed for each team member to work collectively on different aspects of the project.

To increase membership base, the project managers gave a presentation at the ASCE student chapter meeting in the beginning of the fall semester and had the civil engineering advisor send out mass emails. Furthermore, they coordinated with the social media director to create flyers and social media posts to engage students. The social media director was put in charge of creating a team LinkedIn page in order to connect with professionals and make a relationship with the companies that sponsored the team.

The project managers created a preliminary project schedule in the beginning of the project that included milestones indicating the research stages, hull design completion, mix design completion, and deadlines for the mold design, mold construction, and casting day. The schedule was regularly checked and updated by the team leads to ensure that the deadlines were being made. Some changes were done to the project schedule due to weather as well as adding other task items such as the construction of the canoe stands. Critical pathway markings on the calendar were discussed during the bi-weekly leadership meetings to ensure the project continued on track. Milestones for the project were linked using the critical pathway such as the hull design had to be completed before the mold design could be completed and could then proceed with the construction. Some challenges that posed risk to the critical path was the inability to perform mix days during winter break since the project members were out of town and were more exposed to COVID-19 due to the holidays. Another challenge that posed a large risk to the critical path was the ordering of mix materials required to build the canoe. It was said that the order could not arrive on time since some other aggregates were out of stock. Thankfully, The Pumice Store was able to provide the materials just in time for casting day.

For the financial and resource allocation for the project, the project managers focused on reaching out to companies in order to receive donated materials and stay within budget. Companies such as Clarke Construction, donated coveralls, gloves and other PPE to the team and Vulcan Materials Co.

provided some mixing materials to conduct testing as well as for casting day. The project managers also focused on re-using materials and tools that were available from the previous years as well as reaching out to the civil engineering department lab coordinator to borrow tools for the mixing team. This year the project managers also focused the budget on being able to build the program for future years. This would allow for future project managers to focus more on ensuring that the other team leads had the assistance needed rather than focusing on obtaining certain materials that could be of use for many more years. For materials that the mix design and mold design needed, a Google Form was created to facilitate the ordering process. This form required the team leads to conduct research first on finding the most affordable product but ensuring the quality of the product and then providing the quantities needed and the direct link to the item in need. After the items had been reviewed by the project managers, they would be organized and formatted on a Google Sheet and passed along to the advisor to proceed with purchasing the items.

Health & Safety/ Impact of COVID-19

As always, the health and safety of our team is of utmost importance. This year in particular, the COVID-19 pandemic posed challenges for the team as it was required to follow university guidelines for restrictions on in-person activities. The Project Health and Safety Plan addresses the general guidelines set forth by the university, including physical distancing, limiting the size and number of in-person activities, wearing face coverings, and pre-event health screening questionnaires.

Initial safety awareness training was conducted early on in the project, focusing on silica awareness and other hazards of working with concrete. Each stage of the project was assessed for potential risks and hazards. Job Safety Analyses were conducted for each task of construction in order to identify hazards and establish engineering and work practice controls. Team Members took care to follow safe work practices during all phases of the project.

Procedures were established for both minor and emergency medical situations, including the collection of emergency contacts for all team members, identification of local emergency services, as well as the location of first aid at each facility utilized for the project. All team members assisted in cleanup at the conclusion of each work event to ensure preventative maintenance of facilities.

Quality Control and Quality Assurance

Mix

The scope of concrete mixing throughout the project was not done on a commercial scale. Therefore, rigorous OSHA requirements for crystalline silica dust inhalation was not required. Awareness training and special care was taken to minimize any plumbing of silica dust while mixing. Although it is not uniform nor rated to filter such particles, all team members wore ordinary cloth face coverings in order to comply with COVID-19 precautions. This added an additional level of protection. While handingly the concrete mixtures, disposable impervious gloves were worn to prevent contact exposure with the hands. Access to the lab's facilities included eye wash stations in the case of overexposure of silica dust particles to the eyes or splashing of other mixture materials. Additionally, a hose and wheelbarrow of water were on site in the outside working environment. This could be used for the washing of tools, but also skin if necessary.

Mold

The mold for the canoe was ordered from a company who custom cut cross sectional foam blocks. This provided a clean-cut start for the shape of the mold. The next step was to refine and shape the mold down to a smooth surface. Rounding and smoothing the faces and edges of each section in order to align subsequent sections required a bit of work, particularly towards each end. Various methods were hypothesized and tested on extra foam. Chunks of foam were removed with a serrated knife to establish a general shape. The foam was then sanded down by hand with sanding blocks. This sleekend the form of the surface.

Proper knife safety was followed by making deliberate cuts away from one's self and keeping others at a safe distance. Reasonably frequent breaks were taken to avoid mental and physical fatigue. This was done to prevent compromising the safety of team members as well as protecting the quality of the work. Sloppy cuts would have taken off too much material, which would require patched repairs to a damaged mold. Although the use of a power grinder with sandpaper attachment was tested and briefly attempted, this was abandoned due to high friction which melted the foam. During testing, use of the power grinder was conducted under supervision of the lab manager with appropriate safety precautions, such as eye protection, and dust suction engineering controls built into the tool.

QA

Adherence to competition and industry specifications was stressed and checked throughout both the design and construction phases of the project. Regular meetings between design teams, project management, as well as general body meetings ensured coordination and situational awareness for all team members on the project status. Coordination of work was facilitated through shared access to a Google Drive folder where project designs, documents, and records were stored. In addition to archiving all documents in the drive for future reference, a knowledge management program was established to specifically document both successes and failures. By establishing a knowledge base of lessons learned, future teams will have a useful reference of points to sustain as well as areas to improve.

Mix

ASTM concrete standards were used to help the process after creating mixes. When mixing the concrete in a drum mixer, it met the ASTM C172 which is the standard for sampling concrete. As soon as the concrete was well mixed, the ASTM C143 was conducted. This was the slump test in order to check the workability of the freshly made concrete. The slump cone was filled a third of the way then tamped 25 times for every third filled. As the top was cleaned off, the cone was then removed vertically, and slump was measured by the difference in height of the slumped concrete and the cone. The concrete was then packed into plastic cylinders. This met the ASTM C31 for testing and curing the concrete samples. This involved packing the plastic cylinder containers halfway, tamping them with a smaller rod 25 times, and then tapping on the sides 3 times all around. After 28 days of curing, the compression test was conducted -- ASTM C39. This was used with a machine that adds increasing compressive force and is determined as soon as the cylinder is cracked.

Mold Quality Assurance

Despite some setbacks, QA/QC of the mold was maintained throughout the construction process. One of the largest challenges was a missing cross section on one end of the mold, as well as a duplicate cross section on the other end in place of a missing cross section. These errors in the custom ordered cross sections caused erroneous jumps in the continuity of the curvature of the mold. In retrospect, the company should have been contacted immediately upon discovery of the errors, and complimentary replacement cross sections requested for the specific sections. However, the team was able to overcome the challenge by creating a putty of sorts out of glue and foam dust which accumulated as a byproduct of sanding down the cross sections. The putty was used to fill in and smooth out the mold surface at these abrupt jumps.

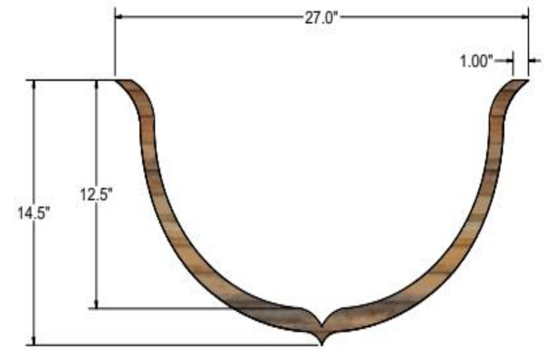
Sustainability

The team made sure to be as sustainable as possible in terms of social, economic, and environmental impacts. Due to the impacts of COVID-19 it was important to lessen the amount of exposure between all participants during the planning, testing and building phases. In order to not compromise the quality of the teamwork, many interactions were conducted over zoom calls. It was also important for the project to be as economical as possible in terms of materials and equipment. Environmental impacts were kept to a minimum through recycling were possible and responsibly discarding waste.

