EXPERIMENTAL STUDY ON MECHANICAL PROPERTIES OF SILICAFUMEANDRECYCLEDCOARSEAGGREGATESWITH PARTIAL REPLACEMENT OF CEMENT AND COARSE AGGREGATES IN M25 GRADE OF CONCRETE

Guide: Mrs.E.PhaniTeja,M.Tech.,Assistantprofessor

Mr.KANCHIHARISH[1]Mr.GANTASYAM[2]Mr.BAINABOINACHAITANYA[3] Mr. DUPILI AKHIL[4]Mr. RISHI KUMAR[5]

[1,2,3,4&5]UGScholars,NarayanaEngineeringCollege,Nellore,AndhraPradesh,India

ABSTRACT

This project presents the results from an experimental investigation into the mechanical properties of M25 grade concrete, incorporating silica fume and recycled coarse aggregate as partial substitutes for cement and coarse aggregate. The increasing interest in using recycled coarse aggregates in fresh concrete as a replacement for natural aggregates stems from their potential environmental and economic advantages. The study commenced with the collection of raw materials for concrete preparation, adhering to the specified quantities derived from the concrete mix design. A series of tests were performed on the raw materials, includingassessmentsoffineness,specificgravity,normalconsistency,initialandfinalsettingtimesofcement,sieve analysisforboth fineandcoarseaggregates. Following the mixdesign,thematerialswerecombined and placed intomoldsinthree layers, with each layerbeingtamped25times.Themoldedcubesweredemoldedthefollowingdayandsubmergedinacuringtankforpe riodsof7,14, and 28 days. After the 7-day curing duration, the specimens underwent compression testing to ascertain the load values at which failure occurred. Similar tests were conducted on cubes cured for 14 and 28 days. The mixes were formulated using varying proportions of silica fume and recycled coarse aggregate, and the results were documented and illustrated in a bar graph. The experimental findings indicate that silica fume enhances themechanical properties of concrete and its capacity to fill voids between cement particles. Consequently, the integration of recycled coarse aggregate and silica fume in concrete production holds promise for enhancing both the sustainability and performance of concrete.

Keywords:*RecycledConcreteAggregates,MechanicalProperties,andSilicafume.*

1.INTRODUCTION

Theconstructionindustryiscontinuouslyevolving,withanincreasingemphasisonsustainabilityandresourceefficiency.Oneof the most promising approaches to achieving these goals is the use of industrial by-products and recycled materials in concrete production.Amongthese,silica fumeandrecycled coarse aggregates(RCA) have gained significant attentiondue to theirpotential to enhance concrete properties while addressing environmental concerns. Silica fume, a by-product of the production of silicon metalorferrosiliconalloys,isafinepowderthatisknownforitspozzolanicproperties.Whenaddedtoconcrete,silicaf ume can significantly improveitsstrength,durability, and workability. Silicafumereacts with thecalcium hydroxidein thecement paste toformadditionalcalciumsilicatehydrate(C-S-H)gel,whichcontributestotheoverallstrengthandreducesthepermeabilityof theconcrete.On theotherhand, recycled coarseaggregates,derived from crushed concretedebris, offer an attractive alternative to natural aggregates. The use of RCA not only helps reduce the demand for virgin aggregates but also addresses the growing issue of construction and demolition waste. However, the incorporation of RCA in concrete can sometimes lead to reduced mechanical properties due to the presence of impurities or weaker bonds in the

recycled materials. The focus of this study is to investigatethemechanicalpropertiesofM25gradeconcretewhencementandcoarseaggregatesarepartiallyreplacedwithsilica fume and recycled coarse aggregates.

1. OBJECTIVE

- Accordingtotheexperimentweconcludethatsilicafumeimprovesmechanicalpropertiesofconcreteandfillthespaces between cement particles.
- Addingthesilicafumeandrecycledcoarseaggregateasapartialreplacementofcementandcoarseaggregatewillimprove the concrete strength, sustainability, durability and performance.

2. METHODOLOGY

1. **Data collection**
2. **Literature**
3. **SelectionofMaterials**
4. **PropertiesofMaterials**
5. **BatchingofMaterials**
6. **CastingofConcreteSpecimen**
7. **TestingonConcreteSpecimen**
8. **MechanicalPropertiesTest**

3. MATERIALSUSED

1. **Cement:**Cementisabindingmaterialandachemicalsubstanceusedforconstructionthatsets,hardens,andadheresto other materials to bind them together. We Considered OPC 53 grade of cement.

Fig1:Cement

2. **FineAggregates:**Fineaggregateplaysacrucialroleinconcretemixdesign.InthisprojectRiversandisusedasitisthefundamental component that makes majority volume in the formulations for making a concrete mix.

