Thermal Performance and Workability of Concrete Containing Rice Husk Ash as a Partial Cement Replacement

M M S D Cooray

Sri Lanka Institute of Advanced Technological Education, Colombo, Western, Sri Lanka

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ABSTRACT

Sri Lanka is the one of major rice producing country. Rice husk produced during the milling of rice. In Sri Lanka, mostly rice husk used as a fuel in the brick industry, Pottery industry and for the boilers. Sometimes rice husk used as fertilizers. Direct combustion of rice husks is harmful to the environment. It is causing environmental pollution. There are many ways of disposing of rice husk to gain economic advantage. RHA can be used as cement replacement material. There are some previous researches on the RHS usage. Most of them were analyzed the properties like compressive strength, workability, Substantial reduction in mass, flexural Strength, water absorption, Moisture movement, Modulus of elasticity ect. So analyzing all above, this paper is evaluated how different percentages of rice husk ash added to concrete mixture influence its thermal performance. Five numbers of concrete samples were tested with different percentages of rice husk ash. Specially thermal conductivity and workability were tested during this study. Five concrete samples were prepared in this study by replacing RSH for cement o % of cement,5 % of cement, 10 % of cement, 15% of cement, and 20%of cement. Then thermal performance is measured for each and every block types. By analyzing data obtaining from the earlier researches and date gathered from this study, finally select the most suitable percentage of RHA for the concrete mixture.

Keywords: Rice husk ash, Concrete, Workability, Thermal performance.

INTRODUCTION

Concrete is the most common building material in the world today. The most commonly used concrete is prepared by using ordinary Portland cement (OPC), coarse aggregates (crushed stone metal), fine aggregates (sand), water and admixtures sometimes. Now concrete is made from various cement-like materials, including fly ash and silica fume. Such elements may help concrete achieve good performance, high quality, light weight, high strength and cheap cost. In this study rice husk ash was used to enhance chemical and physical properties of concrete. Especially tensile strength, workability, thermal performance and compressive strength.

A byproduct of milling rice is rice husk. The demand for rice is rising daily as a result of population growth. Additionally, Sri Lankans eat rice. Thus, the production of rice husk is rising quickly. Nowadays, disposing of large amounts of rice husk is a major issue. The most popular method of disposal is burning. Burning in open fields contributes to significant environmental pollution, which negatively affects the local air quality. Rice husk ash has been found to contain a high percentage of silica, similar to regular Portland cement. so that rice husk ash can be readily used as a substitute for cement.

The main goal of this study is to compare the main characteristics of the finished product, to find the best and the most appropriate percentage of rice husk ash to be used as thermal material and to analyze the effects of adding rice husk ash to the concrete mix instead of cement.

Rice husk is one of the agricultural waste products produced around the world. Every year, hundreds of millions of tons of rice husks are produced worldwide. 20kg rice husk for every 100kg rice output Rice husks contain organic and inorganic constituents. Rice husk ash is obtained by burning the rice husk.

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It is found that silica along with some other elements like alkalis constitutes 87 to 97 per cent of rice husk ash. It is also found that rice husk ash is a very reactive pozzolanic. It can be used in lime-pozzolana mixes and as a substitute for ordinary Portland cement. By varying the temperature range and the time of burning the rice husk, different types of silica can be obtained including crystalline and amorphous forms. Different types of silica have different properties so it is important to produce rice husk ash with the appropriate specifications for a specific end use.

The amorphous form of silica is consisting with silica tetrahedral and it organized in a random three-dimensional network and without regular lattice - structure. Due to this messy arrangement, the structure is having more holes. In this network electrical neutrality is not satisfied. So that it increases the specific surface area in the structure. This reason helps to increase the reactivity. This structure of crystalline silica is created by repetition of a basic fundamental unit and the silicon tetrahedrons in a three-dimensional frame-work. Those factors are influencing the RH ash properties to improve.

The use of rice husk ash is contributing to the production of high quality and low cost concrete and also can reduce the carbon dioxide (CO_2) percentage discharges from the cement production. Low energy consumption also can observe due to the partial replacement of cement by rice husk ash. Production of rice husk ash concrete block will reduce the construction cost with considerable amount. And also due to light weight it is easy to handle. With above mentioned all the reason RHA block will famous among the market and can achieve success and creating new opportunities for husk utilization. Following table shows the comparison of the cement and the rice husk ash.

Property		Portland cement	RHA
Content (%)	SiO_2	21.9	90
	Al_2O_3	6.9	0.39
	Fe_2O_3	3	0.37
	CaO	63	5
	MgO	2.5	—
	SO_3	1.7	0.46
Specific surface[d]		370	
Specific gravity (m2/kg)		3.15	
General use in concrete		Primary binder	As a cement replacement.