Construction Drawings & Specifications

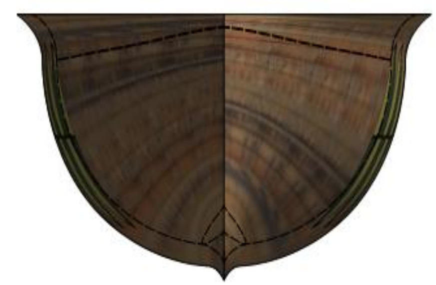
PLAN VIEW
SCALE: 0.06

SIDE ELEVATION VIEW
SCALE: 0.06



CROSS-SECTION
SCALE: 1 / 4

3D PERSPECTIVE VIEW
SCALE: 0.05



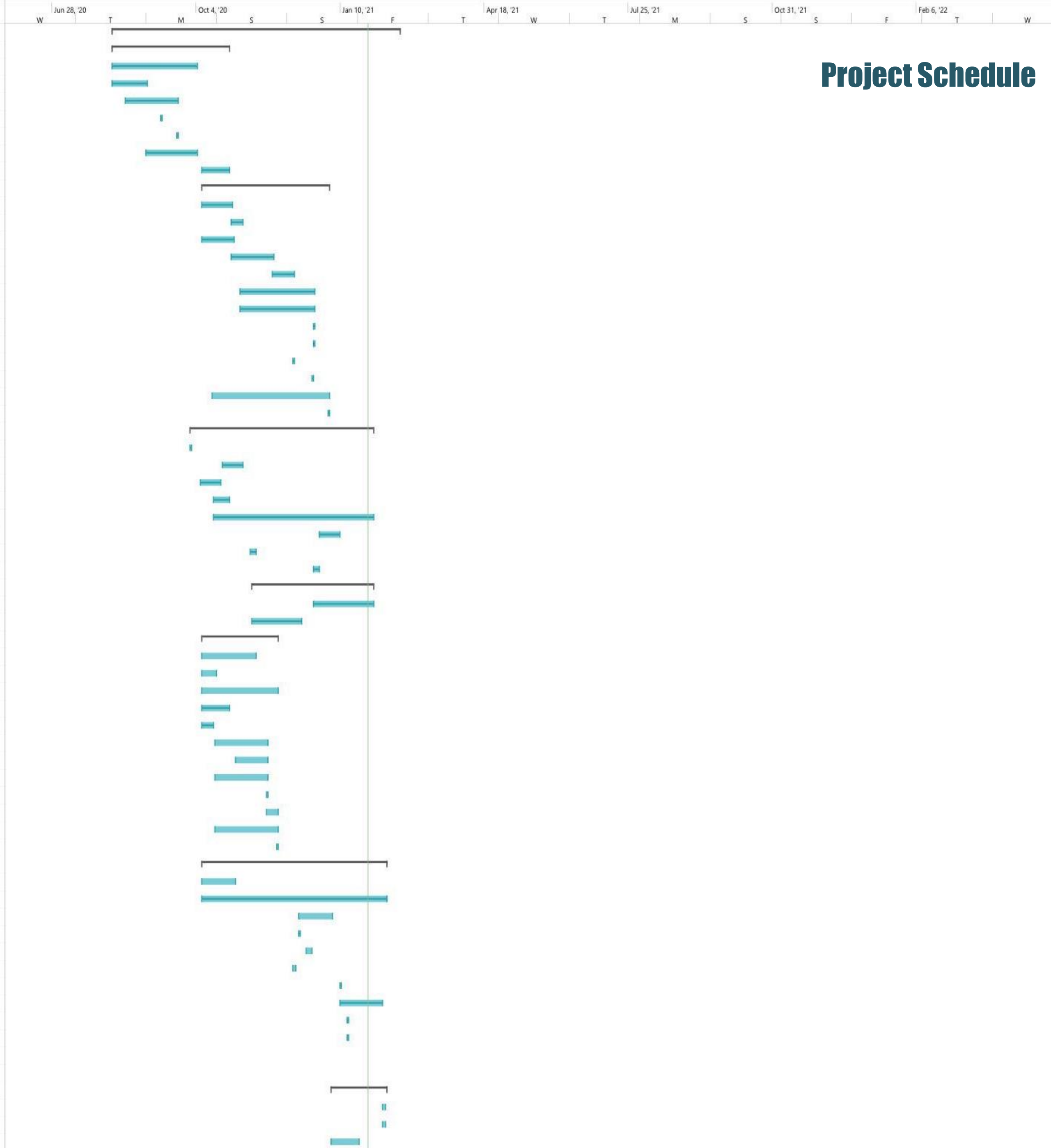
FRONT ELEVATION VIEW
SCALE: 1 / 4

MALE MOLD CONCEPT
SCALE 0.002

DRAWN Nicolas Tenorio	1/6/2021	George Mason University Concrete Canoe
CHECKED		TITLE
QA		Concrete Canoe Hull Layout Final Draft
MFG		
APPROVED		
		SIZE D · DWG NO 1 · REV
		SCALE · SHEET 1 OF 1

Project Schedule

ID	Task Name	Duration	Start	Finish	Actual Duration	Actual Start	Actual Finish
1	**1st Year Timeline**	**140 days**	**Sat 8/8/20**	**Fri 2/19/21**	**93.05 days**	**Sat 8/8/20**	**NA**
2	**Recruitment and Project Structuring**	**56 days**	**Sat 8/8/20**	**Mon 10/26/20**	**56 days**	**Sat 8/8/20**	**Mon 10/26/20**
3	Leadership Structuring	42 days	Sat 8/8/20	Sun 10/4/20	42 days	Sat 8/8/20	Sun 10/4/20
4	Project Interest Marketing	17 days	Sat 8/8/20	Mon 8/31/20	17 days	Sat 8/8/20	Mon 8/31/20
5	Communication Platform Design	26 days	Mon 8/17/20	Mon 9/21/20	26 days	Mon 8/17/20	Mon 9/21/20
6	Interest Meeting	1 day	Thu 9/10/20	Thu 9/10/20	1 day	Thu 9/10/20	Thu 9/10/20
7	First General Body Meeting	1 day	Mon 9/21/20	Mon 9/21/20	1 day	Mon 9/21/20	Mon 9/21/20
8	Determine Project Sub. Leads	26 days	Mon 8/31/20	Sun 10/4/20	26 days	Mon 8/31/20	Sun 10/4/20
9	Inventory	13 days	Thu 10/8/20	Mon 10/26/20	13 days	Thu 10/8/20	Mon 10/26/20
10	**Mix Design (Trial-Build)**	**62 days**	**Thu 10/8/20**	**Sat 1/2/21**	**44.54 days**	**Thu 10/8/20**	**NA**
11	Research	15 days	Thu 10/8/20	Wed 10/28/20	15 days	Thu 10/8/20	Wed 10/28/20
12	Plan/Coordinate In-Person Work Dates/Location	6 days	Wed 10/28/20	Wed 11/4/20	6 days	Wed 10/28/20	Wed 11/4/20
13	Materials Inventory	16 days	Thu 10/8/20	Thu 10/29/20	16 days	Thu 10/8/20	Thu 10/29/20
14	calculate potential mix designs	21 days	Wed 10/28/20	Wed 11/25/20	21 days	Wed 10/28/20	Wed 11/25/20
15	potential reinforcement design	11 days	Wed 11/25/20	Wed 12/9/20	11 days	Wed 11/25/20	Wed 12/9/20
16	Initial Testing	37 days	Tue 11/3/20	Wed 12/23/20	37 days	Tue 11/3/20	Wed 12/23/20
17	Mix Design Refinement	37 days	Tue 11/3/20	Wed 12/23/20	37 days	Tue 11/3/20	Wed 12/23/20
18	Final Design Testing	1 day	Wed 12/23/20	Wed 12/23/20	1 day	Wed 12/23/20	Wed 12/23/20
19	Final Mix Selection	1 day	Wed 12/23/20	Wed 12/23/20	1 day	Wed 12/23/20	Wed 12/23/20
20	Final Reinforcement Selection	1 day	Wed 12/9/20	Wed 12/9/20	1 day	Wed 12/9/20	Wed 12/9/20
21	Order Materials	1 day	Tue 12/22/20	Tue 12/22/20	1 day	Tue 12/22/20	Tue 12/22/20
22	Mix Design Report Draft	58 days	Thu 10/15/20	Sat 1/2/21	0 days	Thu 10/15/20	NA
23	Submit Mix Design Report to Design Report Team	1 day	Sat 1/2/21	Sat 1/2/21	1 day	Sat 1/2/21	Sat 1/2/21
24	**Hull Design (Trial-Build)**	**89 days**	**Wed 9/30/20**	**Mon 2/1/21**	**89 days**	**Wed 9/30/20**	**Mon 2/1/21**
25	Hull Design Guest Speaker	1 day	Wed 9/30/20	Wed 9/30/20	1 day	Wed 9/30/20	Wed 9/30/20
26	Coordardinate with Mold Design	10 days	Thu 10/22/20	Wed 11/4/20	10 days	Thu 10/22/20	Wed 11/4/20
27	Hull Design Research	10 days	Wed 10/7/20	Tue 10/20/20	10 days	Wed 10/7/20	Tue 10/20/20
28	Initial Designs	7 days	Fri 10/16/20	Mon 10/26/20	7 days	Fri 10/16/20	Mon 10/26/20
29	Structural Analysis Calculations	77 days	Fri 10/16/20	Mon 2/1/21	77 days	Fri 10/16/20	Mon 2/1/21
30	Finalize Trial Hull Design	12 days	Sun 12/27/20	Sat 1/9/21	12 days	Sun 12/27/20	Sat 1/9/21
31	Compose Hull Design Section Draft	4 days	Tue 11/10/20	Fri 11/13/20	4 days	Tue 11/10/20	Fri 11/13/20
32	Submit Hull Design Section to Report Team	4 days	Wed 12/23/20	Sat 12/26/20	4 days	Wed 12/23/20	Sat 12/26/20
33	**Structural Analysis (Trial-Build)**	**59 days**	**Wed 11/11/20**	**Mon 2/1/21**	**59 days**	**Wed 11/11/20**	**Mon 2/1/21**
34	Structural Analysis Hull Draft	29 days	Wed 12/23/20	Mon 2/1/21	29 days	Wed 12/23/20	Mon 2/1/21
35	Hydrostatic Pressure Report	24 days	Wed 11/11/20	Mon 12/14/20	24 days	Wed 11/11/20	Mon 12/14/20
36	**Mold Design (Trial-Build)**	**37 days**	**Thu 10/8/20**	**Sat 11/28/20**	**3.45 days**	**Thu 10/8/20**	**NA**
37	Coordinate with Hull Design	27 days	Thu 10/8/20	Fri 11/13/20	0 days	Thu 10/8/20	NA
38	Research	8 days	Thu 10/8/20	Sat 10/17/20	0 days	Thu 10/8/20	NA
39	Coordinate/Plan In-Person Work Dates/Location	38 days	Thu 10/8/20	Sat 11/28/20	0 days	Thu 10/8/20	NA
40	Materials Inventory	13 days	Thu 10/8/20	Mon 10/26/20	13 days	Thu 10/8/20	Mon 10/26/20
41	Finances and Budget	6 days	Thu 10/8/20	Thu 10/15/20	6 days	Thu 10/8/20	Thu 10/15/20
42	Design Hull	27 days	Sat 10/17/20	Sat 11/21/20	0 days	NA	NA
43	Bulkhead Design	17 days	Sat 10/31/20	Sat 11/21/20	0 days	NA	NA
44	Determine Material Costs	27 days	Sat 10/17/20	Sat 11/21/20	0 days	NA	NA
45	Finalize Mold & Bulkhead Design	1 day	Sat 11/21/20	Sat 11/21/20	0 days	NA	NA
46	Material Procurement	7 days	Sat 11/21/20	Sat 11/28/20	0 days	NA	NA
47	Mold Design Section Draft	32 days	Sat 10/17/20	Sat 11/28/20	0 days	NA	NA
48	Submit Mold Design Section to Report Team	1 day	Sat 11/28/20	Sat 11/28/20	0 days	NA	NA
49	**Construction (Trial-Build)**	**90 days**	**Thu 10/8/20**	**Wed 2/10/21**	**65.77 days**	**Thu 10/8/20**	**NA**
50	Coordinate/Plan In-Person Work Dates	17 days	Thu 10/8/20	Fri 10/30/20	0 days	Thu 10/8/20	NA
51	Coordinate with Lab	90 days	Thu 10/8/20	Wed 2/10/21	90 days	Thu 10/8/20	Wed 2/10/21
52	**Prototype Mold Construction**	17 days	Sun 12/13/20	Mon 1/4/21	0 days	Sun 12/13/20	NA
53	Assemble Mold	1 day	Sun 12/13/20	Sun 12/13/20	1 day	Sun 12/13/20	Sun 12/13/20
54	Sanding	2 days	Fri 12/18/20	Mon 12/21/20	0 days	Fri 12/18/20	NA
55	Preppinng for Casting Day	2 days	Wed 12/9/20	Thu 12/10/20	0 days	Wed 12/9/20	NA
56	Bulk Head Construction	1 day	Sun 1/10/21	Sun 1/10/21	1 day	Sun 1/10/21	Sun 1/10/21
57	Trial Casting Day	22 days	Sun 1/10/21	Sun 2/7/21	22 days	Sun 1/10/21	Sun 2/7/21
58	Concrete Curing	1 day	Fri 1/15/21	Fri 1/15/21	0 days	NA	NA
59	Mold Removal	1 day	Fri 1/15/21	Fri 1/15/21	0 days	NA	NA
60	Construction Section Draft				0 days	NA	NA
61	Submit Constuction Section to Report Team				0 days	NA	NA
62	**Finishing (Trial-Build)**	**28 days**	**Mon 1/4/21**	**Wed 2/10/21**	**0 days**	**NA**	**NA**
63	Patching/Sanding Exterior	2 days	Mon 2/8/21	Tue 2/9/21	0 days	NA	NA
64	Patching/Sanding Interior	2 days	Mon 2/8/21	Tue 2/9/21	0 days	NA	NA
65	Sealer Reseacher	15 days	Mon 1/4/21	Fri 1/22/21	0 days	NA	NA