Fig2:FineAggregate

3. **CoarseAggregates:**Naturalcoarseaggregatesusedinconcreteincludegravel,crushedstone,andcrushedrock.These aretypically obtained fromnaturalsourcessuch aspits,riverbeds, andtheseabed.Theyarewashed and cleanedbefore being supplied to customers. Gravel is a naturally occurring aggregate that is typically rounded and smooth due to erosion and water transport.

Fig3:CoarseAggregate

4. **SilicaFume:**Silicafumeisa byproductofsiliconandferrosiliconalloyproduction.Itimprovesstrength,durability,and reduces permeability. Silica fume concrete is composed of cement, silica fume, fine aggregate, coarse aggregate, and water. Fresh and hardened properties of silica fume concrete is superior to conventional concrete. For instance, it has higher compressive and flexural strength.

Fig4:Silica Fume

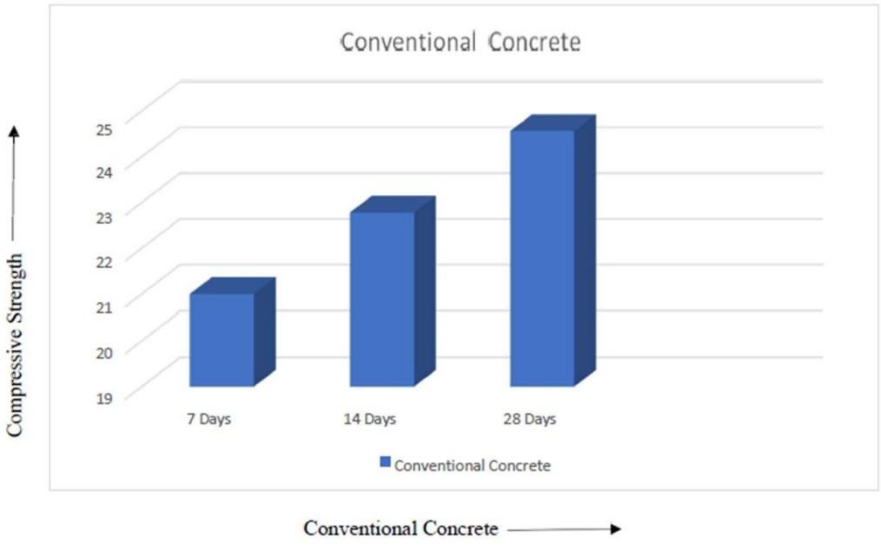
5. **Recycled Coarse Aggregates:** Recycled coarse aggregate (RCA) refersto the coarse aggregate obtainedfromrecycling concrete. It is produced by breaking up and crushing the concrete removed from old roads and buildings, and then separating the mortar from the rock. The use of RCA in new construction applications has gained popularity in recent years due to its potential to make construction more environmentally friendly.

Fig5:RCA

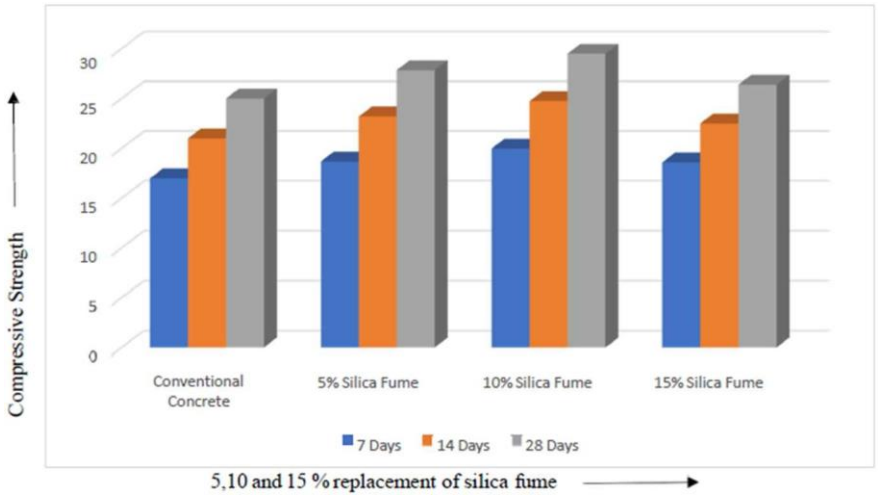
6. **Water:** As water is added to cement as it creates a paste that glues all of the aggregates together.The cement paste then undergoesachemicalprocessknownashydration,thischemicalreactioniswhatallowstheconcretetohardenand become strong and solid. Potable water is used for mixing and curing. It was free from the suspended solids and organic material,which might have affected the properties of the fresh and hardened concrete.

4. RESULTANDDISCUSSION

Inthissection,performtheresultsofexperimentalwork.Theresultsaredisplayedingraphformat.

