EFFECT OF WATER ABSORPTION OF AAC BLOCKS SUBJECTEDTO DIFFERENT TYPES OF WATER RESISTANT COATINGS

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ABSTRACT

Water absorption is one of the main characteristics of building materials, these days all walls are constructed with AAC blocks which are prefabricated and handle ease. Water repellents have become widely used to mitigate the apparent problems arising from rain deposition on such wall types. In this project, we are performing water absorption tests on AAC blocks by applying coatings like cement slurry, wall putty, and waterproofing liquid. We apply these coatings in 1 to 5 layers, depending upon the depth of water penetration of the previous coating. The purpose of this study is to examine to the absorption of water on rendered autoclaved aerated concrete (AAC) block using physical analysis. In this case, we use 48 sample blocks of AAC, three are uncoated and untreated as a control block and 45 coated blocks, fifteen of which were coated with cement slurry by applying 1-5 numbers of coatings, each coating with three samples, the next fifteen of which were coated with pop by applying 1-5 numbers of coating each coating with three samples, and last fifteen of which was coated with waterproofing liquid by applying 1-5 numbers of coating each coating with three samples. all the test samples were immersed in water for the next 24 hours and tested for water absorption, Measurement of water absorption is done by measuring the depth of water penetration and by weight comparison. Based on test results we select the best waterproofing material with the right appropriate coating.

1. INTRODUCTION

Since the beginning of construction, walls have been the fundamental components of every structure. As technology advances, new materials are being developed for wall construction. In the past, mud and stone bricks and clay bricks were used, but today we hardly ever see walls made of stone masonry. But when we use clay bricks more and more, we begin to notice their drawbacks, such as the production's CO2 emissions. When clay is removed from the earth, its fertility declines. Additionally, the location where the kilns are built

also depletes the neighboring land's fertility and has a negative impact on the ecosystem. As a result, fly ash bricks were assumed to be the initial counter. Due to its engineering qualities and lightweight nature, fly ash is a waste product from power plants that are utilized as a pozzolanic ingredient in cement to create fly ash bricks. In addition to utilizing waste materials that cannot decompose, fly ash bricks also benefit the environment by using fewer clay bricks, which limit the formation of rich soil and clay. Fly ash bricks typically contain 60% fly ash, 30% sand, and 10% cement or other cement-related material. Additionally, its compressive strength is higher (7.5 MPa) than that of clay bricks (3.5 MPa). However, it quickly became apparent that there are a number of drawbacks, including the fact that the total dead load increases due to the fly ash bricks' higher density and significantly higher thermal conductivity when compared to clay bricks. Additionally, because of the smooth surface, the plaster does not adhere to the surface well. So, it was considered how to address all of these issues, and the use of AAC blocks was the solution.

AAC blocks prefabricated lightweight cellular structures made with 70- 80% of air voids by using the foaming agent and creating air voids (by the formation of hydrogen bubbles). Compared to the two bricks mentioned above, they are more environmentally friendly. As in the production of both clay and fly ash bricks lot of CO2 is released, and being a greenhouse gas CO2 is one of the prime reasons for As a result of the production of AAC blocks with the least amount of CO2, we can declare that they are the most cost-effective eco-friendly building blocks on the market. We may state that AAC blocks are the most cost-effective eco-friendly building materials on the market since they are created with the least amount of CO2 given that both clay and fly ash bricks, which are both important contributors to global warming, emit a lot of CO2 during production. We also have a lot of additional benefits, such as excellent thermal resistance, acoustic resistance, insect resistance, reduced weight, noticeable strength, and workability. AAC blocks provide 2 excellent thermal resistance and soundproofing because they include 80% air gaps. They will reduce temperature change by 30% when used. Additionally, they are fireproof due to their porous nature. Additionally, they have a compressive strength of at least 4 MPa (4.62 MPa in a test), and they are very workable. While these blocks are used for roughly 40% of all construction in European nations like the UK and about 60% of all construction in Germany.

Since AAC blocks have a porous structure and a higher water absorption capacity than conventional bricks, we prefer various types of water-resisting coatings to reduce this capacity. We are using waterproofing fluid, wall putty, and cement slurry as water-resistant components in this project. By adding these coatings to the surface of AAC blocks, the coated substance seeps into the micro-voids and fortifies the block, hence lowering the absorption of water by AAC blocks.