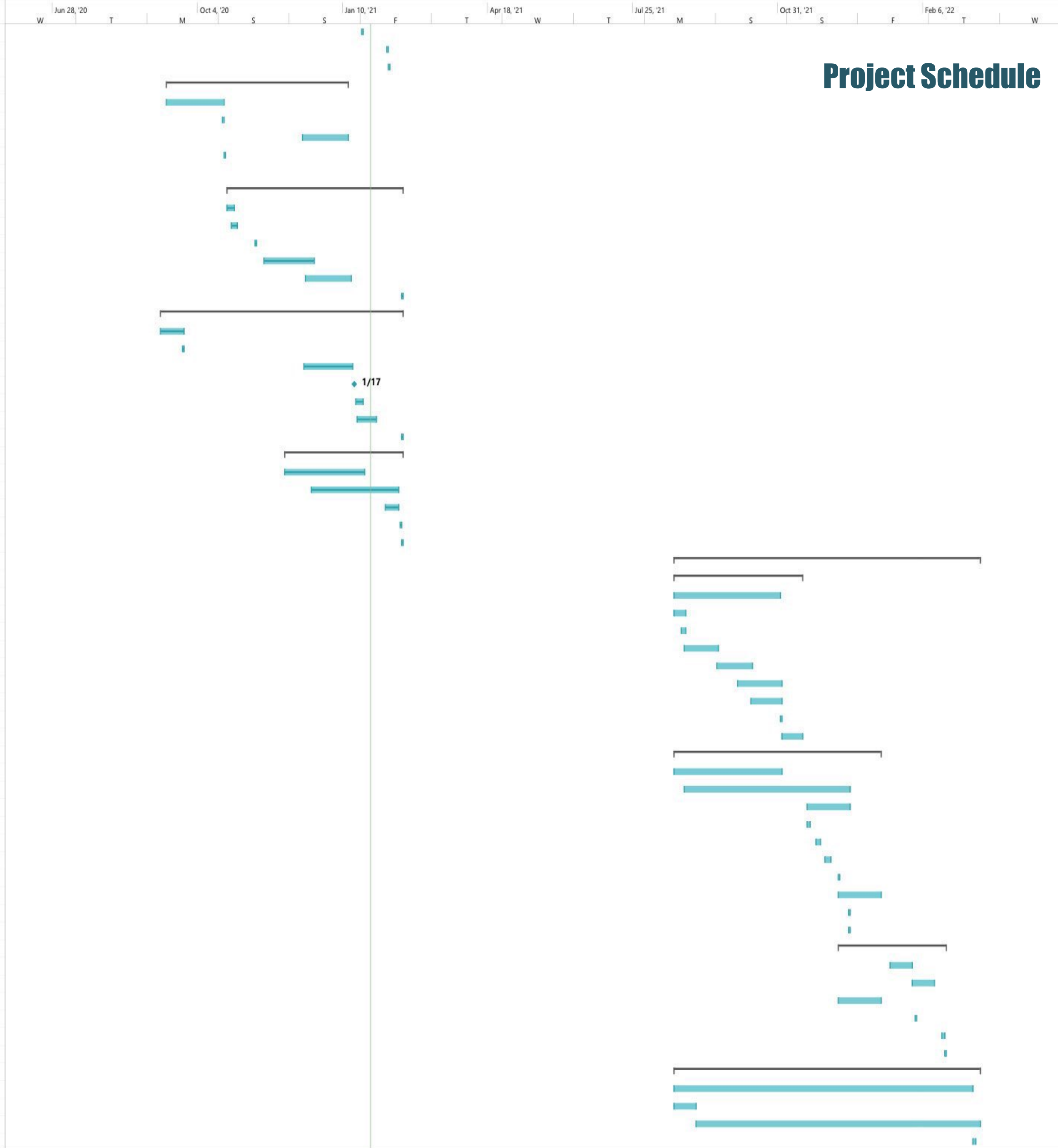


Project: GMU Concrete Canoe 2
Date: Fri 1/29/21

Task | Split | Milestone | Summary | Project Summary | Inactive Task | Inactive Milestone | Inactive Summary | Manual Task | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only | External Tasks | External Milestone | Deadline | Progress | Manual Progress

