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Project Title: LIGHT WEIGHT CONCRETE CANOE

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TITLE: LIGHT WEIGHT CONCRETE CANOE

ABSTRACT

Making a light weight canoe using concrete is the ultimate aim of our project. In order to reduce the usage of natural resources like timber for the construction of a canoe which has some serious ecological problems we had come with a new technology which can replace the usage natural resources for the purpose of sailing in water. Here we make use of the light weight concrete for the construction of the canoe.

Key words: Canoe, Light weight Concrete, Timber

OBJECTIVE

We are grateful to have such an opportunity to learn on the canoe design, concrete technology, construction materials and various other topics. The papers of the foreign universities guided us all through the campaign. Our team meetings, pre and post design discussions helped us to ensure that we were on the right track to making a durably safe canoe. We divided our responsibilities and worked as a team. We projected that the area of material selection will be a key element in giving us the thrust required to win the competition. So we concentrated our efforts towards attaining a perfect mix design along with a feasible construction method. We ensured ourselves to have achieved this by constructing a half-scaled prototype of our final canoe design. We also realized the importance of scheduling our activities and matching it up. Thus here we are with the final report describing the canoe profile, material design, construction methodology adopted and much more.

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INTRODUCTION:

Our aim was to detect and resolve all existing issues in general concrete canoe building and adapt to a much sustainable methodology. Starting with the canoe's construction from scratch and providing equal importance to each and every area with the best suited materials in the canoe was our primary objective to be met, the following were the inferences made after our prototyping and team discussions to fulfill the sustainability criteria of our canoe.

1. Design and construct a sustainable concrete canoe
2. Reduce on-campus waste production by using a secondary waste material for mold, with bricks from construction sites, rather than a silica mold, as has been used in many of the previous years.
3. Reduce the team's overall material usage and water use by switching from an ordinary cement mix design to a metakaoline mix design. The metakaoline mix design incorporates recycled materials and fine sand, rather than costlier silica fumes and fly ash, as its main components.
4. Sustainability also directly influenced on educating team members on the importance of sustainable design through the team's prototyping sessions.

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Stability design

Stability is the resistance of a boat to small changes in the difference between the vertical forces applied on its two sides. The wider the boat and the further its volume is distributed away from its center line, the greater the initial stability. The meta-centric height is a measurement of the initial static stability of a floating body. It is calculated as the distance between the center of gravity of a canoe and its meta-center.

Final Hull Design:

Top Length – 15 m,

Bottom length -14.5 m,

Top Width – 1.50 m,

Bottom Width – 1.30 m

Depth – 0.44 m

Hull profile:

A) Flat Bottomed:

These hulls look just like they sound: the canoe's belly has very little curve, making it highly stable on calm water.

b) Canoe Profile:

Flare

The cross-section of the canoe is curved out-wards to resist tipping and deflect water for a drier ride.

Additional Elements:

• A square stern is adopted to cut across the water with minimum afflux

• The bow radius is increased to improve the carrying capacity and also to speed-up.

c) Final structural design

The pro-e diagram of our canoe was imported to Ansys and was checked for its stress- strain characteristics.

Loading conditions:

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Case 1: 2 point loads each of 80 kg acting at 75cm from both the ends.

Case 2: Uniformly distributed load of 160kg acting on the belly of canoe.

Assumptions:

Thickness of concrete along the side walls – 0.19 m

Thickness along the base of canoe – 0.30 m

Density – 1560 kg/m^3

Young's modulus – 18kN/mm^2

Completed Material Design and Final Test Data

The following were the proposed materials their properties.