1.1 Objective and Scope

The main aim of this study is to experimentally investigate the suitability of the water resisting material for AAC Blocks. the specific objectives are as follows;

1. In this case AAC blocks are coated separately with cement slurry, wall putty slurry and waterproofing

liquid each coated with 1 to 5 layers depending upon the depth of water penetration and performing water absorption test.

2. To investigate the performance of AAC blocks by the use of various types of water resisting materials.
3. To analyze the most effective water resisting material for AAC blocks.

2. METHODOLOGY

2.1 General:

Methodology deals with the materials which we used and methods followed to conduct the study of water absorption of AAC blocks with different layers of water-resistant material coatings.

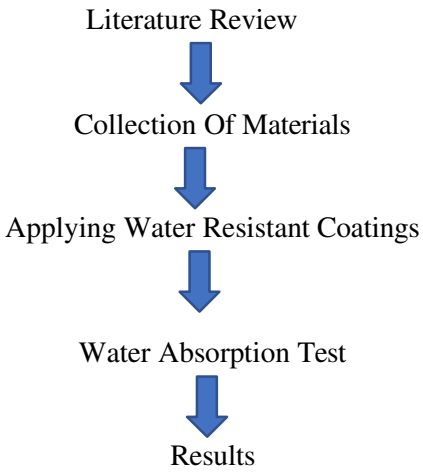

Figure 2.1.Flow chart of Methodology.

2.2Materials Used:

2.2.1 AAC Blocks:

AAC bricks are a light weight, environmentally friendly building material. Precast foam concrete AAC blocks are environmentally friendly building products made of quartz sand, calcined gypsum, lime, Portland cement, water, and aluminum powder particles. concrete foam precast AAC blocks are made of Portland cement, water, calcined gypsum, lime, and aluminum powder particles. They are sustainable building materials. Autoclaved aerated concrete blocks are another name for them. The blocks are created by precisely combining the fundamental components and autoclaving them under pressure and heat to give

them their distinct characteristics. AAC bricks are in high demand these days because of their strength, load-bearing capacity, thermal insulation ability, and so on.

High-rise apartments, other residential structures, and industrial and commercial buildings, including colleges, hospitals, offices, hostels, and schools, are all built using AAC blocks. Due to their exceptional capacity for heat insulation, AAC bricks are utilized in both interior and exterior construction.. They are perfect for high-rise buildings.

Figure2.2: AACBLOCKS

Advantages of AAC blocks:

1. Its increased size allows for more workability and speed i.e fabrication.
2. Earthquake-resistant.
3. A high-rise structure with reduced self-weight.
4. Thermal insulation and energy conservation.
5. Fire-resistant and environmental friendly.
6. It is both sustainable and inexpensive.
7. Increased compressive strength.

2.2.2 Cement:

Cement is a binding powder made by burning a mixture of calcareous, siliceous, argillaceous, and other materials. This produced clinker, a hard substance that is reduced into a powder with a small amount of gypsum. it is a binding substance used in mortar and concrete generate OPC, the most generally used type of cement. PPC (Ultratech Cement) was used in this project.

2.2.3 Wall putty:

Wall putty is a powder made by combining Portland cement, Lime, bentonite, and other ingredients to make a workable solution that can be placed directly to the concrete surface. Birla white wall care putty, a white cement-based and water-resistant compound, was used in this project.

When water is added to wall putty, it forms a thick binding paste that should be placed within hours. This wall putty is used to fill cracks and build surfaces, and it provides a smooth finish, comprehensive coverage, a high refractive index, and paint compatibility. Its unique formula features Extra HP polymers, which repel moisture while reducing flaking.. As you may beware, wall putty is used as a protective basis for expensive paints on interior and outdoor walls. It is also used to level all surfaces and fill gaps and irregularities.