Project Schedule

ID	Task Name	Duration	Start	Finish	Actual Duration	Actual Start	Actual Finish
66	Sealer Selection	1 day	Sat 1/23/21	Sat 1/23/21	0 days	NA	NA
67	Sealing	1 day	Tue 2/9/21	Tue 2/9/21	0 days	NA	NA
68	Canoe Finished	1 day	Wed 2/10/21	Wed 2/10/21	0 days	NA	NA
69	**Visuals and Theme**	**88 days**	**Sun 9/13/20**	**Wed 1/13/21**	**0 days**	**NA**	**NA**
70	Brainstorm Themes	29 days	Sun 9/13/20	Wed 10/21/20	0 days	NA	NA
71	Finalize Theme Selection	1 day	Wed 10/21/20	Wed 10/21/20	0 days	NA	NA
72	Design Theme Graphics	23 days	Mon 12/14/20	Wed 1/13/21	0 days	NA	NA
73	Finalize Theme Graphics	1 day	Thu 10/22/20	Thu 10/22/20	0 days	NA	NA
74	**Display**				0 days	NA	NA
75	**R. John Craig Legacy**	**85 days**	**Sat 10/24/20**	**Fri 2/19/21**	**50.7 days**	**Sat 10/24/20**	**NA**
76	Research Potential Alumni	4 days	Sat 10/24/20	Wed 10/28/20	4 days	Sat 10/24/20	Wed 10/28/20
77	Talk with Alum about past experiences	4 days	Tue 10/27/20	Fri 10/30/20	4 days	Tue 10/27/20	Fri 10/30/20
78	Film	1 day	Thu 11/12/20	Thu 11/12/20	1 day	Thu 11/12/20	Thu 11/12/20
79	Video Editing	24 days	Wed 11/18/20	Mon 12/21/20	24 days	Wed 11/18/20	Mon 12/21/20
80	Finish Video Presentation	23 days	Wed 12/16/20	Fri 1/15/21	0 days	Wed 12/16/20	NA
81	Presentation Due	1 day	Fri 2/19/21	Fri 2/19/21	1 day	Fri 2/19/21	Fri 2/19/21
82	**Enhanced Focus Area**	**118 days**	**Wed 9/9/20**	**Fri 2/19/21**	**118 days**	**Wed 9/9/20**	**Fri 2/19/21**
83	Brainstorm Potential Focus Areas	12 days	Wed 9/9/20	Thu 9/24/20	12 days	Wed 9/9/20	Thu 9/24/20
84	Finalize Focus Areas	1 day	Thu 9/24/20	Thu 9/24/20	1 day	Thu 9/24/20	Thu 9/24/20
85	Report Draft	25 days	Tue 12/15/20	Sat 1/16/21	25 days	Tue 12/15/20	Sat 1/16/21
86	Submit for profession/peer review	0 days	Sun 1/17/21	Sun 1/17/21	0 days	Sun 1/17/21	Sun 1/17/21
87	Final Revisions Review	5 days	Tue 1/19/21	Sat 1/23/21	5 days	Tue 1/19/21	Sat 1/23/21
88	Report Complete	9 days	Wed 1/20/21	Mon 2/1/21	9 days	Wed 1/20/21	Mon 2/1/21
89	Report Due	1 day	Fri 2/19/21	Fri 2/19/21	1 day	Fri 2/19/21	Fri 2/19/21
90	**Design Report**	**58 days**	**Wed 12/2/20**	**Fri 2/19/21**	**58 days**	**Wed 12/2/20**	**Fri 2/19/21**
91	Compose Draft	39 days	Wed 12/2/20	Sun 1/24/21	39 days	Wed 12/2/20	Sun 1/24/21
92	Peer/Professional Editing	43 days	Sun 12/20/20	Tue 2/16/21	43 days	Sun 12/20/20	Tue 2/16/21
93	Final Revisions and Review	7 days	Mon 2/8/21	Tue 2/16/21	7 days	Mon 2/8/21	Tue 2/16/21
94	Paper Complete	1 day	Thu 2/18/21	Thu 2/18/21	1 day	Thu 2/18/21	Thu 2/18/21
95	Paper Due	1 day	Fri 2/19/21	Fri 2/19/21	1 day	Fri 2/19/21	Fri 2/19/21
96	**2nd Year Timeline**	**148 days**	**Sun 8/22/21**	**Wed 3/16/22**	**0 days**	**NA**	**NA**
97	**Mold Design (Actual-Build)**	**62 days**	**Sun 8/22/21**	**Tue 11/16/21**	**0 days**	**NA**	**NA**
98	Coordinate/Plan In-Person Work Dates/Location	52 days	Sun 8/22/21	Mon 11/1/21	0 days	NA	NA
99	Discuss what worked/didn't work from trial-build	7 days	Sun 8/22/21	Sun 8/29/21	0 days	NA	NA
100	Materials Inventory	2 days	Fri 8/27/21	Sun 8/29/21	0 days	NA	NA
101	Determine mold method	17 days	Sun 8/29/21	Mon 9/20/21	0 days	NA	NA
102	Determine Mold Design and Construction Process	18 days	Mon 9/20/21	Wed 10/13/21	0 days	NA	NA
103	Determine Bulkhead Design and Construction Process	22 days	Mon 10/4/21	Tue 11/2/21	0 days	NA	NA
104	Determine Material Costs	15 days	Wed 10/13/21	Tue 11/2/21	0 days	NA	NA
105	Finalize Mold & Bulkhead Design	1 day	Tue 11/2/21	Tue 11/2/21	0 days	NA	NA
106	Material Procurement	10 days	Wed 11/3/21	Tue 11/16/21	0 days	NA	NA
107	**Construction (Actual-Build)**	**100 days**	**Sun 8/22/21**	**Sat 1/8/22**	**0 days**	**NA**	**NA**
108	Coordinate/Plan In-Person Work Dates	53 days	Sun 8/22/21	Tue 11/2/21	0 days	NA	NA
109	Coordinate with Lab Manager	82 days	Sun 8/29/21	Sat 12/18/21	0 days	NA	NA
110	Begin Mold Construction	22 days	Sat 11/20/21	Sat 12/18/21	0 days	NA	NA
111	Assemble Mold	2 days	Sat 11/20/21	Sun 11/21/21	0 days	NA	NA
112	Sanding Mold	2 days	Fri 11/26/21	Sun 11/28/21	0 days	NA	NA
113	Preppinng for Casting Day	3 days	Thu 12/2/21	Sun 12/5/21	0 days	NA	NA
114	Casting Day	1 day	Sat 12/11/21	Sat 12/11/21	0 days	NA	NA
115	Concrete Curing	22 days	Sat 12/11/21	Sat 1/8/22	0 days	NA	NA
116	Mold Removal	1 day	Sat 12/18/21	Sat 12/18/21	0 days	NA	NA
117	Encasing Bulkheads	1 day	Sat 12/18/21	Sat 12/18/21	0 days	NA	NA
118	**Finishing (Actual-Build)**	**51 days**	**Sat 12/11/21**	**Mon 2/21/22**	**0 days**	**NA**	**NA**
119	Patching/Sanding Exterior	12 days	Sat 1/15/22	Sat 1/29/22	0 days	NA	NA
120	Patching/Sanding Interior	12 days	Sun 1/30/22	Sun 2/13/22	0 days	NA	NA
121	Sealer Reacher	22 days	Sat 12/11/21	Sat 1/8/22	0 days	NA	NA
122	Sealer Selection	1 day	Tue 2/1/22	Tue 2/1/22	0 days	NA	NA
123	Sealing	2 days	Sat 2/19/22	Sun 2/20/22	0 days	NA	NA
124	Canoe Finished	1 day	Mon 2/21/22	Mon 2/21/22	0 days	NA	NA
125	**Race Preperation**	**148 days**	**Sun 8/22/21**	**Wed 3/16/22**	**0 days**	**NA**	**NA**
126	Coordinate/Plan In-Person Work Dates	146 days	Sun 8/22/21	Fri 3/11/22	0 days	NA	NA
127	Determine workout/meal plans	12 days	Sun 8/22/21	Sun 9/5/21	0 days	NA	NA
128	Paddler training	138 days	Mon 9/6/21	Wed 3/16/22	0 days	NA	NA
129	Paddler training on trial-build canoe	2 days	Sat 3/12/22	Sun 3/13/22	0 days	NA	NA



Project: GMU Concrete Canoe 2
Date: Fri 1/29/21

Task	Milestone	Project Summary	Inactive Milestone	Manual Task	Manual Summary Rollup	Start-only	External Tasks	Deadline	Manual Progress
Split	Summary	Inactive Task	Inactive Summary	Duration-only	Manual Summary	Finish-only	External Milestone	Progress	

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Appendix B - Mixture Proportions and Primary Mixture Calculations:

Cementitious Materials

Component	Specific Gravity	Volume	Amount of CM	
Portland Cement ASTM C150	3.15	1.35 ft^3	265.81 lb/yd^3	Total cm (includes c) ___638.4____ lb/yd^3 c/cm ratio, by mass __0.42_____
Hess Pozz ASTM C618	2.50	1.24 ft^3	193.55 lb/yd^3	
Fly Ash Class F ASTM C618	2.45	0.87 ft^3	135.59 lb/yd^3	
Silica Fumes ASTM C1240	2.26	0.26 ft^3	36.45lb/yd^3	

Fibers

Component	Specific Gravity	Volume	Amount of Fibers	
PSI Fiberstrand 150 (19mm)	0.91	0.01 ft^3	0.41 lb/yd^3	Total Amount of Fibers ___0.41____ lb/yd^3
-	-	-	-	

Aggregates

Aggregates	Abs (%)	SG_{OD}	SG_{SSD}	Base Quantity, W		Volume, $V_{agg, SSD}$
				W_{OD}	W_{SSD}	
Hess Grade 10 (0.6 – 4.75 mm)	15%	1.60	1.83	247.6 lb/yd^3	283.50 lb/yd^3	2.48 ft^3
Hess Grade 7 (0.6 – 2.38 mm)	14%	1.65	1.88	225.82 lb/yd^3	257.43 lb/yd^3	2.19 ft^3
Hess Grade 5 (0.06 – 2 mm)	14%	1.65	1.88	144.61 lb/yd^3	164.86 lb/yd^3	1.40 ft^3
Expanded Perlite	79%	0.22	0.39	44.9 lb/yd^3	80.37 lb/yd^3	3.27 ft^3

Liquid Admixtures

Admixture	lb/ US gal	Dosage (fl. oz / cwt)	% Solids	Amount of Water in Admixture	
Sika Viscocrete-2100 (9 fl oz/100lb	9.03	56.56	40.10 %	15.02 lb/yd^3	Total Water from Liquid Admixtures, $\sum w_{admx}$ __52.40_____ lb/yd^3
SikaSet NC (18 fl 0z/100lb)	11.46	113.11	49.90 %	31.87 lb/yd^3	
Sika AEA-14 (2.3 fl oz/100 lb)	8.45	14.45	8.00 %	5.51 lb/yd^3	

Solids (dyes, powdered admixtures)

Component	Specific Gravity	Volume (ft^3)	Amount (lb/yd^3)	
Solomon Green Pigment	4.20	0.06 ft^3	14.67lb/yd^3	Total Solids. S_{total} _14.67_______ lb/yd^3

Water

	Amount		Volume
Water, w, $[=\sum (w_{free} + w_{admx} + w_{batch})]$	w/c ratio, by mass ___0.83____ w/cm ratio, by mass _0.35______	219.94 lb/yd^3	3.52 ft^3
Total Free Water from All Aggregates, $\sum w_{free}$		-120.03 lb/yd^3	
Total Water from All Admixtures, $\sum w_{admx}$		52.40 lb/yd^3	
Batch Water, w_{batch}		287.57 lb/yd^3	

Densities, Air Content, Ratios, and Slump

Values for 1 cy of concrete	cm	Fibers	Aggregate (SSD)	Solids, S_{total}	Water, w	Total
Mass, M	628.40 lb	0.41 lb	786.16 lb	14.67 lb	219.94 lb	$\sum M$:1649.58 lb
Absolute Volume, V	3.72 ft^3	0.01 ft^3	9.35 ft^3	0.06 ft^3	3.52 ft^3	$\sum V$:16.66 ft^3
Theoretical Density, T, $(=\sum M / \sum V)$	99.04 lb/ft^3		Air Content, Air, [= (T – D)/T x 100%]			38.3 %
Anticipated Density, D	61.10 lb/ft^3		Air Content, Air, $[= (27 – \sum V))/27 \times 100\%]$			38.3 %
Total Aggregate Ratio $(=V_{agg,SSD} / 27)$	34.62 %		Slump, Slump flow, Spread (as applicable)			1.5+/-0.5 in.
C330 + RCA Ratio $(=V_{C330+RCA} / V_{agg})$	NA %					

