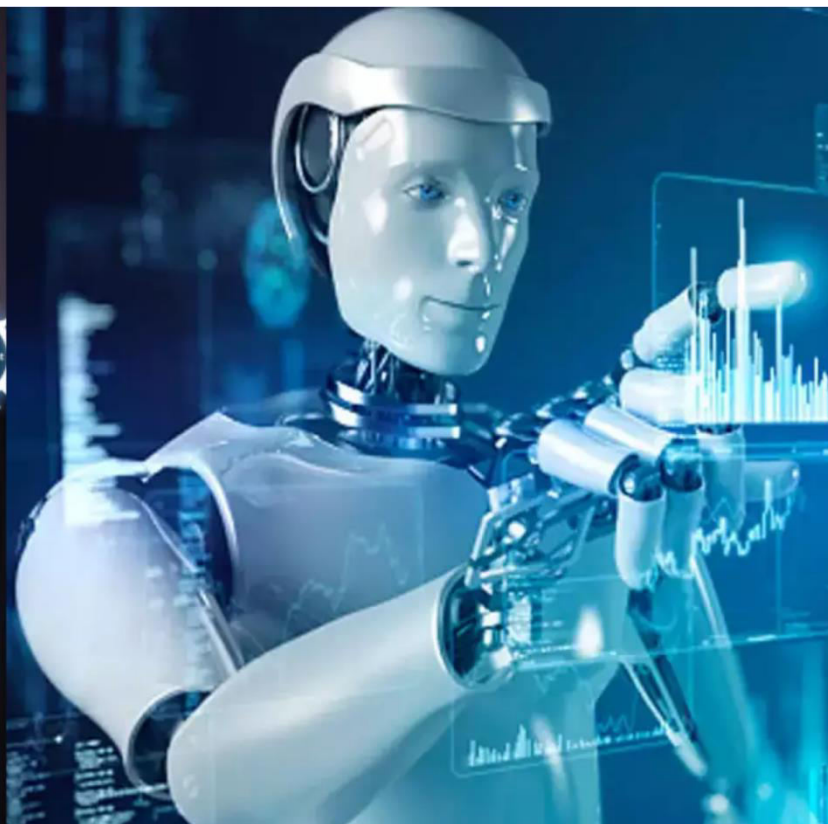




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Investigation on Masonry Mortar by using Waste Materials

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ABSTRACT: The paper analysis of blended lime cement mortar to be substitute blended lime as repairs mortar in restoration works, since the availability of natural hydraulic lime is reduced in many countries, unlike cement. The study focus on the structure of both types of blended mortar on their water- transport properties, in initial of mechanical strength and overall incompatibility risk. The influence of binder type and composition and of binder/aggregate ratio on pore structure was discussed. Cement more markedly the mechanical and water transport properties on blended mortar than hydraulic lime, with consequence on compatibility -properties of blended mortars than hydraulic lime, with consequence on compatibility properties of blended mortars than hydraulic lime can be used but cement.

KEYWORDS: Masonry Mortar, Waste Material, Fly Ash, Red Brick Powder.

I. INTRODUCTION

Masonry mortar is a workable paste made by mixing cementing materials such as cement, lime, fly ash, red brick powder, Sand and water. It is used to bond masonry units such as bricks stone, or concrete blocks, providing both strength and sealing properties to the structure.

The advantages of masonry mortar include improved bonding strength, better workability, easy application, and the ability to accommodate minor size irregularities in masonry units. Mortar also helps absorb slight movements in the wall due to temperature or load variations.

Materials Used:-

1. OPC Cement
2. Hydrated Lime
3. Fly -Ash
4. Red Brick Powder
5. AAC (Autoclaved Aerated Concrete) Powder

OPC Cement:

Cement is typically used to bind sand and aggregate together rather than on its own. Masonry mortar is made from cement mixed with fine aggregate, while concrete is made from sand and gravel. Concrete is the most widely used material on the planet, second only to water in terms of consumption.

