University of Nevada, Reno 2023 Technical Report

TAURUS

Nevada Concrete Canoe Team
University of Nevada, Reno 1664 N
Virginia St. Reno, NV 89557

September 27, 2022

ASCE Student Services 1801
Alexander Bell Drive Reston, VA
20191

Dear ASCE Concrete Canoe Competition Committee,

The University of Nevada, Reno Concrete Canoe Team (NCCT) hereby acknowledges the receipt of the 2023 American Society of Civil Engineers (ASCE) Committee on Concrete Canoe Competitions (C4) Request for Proposal (RFP). We certify that our 2023 project proposal and additional qualifying documentation will be completed and submitted in compliance with the rules and regulations detailed in the 2023 RFP. We also understand the eligibility requirements set forth by the C4 and ensure that all registered participants for the ASCE Student Symposia Concrete Canoe Competition and the Society-wide Competition will meet the requirements. The NCCT understands the "Cerberus Web Client" submission platform and acknowledges the submission deadlines outlined in Exhibit 1 of the RFP. This year’s qualified engineering students and their respective ASCE Society Member ID numbers are listed below.

Participant	ASCE Member ID Number
Kelli Bishop	000012357332
Michaela Bruns	000012287563
Annika Dixon	000012300577
Emily Eaton	000012365295
Nura Tung	000012231762
Cole Evers	000012363901
Nathan Hale	000012284699
Tanner Mcilree	000012304751
Lucas Pritchett	000012282153
Hunter Stramel	000012367162

Additionally, The NCCT hereby certifies that;

- The proposed hull design, concrete mixture design, reinforcement scheme, and construction of the prototype canoe have been performed in full compliance with the specifications outlined in the Request for Proposal.
- The Material Technical Data Sheets (MTDS) and Safety Data Sheets (SDS) have been reviewed by the team.
- The team acknowledges receipt of the Request for Information (RFI) Summary and that their submissions comply with the responses provided.
- The anticipated registered participants are qualified student members, Society Student Members of ASCE, and meet all eligibility requirements

The following signatures from the team captains as well as the ASCE Student Chapter Faculty Advisor certify that the NCCT submission for *Taurus* and the information provided is true.

Sincerely,

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Executive Summary

The city of Reno holds a yearly tradition that holds a bond among its community, dating back to 1919. The first annual Reno Rodeo was held for family and friends. The Reno Rodeo is a PRCA (Professional Rodeo Cowboys Association) sanctioned sporting event and is a non-profit organization comprised of over 900 volunteers. Each year, over 140,000 fans attend the 4th richest PRCA tour rodeo and the 3rd best as recognized by USA Today's 10 Best Readers' Choice. The event impacts the Reno/Sparks area economy, with $42 million going to hotels, casinos, restaurants, and retail outlets. It is with this home tradition that the 2023 NCCT found a theme and symbolism to represent this year's project canoe named *Taurus.*

Table 1: Taurus Dimensions and Reinforcement

Dimensions	
Properties	**Reported Accuracy**
Colors	Brown, White, Maroon
Estimated Weight	280 lbs.
Maximum Length	21 ft.
Maximum Width	27 in.
Maximum Depth	13.2 in.
Average Thickness	0.75 in.
Main Reinforcements	
Carbon Fiber Mesh	
0.25 in Steel Threaded Rob	
Prestressed Kevlar	
Secondary Reinforcements	
Steel Wire	
PVA Fibers	

The University of Nevada, Reno (UNR) takes pride in its students and the cutting-edge research, hands-on experience, and world-class facilities it offers for its community. The University is home to over 20,000 undergraduate students, and 475 of those students comprise the civil and environmental engineering department (UNR 2023). The University upholds its long-lasting history in its seismic research and participation in community involvement.

After coming off of the great success of *Azure*, *Taurus's* projected team wanted to capitalize with a high standard of research and further team development to create a more successful year. This year's team focused on research from previous year's projects and the involvement with outside participants and companies to better understand material use and their impact on the environment during use. Additionally, the encouragement of a young roster of students to uphold key team roles, the development of new testing methods, and improvement on the overall team project were all enforced throughout the canoe's evolution. Challenges quickly arose for the team when the lack of supplies from trusted manufacturers left them with no foam to use for the mold, leaving the Project Managers to compromise with a new solution. After discussion, they decided to use University-provided CNC machine and create numerous wooden ribs that would be shaped similar to the canoe, to then apply a layer over it and act as a shell of the canoe's hull. This is one of the few challenges the team experience this year; however, the team overcame these challenges and worked hard to ensure the team stayed on schedule for the competition.

The hull design team began research with the previous year's paddling team to add their input to the future development and design mechanics of this year's canoe. The team experimented with the former design and tested with a fiberglass practice canoe to improve their understanding of a canoe hull performance. Preliminary hull designs were made, and 3D printed to test water performance and balance. This testing approach gave the hull design team the understanding of the characteristics of a canoe. Following the work of the hull design team, the structural team began examining the preliminary designs with the naval architect software and the NCCT's structural analysis worksheet created by past project managers and has been extensively used since 2008. The team was also able to optimally coordinate key locations for the screws in the pre-stress system as well as design them to efficiently support the concrete and ensure it to be race capable.

The mix team set a goal to refine the structural mix to prioritize lightweight material while still holding adequate strength in the canoe. While testing materials, multiple test batches were created to calculate unit strength and readjusted to improve on each batch. The team closely followed the new gradation requirements from the 2023 RFP as well as following the ASTM standards for materials to optimize a proper and legal mixture. With limited funding at the beginning of the project, the mix team was limited to the material left in our workshop to determine the proper cementitious materials experiment. The team also experimented with pigments and changing colors to find the proper ratio that would effectively showcase the design.

Table 2: Structural and Patch mix properties

Property	Structural Mix	Patch Mix
7-Day Compressive Strength	530 psi	435 psi
28-Day Compressive Strength	780 psi	640 psi
28-Day Tensile Strength	710 psi	580 psi
Density (Wet)	61.9 lb./ft^3	58.1 lb./ft^3
Density (Dry)	51.9 lb./ft^3	57.5 lb./ft^3
Slump, Spread	1.0 in.	3.0 in.
Air Content	16.2 %	2.1 %
Weight	260 lbs.	20 lbs.

The construction team was tasked with developing a new wooden male mold following the unfortunate term of events that led the team to not get their traditional foam mold. They were tasked with finding a safe and effective way to create the mold while still properly casting the canoe to its true design. They also were tasked with doing research and constructing the proper structural support that would meet the standards of the canoe to ensure that no damage would be made once the paddlers entered the canoe. Additional constructions such as the cross-section were also tasked with this team and coordinated among members to be completed.

The project managers were required to adapt and overcome ongoing delays in material acquisition. Proper workshops and collaboration between managers were also key in the progress of the canoe project and remaining on task. Following proper communication between members through meetings and additional communication methods, the team addressed all the tasks. With this, the NCCT was able to complete the project.

The final product blends the hard work and dedication that the NCCT showcased throughout the year. It is with pride that the NCCT is continuing this ongoing tradition of competing in the ASCE Concrete Canoe Competition and the team has the opportunity to present to the Committee of Concrete Canoe Competitions with Nevada's latest edition of this year's canoe, *Taurus*.

ASCE Student Chapter Profile

The UNR ASCE Student Chapter was founded in 1923 and is considered a representation of future student engineers as they develop and connect themselves to professional environments. The UNR ASCE Student Chapter provides its members with countless opportunities to engage members and engineering community. The UNR Student Chapter holds its tradition of providing one-on-one experience with its student members and engineering leaders while also enhancing their understanding and education of professional development skills and providing them with the necessary opportunities for their future careers.

Figure 1: Student Chapter Members at Nationals

The NCCT holds a strong legacy with its participation in the Mid-Pacific Conferences. It is with this competition that the University has an active history of competing at both a regional and national level with some of the team's most recent appearances being *Azure* (7^{th} at nationals, 2022), *Goldstrike* (2^{nd} at regionals, 2019), and *Alluvium* (1^{st} at nationals, 2014). The UNR Student Chapter also regularly competes in the ASCE Steel Bridge Competition, and Sustainable Solutions where they continue to show excellent results.

Figure 2: Student Chapter Members at Volunteering Event (Marv Byers Tournament 2022)

In addition to student competitions, the UNR Student Chapter holds regular meetings and opportunities for the engineering community to engage with members and expose them to the real-world challenges of engineering. It is this engagement with local engineering firms that improve members' professional development as well as provides them with career development opportunities such as resume workshops, firm tours, and networking opportunities.

The Student Chapter hosts regular social events to engage members with the community around them and provide an opportunity of an environment-free of academic pressure. Members have the opportunity to build friendships with one another and improve the environment around them. A regular social event incorporated in the Student Chapter involves the Truckee Meadows Community and keeping the Truckee Meadows clean where students actively clean and improve the parks. In addition to this the Student Chapter hosts canned food drives for the homeless, provides outreach opportunities to promote STEM education for young students, and encourages its members to promote a more sustainable planet.

Figure 3: Local Park Clean Up with Student Chapter

The UNR Student Chapter community and members that are involved, continue to strive and compete concrete canoe competition. It is an honor to have the opportunity of hosting the Intermountain symposium Southwest student competition this year.

Key Team Roles

The 2023 Nevada Concrete Canoe Team for *Taurus* consists of ten key members and a large roster of student participants. The leadership team included two project managers, two mix design managers, one construction manager, one hull design manager, one structural analysis manager, one design manager, one safety manager, and Two head coaches for the paddling team. In addition to these student leaders, student participants helped in the development of the project. The roles and responsibilities of each member of the team are shown below.

Table 3: Members identification

Key Personnel	Role	Responsibilities
Tanner Mcilree (Jr) Lucas Pritchett (So)	Project Manager	Development of fundraising, Budget appropriation, Scheduling, Communication, Task delegation, Project proposal, Technical presentation, QA/QC of project.
Michaela Bruns (Jr)	Mix Design Manager	Research, led the development of design of the concrete mixture. Oversaw mixing onsite.
Jerry Quintos (Jr)	Construction Manager	Research, oversaw and held regular constructions to the overall project.
Mason Loyd (Sr)	Hull Design Manager	Research and developed the overall design of the hull. oversaw hull design construction.
Kelli Bishop (Jr)	Structural Analysis Manager	Research to determine overall concrete strength and system reinforcement. Performed structural calculations.
Nura Tung (Sr)	Design Manager	Developed aesthetic elements of proposal and additional props on canoe and stands.
Christian Aguiar (Jr)	Safety Manager	Oversaw member safety and for proper facility protocol. QA/QC of project. Managed MTDS of proposal.
Mason Loyd (Sr)	Paddling Coach	Expanded the skills of paddling member and ran conditioning.

Student Members	Christian Aguiar (Jr), Vanessa Arias (Jr), Kennedy Bautista (Fr), Cole Evers (Sr), Devyn Del Santo (Fr), Karlie Del Santo (Jr), Miggy Dela Rosa (Fr), Annika Dixon (Jr), Colton Dodge (Sr), Emily Eaton (Fr), Nathan Ernani (So), Zach Flowers (Sr), Mohith Gaddam (Fr), Nathan Hale (Sr), Nicholas Haskell (Sr), Lila Humlick (Fr), Arturo Medina (Sr), Aditya Prathap (Sr), Jordan Price (So), Naomi Schlageter (Jr), Hunter Stramel (So), Trevor Woo (Sr)

Lucas Pritchett (So)
Project Manager

Tanner Mcilree (Jr)
Project Manager

Jerry Quintos (Jr)
Construction Manager

Michaela Bruns (Jr)
Mix Manager

Kelly Keselica
Advisor

Mason Loyd (Sr)
Hull Design Manager

Christian Aguiar (Jr)
Safety Manager

Nura Tung (Sr)
Aesthetics Manager

Kelli Bishop (Jr)
Structural Analysis

Hull Design and Structural Analysis

Taurus's hull design was developed to optimize straight-line speeds, while alteration was also designed to provide stability and make minor improvements to the overall design. The proper optimization to accommodate for these features required hull analysis and study of previous boats to expand our knowledge. Previous years boats such as *Azure* (2022), *Goldstrike* (2019), and *Alluvium* (2014) is the baseline deigns in the development of *Taurus*.

