1) Project Reference Number: 46S_BE_3461

2) Title of the project : STUDIES ON COMPOSITE CEMENT CONCRETE MIXES INCORPORATING FERROCHROME SLAG AS COARSE AGGREGATE

3) Name of the College : B.M.S. COLLEGE OF ENGINEERING,

Department : CIVIL ENGINEERING

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5) Keywords : USING FERROCHROME SLAG AS COARSE AGGREGATE

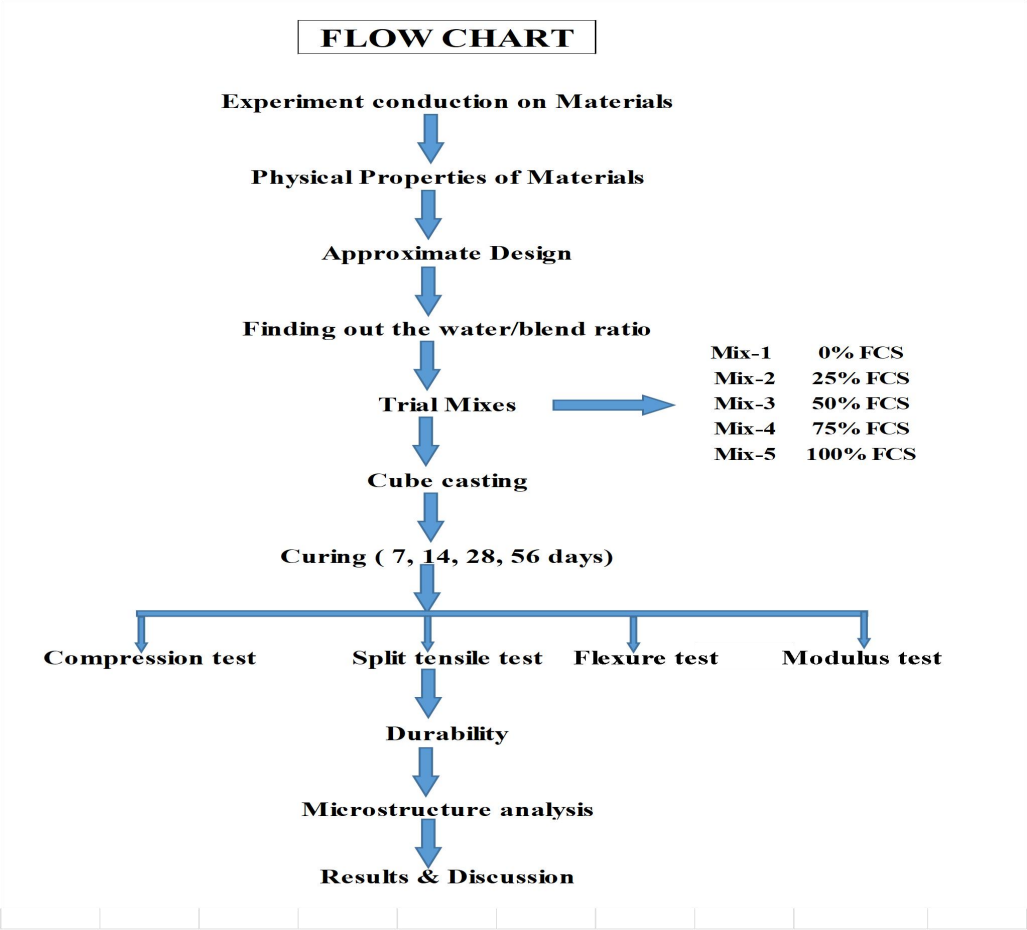
6) Introduction:

- Concrete is a construction material composed of cement (commonly Portland cement) as well as other cementation material such as fly ash and slag cement, aggregate, water and chemical widely used in construction industry.
- In a developing country like India, with fast decrease in the available natural resources which are used for the construction purpose, it has now become vital to search for alternative materials which satisfy the standard requirements.
- Ferrochrome slag is an industrial by-product material extracted during the production process of ferrochrome alloy, which is mostly used in the stainless steel industry.
- For each ton of ferrochrome production, nearly 1.2–1.5 tons of FCS is generated, which becomes a significant challenge for the ferrochrome producers while managing this hazardous waste.
- Due to rapid growth of construction there is continued increase in the use of cement concrete for development and its relative importance in the context of environmental issues, composite cement is used for sustainable development.
- Composite cement is the latest revolutionary offering specially designed for all your concrete based construction requirement. It is a perfect blend waste materials are highly reactive slag, fly ash and silica, which provides high concrete strength and durability, better cohesion, ease of working and quick setting.
- Based on available literatures, FCS concrete mixes experienced a slightly less strength reduction rate than conventional concrete at elevated temperatures up to 800 degree Celsius. The FeCr slag has a comparable physical property like specific gravity, impact strength and crushing strength.
- The strength in compression, split tensile and flexure strength can be increased at a replacement of 40% replacement of FeCr slag as a coarse aggregate in concrete.
- Ferro Chrome Slag of size 6.3mm - 30mm may be used in concrete making as it satisfies the requirements of coarse aggregate as per IS 456-2000 and IS 383-2016.