Table 1 - Comparison of the Chemical & Physical Characteristics.

Environment impact and necessity of RHA block.

When the rice is ground, the husk is usually taken to open areas and burned in fully exposed mounds. Due to environmental restrictions, that approach is inappropriate. In addition, in the production of cement, various dangerous gases are produced (such as carbon dioxide and carbon monoxide). These gases are the primary contributors to global warming. Hence, the utilization of rice husk ash will reduce the quantity of cement in concrete mix. Thus there is a possibility to decrease the pollutants in the environment to some extent. Partial replacement of rice husk ash also results in further improvement of concrete properties. The market introduction of RHA concrete can reduce the building costs to some extent. Also, this block will probably be the lighter one. It can reduce the dead load of the structure. This also reduces the design load. This concrete can also be used in dry areas because of its excellent thermal properties. Finally, the concrete sample proposed can save building costs significantly. It can also be sold as “green” concrete.

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Objectives of the Research

1. Analyzing and Assess feasibility of the utilization of rice husk ash as a cement replacement material and studying thermal performance of concrete which used rice husk ash.
2. Introduce and promote the rice husk ash concrete blocks to construction industry and to the market as the well performing material.
3. Introduce low cost and law weight concrete block to the construction industry and minimize overall project cost.

LITERATURE REVIEW

There are some previous researches regarding the properties of rice husk ash, properties of rice husk ash concrete and also properties of rice husk ash cement mortar. When referring the previous researches rice husk ash can be use instead of cement. Furthermore an idea can take place behaviors of rice hush ash concrete and rice husk ash mortar. Properties like compressive strength, workability, Substantial reduction in mass, flexural Strength, water absorption, Moisture movement, Modulus of elasticity can analyze using previous researches. Thermal performance is analyzed by this research.

Research Paper No 01

- ✓ Farah Alwani Wan Chik ., BadorulHisham ., Abu Bakar ., MegatAzmiMegatJohari&Ramadhansyah. of Putra Jaya School of Civil Engineering, UniversitiSains Malaysia, Engineering Campus, were published on July 2011, IJRRAS 8 , Properties of concrete block containing rice husk ash subjected to girha.

Properties of rice husk ash,

Rice husk was substituted with cement in their investigation. Because this substance is rich in silica, pozzolanic reactions result in the development of strength. RHA was acquired from a nearby paddy mill located in Pari Buntar, Perak, Malaysia. After that, it burned for around six hours at 700ºC to produce ash through furnace gas. The table below lists the RHA's physical characteristics as well as its chemical makeup.

Chemical and physical properties of RHA	
Compound	**Weight percentage, (%)**
Chemical Test	
Silicon oxide (SiO_2)	90
Aluminum oxide (Al_2O_3)	0.39
Ferum oxide (Fe_2O_3)	0.37
Calcium oxide (CaO)	0.46
Magnesium oxide (MgO)	0.88
Potassium oxide (K_2O)	3.1
Na_2O	0.07
Phosphorus oxide (P_2O_5)	1.6
MnO	0.039
LOI	3.03
Physical Test	
Density (g/cm^3)	2.5
Specific surface area (m^2/kg)	11770
Setting time (minutes)	
10%RHA	195
15%RHA	210
20%RHA	210

Table 2 - Chemical and physical properties of RHA

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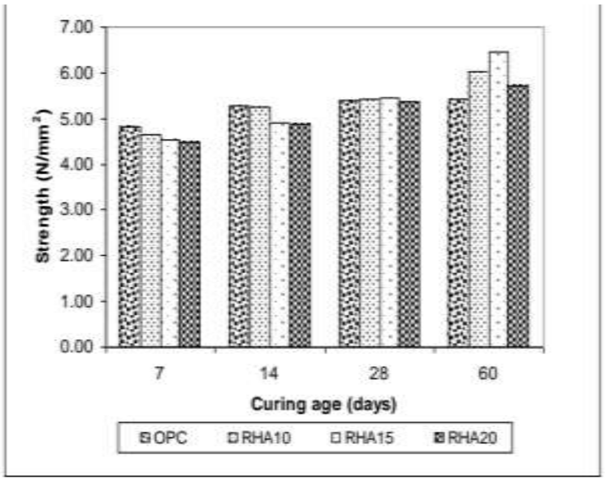
Compressive Strength Test

Following figures shows relationship of compressive strength and age of curing as per the above mentioned research paper.