Discussion of the hull design began with an analysis of the three boats to determine what each of them specialized in and how to incorporate it into the design. Previous paddler input was also very critical in the development of design criteria. After a preliminary discussion considering the initial information and input from paddlers of previous years, as well as performance-analysis to determine efficient hull designs it was determined that *Taurus's* hull design would be created to prioritize stability and straight-line speed. With this in mind, initial designs would use *Alluvium* as the baseline design due to its former success and similar goal in the design process. From here the team began extensive research on canoe performance characteristics. The hydrodynamic forces of friction and wave drag create resistance to the motion of any vessel, while contact between water and the wetted surface area of a canoe creates frictional drag. The wave drag increases exponentially with speed as more energy is required to force water aside. The team kept a longer canoe design was created to reduce wave drag by matching the longer wavelengths generated at higher speeds as well as provide paddlers more room and stability during races.

To improve the canoe's balance and paddler stability the team incorporated a flatter bottom design. The chines were made to have a larger radius of curvature which reduced the canoe from having uncontrolled swaying away from the direction of movement. A sharper keel at the stern was made to become more defined and to increase tracking for the long straightaways during each race. Alterations to the bulkheads were made to increase their width as well as the stern having improved wave drag and initial acceleration due to the sharper keel.

Performance calculations were also created by 3D printing miniature scale models of the canoe prototypes and applying hydraulic testing to each design to understand water performance and applications of frictional forces onto the design. Alteration of each design would be made to further members knowledge on hull design and the effectiveness certain applications have over others. Each design would be printed and could show performance as well as canoe buoyancy that could be used prior to full scale design.

Table 4: Performance data comparison of previous canoes

	Estimated 180 degree turn times	Estimated Average 200-m Sprint Times	Average Wave Drag	Average Skin Drag	Max Beam	Length
Taurus (2023)	7.4 (s)	97 (s)	10.0 (lb)	15.1 (lb)	24.1 (in)	21' 0"
Azure (2022)	6.8 (s)	96 (s)	9.5 (lb)	13.9 (lb)	22.7 (in)	21' 0"
Goldstrike (2019)	6.2 (s)	103 (s)	8.7 (lb)	14.3 (lb)	26.0 (in)	20' 8"
Alluvium (2014)	7.2 (s)	92 (s)	8.9 (lb)	14.9 (lb)	25.7 (in)	21' 8"

Once initial designs and testing was full completed, members begun forming a hull design to be used on casting day. *Taurus's* hull design was determined and structural analysis calculations could begin. In order to achieve the capacity requirements of all anticipated loading conditions, the structural analysis team identified the loading case that would produce the greatest positive and negative moments. The male tandem race was deemed the most extreme using an Excel structural analysis spreadsheet developed by the 2008 UNR team. The spreadsheet analyzes the canoe as a two-dimensional beam to determine the shear forces, bending moments, moments of inertia, centroids, and cross-sectional areas at 1-foot increments based on paddler weights and locations within the boat, compressive strength, and modulus of rupture of the concrete, and slab thickness.

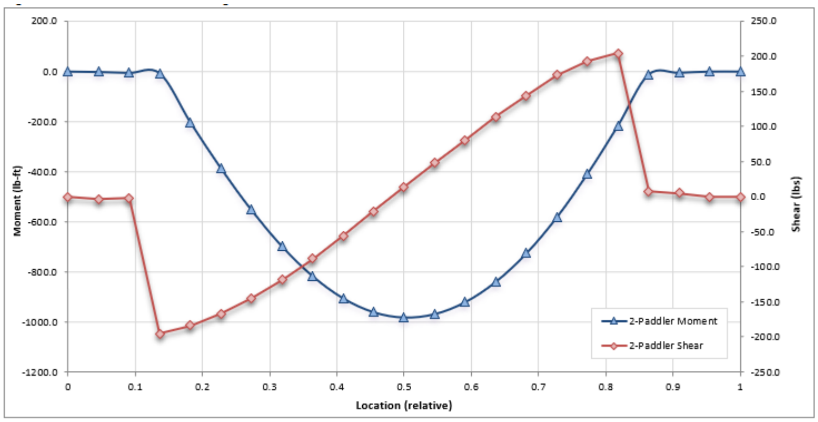


Figure 4: Maximum Shear Value Calculation

The structural analysis team chose to perform more in-depth calculations for the male tandem case as it would generate the greatest stresses. The two male paddlers were taken as two 200-lb point loads, placed 36 in. and 228 in. from the bow. To account for dynamic effects, a load factor of 1.25 was applied to the paddlers' weights the maximum negative moment produced by this scenario was -981.4 lb.-ft in the middle of the canoe and the maximum shear value was calculated to be 203.8 lbs. approximately 216 in. from the bow, as displayed in figure 4.

To combat the peak moment produced by the male tandem loading case, the team examined possible methods for a pre-stress system to maintain structural integrity. Calculations suggested a total of sixteen Kevlar tendons, each supplying a tensile load of 300 lbs., totaling 4,800 lbs. of tensile pre-stress would provide the best resistance. Allowable stress limits of 19 percent for the modulus of rupture and 75 percent for the compressive strength as factors of safety were contained in the calculations. To account for shrinkage, creep, elastic shortening, and steel relaxation, a prestressing loss of 25 percent was assumed. The placement of the tendons would counteract bending in the gunwale and bottom of the canoe.

However, due to human limitations and unforeseen adjustments to the ultimate construction of the canoe, only eight Kevlar tendons could be evenly distributed underneath the boat with an approximate jacking force of 150 lbs. each, providing for 2,400 lbs. of pre-stress. To supply additional pre-stress support to the system, a layer of carbon fiber mesh and four steel ribs were placed at critical locations within the concrete. Advanced calculations were performed for the male tandem case to evaluate two-way punching shear. The base of the canoe was taken as a thin, reinforced concrete slab. A proposed slab thickness of 0.5 in. was analyzed to determine whether it could provide adequate shear strength under the male tandem case examined above.

Mix Design

Taurus is designed to be a durable canoe made with an optimized concrete mix achieved after months of iterative testing to obtain its complex mixture. The main goal for this edition was to obtain a low density while maintaining the necessary strength requirement from our structural analysis and remaining conscious of ideal workability. The baseline mix design included the following materials, Poraver® expanded glass, Utelite® Expanded Shale, type 1 white cement (ASTM C595), Class N metakaolin (ASTM C618), Type S hydrated lime (ASTM C207), Nycon® PVA fibers, Daravair® AT30 (ASTM C260), ADVA® CAST 575 (ASTM C494), MasterLife® SRA 035 (ASTM C494), V-MAR® F100 (ASTM C494), and MasterSure® Z60 (ASTM C494).

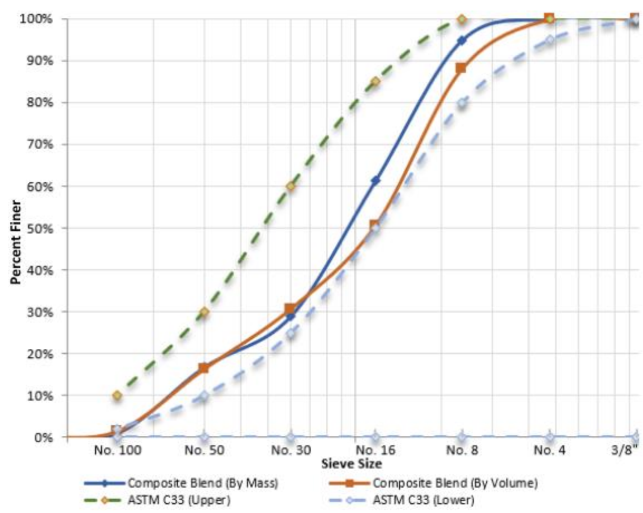


Figure 5: Gradation Curve

To ensure experimental mixes satisfied the RFP requirements, experimental mixes were prepared and tested for density (ASTM C138), compressive strength (ASTM C496), and flexural strength (ASTM C78). Throughout the mix design process, each mix would be tested after a seven-day curing period, up to a total of twenty-eight days to determine each mixture potential compressive, tensile, and flexural strengths.

After three months of testing, and 28 trial batches of concrete, two distinct mixtures were selected with varying textures optimized for their placement on the canoe. The first consistent mix which served as the structural mix is one that can withstand the stresses on the hull. This mix would provide support at critical points throughout the canoe's hull design and hold the overall strength properties of the canoe. The second concrete mix, with the texture of modeling clay, is designed to be our patch mix and helped to fill small voids in the concrete and help with the prevention of cold joints forming. This mixture is malleable enough to fill details and corners while limiting the total concrete used to avoid overwhelming the boat and deteriorating the overall design.

The cementitious matrix in the two mixtures involved the use of metakaolin, Portland Cement (Type I), and hydrated lime cement. The mix design manager found a sufficient increase in compressive, tensile, and flexural strength with varying ratios of these cementitious materials during their research for Taurus. Additional research involved the use of a bi-directional fiberglass mesh encased in the primary concrete mixture to provide members with information on reinforcement materials. Once a finalized mix was designed, the combination of cementitious materials provided ample workability and consistency while reducing unit weight and minimizing the amount of environmentally harmful cement used.

Table 5: Aggregate Properties

Aggregate	Specific Gravity	Absorption	Particle Size (mm)
Poraver® 0.1-0.3	0.85	22.00%	0.1-0.3
Poraver® 0.25-0.5	0.68	15.00%	0.25-0.5
Poraver® 1-2	0.41	7.00%	1.0-2.0
Poraver® 2-4	0.35	7.00%	2.0-4.0
Utellite® 16	1.61	16.30%	1.19-2.38
Utellite® 30	1.59	17.20%	0.595-1.19

Table 6: ASTM Standards

Testing and Manipulations	ASTM Classification
Sample Preparation	ASTM C192/C192M-18
Compressive Strength	ASTM C39/C39M-18
Splitting Tensile Strength	ASTM C496/C39M-17
Flexural Strength	ASTM C78/C78M-18
Air Content	QWTM C138/C138M-17a
Unit Weight	ASTM C138/C138M-17a
Slump	ASTM C143/C143M-15a

A secondary reinforcement material of PVA fibers was used to provide additional structure strength in the concrete. Nycon® PVA fibers in sizes 8mm and 12mm were cost effective and practical in disbursing throughout the mix. These fibers helped improve the tensile and compressive strengths of the concrete while being effective in application to the wood material. These fibers remained lightweight and provided low visibility as to not interfere with the overall design and colors of the concrete.

Research for mix design aggregates sought to take advantage of varying sizes of Poraver®. Poraver® 0.1-0.3 excelled in providing a gradation that fulfilled ASTM C33 and allowed a starting place for workability. The expanded glass Poraver® used in the mix design helped to obtain a more spread-out particle size curve and lightweight concrete. The properties of the aggregates helped in minimizing air content in the concrete and maintained a lightweight density. Varying grain sizes of Utelite® also helped in adding more compressive and tensile strengths to Taurus's mixture while meeting the demands highlighted in the RFP.

The mix team then focused on enhancing the baseline for admixtures. Daravair® AT30 and ADVA® CAST 575 were selected as chemical admixtures for use in Taurus based on their performance in Azure and Goldstrike. Daravair® AT30 is an air-entraining admixture that creates small air bubbles which provide freeze-thaw resistance. ADVA® CAST 575 is a high-range water-reducing admixture that requires less batch water, lowers the water-to-cement ratio, and increases strength. To support the development of Taurus's concrete mixture, new admixtures were introduced to optimize the workability once strength conditions were met and tests proved that the mix designs were buoyant. MasterLife® SRA 035 is a shrinkage-reducing admixture that helps reduce microcracks that naturally form during curing. V-MAR® F100 is a viscosity-modifier agent that provides better stability and resistance to segregation while facilitating placement and consolidation. Lastly, MasterSure® Z60 is a workability-retaining admixture that provides slump retention without retardation. After multiple batches testing a variety of MasterSure® Z60 dosages, the mix team found that this admixture was vital for the ideal mix consistency. The mix team discovered that a dosage of 8.06 fl oz/cwt resulted in the ideal slump (ASTM C 143), workability, and air content, as well as a mix that adhered to the mold of the canoe effectively.