Name	Manufacturer	Type	Standard	URL
Cementitious Materials & Pozzolans				
Class C Fly Ash	Boral Resources	Class C	ASTM C618	link
Class F Fly Ash	Boral Resources	Class F	ASTM C618	link
Hess Standard Pozz	Hess Pumice Grades	Pozzolan	ASTM C618	link
Portland Cement	Lehigh Hanson	Type 1	ASTM C150	link
Sikacrete 950-DP	Sika	Densified Silica Fume Powder	ASTM C1240	link
Newcem	Holcim & Lafarge	Slag Cement	ASTM C989	link
Aggregates				
Hess Grade 2	Hess Pumice Grades	Pumice	ASTM C330	link
Hess Grade 3	Hess Pumice Grades	Pumice	ASTM C330	link
Hess Grade 5	Hess Pumice Grades	Pumice	ASTM C330	link
Hess Grade 7	Hess Pumice Grades	Pumice	ASTM C330	link
Hess Grade 10	Hess Pumice Grades	Pumice	ASTM C330	link
Therm-O-Rock Perlite	Therm-O-Rock West, Inc.	Perlite	ASTM C330	link
Fibers				
NYCON-PVA RECS100	NYCON	PVA	ASTM C1116	link
PSI Fiberstrand 150	Euclid Chemical	Polypropylene Microfiber	ASTM C1116	link
Admixtures				
SikaControl-75	Sika	Type S	ASTM C494	link
ViscoCrete-2100	Sika	Type A and F	ASTM C494	link
Sika AEA-14	Sika	Air Entrainment Admixture	ASTM C260	link
SikaSet NC	Sika	Type C	ASTM C494	link
Reinforcing Materials				
Curing & Sealing Compounds				
Cure 'N Seal (WB)	Sakrete	Compound	ASTM C309	link
Other/Miscellaneous				

Structural Calculations

Assumptions:

-The canoe has uniform rectangular cross sections along the length of the canoe

-The weight of each paddler is 200 lbs represented as point loads

-Calculated weight of the canoe upper limit 246 lbs

-Both weight of canoe and buoyancy force were represented as triangular distributed loads

-Canoe is symmetrical

-For 2 people, the location of each person will be 15% and 85%

-For 4 people, the locations of each person will be at 15%, 30%, 75%, and 90% respectively

-The width from the cross-section is located at the center of the canoe

-Cross-section is a U-shape

-Factor of safety due to dynamics 1.5

ESTIMATE SHEAR STRESS AND BENDING MOMENTS:

Two-Paddlers with Cargo Load

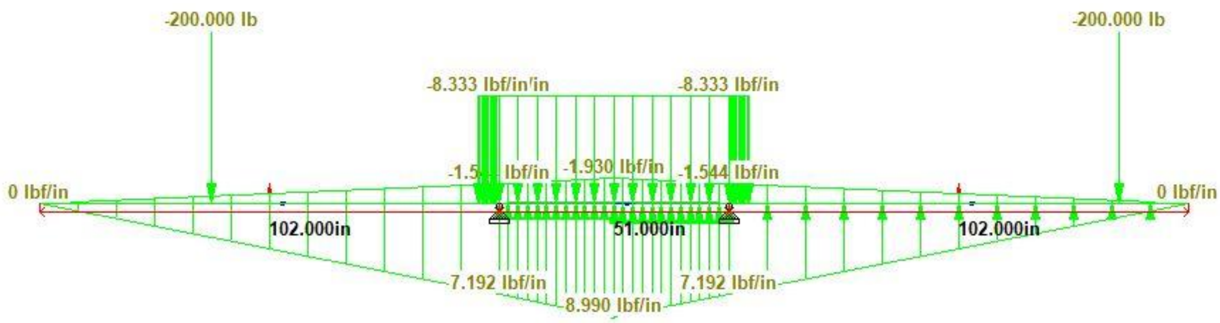


Figure D1: Case 1- Free Body Diagram

L_1 (first section of the canoe) = 102 in

L_2 (second section of the canoe) = 51 in

L_3 (third section of the canoe) = 102 in

W_c (weight of canoe) = 246 lbs

L_c (length of canoe) = 255 in

C (cargo load) = 500 lbs

W_d (distributed load)= $2*W_c+0.5C/0.5*L_c$= 11.160 lb/in

Percent distance between the 1st section and half of the canoe= (102 in/127.5 in) *100= 80%

Wd*(80%) = 11.160 lb/in*0.8= 8.930 lb/in

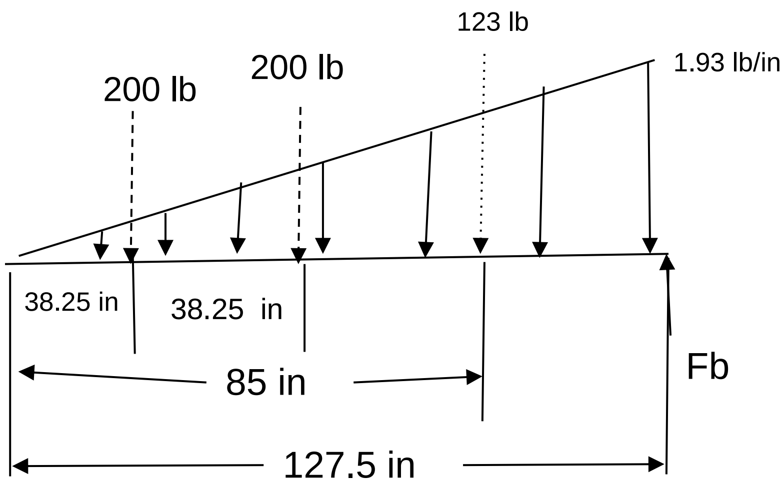


Figure D2: Resulting Shear Diagram of Canoe

$$\Sigma fy = 0$$

$$Fb = 200\ lb + 123lb + 250lb = 573\ lb$$

$$Wb = (2 * 573)/127.5 = 8.99\ lb/in$$

Percent distance from first support and the L/2 = 102/127.5 = 0.8

$$Wb_{80} = 8.99\ lb/in \times 0.8 = 6.56\ lb/in$$

The Diagrams below were captured by STAAD.Pro

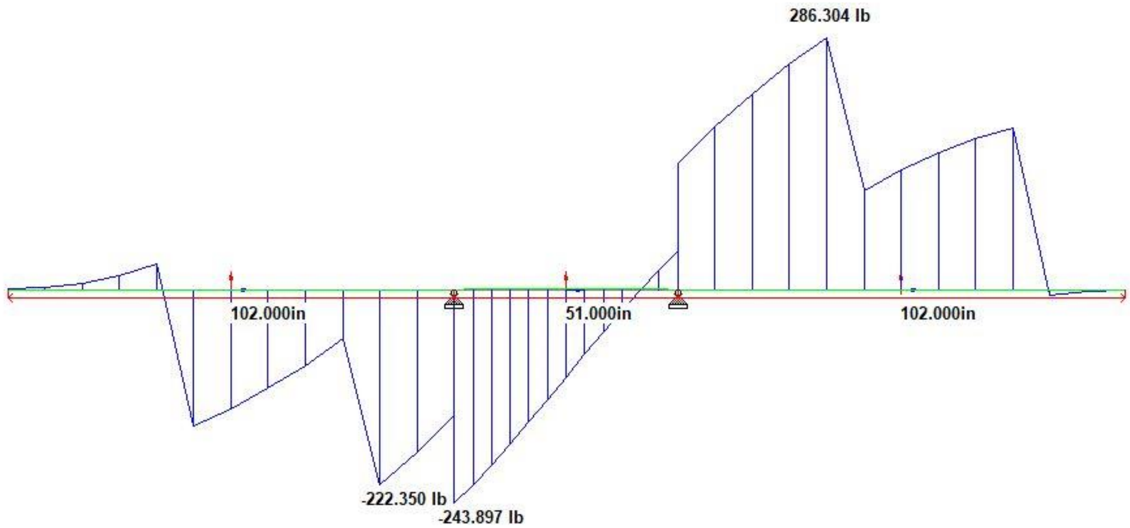


Figure D7: Shear Diagram

The max shear is about 286 lbs.

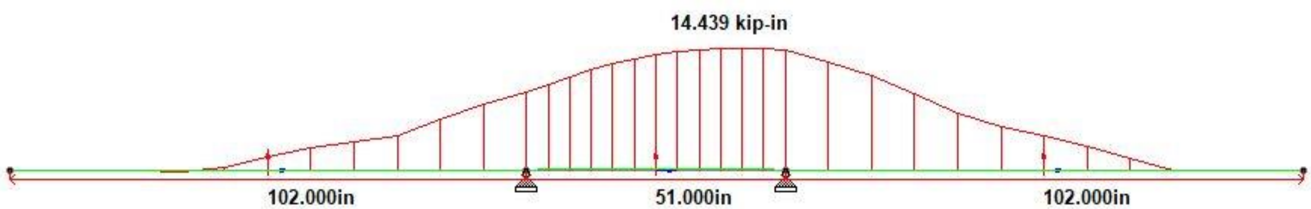


Figure D8: Bending Moment Diagram

According to the Bending Moment Diagram above, the maximum bending moment is 14.439 kip-in.