Graph 1 – Compressive strength Vs Curing Days

Table 3. Average strength data and curing age

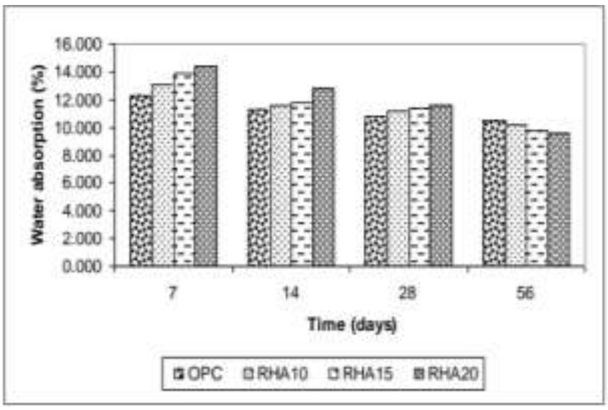
Time (days)	Strength, (N/mm^2)			
	OPC	RHA10	RHA15	RHA20
7	4.83	4.65	4.54	4.47
14	5.28	5.27	4.92	4.87
28	5.38	5.42	5.46	5.35
60	5.42	6.03	6.47	5.71

Table – 3 - Average strength data and curing ages

As per the above date compressive strength of the concrete samples are changing with the curing ages. As per the diagram strength of the rice husk ash concrete at the beginning has dropped down by comparatively to the conventional block. Later it has increased gradually by a certain amount. Ultimately it was gain its best value at the curing age of 60 days for the 15 % of rice husk ash sample. As per the collected date finally 15% of rice husk ash concrete sample is identified as most excellent concrete sample.

Water Absorption

The percentages of water absorption with the curing time between 7 days and 60 days are proved in following figure 6 as per the above mentioned research paper.



Graph 2 – Water absorption in percentage and days

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As per the above graph water absorption property also changes with the curing duration. Within seven days water absorption property will increase gradually with the increment of the rice husk ash percentage. It has achieve its maximum value for the percentage of 20 (i. e 20 % replacement of RHA instead of cement). 14 and 28 days also follow the same pattern of variation. After that water absorption property is getting low and by 56 th day water absorption property getting more less for the 20 % cement replacement sample.

Therefore, the conclusion is that the 0% part of Because of its pores, the RHA exhibits the greatest rate of water absorption. When water evaporates at zero, this occurs. The RHA blocks demonstrate how adding RHA reduces permeability. Increased absorption of the unit masonry results from this. A 5 hours boiling test for concrete block leads to poor of the concrete block and the unit's shape changers after inspection.

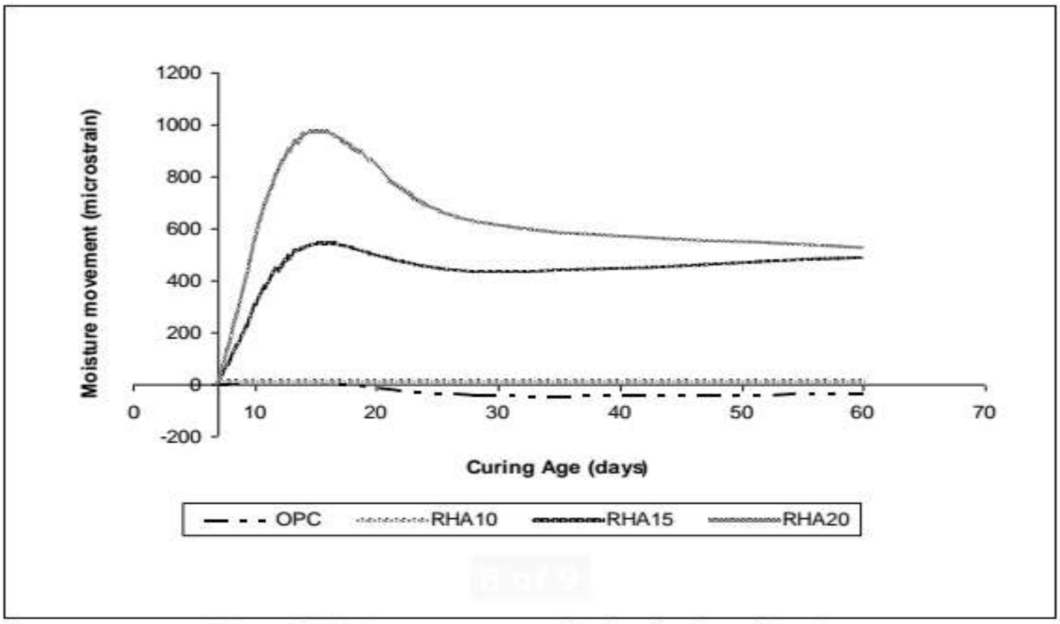
Moisture movement

The moisture migrations for the two directions between seven and sixty days are depicted in the following figures.