Table 7: Admixture Properties

Admixture	Type	Recommended Dosage (fl oz/cwt)	Actual Dosage (fl oz/cwt)
Daravair® AT30	AEA	0.23-3.0	12.0
ADVA® CAST 575	HRWR	2.0-10.0	70.0
MasterLife® SRA 035	SRA	0.5-1.5	6.05
V-MAR® F100	VMA	3.0-12.0	7.25
MasterSure® Z60	Workability-Retaining	2.0-12.0	8.06

Construction

The construction team began the project after concluding that our traditional method of creating a canoe mold using High-Density-Urethane foam was no longer going to be a viable option and was left to find a new way of creating this year's mold. After a discussion with the Project Managers and the Construction Manager, the team opted to use a wooden male mold for its reduction in material use and workability in the development of the canoe. Additionally, the team opted for wood because of the ability to recycle the material from previous projects and reduce the costs the team would have to spend on new material. The team designed an innovative male mold using multiple wooden fins that would be cut to shape using a computer numerical control (CNC) machine, that the University provided used to for its members. The use of the Universities CNC machine provided the team with significant results for the project as it produced the fins at no charge for the team. These fins would then be used to guide a layer vinyl wood flooring to act as the shell for the mold and the wooden fins act as the ribs for support. these flooring sheets were malleable enough to be shaped like the CNC wooden fins below this layer and attached to help hold their shape and not crack the wood. Once attached to the fins, the team designed an innovative male hull design and begin preparing the mold for casting day*.*

Figure 6: Construction of Wood Mold

Initial preparations of the hull design for *Taurus* were made by separating three different sections of the mold to efficiently develop each section with little time waste. Members began preparing by applying a thin layer of fiberglass resin which was painted over the wood sheets to create a layer of friction and help in holding the concrete onto the mold as well as indicate to members, areas of imperfection that could be fixed before casting. After this, the team applied twelve layers of form-release wax onto the mold. The team found that twelve layers of wax were optimal in ensuring that the concrete would not be damaged and will easily be removed from its mold during the pop-off day due to research done before construction as well as research from previous boats.

After the development of the male mold was complete, the team began developing additional structural support for the concrete using layers of carbon fiber mesh, structural rebar rods, and the installation of a prestressing system. The carbon fiber grids were tied together using a fishing line to create a dual layer of reinforcement that spanned from each of the bulkheads. Four structural rebar points were incorporated over the span of each bulkhead as well to provide lateral support. The team found in their research of concrete reinforcement that threaded stainless steel rods provide the most structural support and that the threads in the rod provide more grip to bond with the concrete. The prestressing system after being discussed and debated as mentioned in the Hull and Structural Analysis Chapter amongst members, consisted of eight tendons stressed at 250 lbs. Each tendon would be held at a measured coordinate using the structural analysis worksheet into the hull design at one-foot intervals in between the bulkheads. Screws were used at each of these points to help in holding the stressed tendons. These screws also served as depth gages that would each be marked at both 0.25in from the head of the screw to indicate the end of the inner layer of concrete, as well as 0.5in to indicate the end of the outer layer of concrete to ensure that the concrete would be even throughout during casting.

After preparations for casting were complete the Construction Manager oversaw members on the methods and the preparations of packing the concrete onto the mold using miniature designed male molds that replicate the design of this year's mold. Practice casting days would continue to be simulated to members to provide an understanding of proper packing techniques as to avoid cold joints and reduce air voids in the concrete and maintain its overall strength. During this time the Mix managers began pre-weighing materials for testing as well as for casting day to avoid delays in the materials and mixing of concrete. The Design manager began sketching designs onto the mold and developing foam inlays for members to lay onto the concrete and accurately pack to create the desired outer design for *Taurus*.

Once casting the canoe began, members were set from the bow and stern and began packing the concrete, where they worked towards the center of the canoe. Managers were tasked with overseeing the project and ensuring members were following the pre-traced design while also following proper packing techniques. During casting, members were given spray bottles and damp towels that were layered over the concrete to avoid early setting while also not overusing the spray bottle to make the concrete to moist. After the first layer of concrete was packed, the tied layers of carbon mesh was placed over the concrete and rubbed into the first layer of concrete to allow concrete to attach between each void in the mesh. Additionally, the structural rebar that was molded to the shape of the canoe before casting was also placed over the first layer of concrete at each coordinated critical point according to structural analysis worksheet and manager. The casting of the second layer began with the design manager coordinating with members to ensure a proper design and that colors would not overlap with one another. The bulkheads were cast with foam in its core that would become encased in concrete. Finally, the gunwales were molded on the outside of the boat using a quarter cut wood trimming as the guide. Once this was finished a thin steel wire was run through the gunwales and the concrete could begin the curing process.

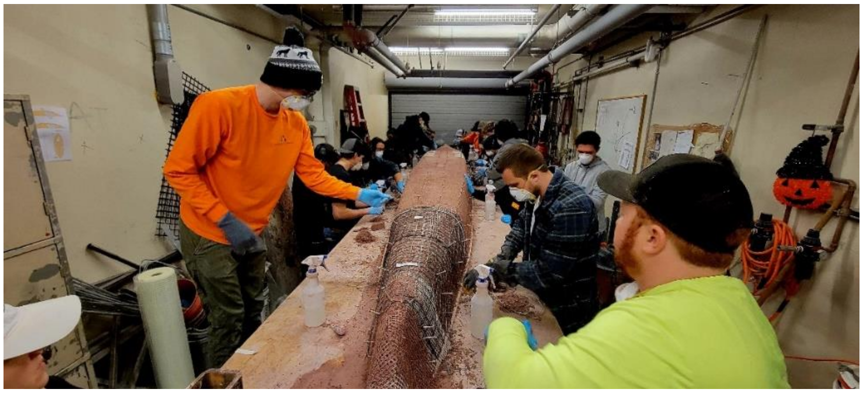


Figure 7: Members Casting on Pour day

For the next seven days after canoe casting, the canoe would be manually watered at four-hour intervals to ensure that the concrete could gain the most strength. Following this process, the team has begun a wet sanding process for the next twenty-one days where they sanded any irregularities in the canoe while using sponges to recycle the used water to be filtered and reused. Team members were instructed to sand in one-foot intervals to create an even and smooth surface for the canoe, intervals were indicated by the spaces between each screw. Once all screws were exposed and counted, they were removed so the team could remove the canoe from the mold.

The wooded structure that holds the mold allowed members to easily and safely remove the mold from the canoe. The wooden mold was carefully transported and rolled onto soft foam cushioning to protect the canoe. Using the three cut sections inside of the canoe as well as the mold release, the team slowly extracted the mold beginning with the middle section. Once the canoe was removed entirely, it was placed into a previously used stand to allow easy access to both the interior and exterior of the canoe. Once the holes left from the screws were patched, the canoe was then sanded, with the exterior reaching a grit of 1200 and the interior being 800 grit. Adhesive lettering was later applied to the sides of the canoe and the canoe was then applied with a concrete sealer before it was competition ready.

Project Management – Scope, Schedule, and Fee

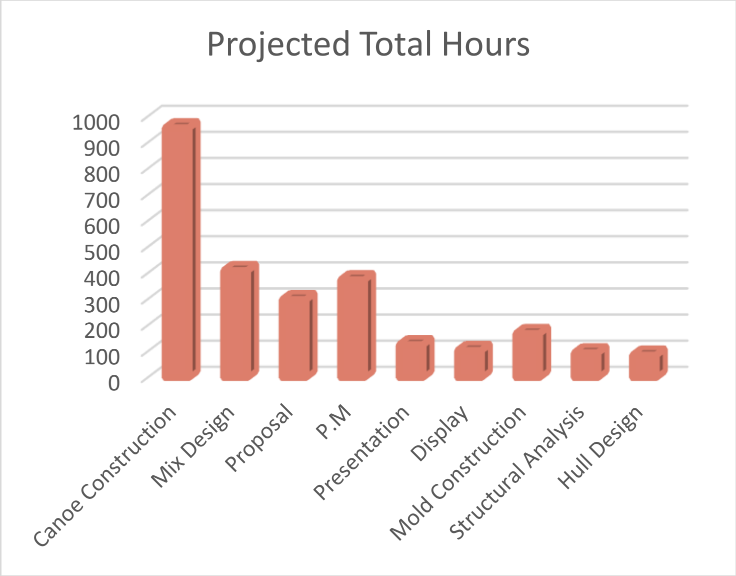


Figure 8: Projected Total Hours

The NCCT project management structure consisted of two project managers overlooking the entire project, seven managers ranging in different special tasks, and a cohort of team members working with team managers to be delegated tasks. Before any significant constructions and work towards the development of the project, managers and previous year's team captains sat down together and discussed the significant rule changes highlighted in this year's RFP. Upon this discussion, the team established initial tasks and considered important information that would impact the progress of the project and any testing developments. An initial storage intake of materials and items was considered, and the transferring of knowledge from previous members and managers to new managers was enforced. An initial supply list was established because of this and would be ordered by the project managers with the NCCT remaining funds to begin initial research. Regular bi-weekly meetings between the project managers and team managers to identify progress or delays in the project. One of the most notable delays of the overall project recognized by the team would be their inability to procure foam material to make this year's canoe mold, as mentioned in the construction chapter, due to manufacturers being unable to procure materials on time. A preliminary schedule was created that determined the team's goals and RFP deadlines, and a critical path was derived from this relation that highlighted major milestones. Any significant changes such as the delay in hull design materials would be revised in the project outline. Upon overlooking the initial schedule, managers determined significant project goals and achievements below, with each having an associated milestone and breakdown.

Task 1: Initial Sketching: With the discussion involving previous and current members, rough-draft designs were created in multiple aspects of the project including the aesthetic design of the canoe, structural design, and mix design. These designs would then be improved upon throughout the lifespan of the project. When teams felt comfortable with each of their initial designs, testing could begin and experimentation with materials and new ideas could start with the priority of finding the best possible design for *Taurus*.

Task 2: Project Fundraising: After initial designs were created an initial funding estimate was created for the team to establish a total cost and determine the required funding that would be needed for material procurement, new tools, testing, and to be saved for future project use. After the team established the remaining funds, they found that the team had roughly $765 at the beginning of the year, and the need for fundraising through sponsorship and local companies would become more critical. Letters and personal meetings with multiple companies were arranged to discuss the NCCT project and its history of competing. The total money raised for this year's competition was $11,500. With this budget, $7244 of this funding was used towards the development of the project and material procurement while the other $4756 would be used as saving funds in the case of an emergency and for future competition teams.