Cracking & Ultimate Bending Moments

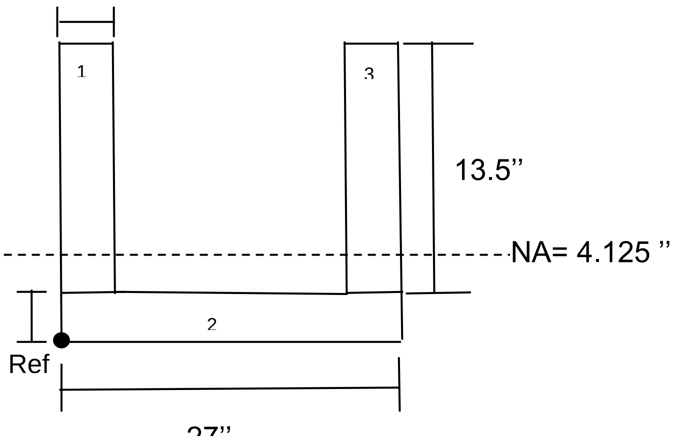


Figure D9: Cracking & Ultimate Bending Moments

<u>Cross Section:</u>

A_1=13.5 in^2

A_2= 27 in^2

A_3= 13.5 in^2

$$\underline{Y} = \frac{\Sigma(yi * Ai)}{\Sigma Ai}$$

$$\underline{Y} = \frac{(2)(13.5)(7.75)+(27)(0.5)}{13.5+13.5+27}$$

$\underline{Y}$= 4.125 in from the bottom

Calculation for Moment of Inertia:

$$Ig = \Sigma Ii + Ai * dyi^2$$

$$Ig = \frac{1}{12}(27)(1)^3 + (27)(1)(4.125 - 0.5)^2 + 2(\frac{1}{12})(1)(13.5)^3 + (1)(13.5)(7.75 - 4.125)^2$$

$$Ig = 944.5078\ in^4$$

Determination of Peak Stresses:

$$\sigma = \frac{My}{I}$$

Max Tensile Stress

$$\sigma^{+} = \frac{(14439\ lb-in)(14.5\ in-4.125\ in)}{944.5078\ in^4} = 158.606\ lb/in^2$$

Max Compressive Stress

$$\sigma^{-} = \frac{(14439\ lb-in)(4.125\ in)}{944.5078\ in^4} = 63.060\ lb/in^2$$

$$\sigma < \frac{f'c}{FOS}$$

$63.060\ lb/in^2 < 1470/1.5\ lb/in^2$

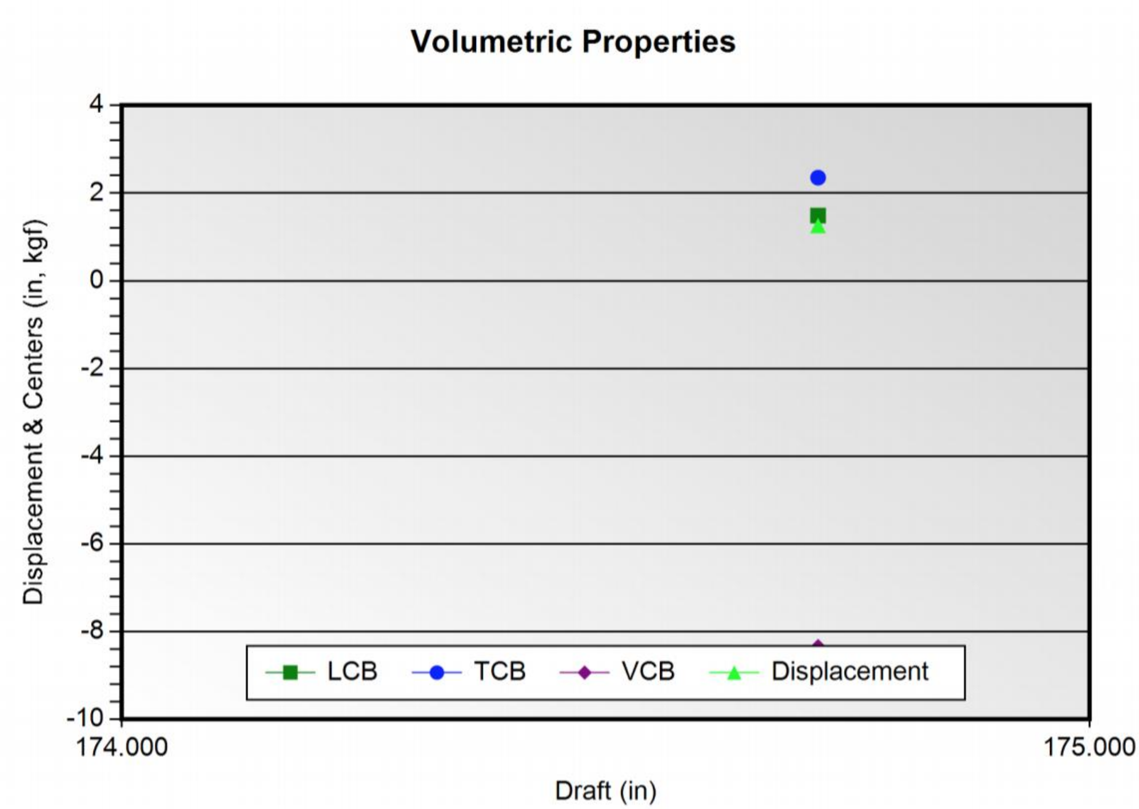
$63.060\ lb/in^2 < 980\ lb/in^2$ OK

Ultimate Bending Moment from the graphs= 14439 lb/in^2

Freeboard Calculations

Volumetric properties graph- estimated freeboard (displaced volumes) and draught values using outputs from Orca 3D (inches) for the shallowest section of canoe.

Graph 1: Unloaded condition (self-weight)