7) Objectives

- Evaluating the fresh properties of composite cement based concrete mixes incorporating ferrochrome slag as a coarse aggregate at various replacement levels with the naturally available crushed granite chips.
- To evaluate the mechanical properties and durability of composite cement based concrete mixes.
- Microstructural characterization namely SEM(Scanning electron microscope), EDAX(Energy dispersive xray), XRD(X-ray diffraction) of better performing composite cement based concrete mixes.

8) Methodology



9) Results

Test type	Cube compression Test (Mpa)		
Curing after	7Days	28Days	56Days
Mix			
CCCNCA-0	21.68		57.47
CCCFCSA-25	30.75		
CCCFCSA-50		51.41	58.01
CCCFCSA-75		50.835	
CCCFCSA-100	41.51	50.12	35.74

	Flexure Test (Mpa)		
Mix	7Days	28Days	56Days
CCCNCA-0	3.46		
CCCFCSA-25			
CCCFCSA-50			
CCCFCSA-75			

CCCFCSA-100	4.46	4.49	

Test type	Elevated Temperature Test (Mpa)			
Test conducted after 56 Days curing				
Temperature in C	200	400	600	800
Mix				
CCCNCA-0	61.92			
CCCFCSA-25				
CCCFCSA-50	60.12			
CCCFCSA-75				
CCCFCSA-100	62.51			

Test type	Saturated water absorption				
	7 Days				
	W1 (Kg)	W2 (Kg)	W3 (Kg)	(W1-W2)*100/W1 (%)	(W1-W3)*100/W1 (%)
Mix				Initial absorption	Saturated water absorption
CCCNCA-0					
CCCFCSA-25					
CCCFCSA-50					
CCCFCSA-75					
CCCFCSA-100	1.153	1.172	1.192	1.64	3.38
	28 Days				
	W1 (Kg)	W2 (Kg)	W3 (Kg)	(W1-W2)*100/W1 (%)	(W1-W3)*100/W1 (%)
Mix					
CCCNCA-0					
CCCFCSA-25					
CCCFCSA-50					
CCCFCSA-75					
CCCFCSA-100	1.16	1.169	1.177	0.775	1.465
	56 Days				
	W1 (Kg)	W2 (Kg)	W3 (Kg)	(W1-W2)*100/W1 (%)	(W1-W3)*100/W1 (%)
Mix					
CCCNCA-0					
CCCFCSA-25					
CCCFCSA-50					
CCCFCSA-75					
CCCFCSA-100					

Test type	Sorptivity Test (kg)											
	7 Days				28 Days				56 Days			
Time in min	30 min	60 min	90 min	120 min	30 min	60 min	90 min	120 min	30 min	60 min	90 min	120 min
Mix												
CCCNCA-0												
CCCFCSA-25												
CCCFCSA-50												
CCCFCSA-75												
CCCFCSA-100	1.15	1.161	1.161	1.163	1.24	1.249	1.249	1.251				

10) Scope for future work

- This review work has undertaken FCS's physical and chemical characteristics and its following utilization as coarse aggregate incorporating composite cement concrete producing green and sustainable concrete.
- Ferrochrome slag is an industrial by-product material extracted during the production process of ferrochrome alloy, which is mostly used in the stainless steel industry. The environment categorizes FCS as hazardous waste material.
- The vast majority of the quantities is not used in any application and is disposed of without being reused, posing a threat to the local environment.
- Composite cement is readily available in the industry manufactured by JSW and ferrochrome slag aggregate are available as a waste material.
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- Locations of cement plants in relation to sources of blending materials are also a significant factor in the growth of blended cements. In composite cements, there are more than one blending materials, like fly ash + slag or slag + limestone. It, therefore, requires additional facilities for storing and processing the second blending material. Composite cements have been standardized like common OPC, PPC and BFSC.
- The results obtained are compared with conventional coarse aggregate (0% replacement) concrete Waste ferrochrome slag may be an alternative option to be used as green coarse and fine aggregates in the production of concrete.