

CONQUER-IT

PROBLEM STATEMENT

Introduction:

Today, the use of lightweight concrete materials is a growing demand. It has been practiced since ancient times when the Romans built Pantheon, the aqueducts, and the Colosseum in Rome. Expanded Polystyrene (EPS) Concrete is one of the forms of lightweight concrete. It is created by using small lightweight EPS balls as an aggregate instead of the crushed stone that is used in regular concrete. It is not as strong as stone-based concrete mixes but has other advantages such as increased thermal and sound insulation properties, easy shaping and ability to be formed by hand with sculpturing and construction tools. It is used for constructing the road, thermal controlled wall and bridges etc. At present, lightweight aggregates are produced in a very wide range of densities varying from 50kg/m³ from expanded perlite to 1000kg/m³ for clinkers. It is possible to make lightweight aggregate concrete of 80MPa compressive strength and thermal resistance up to 6 times that of normal weight concrete.

Few of the advantages of EPS Concrete are listed below:

- EPS reduces the weight of concrete, helps in easy removal, transport, and erection of precast products.
- Insulation EPS is a well-established material for the construction industry and offers a proven and economic solution which helps specifiers maintain build costs and construction budgets.
- Lightweight concrete has comparatively less tendency to spall. Hence, its fire resistance is greater as compared to the ordinary concrete.
- Sound absorption of EPS concrete is good because of the air voids and it reduces the cost up to 40 percent to that of normal concrete.

Some applications of Lightweight concrete are decks of long-span bridges, fire, and corrosion protection, covering for architectural purposes, heat insulation on roofs, insulation of water pipes, filling for floor and roof slabs, construction of partition walls and panel walls in framed structures, production precast building blocks, and low-cost housing.

As a budding civil engineer, this is a perfect time and AAKAAR's "ConquerIT" is the best stage to get you introduced to this astonishing concept of Lightweight Concrete. This year AAKAAR has chosen to investigate into another measurement of concrete, i.e. Load bearing capacity of floating concrete. Effectively a standout amongst the most occurrence points in Research and Development, Lightweight Concrete is quickly picking up prominence in the world.

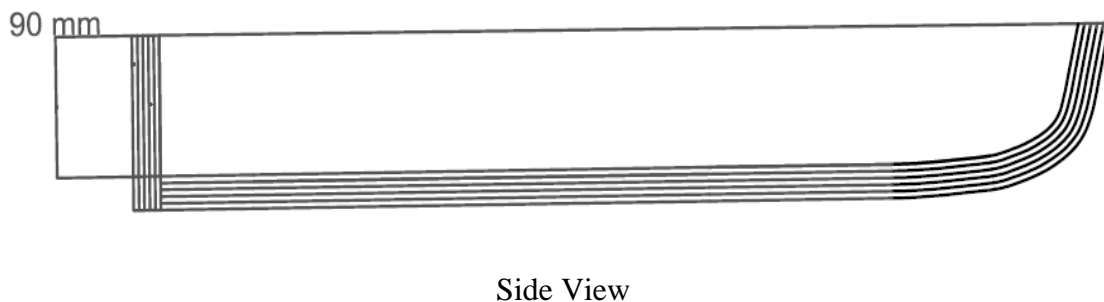
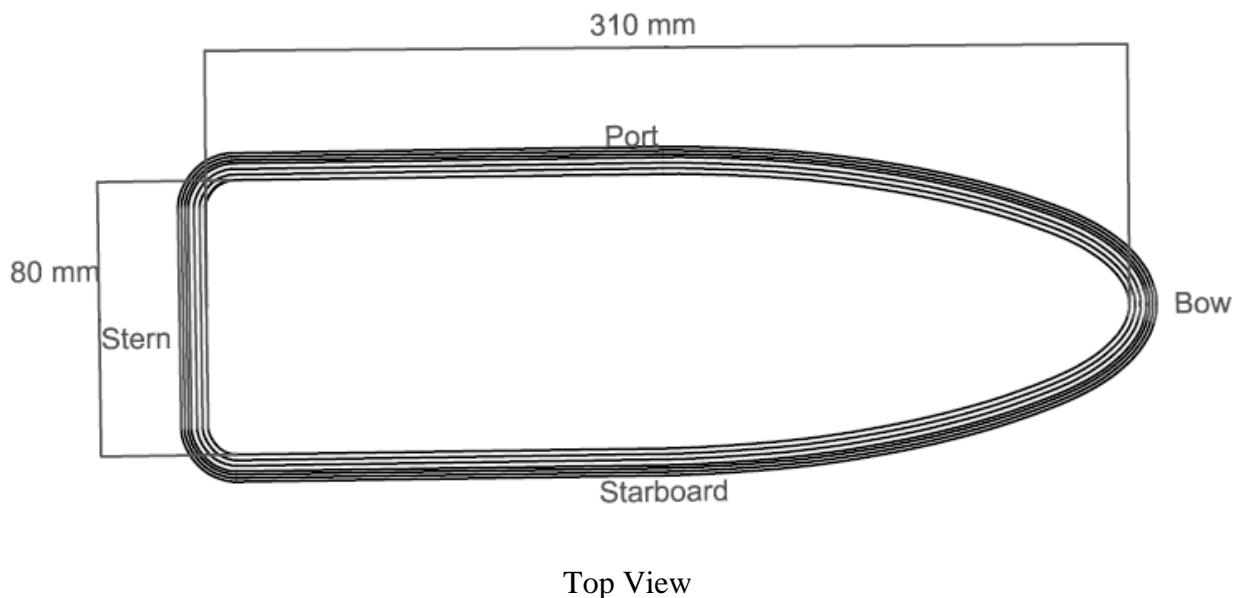
Task:

- 1) Design and build a Concrete Canoe using Expanded Polystyrene (EPS) Concrete which will be tested for Load bearing capacity of floating canoe.
- 2) Cast three concrete cubes of the same mix for the compressive strength test.

Dimensions:

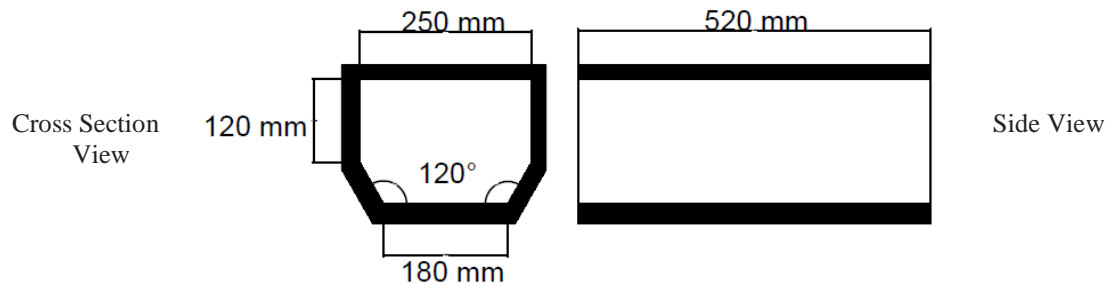
The participants need to bring three concrete cubes and a concrete canoe made of same Expanded Polystyrene (EPS) Concrete mix. The Canoe must consist of a stern, bow and a port and starboard side. All are integrated as components of the canoe as a single structure. The specimen, with minimum dimensions, should completely lie inside a box which needs to be satisfied for testing of the canoe. The minimum dimensions of the specimen are:

- **Minimum hollow space dimensions** of canoe are
 - The minimum length of the stern to bow must be 310mm +/- 5mm.
 - The minimum width of the port to starboard side must be 80mm +/- 5mm.
 - The minimum height must be 90mm +/-5mm.



- The sides of the canoe should be tapered with the bottom width of the canoe at least should be 3 cm less than the upper width of the canoe.
- Choose the thickness of canoe according to your design but ensure that it does not exceed more than 6 cm.
- The top surface of stern and bow should be at the same level.