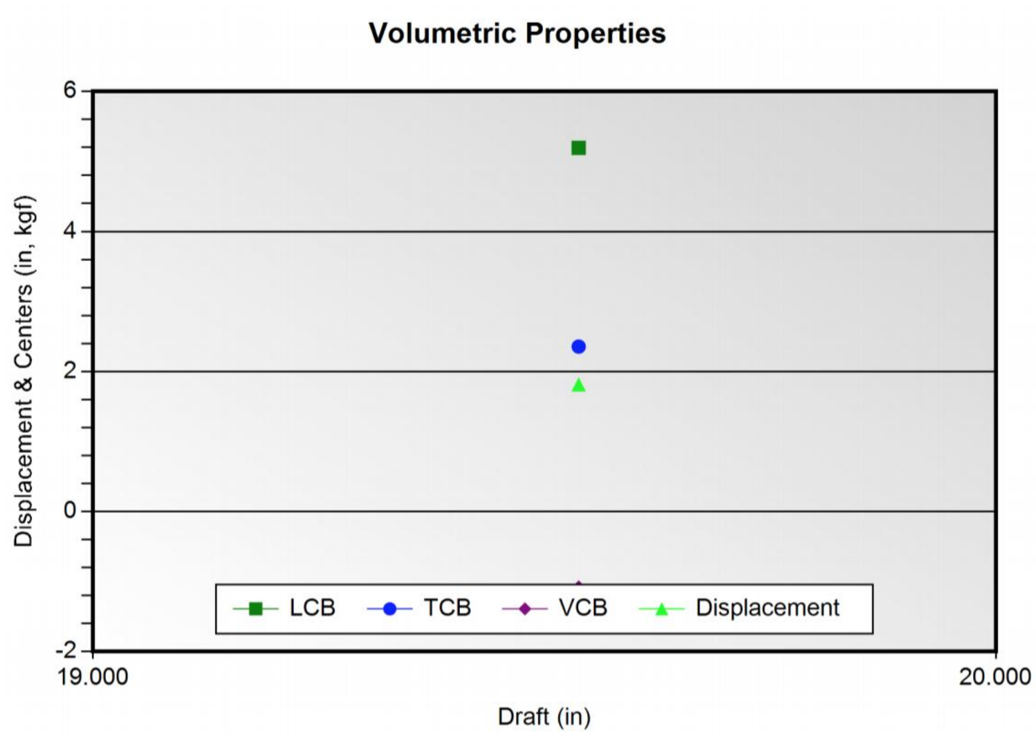


LCB:Longitudinal Center of Buoyancy

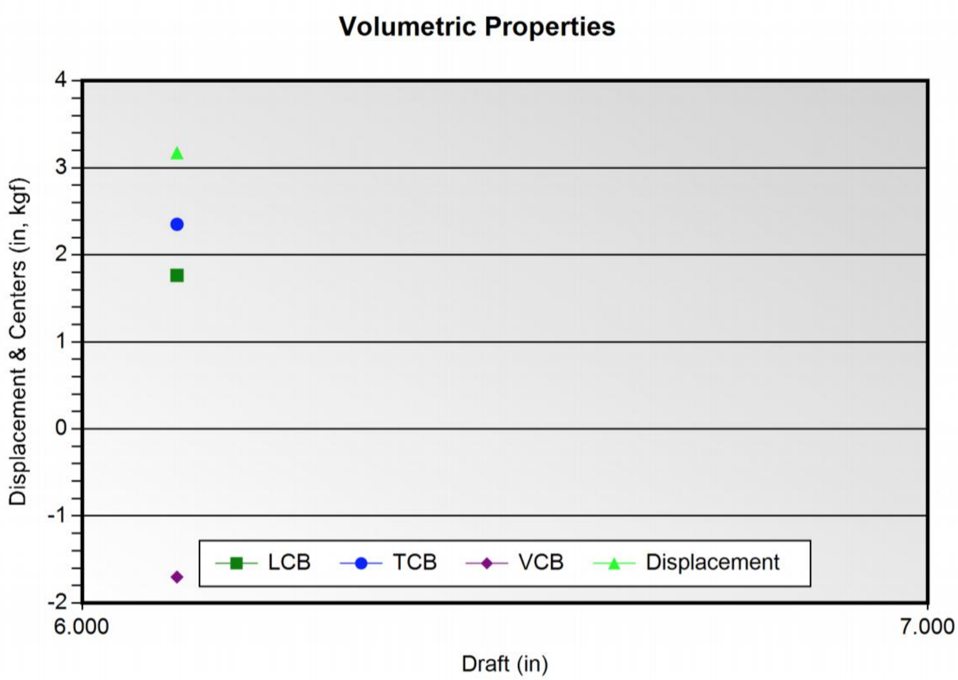
VCB: Vertical Center of Buoyancy

TCB: transversal center of buoyancy

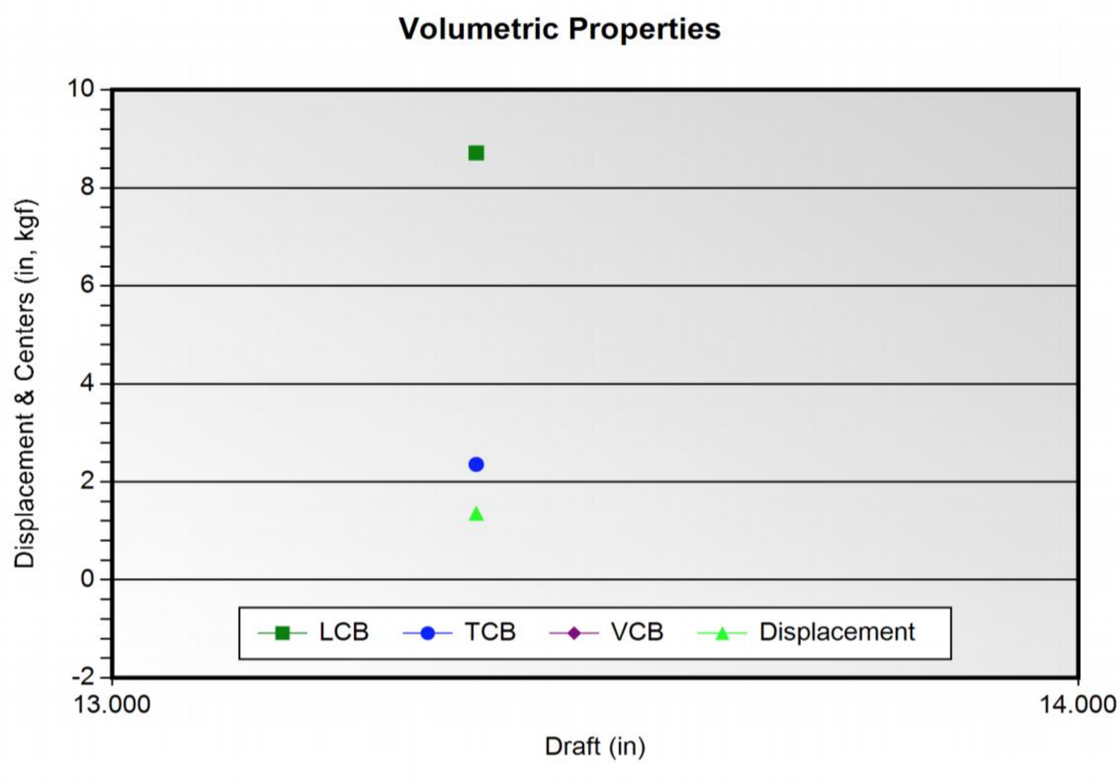
Graph D2: Male Tandem (181.437 kgf/400 lbs)



Graph D3: Female Tandem (136.078 kgf/300 lbs):

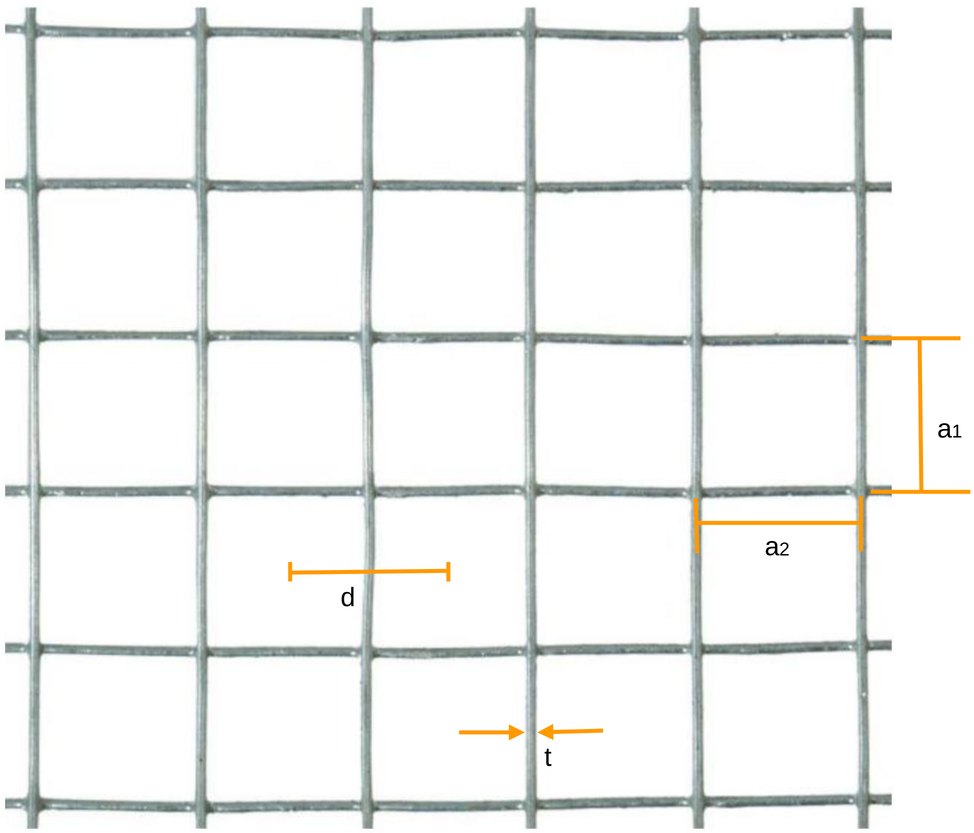


Graph D4: Four Person Co-Ed (317.515 kgf/700 lbs)



Percent Open Area

Figure E1: Reinforcement of the Canoe



n_1= Number of apertures along sample length

n_2= Number of apertures along sample width

d_1= Spacing of reinforcing (center-to-center) along sample length

d_2= Spacing of reinforcing (center-to-center) along sample width

t_1= Thickness of reinforcing along sample length

t_2= Thickness of reinforcing along sample width

a_1= Aperture dimension for length

a_2=Aperture dimension for width

t_1=t_2= 0.039 in

n_1=n_2= 5

a_1=a_2= 0.5

d_1= $a_1+2(\frac{t_1}{2})$= 0.539 in

d_2= $a_2+2(\frac{t_{12}}{2})$= 0.539 in

$Length_{sample}$= $n_1 \cdot d_1$= 5·0.539 in= 2.695 in

$Width_{sample}$= $n_2 \cdot d_2$= 5·0.539 in= 2.695 in

$Area_{open}$= $n_1 \cdot n_2 \cdot a_1 \cdot a_2$= 5·5·0.5 in·0.5 in= 6.25 in^2

$Area_{total}$= $Length_{sample} \cdot Width_{sample}$ = 2.695 in·2.695 in= 7.263 in^2

POA=$\frac{Area_{open}}{Area_{total}}$=$\frac{6.25\ in^2}{7.263\ in^2} * 100\% = 86.05\%$

POA > 40% OK

Thickness

19-Gauge Wire Mesh: $t_{19\text{-Gauge Wire}}$= 0.039 in

Total thickness of the hull: t_{hull}= 1 in

1 layer 19-Gauge Square Grid Reinforcement Mesh

Reinforcing Material ratio: $\frac{t\ 19-Gauge\ Wire}{t\ hull} * 100\%$ =3.9% < 50% OK

No extra reinforcement for the bulkheads was used.

The Lockdown Monster has a uniform thickness of 1 inch all around.

Labor and Material Rates

Table F2: Individual Direct Labor Cost Calculations

		Title	Hours * RLR	Indvidual Direct Labor Cost
PROJECT MANAGEMENT	372.4			
Bridget Smith	201.9	Principal Design Engineer	$10,095.00	$33,353.88
Karla Pineda	109	Principal Design Engineer	$4,905.00	$16,206.12
Rayan Elmisurati	61.5	Graduate Field Engineer	$1,537.50	$5,079.90
BACK BONES	133			
Camila Renjel	69.25	Technician/Drafter	$1,385.00	$4,576.04
Nikolas Hawley	63.75	Quality Manager	$2,231.25	$7,372.05
TECNICAL PROPOSAL	35.75			
Ivan Ramos	19.25	Technician/Drafter	$385.00	$1,272.04
Rachel Smith	6.75	Clerk/Office Admin	$101.25	$334.53
Anna Campo	9.75	Technician/Drafter	$195.00	$644.28
HULL DESIGN TEAM	354.5			
Anagil Lobo	111.75	Design Manager	$5,028.75	$16,614.99
Camille Fulton	42.75	Graduate Field Engineer (EIT)	$1,068.75	$3,531.15
Omar Moussa	18.5	Graduate Field Engineer (EIT)	$462.50	$1,528.10
Romelia Belteton	45	Project Design Engineer (P.E.)	$1,575.00	$5,203.80
Sunny Ruprai	14.75	Graduate Field Engineer (EIT)	$368.75	$1,218.35
Tim Davis	68.75	Project Design Engineer (P.E.)	$2,406.25	$7,950.25
Nick Tenorio	53	Laborer/Technician	$1,325.00	$4,377.80
MIX DESIGN TEAM	334.4			
Beverly Duran	122.75	Project Design Engineer (P.E.)	$4,296.25	$14,194.81
Adam Alamin	46.75	Graduate Field Engineer (EIT)	$1,168.75	$3,861.55
Julian Klien	12.5	Clerk/Office Admin	$187.50	$619.50
Caleb Hanneman	14.5	Technician/Drafter	$290.00	$958.16
Grace Morrissey	28.9	Technician/Drafter	$578.00	$1,909.71
Jhois Moya	22.5	Laborer/Technician	$562.50	$1,858.50
Tyler Moskal	16.5	Laborer/Technician	$412.50	$1,362.90
Ryah Nadjafi	29.75	Graduate Field Engineer (EIT)	$743.75	$2,457.35
Marcos Sanchez-Burgos	40.25	Laborer/Technician	$1,006.25	$3,324.65
MOLD DESIGN TEAM	117			
Skylar Pierce	29	Project Design Engineer (P.E.)	$1,015.00	$3,353.56
Musanna Nasher	44.25	Project Construction Manager	$1,770.00	$5,848.08
David Hickel	4.25	Clerk/Office Admin	$63.75	$210.63
Marjorie Trinidad	4	Clerk/Office Admin	$60.00	$198.24
Michael King	12.25	Clerk/Office Admin	$183.75	$607.11
Moises Herrera	17.75	Laborer/Technician	$443.75	$1,466.15
Brendan Wilkins	5.5	Clerk/Office Admin	$82.50	$272.58
		Project Members Total	$45,934.25	$151,766.76
Outside Consultants				
Keila Lombardozzi	1.75	Outside Consultant	$350.00	$1,156.40
Doaa Bondok	10.5	Outside Consultant	$2,100.00	$6,938.40
Jerzy Zemajtis	2.5	Outside Consultant	$500.00	$1,652.00
Ferman Jabbari	6.2	Outside Consultant	$1,240.00	$4,096.96
Cary Caruso	0	Outside Consultant	$0.00	$0.00
Ayleen Leonhardt	2	Outside Consultant	$400.00	$1,321.60
Seth Randall	2	Outside Consultant	$400.00	$1,321.60
Furqan	10	Outside Consultant	$2,000.00	$6,608.00
Johnnie Hall	51.75	Outside Consultant	10350	34196.4
		Outside Consultant Total	$17,340.00	$57,291.36