It was observed that the header and stretcher faces of the concrete blocks had shrunk. The samples were exposed to the surrounding humidity and temperature while being stored on the ground. Early on, rapid water loss was induced by moisture movement on both sides. The plotted graph below illustrates it. The test age revealed a contraction between the ages of 28 and 60, and the head facial orientation findings indicate that the moisture mobility of the OPC portion has progressively diminished. Blocks were tending to shrink with the age linearly. The RHA20 sample demonstrates that the highest positive moisture movement value was reached within 14 days, after which it declined with age.

Moisture movements are located between RHA10 and RHA20 blocks, and RHA15 and RHA20 exhibit a similar graph pattern. The RHA10 shows a small drop obtained at 7 days and moisture movement gives almost constant result at later age sample. The moisture migration for the stretcher direction for the OPC, RHA10, RHA15, and RHA20 block units was shown in the following figure.

As compared between the both faces direction, it was revealed that shrinkage value is lower at stretcher direction. OPC and RHA10 blocks tend to shrink while RHA20 shows contrast graph trend where expansion occur against the curing age. This is attributed to higher replacement level of RHA that exist in the block.



Graph 3 – Moisture movement for header face Direction

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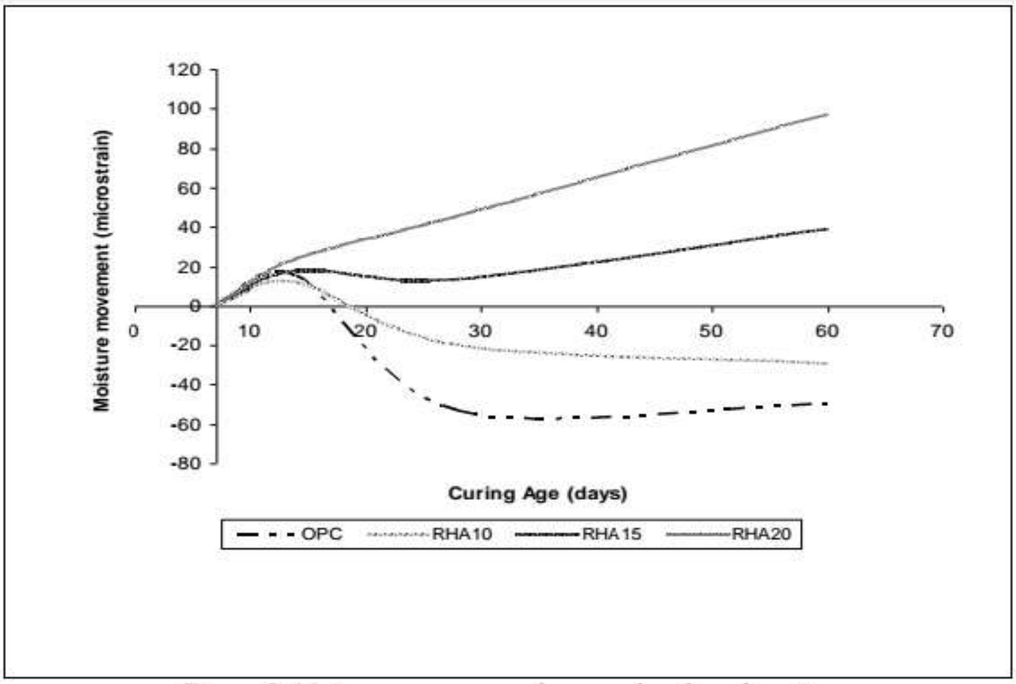

Graph 4 - Moisture movement for stretcher face Direction

Modulus of elasticity

Following table summarizes the results of the different types of unit the blocks. Observations were recorded at the 7days, 14 days, 28 days and 60 days. The elastic modulus calculated by using secant modules method using the linear part of the stress-strain curve. The proportional limitations were taken nearly 30% of the obtained energy. The secant modulus of the block unit was between 0.65 and 0.85 GPa. It shows that for all blocks except the RHA20 block the minimum result rate of 0.44 GPa exceeds 0.5 GPa. RHA15 exhibited the highest modulus of elasticity. When using RHA as a semi-cement replacement material in the range of 0 to 20%, there is a significant increase in censorship. So it can be most reasonable to conclude that RHA replacement influences the behavior of modulus of elasticity.