2.2.4 water proofing liquid:

To make the surface resistant to water penetration, water-proofing liquid is utilized. in this project we employed Ultratech WEATHER PRO WP+200,an integral water proofing compound that has been precisely developed to enhance the performance characteristics of concrete, plaster, and mortar. It increases the compressive strength of concrete, plaster, and mortar as well as cohesiveness and minimizes water permeability.

2.3 water-resisting coating materials:

Applying an impervious material layer to blocks prevents liquid from penetrating or destroying them; instead, it causes the liquid to be repelled away from the block. We need to lessen the water absorption here by using water-resisting coatings since AAC blocks are a pervious and porous compound because of voids in their structure that absorb water and cause water-borne pollutant sand chemicals that will cause the block to deteriorate.

Coating materials

1. Cement slurry
2. Wall putty slurry
3. Water-proofing liquid

2.3.1 preparation of coating materials:

2.3.1.1 Cement Slurry:

The easiest and most reliable method of water-resisting is using of cementicious in construction work. The materials used for water proofing of concrete is in the form of cement slurry, Which is a compound mixture of cement and water, The standard mix ratio is 1(cement):3(water) to 1:6.Which is in liquid form when we applied it to the AAC block the slurry will penetrate into the pores and forms a thin layer at the top when it hardens, acts as an impermeable layer and gives strength, hardness and durability to the AAC

block.

Properties of cement slurry:

1. Slurry density
2. Thickening time
3. Fluid loss control

2.3.1.2 Wall putty slurry:

Generally, we use wall putty to cover the uneven surfaces and holes, but in this case, we are making the wall putty slurry by mixing the wall putty and water in the ratio (1:3).Which is in liquid form when we applied it to the AAC block the slurry will penetrate into the pores of the AAC and forms a thin layer at the top when it hardens, acts as an impermeable layer and gives strength, hardness, and durability to the AAC block.

2.3.1.3 Water-proof liquid:

Water proof liquid:

Liquid water-proofing is being applied here as a layer that resists water. It is a process for coating a surface or object with a liquid to make it water-resistant under particular conditions. Whether single- or multi-component, the liquid coatings are simple to use and offer durable defense for surfaces like concrete, metal, and wood.

Because liquid waterproofing can easily penetrate difficult and uneven surfaces and cover products with intricate, convoluted geometries, the range of items and surfaces that can be shielded against corrosion and other problems brought on by water exposure has risen.

Liquid water proofing offers the following advantages:

1. It's easy to apply with a brush or a sprayer.
2. Offers a seamless, smooth coating.
3. Can be applied over coated surfaces that already have coatings because it does not require considerable surface preparation prior to application.
4. Has easy maintenance and can be used on both hot and cold surfaces.

2.4 TEST PROCEDURE:

2.4.1: Preparation of AAC blocks for test:

1. Take 24 AAC blocks.
2. Cut them in half to make 48 sample blocks.
3. For this cutting the AAC blocks measure the AAC Block length and mark at the center point and draw

a line and with the help of a saw cut the AAC block in half.

4. 1st three AAC blocks are uncoated and the Remaining 45 samples are coated. 15 blocks are coated with cement slurry, the next 15 with wall putty and the last 15 with waterproofing liquid by applying 1-5 numbers of coatings each coating with 3 samples, number of coatings will depend upon the depth of penetration of the previous layer.

Figure2.3. cutting the AAC blocks in half.

2.4.2 Coating with Water Resisting materials:

Cement slurry: Here we are using a 1:3 cement slurry ratio

One coating:

1. Take 500gms of dry cement and add 1.5lit water to the cement and mix slowly, incorporating the water into the cement until a uniform paste forms. If the slurry is too thick, add more water a few tablespoons at a time until the desired consistency is achieved. Use the slurry within an hour as it will start to harden as the hydration process begins.
2. Apply single coating of cement slurry to all sides of the new ACC block and let it dry for 24 hrs and take the weight as (w1).
3. Immerse it in normal water for the next 24 hours and remove the specimen from the water after 24 hours and wipe out the water with a damp cloth and weigh the specimen.
4. Take the weight as (w2) of the specimen after 3 minutes of removing it from the water.
5. and cut it into half and measure the depth of water penetration mark from four sides of the blocks.

Figure 2.4 Cement slurry (1:3).