Table F3: Direct Labor Cost

Total Human Hours	Direct Labor Cost
1397.25	$151,766.76

Table F4: Projected Total Hours

	Year 1	Year 2 (projected)	Total
Project Management	372.4	300	672.4
Hull Design	354.5	0	354.5
Structrual Analysis	124.625 [1]	0	124.625
Mixture Design & Developement	334.4	0	334.4
Mold Construction	197.25	200	397.25
Canoe Construction	135.5	130	265.5
Technical Proposal Report	52.75	0	52.75
Enhanced Focus Area Report	2	0	2
Technical Presentation	8	0	8
		OVERALL TOTAL	2211

Table F5: Mold Construction Lump Sum

Description	Cost
Sand paper, sanding block, tarp, plastic sheet	$133.38
Foam Order	$1,721.40
HI-STRNGTH 90 17.6FLOZ 3M AEROSOL ADHESIVE	$129.90
Industrial 6" Hot Knife	$211.03
Sand paper and sanding blocks	$43.85
Materials for making casting table longer	$71.72
tape, zip ties, sewing wire	$29.62
Form Release Oil	$121.50
Gorilla Tape	$29.94
TOTAL	**$2,492.34**

Table F6: Cost to Build a Single Canoe

Description	Quantity	Cost
Portland Cement	80 lbs	$10.77
Hess Pozz	70 lbs	$43.00
Fly Ash Class F	50 lbs	$1.88
Silica Fumes	20 lbs	$22.00
Hess Grade 10	80 lbs	$39.00
Hess Grade 7	75 lbs	$43.00
Hess Grade 5	45 lbs	$19.50
Expanded Perlite	15 lbs	$16.97
PSI Fiberstrand 150	1 lb	$8.00
Sika Viscocrete 2100	15 fl oz	$0.66
SikaSet NC	30 fl oz	$2.02
Sika AEA 14	10 fl oz	$0.23
Reinforcement	50 ft^2	$148.00
	Total	$355.03

Table F7: Transportation

Traveling from GMU to University of Wisconsin-Platteville	
Distance (miles)	881
Time w/o stopping (hours)	14
Time accounting for stops (hours)	18
UHAUL Rental estimate	**$1,160.00**

Pre-Qualification Form

GEORGE MASON UNIVERSITY

(school name)

We acknowledge that we have read the 2021 ASCE Concrete Canoe Competition Request for Proposal and understand the following (*initialed by team captain and ASCE Faculty Advisor*):

The requirements of all teams to qualify as a participant in the Conference and Society-wide Final Competitions as outlined in Section 2.0 and Exhibit 3.	BS DB
The requirements for teams to qualify as a potential Wildcard team including scoring in the top 1/3 of all Annual Reports, submitting a Statement of Interest, and finish within the top 1/2 of our Conference Concrete Canoe Competition (Exhibit 3)	BS DB
The eligibility requirements of registered participants (Section 2.0 and Exhibit 3)	BS DB
The deadline for the submission of *Letter of Intent* and *Pre-Qualification Form* (uploaded to ASCE server) is October 22, 2020.	BS DB
The last day to submit *ASCE Student Chapter Annual Reports* to be eligible for qualifying (so that they may be graded) is February 1, 2021.	BS DB
The last day to submit *Request for Information* (RFI) to the C4 is January 22, 2021.	BS DB
Teams are responsible for all information provided in this *Request for Proposal*, any subsequent RFP addendums, and general questions and answers posted to the ASCE Concrete Canoe Facebook Page, from the date of the release of the information.	BS DB
The submission date of *Technical Proposal* and *Enhanced Focus Area Report* for Conference Competition (uploading of digital copies to ASCE server) is Friday, February 19, 2021.	BS DB
The submission date of *R. John Craig Presentation* for Conference Competition (uploading of presentation to ASCE server) is Friday, February 19, 2021.	BS DB
The submission date of *three (3) Peer Reviews* to the respective teams' folders (uploading of digital copies to ASCE server) is Friday, March 12, 2021.	BS DB
The submission date of *Technical Proposal* and *Enhanced Focus Area Report* for Society-wide Final Competition (uploading of digital copies to ASCE server and mailed hard copies to ASCE Headquarters) is Thursday, May 20, 2021.	BS DB

BRIDGET SMITH	10/19/2020	Doaa Bondok	10/20/2020
Team Captain	*(date)*	*ASCE Student Chapter Faculty Advisor*	*(date)*
(signature)		Doaa Bondok *(signature)*	

Pre-Qualification Form

GEORGE MASON UNIVERSITY

As of the date of issuance of this Request for Proposal, what is the status of your school / university's 2020-21 classroom instruction (in-person, remote, hybrid)? What is anticipated after Thanksgiving break? If in-person or hybrid, do you have access to laboratory space or other facilities outside of classes?

The University is providing hybrid instruction for the 2020-21 school year. After thanksgiving break, instruction will remain hybrid and we will have access to laboratory space.

In 250 words or less, provide a high-level overview of the team's Health & Safety (H&S) Program. If there is currently not one in place, what does the team envision their H&S program will entail? Include a discussion on the impact of COVID-19 on the team's ability to perform work and what plans would be implemented assuming work could be performed.

The Safety Manager is currently in the process of developing our H&S plan in compliance with competition rules, George Mason University's (GMU) office of Environmental Health and Safety, as well as "Safe Return to Campus" (SRC) COVID-19 guidelines set forth by GMU. The development of this plan will include an evaluation of project worksites and identify all potential hazards, then develop engineering controls that will mitigate identified hazards.

Additionally, various safety training will be required based on the work each team member will be performing. Training may include lab safety, respiratory protection, and silica awareness. All team members will be provided with appropriate PPE required to be worn when on-site. All students and faculty were required to complete the University's SRC training session outlining the hazards and mitigation steps associated with COVID-19. Adherence to these policies are mandatory per GMU, and will be strictly followed in the process of planning and executing any in-person project work.

Emergency contact information for each team member is being collected, will be kept at worksites, and made digitally available to team leadership. On-site will also be an emergency preparedness guide and MSDS's outlining emergency procedures for each of the materials to be worked with.

Students and faculty are required to complete a daily health check questionnaire to help facilitate contact tracing and screen for people who may need to refrain from attending in-person activities due to COVID-19 exposure. An "all clear" questionnaire result will be verified by leadership for all participating in in-person activities.

In 150 words or less, provide a high-level overview of the team's current QA/QC Program. If there is currently not one in place, what does the team envision their QA/QC program will entail?

The QA/QC Manager is currently developing the team's QA/QC Program. The QA Manager, in addition to sub-team leads and project managers will continually monitor and review sub-teams' plans and work to ensure all decisions made are in-line with the requirements set forth in the National Concrete Canoe Call for Proposals.

The QA/QC Manager along with project managers will also be working with the sub-teams to develop methods of ensuring the constructed canoe (if constructed) matches the design developed.

This includes the collection of quantitative data as well as signoffs by the appropriate body assuring that all procedures were followed as agreed upon.

Has the team reviewed the Department and/or University safety policies regarding material research, material lab testing, construction, or other applicable areas for the project?

Material testing will be performed in the Sci-Tech campus lab of George Mason University (GMU) under the supervision of the university's Lab Manager. The team will be following all safety policies required by the Lab and GMU. Construction of the canoe (if completed) will be in the Sci-Tech campus lab of George Mason University. The Safety/QA/QC Manager will be coordinating with the Sci-Tech Lab Manager to evaluate potential work site hazards. Once completed, the Safety/QA/QC Manager will go over the hazards with the team prior to conducting work and inform them of GMU's policies regarding each hazard.

The anticipated canoe name and overall theme is – *(please provide a brief description of the theme. The intent is to allow ASCE to follow up to determine if there may be copyright or trademark issues to contend with, as well as to provide insight). Note: teams may re-use past themes.*

Our theme for the 2020-21 concrete canoe competition is The Lockdown Monster. We chose this theme because of the COVID-19 lockdown and how "scary" the whole pandemic has been.

Has this theme been discussed with the team's Faculty Advisor about potential Trademark or Copyright issues?

Our Faculty Advisor is aware of our theme and there is no conflict with any trademark.

The core project team is made up of _28_ people.

George Mason University
Concrete Canoe Team
4400 University Drive
Fairfax, VA 22030

American Society of Civil Engineers
Concrete Canoe Committee
1801 Alexander Bell Drive
Reston, VA 20191

Dear Concrete Canoe Committee, **October 20, 2020**

The George Mason University Concrete Canoe Team is writing this letter to inform you that we have received the Request for Proposal for the 2020-21 National Concrete Canoe Competition. The team has reviewed the solicitation for a Technical Proposal and understands that there are two enhanced focus areas, the R. John Craig Legacy Competition, and three peer reviews of other teams' proposals required. The team's enhanced focus areas will be mix design and construction.

We plan on designing and building a full-scale concrete canoe for this year's competition. The team will follow and be in compliance with all the design regulations described in the Request for Proposal. We will have access to University Labs and will ensure that all University and CDC Health and Safety Guidelines are being followed.

Our team looks forward to learning and gaining valuable experience through this year's competition.

Sincerely,

The George Mason University Concrete Canoe Team

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