Hydrated Lime:

Lime Hydrated Lime, or calcium hydroxide is also recognized among a host of other identifiers including caustic lime, builders' lime, slack lime, calcium, or pickling lime. It is an inorganic compound that is a non-flammable, orderless, colourless white crystal or powder.

Fly Ash:

Fly ash is a byproduct from burning pulverized coal in electric power generating plants. During combustion, mineral impurities in the coal (clay, feldspar, quartz, and shale) fuse in suspension and float out of the combustion chamber with the exhaust gases. As the fused material rises, it cools and solidifies into spherical glassy particles called fly ash. Fly ash is collected from the exhaust gases by electrostatic precipitators or bag filters.

Red Brick Powder:

A Red brick powder is a type of construction material used to build walls, pavements and other elements in masonry construction. Properly, the term brick denotes a unit primarily composed of clay. But is now also used informally to denote building units made of other materials or other chemically cured construction blocks.

AAC (Autoclaved Aerated Concrete):

An autoclaved aerated concrete (AAC) also known as autoclaved cellular concrete is a lightweight, precast building materials that is used to traditional concrete blocks and clay bricks. It was developed in the mid 1920 by John Axel Erikson Unlike cellular concrete, which is typically mixed and poured on site. AAC products are manufactured in factory under controlled conditions.

II. LITERATURE SURVEY**João A. P. P. Almeida. (2024)**

Masonry structures are susceptible to damage and collapse due to seismic actions, a problem in many urban areas. To address this issue, researchers are studying the use of fibre-reinforced mortars as overlay strengthening systems. This study assessed the use of synthetic polyacrylonitrile (PAN) fibres as reinforcement of natural hydraulic lime mortar, focusing on their influence on fresh behaviour and mechanical properties. Natural hydraulic lime (NHL) was chosen for its compatibility with typical older ceramic and natural stone structural masonry and contemporary ceramic brick infill masonry substrates, as well as for the sustainability benefits. The study also assessed the contribution of the PAN Fibers to toughness enhancement in the developed formulations.

Hui-gang Xiao et al (2023)

The mechanical properties of nano-Fe₂O₃ and nano-SiO₂ concrete mortar were experimentally studied. The experimental results showed that the compressive and flexural strength measured at the 7th day and 28th day of the cement mortars mixed with the nano-particles were higher than that of a plain cement mortar.

R.M. Damle, N et al (2023)

Traditional buildings since many centuries have used lime as a binder and finishing behaviour OPC cement and lime plaster material. However, in contemporary construction practices, lime mortar and lime plaster have been replaced by cement mortar and cement plaster. Lime is a sustainable and self-healing material whose strength increases with time. In addition to its pleasing appearance, properties building with lime mortar and lime plaster are also breathable due to moisture transfer across the envelope.

Aranzazu Sierra-Fernandez et al (2024)

Lime-based mortars are one of the principal choices for building and restoration projects, Luz S. Gomez-Villalba, M. Mar Barbero-Barrera, Adél Len, Zuzana Silka mortars induced by ceramics and owing to their unique qualities and material compatibility. Admixtures have long been nanoparticle additives incorporated to enhance the performance and durability of mortars, with ceramics being a traditional choice. More recently, the addition of nanoparticles has been explored as a means to further improve these properties.

Magdalena Daniszewski (2017)

Magdalena Daniszewski (2017) conducted an extensive review on the incorporation of waste materials into mortar and concrete as partial replacements for conventional ingredients such as cement, sand, and aggregates. The study emphasized the environmental and economic benefits of recycling industrial and construction waste, reducing natural resource consumption, and minimizing landfill disposal. The research highlighted various types of waste materials—such as fly ash, silica fume, ground granulated blast furnace slag (GGBS), red mud, recycled aggregates, waste glass, and rubber particles—used in concrete and mortar production. Each material was analyzed based on its physical and chemical properties, its effect on workability, strength, and durability, and its suitability for structural or non-structural applications. emissions significantly.