Two coatings:

1. Take another AAC block Apply 1st coating to all sides and let it dry for 24 hrs.
2. Apply 2nd coating to all sides of the ACC block and let it dry for 24 hrs and take the weight as (w1).
3. Immerse it in normal water for the next 24 hours and remove the specimen from the water after 24 hours and wipe out the water with a damp cloth and weigh the specimen.
4. Take the weight as (w2) of the specimen after 3 minutes of removing it from the water.
5. Repeat the same procedure up to 4-5 coatings. Until the depth of penetration is zero or equal.

Repeat the same procedure with wall putty and water-proofing liquid.

3. Results And Discussions

3.1Water Absorption test:

Water absorption, as evaluated by the ratio of wet weight to dry weight, often refers to how much water the tested material absorbs. It is expressed in percentages. it gives an idea of the strength of the material. Porous materials will absorb more water and are often not suitable unless they are determined to be suitable based on strength.

$$W = \left(\frac{w2-w1}{w1}\right) \times 100\ (\%)$$

W = water absorption coefficient

W1= dry weight of the AAC block

W2= weight of the AAC block after immersing it in water for 24 hours.

Based on the test results we can select the best water-resisting material with an appropriate layer of coating.

3.1.1 water absorption of uncoated sample AAC blocks:

1. 1st three blocks are uncoated, take the dry weight (w1)
2. And immerse it in water for the next 24 hours and take the wet weight as (w2).
3. Let it sundry for 4 hours and cut it in half and measure the water penetration mark.

Figure 3.1. Uncoated AAC Blocks.

Table 3.1. Test Results of uncoated AAC blocks

Samples	Dry weight (w1) in kgs	Wet weight (w2) in kgs	W= ((W2-W1)/W1) ×100 (%)	W avg (%)
Sample 1	5.596	8.395	50	50.6
Sample 2	5.450	8.229	51	
Sample 3	5.735	8.578	50.8	

Table 3.2. COATED AAC BLOCKS

No of layers	Cement slurry (%)	Wall putty slurry (%)	Water proofing Liquids (%)
One layer	49.12	49.38	49.00
Two layers	47.96	45.36	44.51
Three layers	44.02	41.76	39.93