Following is the given sketch of the box in which your canoe should lie completely:



The concrete cubes should have a dimension of 100mm*100mm*100mm with an allowance of +/-5mm on all sides. Any failure to adhere to these dimensions will lead to disqualification of teams.

Material:

Concrete Specimens

- The participants are advised to use standard OPC cement, expanded polystyrene as aggregates, fly ash, and water. Same Expanded Polystyrene (EPS) Concrete mix should be used to cast both the specimens.
- The nominal maximum size of EPS as aggregate allowed is of 8mm.

Choose ratio of expanded polystyrene to cement by mass percent (α) from the range $2.5 < \alpha < 4.5$

$$\alpha = \frac{\text{Mass of EPS}}{\text{Mass of Cement}} \times 100$$

Testing Criteria:

All the rounds will happen on the same day of competition

The testing will be done in three rounds:

➤ First Round

Compressive strength, the concrete cubes will be subjected to a compressive load using a Compressive Testing Machine (CTM) at rate load of 0.5 kN/sec. The compressive strength of concrete cubes will be noted to two decimal places for all three cubes. Then the average Compressive strength of all the cubes will be calculated.

Scoring:

The average Compressive strength will be taken for scoring. Participants will get points for this round as follows:

Avg. Strength (MPa)	Points (S1)
0.00-0.05	00
0.06-1.50	10
1.51-2.50	20
2.51-3.51	35
>3.51	50

Penalty: Any dimension (x) of the cube having deviation of more than +/- 5 mm, will not be tested. Only tested cubes will be used in order to determine average compressive strength.

If all the three cubes have deviation of more than +/- 5 mm, the team will be disqualified.

➤ Second Round

Measurement of the stability of canoe, first the canoe will place in water, after 20 seconds we measure the angle of inclination of the top surface of the stern with respect to horizontal. This is the sign of stability of the canoe.

Scoring:

- In this round, the stability of canoe will be calculated by the angle of inclination of the top surface of the stern with respect to horizontal.
- If the angle of inclination lies in between 0-5°, the participants will get S2= 50 points.
- If the angle of inclination exceeds 5°, the participant will get points as follow:

Angle (In degree)	Points (S2)
5.01-10.00	40
10.01-15.00	30
15.01-20.00	20
20.01-25.00	10

- If the angle of inclination goes beyond 25° or any of the top edges of port or starboard side touches water level, participants will get S2 = 0 point for this round.

➤ Third Round

Load bearing capacity of floating canoe: Participants will start putting the small weights of 200 gm in the gap of 30 sec in the hollow space of canoe until the canoe will sink. The previous load on which the canoe will sink or topple will be taken as the load-bearing capacity

of the canoe. If the canoe sinks or topples while the first packets of weight are placed, the participants will get zero points of this round.

Scoring:

In this round, load-bearing capacity of the canoe will be tested. Will place the loading quantity amount of 200 gm in the gap of 30 sec. For this round, participants will get points as follow:

Load (In Kg)	Points (S3)	Load (In Kg)	Points (S3)
0.40-0.80	20	2.81-3.20	50
0.81-1.20	25	3.21-3.60	60
1.21-1.60	30	3.61-4.00	70
1.61-2.00	35	4.01-4.40	80
2.01-2.40	40	4.41-4.80	90
2.41-2.80	45	4.81-5.20	100

If the canoe can bear a load of 5.2 kg, we will measure minimum height (h) of the edge of port or starboard side from water level with containing 5.2 kg and the final score of this round will be taken into account as:

$$S4 = (S3, \text{corresponding to load bear}) + \text{Bear load} \times \left(\frac{5 \times h}{\text{height of canoe}} \right)$$

Otherwise, the points S3 will be taken to corresponding load bear.

Note:

1. Only one member of the team will place the load in canoe according to themselves in the whole testing.
2. If seepage or any kind of crack or damage will occur during testing, testing will stop at that moment and note down the reading.
3. The team members are responsible for handling the canoe. No responsibility is borne by team Aakaar if the canoe suffers any form of damage during testing.