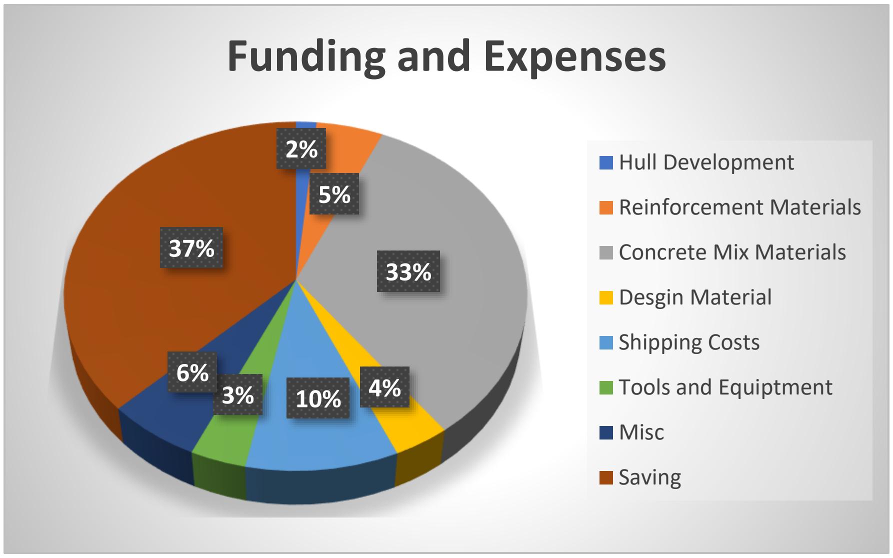


Figure 9: Funding and Expenses

Task 3: Manager and Member Training: To ensure the safety of members for this project and to ensure effective development and testing, it was imperative that the team would be trained and understood the design of the workshop and tools inside. This provided new members a chance to become more familiar with the project and the work that would be involved during the lifecycle of the project. In addition to workshop safety training, an understanding of the competition and a review of the RFP was given to them for more clarity and understanding of the competition.

Task 4: Tasks before Canoe Casting: Specific tasks such as the hull design analysis and proper mold creation. Following mold construction, structural analysis creating a finalized product of critical points in the and the required reinforcements and strengths needed to meet race demands. This research was calculated using the mix design team finalized concrete mic after they experimented with cement mix materials as well as calculated the proper ratio that provide strength requirement for the canoe to become competition ready. Once a final mix design was created the team began pre-weighing materials before canoe casting could begin to reduce delays between concrete batches. In addition to this, the construction team began developing the required reinforcement materials for the canoe. The design of a prestressing system, fitting carbon mesh reinforcement, and structural ribs around the mold would be completed before the team's pour day when the canoe's concrete would begin getting poured and packed. After each team finished its initial tasks, a final call for materials and tools was created and the team could proceed with cast day.

Task 5: Canoe Casting: Once the initial tasks were completed and all material was delivered and organized, the team had a general meeting with members to address the key points about casting a canoe and the proper packing methods, using previous projects as examples. Once members felt situated with an understanding of cast day, a date was set, and the team proceeded with the development of the *Taurus*.

Task 6: Canoe Finishing: After the canoe had been cast, the team would spend time finishing the canoe to ensure that the concrete rests with the desired strength requirement. Immediately following cast day, the concrete would be hydrated at 4-hour intervals the following week by members to ensure its structural integrity. During this time, sanding would begin with the task of removing the screws of the pre-stressing system and then smoothing both the inner and outer layers of concrete on the canoe. Any damage to the concrete created on cast day or holes from the screws would be filled with a patch mixture, designed by the mix managers. Once all damages were patched, and the team reached the desired sanding grit on both layers of concrete, a sealer was applied to the entire boat and adhesive sticker's signifying the name of the boat and University were applied.

Quality Control and Quality Assurance

To effectively establish and maintain the workload of the NCCT quality control and quality assurance (QA/QC) program, a structured manager system was established with the involvement of managers and former project managers. This system dissolved the work amongst managers and offered the opportunity for members to designate themselves with the manager in their field and interest and work. This system effectively allowed project leaders to acknowledge and increase the efforts of members with the work they put into the development of Taurus.

The NCCT's quality assurance program was handled by the work of the project managers as they scheduled regular meetings for both the teams of members and managers where the training, transfer of knowledge, and opportunities of practice were. During the early stages of the project, members were trained on the essential information and procedures of the workshop and any tools or equipment involved. This training ensures members' safety and helps increase effective efforts toward each construction day. During the training process of new members, the transfer of knowledge among current and previous managers occurred, allowing the team to schedule and plan any needed constructions or research needed to produce a quality product. This also allowed managers to start new research in material and ensure the team meets any ASTM standards or rules highlighted in the RFP. The final branch of the NCCT quality assurance program involved practices opportunities. Regarding the project's development, this involved construction providing members opportunities to learn through trial and error on practice days for more involved and serious constructions. One of these practice days included a practice concrete casting day where members will use trial batches of concrete and learn proper packing techniques and how to avoid early curing of the concrete on old canoe molds. This branch also included team members' development amongst their peers and members. For the paddlers', regular paddling practice was held to improve form for races and conditioning of members, and numerous social events for members to develop friendships.

NCCT's quality control program included the preparations that lead up prior to canoes casting. A major development the team had in this program involved our concrete mix research. NCCT spent extensive time researching materials and developing a strong and lightweight concrete mix. During this research process compressive and bending testing needed to be done on initial concrete batches to understand their strength properties and find any defect that remains in the concrete development. After testing was finished, materials were pre-weighed as to avoid delays in concrete batches and early curing in the canoe as to avoid cold-joint and a weaker canoe. The grade screws in the canoe mold also applied quality control to our program by ensuring even layering of concrete and identifying critical weak points. Additional concrete reinforcements were measured and fitted onto the mold prior to pour, to be quickly applied the day of casting to also avoid delays. Additional control practices after cast day would include the paddlers simulating race day by using practice canoes made out of fiberglass and attaching heavy buckets to the canoe to simulate the weight of a concrete canoe.

Sustainability

Throughout the development of the project, the NCCT continued to push efforts towards incorporating the three pillars of sustainability to continue the effective progression of the project and maintain the sustainability of the environment and ecosystem. to increase these efforts the NCCT prioritized its focus on the social and environmental impacts.

The team has continued to practice social efforts with the involvement of its members and the local community. In addition to regular meetings and events solely for the teams' project, they also participate in regular social events such as park clean up's, food drives, volunteering events, and more. Many of these events are held to promote members' involvement and encourage opportunities for them to become more involved with their community while promoting cleaner efforts that help the community. This also promotes leadership and friendship among members. In addition to social community events, the team also reaches out to local engineering companies and officials to meet with members and offer real-world advice and guidance. On top of providing education to members, these companies regularly support the team's efforts through sponsorships and/or material donations. Social events such as the "Nevada Infrastructure Concrete Conference" (NICC) was just one of these events that allowed our team managers the opportunity to table and watch presentations from experts as they presented the latest technological developments, formulations, and innovations of concrete infrastructure.

Figure 10: Members Participation at NICC Event

The NCCT also prioritized environmental impacts throughout the duration of the project in hopes of providing economic support and maintaining the health and beauty of the Reno area. Efforts to promote this primarily included recycling large amounts of materials from previous projects and incorporating that material into our canoe and future projects. This includes the recycling of materials such as a previous year's shipping container they used for their canoe and incorporating that wood to be used into our mold creation or breaking down previous year's canoes and recycling material such as concrete reinforcements like rebar, or concrete mix components and using that material for research. In addition to this pushed efforts of recycling material. The NCCT also had a reduction in shipping materials as well as the team's focus on using a CNC machine the campus provided rather than using a third-party supplier provided a reduction in carbon footprint due to the lower amount of shipping needed for materials as well as not needing to travel outside of the city for the development of our mold. Paddlers also acquired a dock to reduce carbon footprint by storing the practice canoes rather than having the need to tow a trailer between the University and Marina every week.

Economic efforts for NCCT included the saving of funding and recycling materials for the project. As mentioned in previous sections, the NCCT started the year with roughly $500 dollars to begin research and construction practices. After the project managers established the team, they promoted funding through sponsors by meeting with representatives of Engineering firms. During these meeting the project managers established the vision of the project and what sponsors provide the team and its members. Funding this year was projected to be $11,500 to be devoted to the success of the project as well as saving for future competitions. Additional saving's, came from recycling materials to be used for this year, such wood that was used in the development of this year's mold. Further recycled material such as concrete reinforcements, or reusing cementous materials also encouraged these economic efforts.

Health and Safety

The health and safety of the NCCT were a continuous priority for the team during the development of the project and any additional social events. The team's Project Managers and the newly implemented Safety Manager oversaw and enforced any safety precautions should they be needed during construction and the use of materials. Each of the managers was trained with an understanding of proper material and tool use in the workshop, as well as an understanding of the design of the workshop and where proper safety equipment could be found in the case of an emergency.

Before any significant construction could begin in the workshop, new and former members were each presented with a proper understanding of the tools and equipment to be used throughout the year. Locations of safety equipment such as a fire extinguisher, eye-wash station, air purifiers, etc. would always be exposed for ease of access and informed to members for their use. University faculty members were also on standby to provide additional safety measures and more information and how to properly use testing materials. In addition to faculty involvement, the University of Nevada Reno Health and Safety administration oversaw the workshop and informed the managers of any significant concerns they may have regarding any hazards to members' health. Throughout the development of the project.

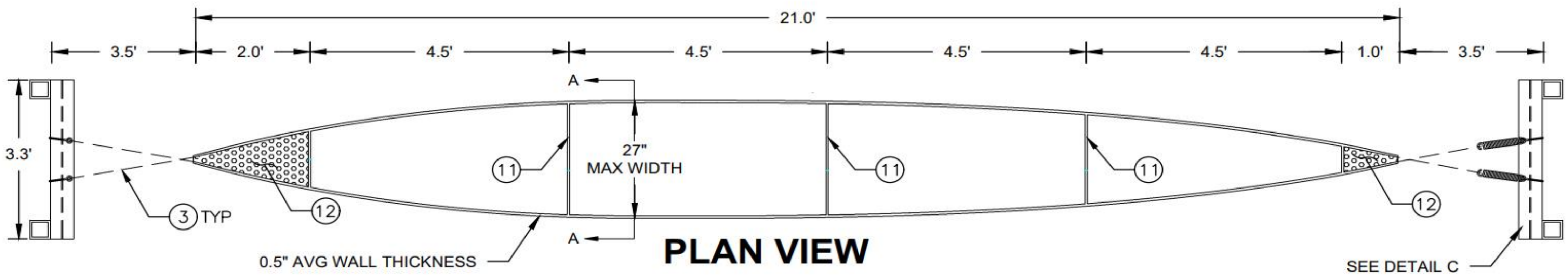
This year health and safety became more prioritized due to the use of concrete staining as mentioned in the RFP. The team opted to use a water base stain to apply an astatic design onto the exterior of the canoe. Using a water base stain made it easier to use and much safer for members to work with. To ensure members' safety we prioritize the use of proper PPE and provided members with an assortment of tools in the application of the staining material. Research backed this decision seeing as how the workability with acid-base stain would become hazardous to members and create possible problems in the application process.

Value and Innovation

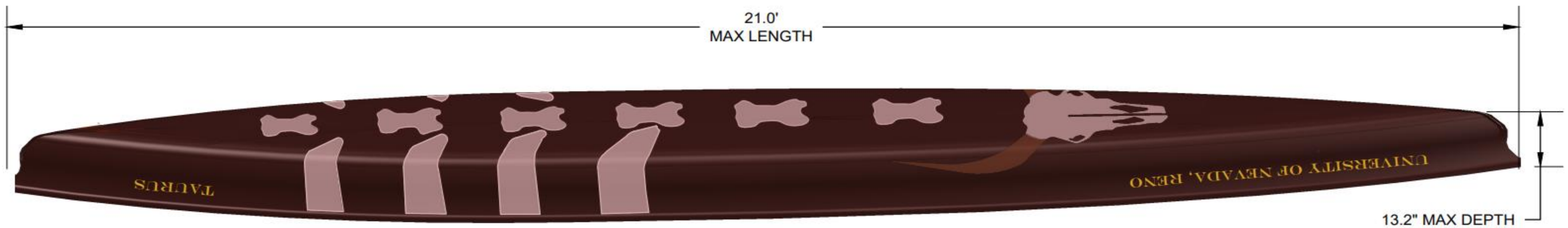
Value to the NCCT stems from the transfer and preservation of knowledge between each competition year. Initial development of Taurus and the project would be staggered due to the loss of information and a need to research information that could have been easily saved and transferred from one project manager to another. These delays would in turn delay progress of the overall project and potentially jeopardize the ability for members to meet deadlines. To avoid any further information loss the NCCT begun developing means of storing knowledge and implementing it into the progress of the coemption.

