SRM SOCIETY OF CIVIL ENGINEERS
IN ASSOCIATION WITH
INDIAN CONCRETE INSTITUTE PRESENTS

CONCRETUS 20'

NATIONAL LEVEL TECHNICAL FEST

DAVIDOVITS

Competition Domain: **Concrete Technology**

GEOPOLYMER CONCRETE

Abstract: **The global demand of concrete for the construction of sustainable infrastructure is continuously increasing in order to maintain the ongoing growth and to fulfill the needs of increasing population. An important ingredient in conventional concrete is OPC (Ordinary Portland Cement). One tonne production of OPC requires about two tonnes of raw materials and releases approximately one tonne of CO2. Thus the cement industry is responsible for some of the green house emission into the atmosphere. One method to produce the more environment friendly concrete is to reduce the use of OPC in concrete.**

Geopolymer Concrete is such a novel construction material made from Alkali activated Aluminosilicate and aggregate, that does not need the presence of Portland cement as a binder. These are polymers produced by the alkaline activation of materials of geological origin such as Kaoline or bentonite or industrial by products such as Fly ash and silica fume. Also the production of geopolymer concrete can be carried out using existing technology with a few changes.

THE OUTPUT

- Create opportunity to explore into a new dimension of Green and Sustainable concrete.
- A quick study into the most happening R&D topic in civil - The Geoplymer Concrete.

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DAVIDOVITS - GEOPOLYMER CONCRETE

INTRODUCTION

The global demand of concrete for the construction of sustainable infrastructure is continuously increasing in order to maintain the ongoing growth and to fulfill the needs of increasing population. An important ingredient in conventional concrete is OPC (Ordinary Portland Cement). One tonne production of OPC requires about two tonnes of raw materials and releases approximately one tonne of CO_2. Thus the cement industry is responsible for some of the green house emission into the atmosphere. One method to produce the more environment friendly concrete is to reduce the use of OPC in concrete.

Geopolymer Concrete is such a novel construction material made from Alkali activated Aluminosilicate and aggregate, that does not need the presence of Portland cement as a binder. These are polymers produced by the alkaline activation of materials of geological origin such as Kaoline or bentonite or industrial by products such as Fly ash and silica fume. Also the production of geopolymer concrete can be carried out using existing technology with a few changes.

The properties of GPC include:

- Great use in pre cast concrete industry
- High early strength
- Low Shrinkage
- High freeze and thaw resistance
- Enhanced Sulfate resistance
- Corrosion resistance
- Less curing time

As budding civil engineers, now it is the right time and SRM IST "CONCRETUS'20" is the best platform to innovate this aspect of civil engineering.

This year SRM IST has decided to explore into a new dimension of Green and Sustainable concrete - Geopolymer Concrete. Already one of the most happening topics in Research & Development, Geopolymer Concrete is rapidly gaining popularity in the industrial sector worldwide.

CHALLENGE

Prepare three cubes of Geopolymer Concrete of dimension 150x150x150 mm having compressive strength between 30 to 40 MPa (N/mm^2). The density (Surface dry) of the cubes should not exceed 2500 kg/m^3.

Before testing, the average compressive strength of the three cubes have to be predicted by the participating team one week prior to the competition date and send it through the google forms which will be mailed to you on a later date.

TESTING CRITERIA

- The cubes will first be tested for density. The mass will be measured using a sensitive weighing balance. The volume will be calculated by measuring the sides of the cube manually using Vernier calipers. From the obtained data, density will be calculated.
- Compressive strength will be measured using compression testing machine (CTM),
- The rate of loading will be 140 kg/cm^2 per minute

MARKING SCHEME

Predicted average compressive strength by the participating team =W Compressive strength of three blocks/cubes after testing = A1, A2, A3 Average compressive strength after testing = f_{ck}

f_{ck} = (A1 + A2 + A3)/3

Score 1 = 100 – {[W-f_{ck}] x 200/W}

There will be deduction of score for deviation of compressive strength of each block from predicted value, which will be as follows:

1. If Value of compressive strength of cube, A > Predicted average compressive strength, W then {2 x [W-A]} will be deducted

2. If Value of compressive strength of cube, A < Predicted average compressive strength, P then {3 x [W-A]} will be deducted

3. All values will be rounded off to two decimal places

In case of a tie of final score, the participant having larger score 1 will be considered.