TABLE 1: List of materials used and their properties

OPC 53 grade:	Possess higher strength and highly durable sound concrete
Metakaoline:	Increased compressive and flexural strength. Reduced permeability and reduced shrinkage (due to particle packing) and increased durability and enhanced workability.
Fibre Glass Mesh:	High tensile strength and small elongation (3%), water resistant property. High flexibility and resistant to aging.
Fine Sand:	Provides strength and shrinkage control
Shrinkage reducing admixtures (CEBEX 100):	Prevents shrinkage cracks and improves concrete durability

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MOULD DESIGN & FABRICATION

A female mould was chosen in comparison to male mould based on the economic aspects. A male mould is the shape of the object being formed, and the material is casted from inside using shotcreting and other means. This procedure was considered not to be economically viable and hence the female mould which forms exterior surface of the object (the mould being the reverse of the shape of the object) was adopted.

1. The initial strategy was to bench mark all our requirements, post which we categorized all design criteria that our canoe is supposed to satisfy.
2. Once deliberations and optimal strategizing were done with, the design team laid hands upon the soft copy of the canoe.
3. Done with the design we were set to get our hands dirty prior to which we scaled the soft copy to an optimum 1:1 ratio and then the plotter was used to get a hard copy of the same.
4. For the foundation we customized plywood boards on which our first brick mould was set up, considering all necessary parameters this was done till we reached our proposed height.
5. At this stage our canoe was inverted, excluding the tolerance gap and allowances we filled up the remaining gaps with secondary composite materials such as plastic bag remains, sand particles etc.
6. Now the mould was to be check for leveling for which the spirit level was relied upon, necessary adjustments were made in order to meet our proposed theoretical stats.
7. A layer of cement-sand mortar in the ratio 1:5 was applied over the mould along with bentonite slurry paste for fabrication of mould.
8. Ribs were also formed on the mold as per the guidance of our professor in order to improve the strength of the canoe.

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Sustainability:

Since India is witnessing a National concrete Canoe Championship for the first time our aim was to detect and resolve all existing issues in general concrete canoe building and adapt to a much sustainable methodology. Starting with the canoe's construction from scratch and providing equal importance to each and every area with the best suited materials in the canoe was our primary objective to be met, the following were the inferences made after our prototyping and team discussions to fulfill the sustainability criteria of our canoe.

1. Design and construct a sustainable concrete canoe, and compete at the regional and national level of the National Concrete Canoe Competition.

2. Reduce on-campus waste production by using a secondary waste material for mold, with bricks from construction sites, rather than a silica mold, as has been used in

many of the previous years.

3. Reduce the team's overall material usage and water use by switching from an ordinary cement mix design to a metakaoline mix design. The metakaolin mix design

Incorporates recycled materials and fine sand, rather than costlier silica fumes and fly

ash, as its main components.

4. Sustainability also directly influenced on educating team members on the importance of sustainable design through the team's prototyping sessions.

Innovation:

Casting process of the canoe saw innovations being carried out, by addition of double reinforcements in order to increase the overall strength. In order to increase the tensile strength two layers of mesh were sandwiched between three cover layers of cement mix and admixtures. The canoe is casted with inner ribs to enhance its strength. Tests carried out between Silica fumes and Metakaolin went by Meatakaloins increased properties which resulted in its usage for the first time in building a canoe.

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Figure 1.1. Casting of the concrete in the mould