III. METHODOLOGY



Fig.1 OPC Cement

Fig.2 Fly Ash

Fig.3 Hydrated Lime

Fig.4 Brick Powder

Fig.5 AAC Block Powder

1. Initial and final setting time of cement

An initial setting time is regarded time elapsed between the moment of water which is added to cement to the time that the paste start losing its plasticity. The final setting time is the time elapsed between the moment the water is added to the cement, and the time when the paste has completely lost its plasticity and has attained sufficient firmness to resist certain definite pressure. The temperature of moulding room, dry materials and water shall be maintained at $27 \pm 2^\circ\text{C}$. The relative humidity of the laboratory shall be 65 ± 5 percent.

2.Preparation of Test Block.

1.Prepare a neat cement paste by gauging the cement with 0.85 times the water required to give a paste of standard consistency. Potable or distilled water shall be used in preparing the paste. The paste shall be gauged in the manner and under the conditions prescribed in IS:4031 (Part 4)- 1988.

2. Start a stop-watch at the instant when water is added to the cement. Fill the Vicat mould with a cement paste gauged as above, the mould resting on a nonporous plate. Fill the mould completely and smooth off the surface of the paste making it level with the top of the mould. The cement block thus prepared in the mould is the test block.

3. Immediately after moulding, place the test block in the moist closet or moist room and allow it to remain there except when determinations of time of setting are being made.

3.Determination of Initial Setting Time

1. Place the test block confined in the mould and resting on the non-porous plate, under the rod bearing the needle (C); lower the needle gently until it comes in contact with the surface of the test block and quickly release, allowing it to penetrate into the test block. In the beginning, the needle will completely pierce the test block.

2. Repeat this procedure until the needle, when brought in contact with the test block and released as described above, fails to pierce the block beyond 5.0 ± 0.5 mm measured from the bottom of the mould. The period elapsing between the time when water is added to the cement and the time at which the needle fails to pierce the test block to a point 5.0 ± 0.5 mm measured from the bottom of the mould shall be the initial setting time.

4.Determination of Final Setting Time

1. Replace the needle (C) of the Vicat apparatus by the needle with an annular attachment (F).

2. The cement shall be considered as finally set when, upon applying the needle gently to the surface of the test block, the needle makes an impression thereon, while the attachment fails to do so.

3. The period elapsing between the time when water is added to the cement and the time at which the needle makes an impression on the surface of test block while the attachment fails to do so shall be the final setting time.

V. Fineness of cement (IS 4031:1991)

Fineness of cement (IS 4031:1991) Fineness test of cement is done to determine the particle size of cement shown in fig 3.9. As, the rule of thumb, the finer the cement particle the best will be the cement and on the other hand the course the particles it will not be that good. As per Indian standard, the cement partial more than 10% shall not on the sieve (90um).

5.Soundness Test of Cement (Is 4031 Part 3)

Specific gravity refers to the ratio of a substance's density to the density of a reference substance at a fixed temperature. In other words, it is the ratio of the mass of a substance to the mass of the reference substance. This principle applies to cement as well. The volume must remain constant in both the substance and reference material; if not, the concept of specific gravity becomes invalid, as the mass or density would change.

6.Test On Specific Gravity of Cement

The specific gravity of cement is defined as the ratio of the weight of a given volume of cement to the weight of an equal volume of water. It is a dimensionless number that indicates how much heavier the substance is compared to water. To determine the specific gravity of cement, the weight of a specified volume of cement is compared to the weight of an equal volume of water.

Mix Design

Masonry mortar is an homogeneous and hardened mass made from specific proportion such as cement, lime, fly ash waste concrete block powder, and water. The grade masonry mortar varies great depending on an proportion material IS 2250:1981 all specific proportion and a ratio in which the material should ne combine to achieve a specific grade masonry mortar. The code material ratio up to certain grade, beyond specific proportion has been accepted.