Previous project managers and members have designed a website the NCCT uses to publish information on the competition as well as past proposals. This website has been maintained in the life span of the competition and its impact on UNR since 2006. This year is no different and will continue to be preserved. However, information not presented on this page would traditionally be lost by members who have furthered their engineering careers past College. The development of a private computer server provided for members from the University would be prepared and program for the use of members. Information stored on this server would include trusted manufactures of the team, spreadsheet and data to be used for calculations, professional accounts for purchasing materials and additional testing and brainstorming expressed from members in each respective coemption year.

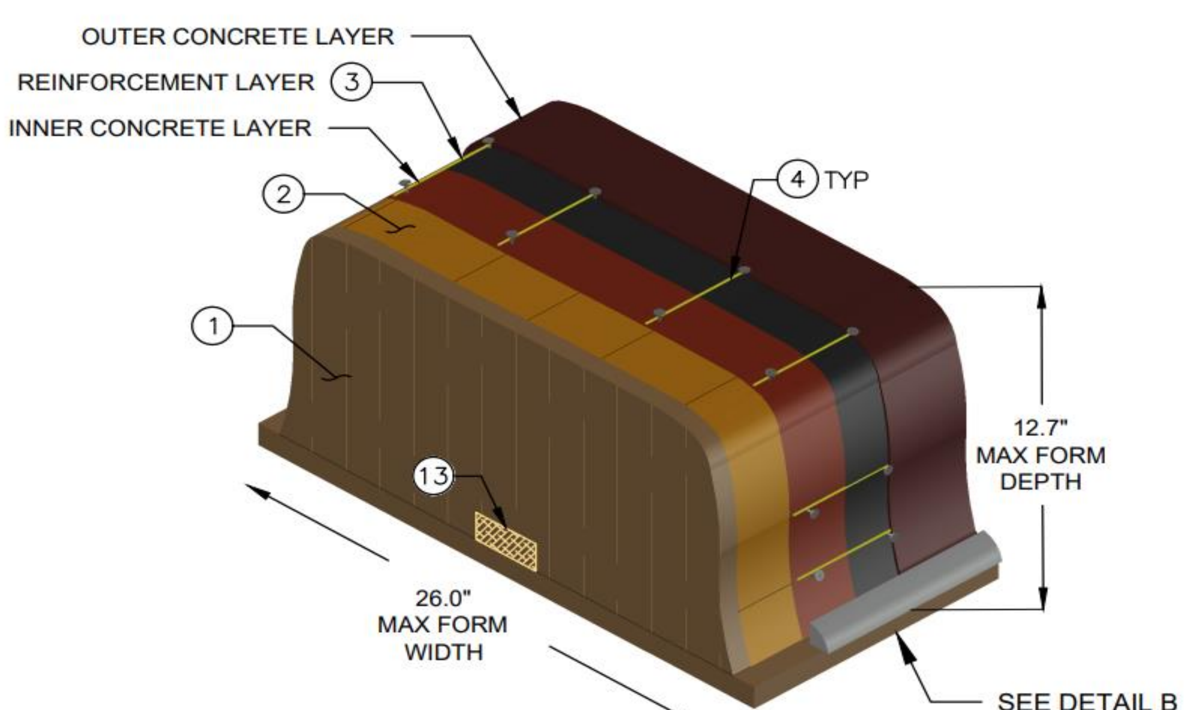
This use of the server keeps development and research consistent as knowledge will become easier to access for future projects. The server will remain to be used, easily maintained by the University faculty, and will continue to be an effective resource for members' development.



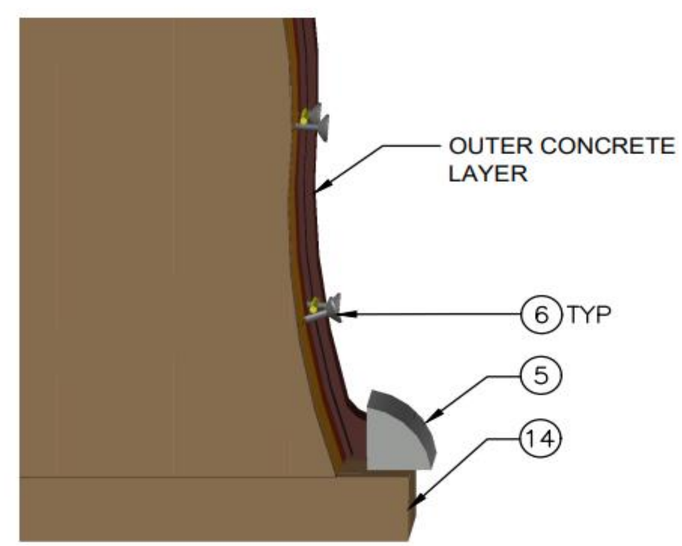
PLAN VIEW



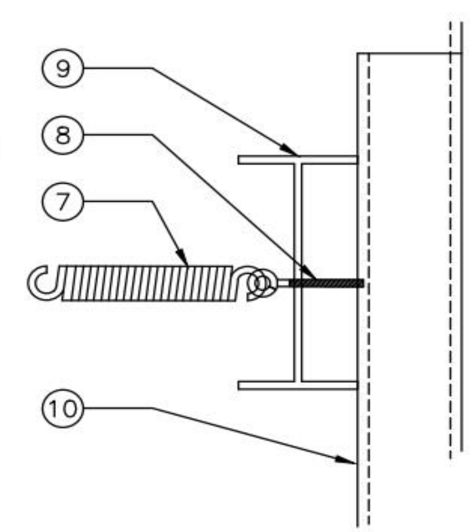
PERSPECTIVE VIEW



CROSS SECTION A - A
ISOMETRIC VIEW



Detail B
GUNWALE



Detail C
LONGITUDINAL PRESTRESS ANCHORAGE

University of Nevada, Reno
Concrete Canoe

Bill of Materials

	Qty	Description
	35 lbs.	Type 1 White Portland Cement
	42 lbs.	Metapor®,Class N, Metakaolin
	33 lbs.	Hydrated Lime Type S
	5.2 lbs.	Nycon® PVA Fibers
	54 lbs.	Poraver®
	19 lbs.	Expanded Shale
	1.5 gal.	ADVA® Cast 575 (HRWR)
	0.5 gal.	V-Mar® F100 (VMA)
	3.2 lbs.	Powder Pigment
	0.7 gal.	Daravair® AT30
	0.4 gal.	Masterlife® SRA 035
	0.5 gal.	MasterSure® Z60
	90 fl. oz.	Sealer
	1 unit	Vinyl Lettering
①	1 unit	Plywood Fin Sections
②	27 sq. ft.	Vinyl Flooring
③	27 sq. ft.	CT 272 Carbon Fiber Grid
④	168 ft.	1/8" Kevlar® Cable
⑤	45 ft.	Quarter Round Molding (3/4" x 3/4")
⑥	212 ct.	Grade Screw
⑦	8 ct.	Steel Spring (L: 6" W: 1.5" k=0.2 k/in)
⑧	28 ct.	Eye Bolt/Nut (L: 6" Dia: 1/2")
⑨	2 ct.	W 12 x 22 Steel
⑩	4 ct.	HSS 3-1/2" x 3-1/2" x 3/8"
⑪	3 units	1/4" Threaded Steel Rebar
⑫	1 c.u ft.	Foam Bulkhead
⑬	19 ft.	2"x4" Lumber
⑭	92 sq. ft	Plywood Table

GENERAL NOTES:

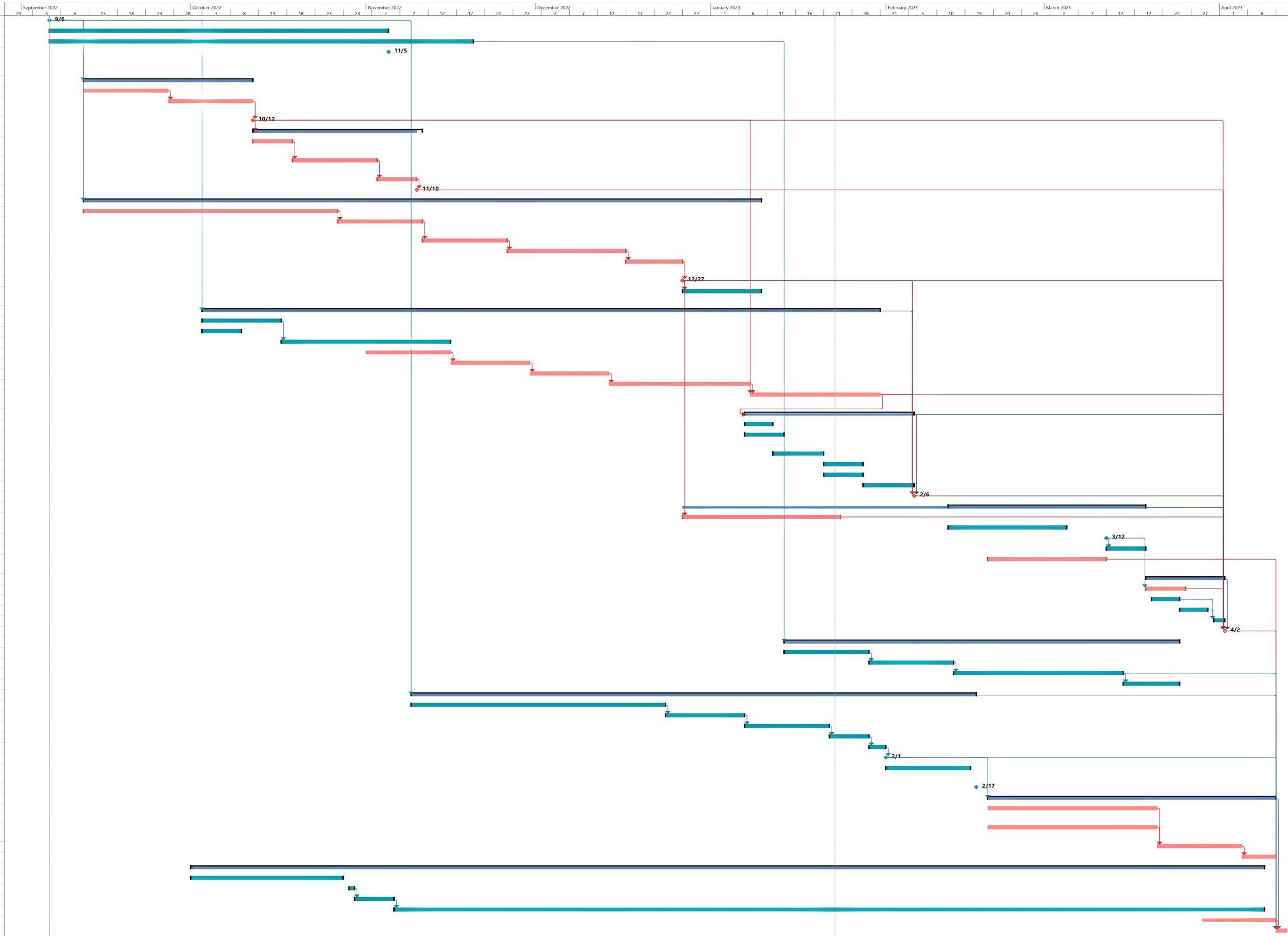
1. DRAWINGS NOT TO SCALE.
2. ONLY 2 OF 8 LONGITUDINAL PRE-STRESS ANCHORAGES ARE SHOWN FOR CLARITY.