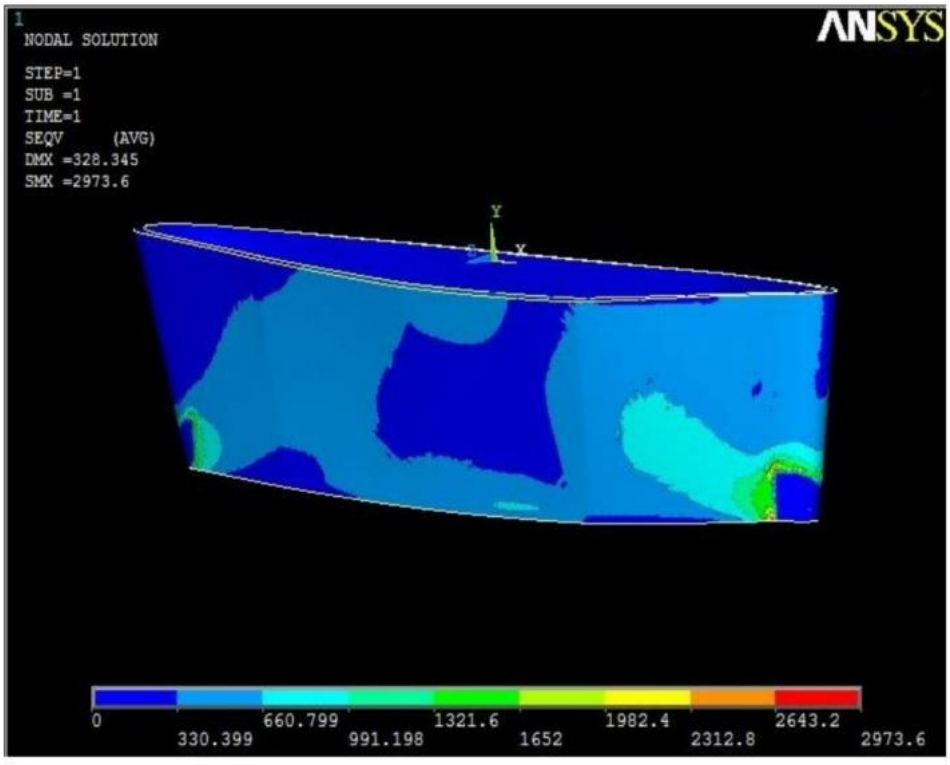

Figure 1.2. Analysis diagram using ANSYS

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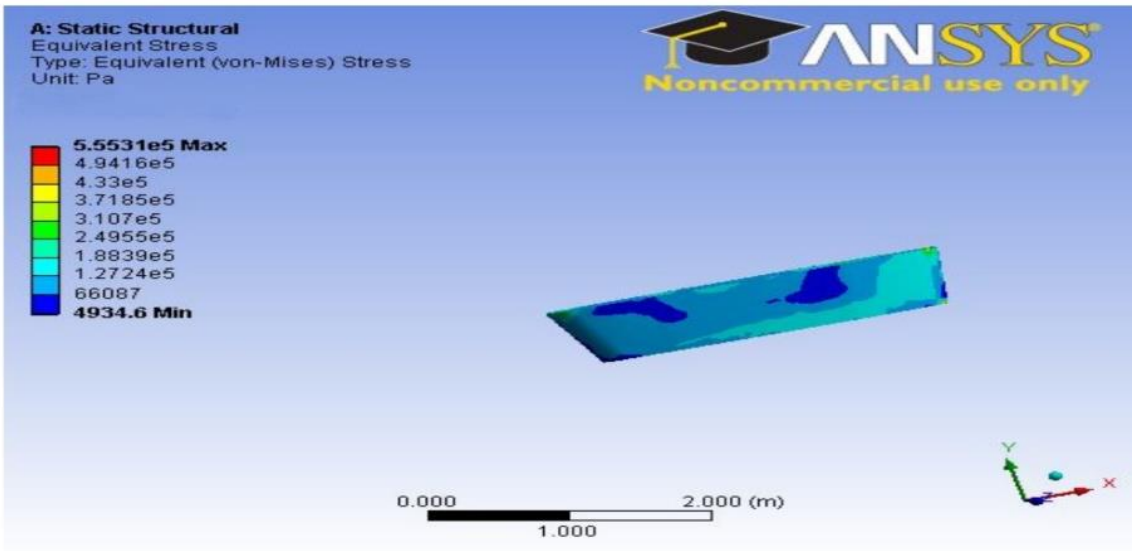

Figure 1.3. Analysis for load case 2

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CONCLUSION

- This technology is a more sustainable when comparing to the conventional one.
- This will be cheaper when manufactured in a large industrial scale.
- Further implementation of new mix designs will bring additional strength and durability of the canoe.
- It can be also used in smaller yachts and medium sized boats.

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