Final Score

- A Score of S5 which will vary from 0 to 20 points will be allotted on the basis of your report. A detailed description of report format is given below.
- Total score $S = S1 + S2 + (S3 \text{ or } S4) + S5 - P$ (Penalties) will be taken in order to declare a winner. In the case of a tie, Score of rounds in order of $S3 > S2 > S1$ will take to declare winner

Report:

- A report has to be submitted along with the cubes which should include the following:
Technical mix design report includes material specifications, mix proportions, the concentration of expanded polystyrene used, amount and type of admixture used, casting procedure and curing procedure.
- The date of casting the cubes and canoe.
- Report should be duly signed by a professor, who is a registered faculty member of any engineering college recognized by Government of India
- Report should not exceed 6 sides of an A4 sheet
- Each report will be examined by AAKAAR team and participants whose reports are not signed by the faculty member will not be allowed to take part in the competition.

Penalties (P):

- Any dimension (x) of the cube having deviation of more than ± 5 mm, will not be tested. Only tested cubes will be used in order to determine average compressive strength. If all the three cubes having deviation of more than ± 5 mm, the team will be disqualified.
- Any given dimension (x) of Canoe having deviation of more than ± 5 mm, then a penalty of P=5 points will be deducted for every deviated dimension.

Rules:

- Bring from home competition so certificates will be awarded to every qualified entry.
- Student should form teams comprising of maximum 4 members. Students from different colleges can also form a single team.
- A Canoe and three concrete cubes to be brought by each team.
- Apply a thin layer of cement paste and oil paints **only to the outer side** of the canoe. While casting, **a short 2 min video has to be shot by the participants by keeping Canoe and cubes side by side** to ensure that participants have used the same mix to cast all the samples. This video has to be sent via e-mail id of the group leader to aakaar.competitions@gmail.com. The Subject of the mail: Video Submission for ConquerIt: AKR-NNN-XXX (AAKAAR id of group leader). The mail should also contain name and AAKAAR IDs of all the team members at least 7 days prior to the date of the competition.
- No restriction on use of types of chemical admixtures
- No aggregate other than EPS should be used. If found, will lead to direct disqualification
- Any curing method can be adopted
- Teams not submitting the report will be disqualified.
- No certificate will be provided to disqualified teams
- Report will be judged by AAKAAR Team
- The decision of AAKAAR team will be final

Contact information:

For any queries regarding this competition drop a mail to the given email id. We will try our best to revert back as soon as possible. Please **avoid contacting** AAKAAR team members directly without following the first step.

Email Id: aakaar.competitions@gmail.com

(Subject: Query regarding ConquerIt competition: Team Leader Name AAKAAR ID)

Vishal Kochar (7021682119)

Dhiraj Soni (8955882377)

Queries done only by email will be taken as genuine in future, not by the call.

Terminology:

- **Bow:** The bow is the forward part of the canoe where the sides port and starboard meet to a point.
- **Stern:** The stern is the back or aft-most part of a canoe. The stern lies opposite of the bow, the foremost part of a canoe.
- **Port:** When looking forward towards the bow of a canoe, the port refers to the left sides of the canoe.
- **Starboard:** When looking forward towards the bow of a canoe, starboard refers to the right sides of the canoe.

General Checklist:

This checklist is solely to help participants from our side. This checklist does not cover all the steps but is just a small guideline.

- Register for the competition and get the confirmation email of registration within 24 hr. along with payment link
- Pay registration fee
- Do mix design (Design mix by choosing the above equation, expanded polystyrene does not impart much compressive strength it helps in reducing weight of concrete)
- Design and fabricate a mold for Canoe. (You can try thermocol mold for canoe)
- Cast Canoe and cubes together (Record a short 2 min video as mentioned in rules)
- Cure the specimens
- Prepare a short report and get it signed by faculty
- Bring the specimen to AAKAAR 2018 on 17-18 March 2018 for testing.
- Win the Competition. (Can you??)

ALL THE BEST!!!
TEAM COMPETITIONS, AAKAAR 2018