DESIGN DRAWING

DATE: 2/9/2023
DESIGNED BY: L. Pritchett; T. Mcilree, M. Bruns
DRAWN BY: Z. Flowers

Project Schedule

ID	Task Name	Duration	Start	Finish	Predecessors
1	**Rule's released**	**0 days**	**Tue 9/6/22**	**Tue 9/6/22**	
2	**Recruitment**	**60 days**	**Tue 9/6/22**	**Sat 11/5/22**	
3	**Fundraising**	**75 days**	**Tue 9/6/22**	**Sun 11/20/22**	
4	**Deadline for project prliminary scheduale, letter of Intent, and RFQ**	**0 days**	**Sat 11/5/22**	**Sat 11/5/22**	
5	**Hull Design**	**30 days**	**Mon 9/12/22**	**Wed 10/12/22**	**1**
6	Hull design research	15 days	Mon 9/12/22	Tue 9/27/22	
7	Hull design development	15 days	Tue 9/27/22	Wed 10/12/22	6
8	Finish hull design	0 days	Wed 10/12/22	Wed 10/12/22	7
9	**Structural analysis**	**30 days**	**Wed 10/12/22**	**Fri 11/11/22**	**8**
10	Computer and software learning	7 days	Wed 10/12/22	Wed 10/19/22	
11	Computer programing and analysis	15 days	Wed 10/19/22	Thu 11/3/22	10
12	Design	7 days	Thu 11/3/22	Thu 11/10/22	11
13	Analysis complete	0 days	Thu 11/10/22	Thu 11/10/22	12
14	**Concrete mix design**	**120 days**	**Mon 9/12/22**	**Tue 1/10/23**	**1**
15	Research	45 days	Mon 9/12/22	Thu 10/27/22	
16	Early design and testing	15 days	Thu 10/27/22	Fri 11/11/22	15
17	Mix aesthetic testing	15 days	Fri 11/11/22	Sat 11/26/22	16
18	Aquiring materials	21 days	Sat 11/26/22	Sat 12/17/22	17
19	Finalizing materials and aesthetic	10 days	Sat 12/17/22	Tue 12/27/22	18
20	Final mix design	0 days	Tue 12/27/22	Tue 12/27/22	19
21	Pre-weigh mix material	14 days	Tue 12/27/22	Tue 1/10/23	20
22	**Construction**	**120 days**	**Mon 10/3/22**	**Tue 1/31/23**	**1**
23	Research	14 days	Mon 10/3/22	Mon 10/17/22	
24	Safety/Lab training	7 days	Mon 10/3/22	Mon 10/10/22	
25	Recylcing material	30 days	Mon 10/17/22	Wed 11/16/22	23
26	Aquiring materials	15 days	Tue 11/1/22	Wed 11/16/22	
27	Table construction	14 days	Wed 11/16/22	Wed 11/30/22	26
28	CNC wooden fins	14 days	Wed 11/30/22	Wed 12/14/22	27
29	Sanding wood	25 days	Wed 12/14/22	Sun 1/8/23	28
30	Constructing canoe mold	23 days	Sun 1/8/23	Tue 1/31/23	8,29
31	**Mold preperation**	**30 days**	**Sat 1/7/23**	**Mon 2/6/23**	**30**
32	Tie reinforcements	5 days	Sat 1/7/23	Thu 1/12/23	
33	Concrete curing preparation	7 days	Sat 1/7/23	Sat 1/14/23	
34	Resin	9 days	Thu 1/12/23	Sat 1/21/23	
35	Sanding	7 days	Sat 1/21/23	Sat 1/28/23	
36	Wax	7 days	Sat 1/21/23	Sat 1/28/23	
37	Prestress instillation	9 days	Sat 1/28/23	Mon 2/6/23	
38	**Canoe casted**	**0 days**	**Mon 2/6/23**	**Mon 2/6/23**	**20,30,31,22**
39	**Canoe curing**	**35 days**	**Sun 2/12/23**	**Sun 3/19/23**	
40	Concrete curing	28 days	Tue 12/27/22	Tue 1/24/23	20
41	Wet sanding	21 days	Sun 2/12/23	Sun 3/5/23	
42	Mold removal	0 days	Sun 3/12/23	Sun 3/12/23	
43	Dry sanding	7 days	Sun 3/12/23	Sun 3/19/23	42
44	Cross section construction	21 days	Sun 2/19/23	Sun 3/12/23	
45	**Patching**	**14 days**	**Sun 3/19/23**	**Sun 4/2/23**	
46	Patching	7 days	Sun 3/19/23	Sun 3/26/23	42
47	Sanding interior	5 days	Mon 3/20/23	Sat 3/25/23	
48	Sanding exterior	5 days	Sat 3/25/23	Thu 3/30/23	
49	Applying sealing	2 days	Fri 3/31/23	Sun 4/2/23	47,48
50	**Canoe completion**	0 days	Sun 4/2/23	Sun 4/2/23	8,13,20,30,31,38,39,45,40,46
51	**Display**	**70 days**	**Sat 1/14/23**	**Sat 3/25/23**	**3**
52	Idea development	15 days	Sat 1/14/23	Sun 1/29/23	
53	Theme and logo design	15 days	Sun 1/29/23	Mon 2/13/23	52
54	Prop construction	30 days	Mon 2/13/23	Wed 3/15/23	53
55	Styling and finishing	10 days	Wed 3/15/23	Sat 3/25/23	54
56	**Report development**	**100 days**	**Wed 11/9/22**	**Fri 2/17/23**	**1**
57	Rough draft	45 days	Wed 11/9/22	Sat 12/24/22	
58	Peer review/edit	14 days	Sat 12/24/22	Sat 1/7/23	57
59	Final draft	15 days	Sat 1/7/23	Sun 1/22/23	58
60	Review	7 days	Sun 1/22/23	Sun 1/29/23	59
61	Printing	3 days	Sun 1/29/23	Wed 2/1/23	60
62	Paper completion	0 days	Wed 2/1/23	Wed 2/1/23	61
63	final proofreading and printing	15 days	Wed 2/1/23	Thu 2/16/23	
64	Paper due	0 days	Fri 2/17/23	Fri 2/17/23	
65	**Presentation**	**51 days**	**Sun 2/19/23**	**Tue 4/11/23**	**62**
66	Develop verbal presentaion	30 days	Sun 2/19/23	Tue 3/21/23	
67	Develop technical presentation	30 days	Sun 2/19/23	Tue 3/21/23	
68	Practice	15 days	Tue 3/21/23	Wed 4/5/23	66,67
69	Revise and finalize	6 days	Wed 4/5/23	Tue 4/11/23	68
70	**Paddling**	**190 days**	**Sat 10/1/22**	**Sun 4/9/23**	
71	Paddle teaching	27 days	Sat 10/1/22	Fri 10/28/22	
72	Tryouts	1 day	Sat 10/29/22	Sun 10/30/22	
73	Paddle selection	7 days	Sun 10/30/22	Sun 11/6/22	72
74	Paddle practice	154 days	Sun 11/6/22	Sun 4/9/23	73
75	**Confrence preperations**	**13 days**	**Wed 3/29/23**	**Tue 4/11/23**	
76	**Intermountain Southwest Confrence**	**2 days**	**Tue 4/11/23**	**Thu 4/13/23**	**50,54,65,75,56,62,44**



Project: CC Project Outline(Wor
Date: Mon 1/23/23

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 | Critical | Critical Split | Progress | Manual Progress

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Appendix B - Mixture Proportions and Primary Mixture Calculation

MIXTURE: Structural Mix

CEMENTITIOUS MATERIALS

Component	*Specific Gravity*	*Volume (ft3)*	*Amount of CM (lb/yd3)*	
Portland Cement, Type I, (White)	3.15	0.79	156.76	Total cm (includes c) 522.53 lb/yd3 c/cm ratio, by mass 0.3
Metapor, Class N (Metakaolin)	2.06	1.63	209.01	
Hydrated Lime Cement Type S	2.21	1.14	156.76	

FIBERS

Component	*Specific Gravity*	*Volume (ft3)*	*Amount of Fibers (lb/yd3)*	
Nycon PVA (8mm)	1.3	0.117	9.52	Total Amount of Fibers 19.04 lb/yd3
Nycon PVA Fibers (12 mm)	1.3	0.117	9.52	

AGGREGATES (EXCLUDING MINERAL FILLERS PASSING NO. 200 SIEVE)

Aggregates	*Abs (%)*	*SGOD*	*SGSSD*	*Base Quantity, W (lb/yd3)*		*Volume, Vagg, SSD (ft3)*
				WOD (lb/yd3)	*WSSD (lb/yd3)*	
Poraver® Siscorspheres 0.1-0.3 mm	22.0	0.85	1.037	127.20	155.18	2.40
Poraver® Siscorspheres 0.25-0.5 mm	15.0	0.68	0.782	101.76	117.02	2.40
Poraver® Siscorspheres 1-2 mm	7.0	0.41	0.439	102.26	109.42	4.00
Poraver® Siscorspheres 2-4 mm	7.0	0.35	0.375	69.83	74.72	3.20
Utelite 16	16.3	1.61	1.872	160.42	186.57	1.60
Utelite 30	17.2	1.59	1.863	237.93	278.85	2.40

LIQUID ADMIXTURES

Admixture	*lb/US gal*	*Dosage (fl. oz / cwt)*	*% Solids (%)*	*Amount of Water in Admixture (lb/yd3)*	
Daravair AT30 (AEA)	8.30	12.00	5.00	4.67	Total Water from Liquid Admixtures, ∑wadmx 31.27 lb/yd3
ADVA Cast 575 (HRWRA)	8.90	70.00	40.00	18.46	
BASF MasterLife SRA 035	8.25	6.05	1.00	2.44	
BASF MasterSure Z60	8.68	8.06	19.90	2.77	
V-MAR F100	8.50	7.25	3.50	2.94	

SOLIDS (DYES, POWDERED ADMIXTURES, AND MINERAL FILLERS)

Component	*Specific Gravity*	*Volume (ft3)*	*Amount (lb/yd3)*	
Fishstone Powdered Pigment	1.27	0.090	7.15	Total Solids. Stotal 7.15 lb/yd3

WATER

		Amount (lb/yd3)	*Volume (ft3)*
***Water**, w, [=∑ (w_{free} + w_{admx} + w_{batch})]*	w/c ratio, by mass **1.14** w/cm ratio, by mass **0.35**	181.02	2.90
***Total Free Water from All Aggregates**, ∑w_{free}*		-122.37	
***Total Water from All Admixtures**, ∑w_{admx}*		26.45	
***Batch Water**, wbatch*		276.94	

DENSITIES, AIR CONTENT, RATIOS, AND SLUMP

Values for 1 cy of concrete	*cm*	*Fibers*	*Aggregate (SSD)*	*Solids, S_{total}*	*Water, w*	*Total*
***Mass**, M (lb)*	522.53	19.04	921.77	7.15	181.02	∑M: 1651.51
***Absolute Volume**, V (ft3)*	3.56	0.23	15.99	0.09	2.90	∑V: 22.77
***Theoretical Density**, T, (=∑M / ∑V) (lb/ft3)*	72.53		***Air Content, Air**, [= (T – D)/T x 100%] (%)*			15.66
***Measured Density**, D (lb/ft3)*	61.17		***Air Content, Air**, [= (27 – ∑V))/27 x 100%] (%)*			15.67
***Total Aggregate Ratio** (=$V_{agg,SSD}$/27) (%)*	59.21%		***Slump, Slump flow, Spread** (as applicable) (in)*			1.00

MIXTURE: Patch Mix

Cementitious Materials

Component	*Specific Gravity*	*Volume (ft3)*	*Amount of CM (lb/yd3)*	
Portland Cement, Type I, (White)	3.15	0.44	87.38	Total cm (includes c) 606.8 lb/yd3 c/cm ratio, by mass 0.14
Metapor, Class N (Metakaolin)	2.06	2.59	333.13	
Hydrated Lime Cement Type S	2.21	1.35	186.29	

Fibers

Component	*Specific Gravity*	*Volume (ft3)*	*Amount of Fibers (lb/yd3)*	
Nycon PVA (8mm)	1.30	0.117	9.52	Total Amount of Fibers 19.04 lb/yd3
Nycon PVA Fibers (12 mm)	1.30	0.117	9.52	