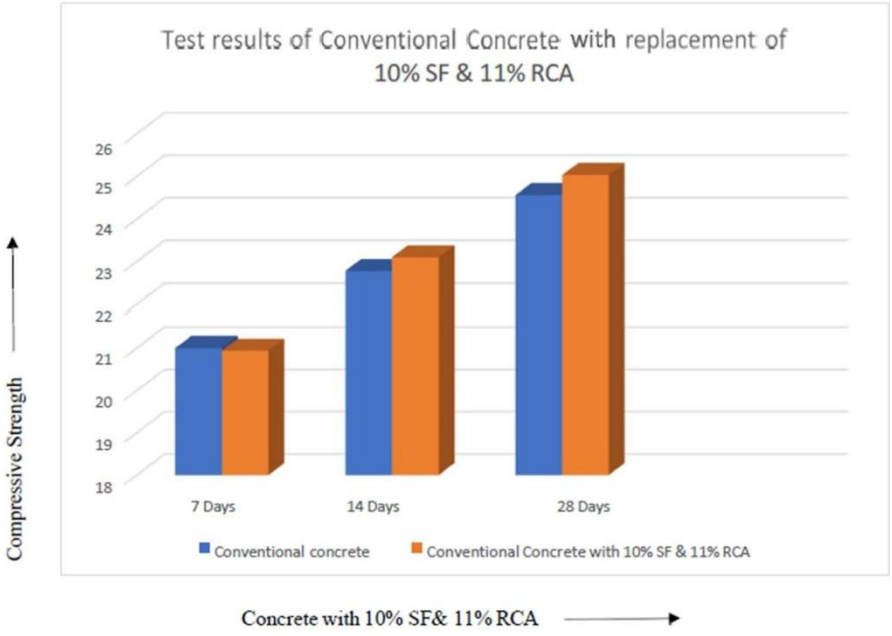


Graph1TestresultsofConventionalConcretefor7,14,28Days



Graph2Compressivestrengthtestforconcretewithreplacementofsilicafumefor7, 14, 28

Days



Graph3Compressivestrengthtestforconcretewithreplacementof10%SF&11% RCA

5. CONCLUSION

Based on the experimental investigation carried out on concrete by using various percentages of silica fume i.e., 5%, 10%, 15% and replacement of 11% RCA.

- Theresultsshowedthatadding10%silicafumeyieldedthehighestcompressivestrengthwhencomparedtousing5%and 15%silicafume.Wenoticedthat5%and15%silicafumeconcretestrengthwasslightlylowerthan10%silicafumedue to its pozzolanic activity.
- WhencomparedtoconventionalconcreteM25gradeofconcretecontainingRCA11%and10%silicafumeachieves its maximum strength after 28 days.

6. REFERENCES

1. Charles E. Pierce, Larry R. Brown and Samuel Foster. “Engineering Properties of Recycled Organic Aggregate for Controlled Low-Strength Materials”, June 28- June 30,2010.
2. K.LochanSaiTeja,“Partialreplacementofcoarseaggregateswithdemolishedconcretewastealongwithaddingof admixture”, July-2023.
3. G. Murali, K.R. Jayavelu, N. Jeevitha, M. Rubini and N.R., “Experimental investigation on concrete with partial replacement of coarse aggregate”, April 2012.
4. MohdMonish,VikasSrivastava,V.C.Agarwal,P.K.MehtaandRakeshKumar,“Demolishedwasteascoarseaggregat e in concrete”, J. Acad. Indus. Res. Vol.1February 2013.
5. Shivakumar,M.N,NithinK.S,B.MGangadharappa,“Useofbuildingdemolishedwasteascoarseaggregateinporous concrete”, June 2004.
6. Preeti Saini, Deepakar Kr. Ashish P.G., “A Review on Recycled Concrete Aggregates”, April 2015. Nikita Patel, Dr. Piyush Patel, “Use of Demolished Concrete Materials in Concrete andComparative Study of its Mechanical Properties: NDT Comparison”, October2013.Prakash Somani,
7. Prakash Somani, BrahmtoshDubey, Lavkesh Yadav, Jitendra Kumar, Abhishek kumarMahipal Singh, “Use of demolished concrete waste in partial replacement of coarse aggregate in concrete” , volume 3 Issue 5 May 2016.
8. R.Siva Kumar, H.MohammedYousuf, M.Haripriya, “An Experimental study on partial replacement for coarse aggregate by Granite Waste”, Vol. 3Issue March 2016.
9. Bhanja, S., B. Sengupta, b., î‘ͲͲ,Ò DzModified water cement ratio law for silica fume concretes Dz. Cement and Concrete research, 33, pp 447-450, August 2001.
10. Mohameds.Morsy,Sayeds.Shebl,“Effectofsilicafumeandmetakaolinpozzolanaontheperformanceofblended cement pastes against fire, Ceramics-Silikáty” 51 (1) 40-44, January2007.
11. Karein S. Mahmoud Motahari, Ramezanianpour A.A., TaghiEbadi, IsapourSoroush,(2017) A new approach for application of silica fume in concrete: WetGranulation. Construction and Building Materials page573–581.