Grade	Cement	Lime	Fly Ash	Brick Powder	AAC Powder
M1	50	50	0	0	0
M2	50	30	5	5	10
M3	60	30	0	5	5
M4	35	10	35	15	5
M5	40	10	30	15	5
M6	45	10	25	15	5
M7	50	10	30	10	0
M8	50	10	20	10	10
M9	55	5	25	10	5
M10	50	20	10	10	10



Fig No 1. Weighing



Fig, No 2. Mixing



Fig, No 3. Casting



Fig No 4. Mould Fill



Fig No 5. Vibration



Fig No 6. Unmould cubes



Fig No 7. Curing



Fig, No 8. Testing



Fig, No 9 Cracks

IV. EXPERIMENTAL RESULTS

The compressive strength test was conducted for 7,14, and 28 days to evaluate the strength development of standard mortar cubes and cubes containing fly Ash, AAC block powder, lime, cement, red brick powder and water.

Mixed Design	7 Days (N/mm ²)	14 Days (N/mm ²)	28 Days (N/mm ²)
M1	3.25	4.88	7.50
M2	3.0	4.50	6.38
M3	4.50	6.75	9.0
M4	1.75	2.63	5.50
M5	2.25	3.38	6.50
M6	2.60	3.90	6.20
M7	2.90	4.35	5.88
M8	2.95	4.43	6.90
M9	3.50	5.25	7.22
M10	3.10	4.65	6.8

V. CONCLUSION

In this test we determine the compressive strength of cement mortar, finally we got a result after doing all procedure accurate. We determine the compressive strength of all cubes because each cubes have a different compressive strength, if we compare aware result with standard which is the compressive strength must be greater than (9.0 MPa) for 28 days. As we known our result is greater than standard. If we have an error in this test than we will have them in the processes especially in the compaction of cement mortar process, but we did the test on 10 cubes and we got the result. In conclusion the purpose this test is to determine the resistance of cement mortar from compression load and compare the result with standard finally we got the result

REFERENCES

1. Ayanlere Et al (2023) "Effects of water-cement ratio on bond strength of concrete." Mater. Today, Proc.
2. Concretes: II. Experimental validation." Cem. Concrete. Res. 35 (1): 185–188 Bu, C., B. Tan (2023). "Activation method and reuse of waste concrete powder—A review." Sustainability 15 (6): 5451.
3. Barcelo Et al (2014). "Cement and carbon emissions." Mater. Struct. 47 (6): 1055–1065.
4. Chang, P. K. Et al (2004). "An approach to optimizing mix design for properties of high-performance concrete." Cem. Concrete. Res. 34 (4): 623–629.
5. Chen, G. M Etl (2021). "Compressive behaviour of concrete incorporating clay brick fines added by paste replacement method." J. Mater. Civ. Eng. 33 (7): 04021141.
6. Deng, X Etl (2021). "An accelerator prepared from waste concrete recycled powder and its effect on hydration of cement-based materials." Constr. Build. Mater. 296 (Aug): 123767.
7. Mechanical properties of lime-cement masonry mortars in their early ages.
8. Meera Ramesh, Miguel Azenha, and Paulo B. Lourenço (2020) "The Department of Civil Engineering, ISISE, Universidade do Minho, Portugal
9. Contribution of Fly Ash to the Properties of Mortar and Concrete "Construction and Building Materials, Elsevier. concretes: II. Experimental validation." Cem. Concur Res. 35 (1): 185–188 Bu, C., B. Tan (2023). "Activation method and reuse of waste concrete powder—A review." Sustainability 15 (6): 5451.
10. Impact of accelerated carbonation on OPC cement paste blended with fly ash "Cement and Concrete Research, Volume 67, Pages 226–236.A. Morandi, M. Thierry, and P. Dangla (2015).



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