Four layers	34.63	35.68	31.74
Five layers	29.70	30.91	26.50

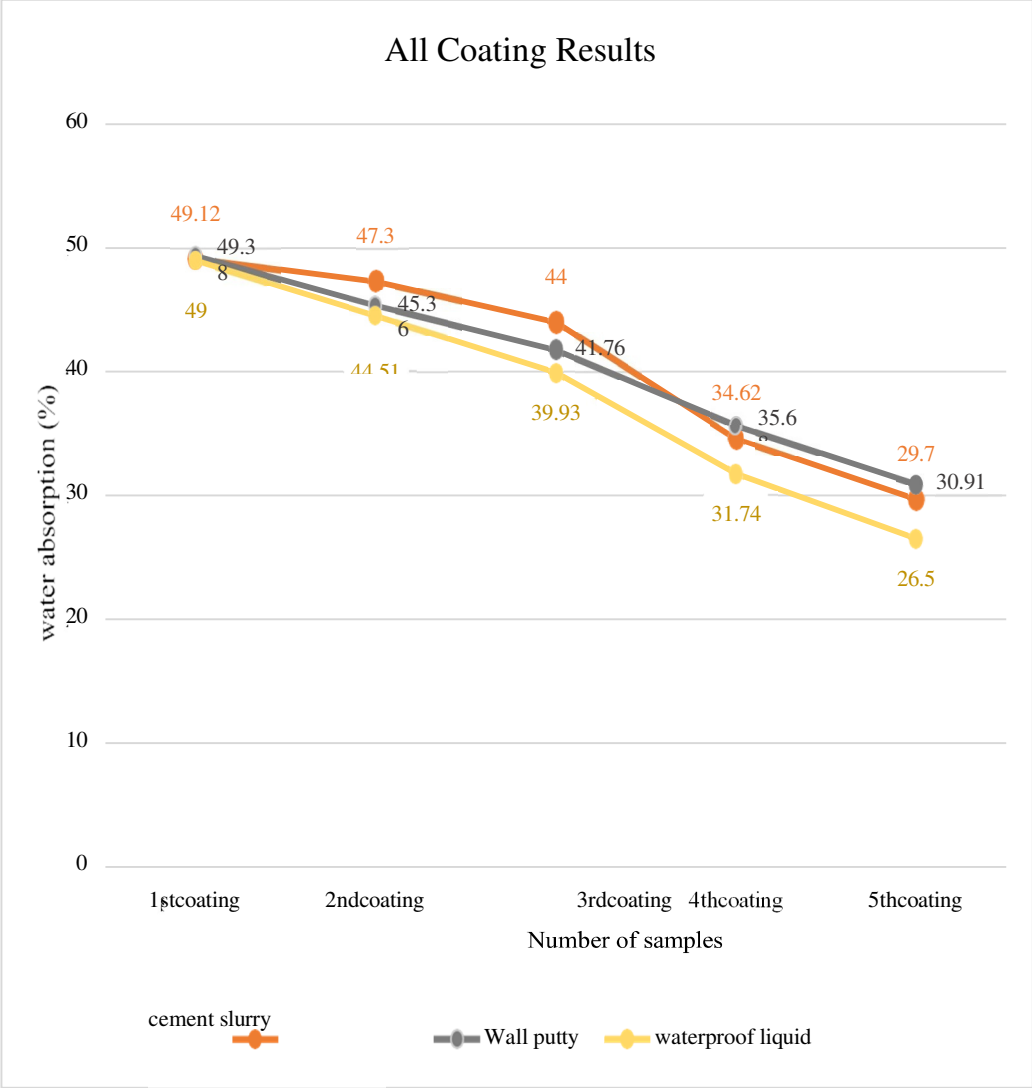

Figure 3.2: comparing all coating results of cement slurry : wall putty slurry : water proof liquid coatings.

3.2 Depth of Water Penetration:

1. After taking the wet block, we can cut the block in the middle.
2. Measure the watermark from four sides of the block.
3. The depth of penetration will decrease with the increment of a layer of water resistant coating.
4. Measure it until the depth of penetration is zero or the same as the previous layer.

4.CONCLUSION

1. water absorption of cement slurry gradually decreases from 1st coating to last coating i.e. 49.12% to 29.7%.
2. water absorption of wall putty slurry gradually decreases from 1st coating to last coating i.e. 49.38% to 30.91%.
3. water absorption of wall putty slurry gradually decreases from 1st coating to last coating i.e. 49% to 26.5%.

4.1 Comparison of all coating materials:

1. At, first coating almost all the water resisting materials behaves same. 1) cement slurry has 49.12% of water absorption.
2. wall putty slurry has 49.38% of water absorption.
3. water proof liquid slurry has 49% of water absorption. 2. up to 3rd coating cement slurry coating has higher water absorption than wall putty coating. 3. but from 4th coating cement slurry has lesser water absorption than wall putty slurry coating.
4. at 4th coating cement slurry has 3.06 % less than the wall putty slurry coating.
5. at 5th coating cement slurry has 4.07 % less than the wall putty slurry coating.
6. In all five coatings water proof liquid material has less amount of water absorption. so water proof liquid is best over wall putty and cement slurry coating.

4.2 Comparison of water absorption by depth of penetration:

1. In uncoated AAC block shows full depth from the exposed surface.
2. In cement slurry coatings first two coatings behave same depth of penetration i.e. full depth. from third coating the water penetration mark clearly visible but not that much difference in depth. it shows almost equal penetration in fourth and fifth coatings.
3. In wall putty slurry coatings first two coatings behave same depth of penetration i.e. full depth. from third coating the water penetration mark is clearly visible but not that much difference in depth. from fourth and fifth coating it gradually decreases.
4. In water proofing liquid coatings first coating shows full depth of penetration. in second coating the penetration mark is clearly visible but it almost closes to the full depth, from third coating the water penetration mark clearly visible and has less depth than second coating. from fourth and fifth coating it

gradually decreases.

In this two cases water proofing liquid behaves high water resistant than cement slurry and wall putty, it also shows less depth of water penetration comparing with both materials.