Aggregates (Excluding Mineral Fillers Passing No. 200 Sieve)

Aggregates	*Abs (%)*	*SGOD*	*SGSSD*	*Base Quantity, W*		*Volume, Vagg, SSD (ft3)*
				WOD (lb/yd3)	*WSSD (lb/yd3)*	
Poraver® Siscorspheres 0.1-0.3 mm	22.00	0.85	1.04	113.38	138.32	2.14
Poraver® Siscorspheres 0.25-0.5 mm	15.00	0.68	0.78	129.57	149.01	3.05
Poraver® Siscorspheres 0.5-1.0 mm	9.00	0.41	0.45	115.76	126.18	4.52
Poraver® Siscorspheres 1-2 mm	7.00	0.35	0.37	140.63	150.47	6.44
Utelite 30	17.20	1.59	1.86	45.45	53.27	0.46

Liquid Admixtures

Admixture	*lb/US gal*	*Dosage (fl. oz / cwt)*	*% Solids (%)*	*Amount of Water in Admixture (lb/yd3)*	
ADVA Cast 575 (HRWRA)	8.9	60	40	15.82	Total Water from Liquid Admixtures, ∑wadmx 34.05 lb/yd3
V-MAR F100	8.5	45	3.5	18.23	

Solids (Dyes, Powdered Admixtures, and Mineral Fillers)

Component	*Specific Gravity*	*Volume (ft3)*	*Amount (lb/yd3)*	
Fishstone Powdered Pigment	1.27	0.09	7.15	Total Solids. Stotal 7.15 lb/yd3

Water

		Amount (lb/yd3)	*Volume (ft3)*
Water, w, [=∑ (Wfree + Wadmx + Wbatch)]	w/c ratio, by mass 2.67 w/cm ratio, by mass 0.38	233.01	3.73
Total Free Water from All Aggregates, ∑Wfree		-72.46	
Total Water from All Admixtures, ∑Wadmx		31.54	
Batch Water, Wbatch		273.93	

Densities, Air Content, Ratios, and Slump

Values for 1 cy of concrete	*cm*	*Fibers*	*Aggregate (SSD)*	*Solids, Stotal*	*Water, w*	*Total*
Mass, M (lb)	606.8	19.04	617.25	7.15	233.01	∑M: 1483.25
Absolute Volume, V (ft3)	4.38	0.23	16.61	0.09	3.73	∑V: 25.04
Theoretical Density, T, (=∑M / ∑V) (lb/ft3)	59.24		*Air Content, Air, [= (T – D)/T x 100%] (%)*			7.26
Measured Density, D (lb/ft3)	54.94		*Air Content, Air, [= (27 – ∑V))/27 x 100%] (%)*			7.26
Total Aggregate Ratio (=Vagg,SSD / 27) (%)	0.62		*Slump, Slump flow, Spread (as applicable) (in)*			1.00

Step 1 Cementitious Materials

$$V_{cement} = \frac{M_{cement}}{SG_{cement} * 62.4\frac{lb}{ft^3}}$$

Portland Cement, Type 2, (white)

$$V = \frac{156.76\ lb}{3.15 * 62.4\frac{lb}{ft^3}} = 0.798\ ft^3$$

PowerPozz, Class N (Metakaolin)

$$V = \frac{209.01\ lb}{2.06 * 62.4\frac{lb}{ft^3}} = 1.63\ ft^3$$

Hydrated Lime, Type S

$$V = \frac{156.76\ lb}{2.21 * 62.4\frac{lb}{ft^3}} = 1.14\ ft^3$$

$$\Sigma\, V_{cement} = 0.798\ ft^3 + 1.63\ ft^3 + 1.14\ ft^3 = 3.57\ ft3$$

$$\Sigma\, M_{cement} = 156.76\ lb + 209.01\ lb + 156.76\ lb = 522.53\ lb$$

$$\frac{c}{cm} = \frac{156.76\ ft^3}{522.53\ ft^3} = 0.30$$

Step 2 Fibers

$$V_{fibers} = \frac{M_{fibers}}{SG_{fibers} * 62.4\frac{lb}{ft^3}}$$

Nycon PVA Fibers (8 mm)

$$V = \frac{9.52\ lb}{1.3 * 62.4\frac{lb}{ft^3}} = 0.117\ ft^3$$

Nycon PVA Fibers (12 mm)

$$V = \frac{9.52\ lb}{1.3 * 62.4\frac{lb}{ft^3}} = 0.117\ ft^3$$

Step 3 Aggregates

$$V_{aggregates} = \frac{M_{aggregates(OD)}}{SG_{aggregates(OD)} * 62.4\ \frac{lb}{ft^3}} = \frac{M_{aggregates(ssd)}}{SG_{aggregates(ssd)} * 62.4\ \frac{lb}{ft^3}}$$

Poraver 0.1-0.3 mm

$$V = \frac{127.20\ lb}{0.85 * 62.4\ \frac{lb}{ft^3}} = \frac{155.18\ lb}{1.04 * 62.4\ \frac{lb}{ft^3}} = 2.40\ ft^3$$

Poraver 0.25-0.5 mm

$$V = \frac{101.76\ lb}{0.68 * 62.4\ \frac{lb}{ft^3}} = \frac{117.02\ lb}{0.78 * 62.4\ \frac{lb}{ft^3}} = 2.40\ ft^3$$

Poraver 1-2 mm

$$V = \frac{102.26\ lb}{0.41 * 62.4\ \frac{lb}{ft^3}} = \frac{109.42\ lb}{0.44 * 62.4\ \frac{lb}{ft^3}} = 4.00\ ft^3$$

Poraver 2-4

$$V = \frac{69.83\ lb}{0.35 * 62.4\ \frac{lb}{ft^3}} = \frac{74.72\ lb}{0.38 * 62.4\ \frac{lb}{ft^3}} = 3.20\ ft^3$$

Utelite 16

$$V = \frac{160.42\ lb}{1.61 * 62.4\ \frac{lb}{ft^3}} = \frac{186.57\ lb}{1.87 * 62.4\ \frac{lb}{ft^3}} = 1.60\ ft^3$$

Utelite 30

$$V = \frac{237.93\ lb}{1.59 * 62.4\ \frac{lb}{ft^3}} = \frac{278.85\ lb}{01.86 * 62.4\ \frac{lb}{ft^3}} = 2.40\ ft^3$$

$$\Sigma\, V_{aggregates} = 2.40\ ft^3 + 2.40\ ft^3 + 4.00\ ft^3 + 3.20\ ft^3 + 1.60\ ft^3 + 2.40\ ft^3 = 16.00\ \ ft^3$$

$$\Sigma\, M_{aggregates} = 155.18\ lb + 117.02\ lb + 109.42\ lb + 74.72\ lb + 186.57\ lb + 278.85\ lb = 921.76\ lb$$

$$Aggregate\ Ratio = \frac{16.00\ ft^3}{27\ ft^3} * 100 = 59.26$$

Step 4 Admixtures

$$w_{admx} = \frac{dosage * cwt\ of\ cm * water\ content * 1\ gal * density(\frac{lb}{gal})}{128\ fl.oz.}$$

Daravair AT30

$$w = \frac{\left(12\ \frac{fl.oz.}{cwt}\right) * (6.3207\ cwt) * \left[\frac{100-5}{100}\right] * 1\ gal * 8.3\ \frac{lb}{gal}}{128\ fl.oz.} = 4.67\ lb$$

ADVA Cast 575

$$w = \frac{\left(70\ \frac{fl.oz.}{cwt}\right) * (6.3207\ cwt) * \left[\frac{100-40}{100}\right] * 1\ gal * 8.9\ \frac{lb}{gal}}{128\ fl.oz.} = 18.46\ lb$$

BASF MasterLife SRA 035

$$w = \frac{\left(6.05\ \frac{fl.oz.}{cwt}\right) * (6.3207\ cwt) * \left[\frac{100-1}{100}\right] * 1\ gal * 8.25\ \frac{lb}{gal}}{128\ fl.oz.} = 2.44\ lb$$

BASF MasterSure Z60

$$w = \frac{\left(8.06\ \frac{fl.oz.}{cwt}\right) * (6.3207\ cwt) * \left[\frac{100-19.90}{100}\right] * 1\ gal * 8.68\ \frac{lb}{gal}}{128\ fl.oz.} = 2.77\ lb$$

V-MAR F100

$$w = \frac{\left(7.25\ \frac{fl.oz.}{cwt}\right) * (6.3207\ cwt) * \left[\frac{100-3.5}{100}\right] * 1\ gal * 8.5\ \frac{lb}{gal}}{128\ fl.oz.} = 2.94\ lb$$

$$\Sigma\ w_{admx} = 4.67\ lb + 18.46\ lb + 2.44\ lb + 2.77\ lb + 2.94\ lb = 31.27\ lb$$

Step 5 Solids

$$V_{solids(solids)} = \frac{M_{solids}}{SG_{solids} * 62.4\ \frac{lb}{ft^3}}$$

$$V = \frac{7.15\ lb}{1.27 * 62.4\ \frac{lb}{ft^3}} = 0.09\ ft^3$$

$$\Sigma\ v_{Solids} = 0.09\ ft^3 = 0.09\ ft^3$$
$$\Sigma\ w_{admx} = 7.15\ lb = 7.15\ lb$$

Step 6 Water

$$w = \frac{w}{cm} * cm$$

$$w_{batch} = w - (w_{free} + \Sigma\ w_{admx})$$

$$MC_{total} = \frac{W_{stk} - W_{OD}}{W_{OD}} * 100$$

$$MC_{free} = MC_{total} - Abs$$

$$w_{free} = W_{OD} * \frac{MC_{free}}{100\%}$$

MC_{total}	MC_{free}	w_{free}
Poraver® 0.1-0.3 mm $\frac{127.20-127.20}{127.20}*100\% = 0.00\%$	$0.0\% - 22\% = -22.00\%$	$127.20*\frac{-22.00\%}{100\%} = -27.98$
Poraver® 0.25-0.5 mm $\frac{101.76-101.76}{101.76}*100\% = 0.00\%$	$0.0\% - 15\% = -15.00\%$	$101.76*\frac{-15.00\%}{100\%} = -15.26$
Poraver® 1-2 mm $\frac{30.34-30.34}{30.34}*100\% = 0.00\%$	$0.00\% - 7\% = -7.00\%$	$102.26*\frac{-7.00\%}{100\%} = -7.14$
Poraver® 2-4 mm $\frac{69.83-69.83}{69.83}*100\% = 0.00\%$	$0.0\% - 7\% = -7.00\%$	$69.83*\frac{-7.00\%}{100\%} = -4.89$
Utelite® 16 $\frac{160.42-160.42}{160.42}*100\% = 0.00\%$	$0.0\% - 16.3\% = -16.30\%$	$160.42*\frac{-16.30\%}{100\%} = -26.15$
Utelite® 30 $\frac{237.93-237.93}{237.93}*100\% = 0.00\%$	$0.0\% - 17.2\% = -17.20\%$	$237.93*\frac{-17.20\%}{100\%} = -40.92$

Step 7 Densities, Air Content, Slump, and Ratios

$$M = Amnt_{cm+}Amnt_{fibers+}Amnt_{aggr.+}Amnt_{w+}Amnt_{solids}$$

$$V = V_{cm} += V_{fibers} + V_{aggr.} + V_{w} + V_{solids}$$

$$T = \frac{M}{V}$$

$$Air\ Content = \left(\frac{T-D}{T}\right) * 100\%$$

$$M = 522.53\ lb + 19.04\ lb + 921.77\ lb + 7.15\ lb + 181.02\ lb = 1651.51\ lb\ lb$$

$$V = 3.56\ ft^3 + 0.23ft^3 + 15.99ft^3 + 0.09ft^3 + 2.9ft^3 = 22.77ft^3$$

$$T = \frac{1651.51\ lb}{22.77ft^3} = 72.53\ lb/ft3$$

$$D = \frac{1651.51\ lb}{27.00ft^3} = 61.17\ lb/ft3$$

$$Air\ Content = \left(\frac{72.53\ \frac{lb}{ft^3} - 61.17\frac{lb}{ft^3}}{72.53\frac{lb}{ft^3}}\right) * 100\% = 15.66\%$$

$$Air\ Content = \left(\frac{27\ ft^3 - 22.77ft^3}{27ft^3}\right) * 100\% = 15.6$$