Example :

Suppose your predicted score, W = 35.00 N/mm^2

Compressive strength of cubes after testing : A1=34.00 N/mm^2; A2=33.50 N/mm^2;

A3 =36.00 N/mm^2

Average compressive strength, X = (34.00 + 33.50 + 36.00)/3 = 34.50 Score 1 = 100 – {[35.00-34.50] x 200/35.00} = 97.14

Deducted scores : A1 < W, So 3 x [34.00-35.00]=3.0; A2 < W So 3 x [33.50-35.00]=4.50;

A3 > W So 2[36.00-35.00] = 2.00

Deducted score = 3.00 + 4.50 +2.00 = 9.50

Final score = Score 1 - deducted score = 97.14 - 9.50 = 87.64

RULES

- Student should form teams comprising of maximum 3 to 4 members.
- 3 cubes of size 150 x 150 x 150 mm with a tolerance of 5mm have to be submitted. Anything more than 5 mm will lead to direct disqualification. Then density should not exceed for 2500 kg/m^3.
- Any trace of OPC (ordinary Portland cement) found in the cubes will lead to direct disqualification.
- You can use of M. Sand, 10 – 12.5 mm aggregates only; use other than leads to direct disqualification.
- No restriction on use type of Chemical admixtures.
- Reinforcement of any type is strictly prohibited. If found, will lead to direct disqualification.
- No metallic aggregate should be used. If found, will lead to direct disqualification.
- Any curing method can be adopted.
- There is no bar on how many days prior to competition the cubes are cast.
- No paint should be added or used; it will lead to direct disqualification.
- No certificate will be provided to disqualified teams.

REPORT(5 POINTS)

A report, which carries 5 points, has to be submitted along with the cubes which should

Include the following:

- Technical mix design report which includes material specifications, casting and curing procedure. Students can modify the table 1 appropriately as per the materials used in the mix.
- Cost analysis of the geopolymer concrete. Students can modify the table 3 appropriately as per the materials used in the mix.
- Photograph of the materials before mixing
- The date of casting the cubes
- The following table on a separate A4 Sheet

Table No -1 Mix Ratio of Chemical and Binder details:

MIX Ratio	Na_2SiO_3 Molar Ratio	NaOH Molarity	NaOH:Na_2SiO_3:H_20 Ratio	Liquid/Binder Ratio (GGBS,Flyash)	Flyash :GGBS Ratio

Table No:2 Compressive Strength Details (f_{ck})

Specimen Number	Age of Concrete (No of Days)	Size of Specimens (mm)	Weight of Specimen (kg)	Density of specimen (kg/m^3)	Load (kN)	Compressive Strength (N/mm^2)
1						
2						
3						

Table No: 3 Cost Analysis of Geopolymer Concrete Per cubic metre :

Material	Rate (Rs/Kg)	Quantity (Kg)	Cost Amount (Rs)
Fly Ash	2.00		
GGBS	5.00		
M. Sand	1.50		
10 – 12.5 mm Aggregate	1.00		
NaOH	50.00		
Na_2SiO_3	15.00		
Water	0.05		
Super Plasticizers	50.00		
Silica fume (Admixture)	30.00		
		Total Amount Rs	

- Report should be duly signed by a Professor, who is a registered faculty member of your institution/Engineering college.
- Report should not exceed 5 sides of an A4 sheet
- Report will be judged by SRM IST Team
- The decision of SRM IST team will be final
- Teams which don't submit the report will be disqualified.