Appendix C – Hull Thickness/Reinforcement and Percent Open Area Calculations

Summary of Reinforcement Thickness:

Reinforcement Material	Material Thickness (in.)
Carbon Fiber Mesh	0.035
Kevlar Tendons	0.125
Threaded Rod	0.25

Section A: Standard Canoe Wall, Typical
Minimum Concrete Wall Thickness: **0.5 in.**

$$\frac{t_{Reinforcement}}{t_{Concrete}} = \frac{t_{tendon}+2\times t_{CarbonMesh}}{t_{Concrete}} = \frac{0.125+2\times 0.035}{0.5} = 39\% \leq 50\%$$

Section B: Rib Location
Minimum Concrete Wall Thickness: **1.5 in.**

$$\frac{t_{Reinforcement}}{t_{Concrete}} = \frac{t_{tendon}+2\times t_{CarbonMesh+}\, t_{Threaded\ Rod}}{t_{Concrete}} = \frac{0.125+2\times 0.035+0.25}{1.5} = 29.7\% \leq 50\%$$

Section C: Gunwale
Minimum Concrete Wall Thickness: **1.75 in.**

$$\frac{t_{Reinforcement}}{t_{Concrete}} = \frac{t_{Threaded\ Rod}}{t_{Concrete}} = \frac{0.375}{1.75} = 21.4\% \leq 50\%$$

Section D: Bulkhead
Minimum Concrete Wall Thickness: **1.0 in.**

$$\frac{t_{Reinforcement}}{t_{Concrete}} = \frac{2\times t_{Threaded\ Rod}}{t_{Concrete}} = \frac{2\times 0.25}{1.0} = 50\% \leq 50\%$$

Section E: Anchorage Zone
Minimum Concrete Wall Thickness: **1.0 in.**

$$\frac{t_{Reinforcement}}{t_{Concrete}} = \frac{2\times t_{Tendon}}{t_{Concrete}} = \frac{2\times 0125}{1.0} = 25\% \leq 50\%$$

General Note: Reinforcement thicknesses determined as per Exhibit 5 of the 2023 ASCE National Concrete Canoe Competition Rules and Regulations

Percent Open Area Calculations: Carbon Fiber Grid

Variable	Definition	Carbon Fiber Grid Parameters
N_1	Number of apertures along sample length	6
N_2	Number of apertures along sample length	7
$Aperture_1$	Spacing of reinforcement (center to center) along sample length	1.5 in.
$Aperture_2$	Spacing of reinforcement (center to center) along sample length	1.5 in.
T_1	Thickness of reinforcement along sample length	0.15 in.
T_1	Thickness of reinforcement along sample length width	0.15 in.

Carbon Fiber Grid Reinforcement

$$d_1 = \text{aperture}_1 + 2 \times \left(\frac{t_1}{2}\right) = 1.5 \text{ in.} + 2 \times \left(\frac{0.15\ in.}{2}\right) = 1.65 \text{ in.}$$

$$d_2 = \text{aperture}_2 + 2 \times \left(\frac{t_2}{2}\right) = 1.5 \text{ in.} + 2 \times \left(\frac{0.15\ in.}{2}\right) = 1.65 \text{ in.}$$

$$\text{Length} = n_1 \times d_1 = 6 \times 1.65\ in. = 9.9 \text{ in.}$$

$$\text{Width} = n_2 \times d_2 = 7 \times 1.65\ in. = 11.55 \text{ in.}$$

$$\sum Area_{open} = n_1 \times n_2 \times amperture_1 \times amperture_2 = 6 \times 7 \times 1.5\ in. \times 1.5\ in. = 94.5\ in.^2$$

$$\sum Area_{total} = Length \times Width = 9.9\ in. \times 11.55 in. = 114.345\ in^2$$

$$\text{POA} = \frac{\sum Area_{open}}{\sum Area_{total}} = \frac{94.5\ in.^2}{114.345\ in.^2} = 82.6\% \ (> 40\% \text{ min})$$

O. K

Appendix D – Detailed Fee Estimate

Direct Labor Cost and Hours Estimate			
Personnel	Hourly Rate	Hours	Total
Principle Design Engineer	$50	324	$16,200
Design Manager	$45	265	$11,925
Project Construction Manager	$40	153	$6,120
Construction Superintendent	$40	189	$7,560
Project Design Engineer (P.E)	$35	378	$13,230
Quality Manager	$35	187	$6,545
Graduate Field Engineer (EIT)	$25	98	$2,450
Technician/Drafter	$20	67	$1,340
Laborer/Technician	$25	874	$21,850
Clerk/Office Admin	$15	77	$1,155
	Total	2612	$88,375

Labor Costs	
Total Cost	$88,375
Direct Employee Costs (DEC)	1.5
Indirect Employee Costs (IEC)	1.3
Profit Multiplier (P)	18%
DL = [Σ(RLR*HRS)] *(DEC + IEC)*(1+P)	203,350.88
Expense Costs	
Total Material Cost (MC)	$779.71
Direct Expense (DE)	$1,200
Markup (M)	10%
Expenses [E = (ΣMC + ΣDE) *(1+M)]	$2,177.68
Shipping Cost for Canoe (Reno - Platteville)	$5,638

Material Cost				
Construction				
Material	Unit Price	Unit	Units	Cost
1/8" Kevlar Cord	$1.14	ft	168	$191.52
Carbon Fiber Mesh Grid	$16.50	ft	27	$445.50
1/4" Rebar	$1.01	ft	14	$14.14
Concrete Sealer	0.39	ft2	120	46.8
Foam	$8.84	ft^3	1	$8.84
Rubber Spacer	$0.15	ft	168	$25.20
Concrete				
Material	Unit Price	Unit	Units	Cost
Portland Cement, Type I (White)	$0.12	lb	35	$4.20
Metakaolin	$0.46	lb	42	$19.32
Hydrated Lime, Type S	$0.15	lb	33	$4.95
Nycon PVA Fibers	$1.05	lb	5.2	$5.46
Poraver® expanded glass	$0.32	lb	54	$17.28
Expanded Shale	$0.37	lb	19	$7.03
Pigment	$1.42	lb	3.2	$4.54
Daravair AT30	$9.45	gal	0.7	$6.62
ADVA Cast 575	$9.12	gal	1.5	$13.68
Masterlife SRA 035	$7.24	gal	0.4	$2.90
VMAR	$9.22	gal	0.5	$4.61
MasterSure Z60	$7.85	gal	0.5	$3.93
		Total	573	$779.71

Grand Total	$208,988.88

Appendix E – Supporting Documentation

Pre-Qualification Form (Page 1 of X)

University of Nevada Reno
(school name)

We acknowledge that we have read the 2023 ASCE Society-wide Concrete Canoe Competition Request for Proposal and understand the following (*initialed by team project manager and ASCE Faculty Advisor*):

The requirements of all teams to qualify as a participant in the ASCE Student Symposium and Society-wide Competitions as outlined in Section 3.0 and Exhibit 3.	LP	KDK
The eligibility requirements of registered participants (Section 3.0 and Exhibit 3)	LP	KDK
The deadline for the submission of *Letter of Intent, Preliminary Project Delivery Schedule* and *Pre-Qualification Form* (uploaded to ASCE server) is November 4, 2022; 5:00 p.m. Eastern	LP	KDK
The last day to submit *ASCE Student Chapter Annual Reports* to be eligible for qualifying (so that they may be graded) is February 1, 2023	LP	KDK
The last day to submit *Request for Information* (RFI) to the C4 is January 27, 2023	LP	KDK
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.	LP	KDK
The submission date of *Project Proposal*, and *MTDS Addendum* for the Student Symposium Competition (uploading of electronic copies to ASCE server) is Friday, February 17, 2023.	LP	KDK
The submission date of *Project Proposal, and MTDS Addendum* for Society-wide Final Competition (hard copies postmarked to ASCE and uploading of uploading of electronic copies to ASCE server) is May 10, 2023; 5:00 p.m. Eastern.	LP	KDK

Lucas Pritchett
Team Captain

9/27/22
(date)

Kelly Kesélica
ASCE Student Chapter Faculty Advisor

9/27/22
(date)

[signature]
(signature)

[signature]
(signature)

Pre-Qualification Form (Page 2 of X)

University of Nevada - Reno
(school name)

As of the date of issuance of this Request for Proposal, what is the status of your school / university's 2022-23 classroom instruction (in-person, remote, hybrid)? What is anticipated after Thanksgiving and winter holiday break? If in-person or hybrid, do you have access to laboratory space or other facilities outside of classes?

The University of Nevada, Reno (UNR) and the Nevada Concrete Canoe Team (NCCT) are proceeding with in-person classes for the 2021-2022 school year. Keeping students and faculty in good health remains a priority as we continuously restock and supply members with the appropriate health and safety equipment needed to proceed with regular laboratory/construction meeting's. After Thanksgiving and winter holiday break, class is anticipated to maintain in-person attendance and members will still remain to regularly meet throughout the semester. The NCCT, with approval from University officials, will have access to laboratory space and our work space outside of classes and during off hours of campus activity.

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.

UNR's NCCT has the following H&S Program in place:

1. Safety Management
   All members will be required to wear and follow proper PPE, including long-sleeved shirts, pants, closed toed shoes, gloves, and N-95 masks. The NCCT will work closely with the university's Environmental Health & Safety (EH&S) Office to ensure proper safety measures are in place. Additionally the NCCT has established a new leadership role of a Safety Manager who will maintain the guidelines listed above and by the EH&S Office to ensure that members will remain in good health during experiments. The NCCT abides by strict policies in regard to proper use and storage of chemicals and tools.

2. Cleaning
   After each workday, cleaning of the workspace and tools is required. Brooms, wash cloths, and a newly provided power washer and floor maintenance material will be properly used after each work day. All tools, material, and chemicals are to be returned to its proper storage bin and/or locker.

3. Workday Overview
   Before a workday, a general meeting will be held by the Project Manager's to familiarize members on the workday's goals, proper construction techniques, chemical management, and safety concerns.

4. COVID-19
   Although the mask mandate for COVID- 19 is no longer mandatory, members will still follow proper symptom protocols. Members who have symptoms of or test positive for COVID- 19 must report to the Safety Manager and may not participate on the NCCT until a negative test is provided. All team members will be notified if someone was affected by COVID-19.

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 NCCT has the current QA/QC program in place:

1. Scheduling

Team managers will meet in-person regularly to discuss deadlines and important dates regarding the project delivery schedule. Updates regarding project deadlines, modifications, or delays will also be regularly discussed in these meeting's.

2. Preparations

Before each workday, a meeting will be held with the managers of the project. The meeting entails reviewing proper construction and mix techniques, safety concerns and protocols, and any problems that may occur during the regularly scheduled workday.

3. Oversight

Trained Team Manager's and the knowledge of former members will ensure workday's are conducted safely and effectively. Together, they will ensure all members are performing proper construction techniques, quality work is being produced, and any errors are resolved such that the overall quality is not diminished.

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?

Yes, all qualifying team manager's and members with a significant enough role will receive proper University training for the laboratory before any construction or mix design begins.

The anticipated canoe name and overall theme is – (*please provide a brief description of the anticipated 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.***)**

The team's anticipated canoe theme for 2022-2023 is to incorporate the Reno rodeo and its western style design into our boat. Following this theme, the potential designs would stay close to home and try to incorporate designs seen at the Rodeo.

Additionally, the potential name of this year's boat is "Taurus"

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

Yes. There will be no issues with the theme so long as we provide our own art or get permission/cite from the necessary parties involved.

The core project team is made up of 10 **number of people.**