Block types	Block	
	Elastic modulus, E (GPa)	Strength, (N/mm^2)
OPC	0.70	5.81
RHA10	0.81	6.23
RHA15	0.85	6.70
RHA20	0.65	5.37

Table 4 – Elastic modulus at different replacement of RHA

Standard Consistency with Setting Time

Below figure 3 displays that when the water content is increasing with increasing of cement replacement level. The reason for the increase in water requirement mix is that the specific surface area is much larger than the OPC in the area. This can be seen from the plot graph presented in Figure 4. Furthermore with the increment of RHA content up to 15% shows the increment of the initial setting time. But for the 20% of RHA replacement shows the reduction of the initial setting time. At last setting time for cement is measured at 20% replacement level. During the final setting time for the replacement level from 0 to 20%, it ranges from 120 to 210 minutes. OPC with 0% RHA shows minimum result line for start and end processing times. The final processing time begins to yield a similar result at the 20% replacement level of RHA.

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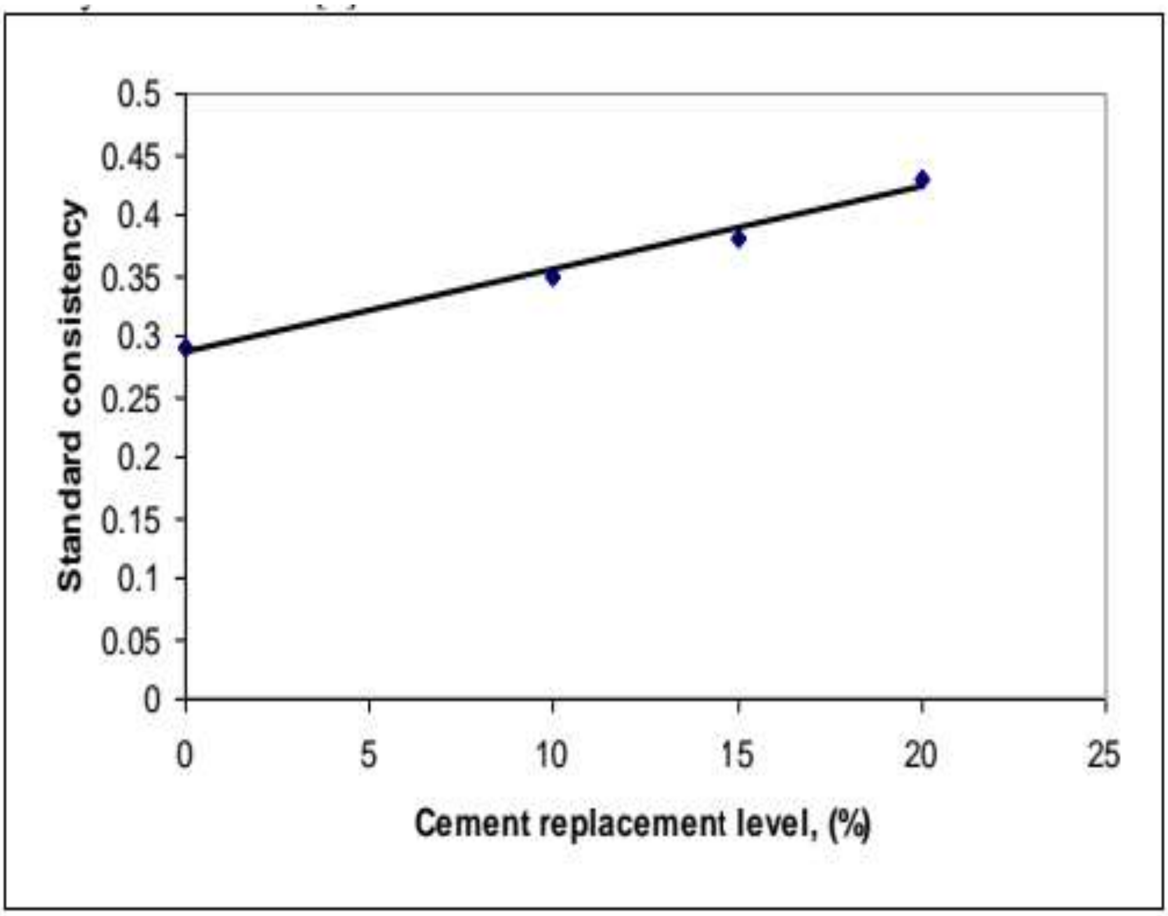
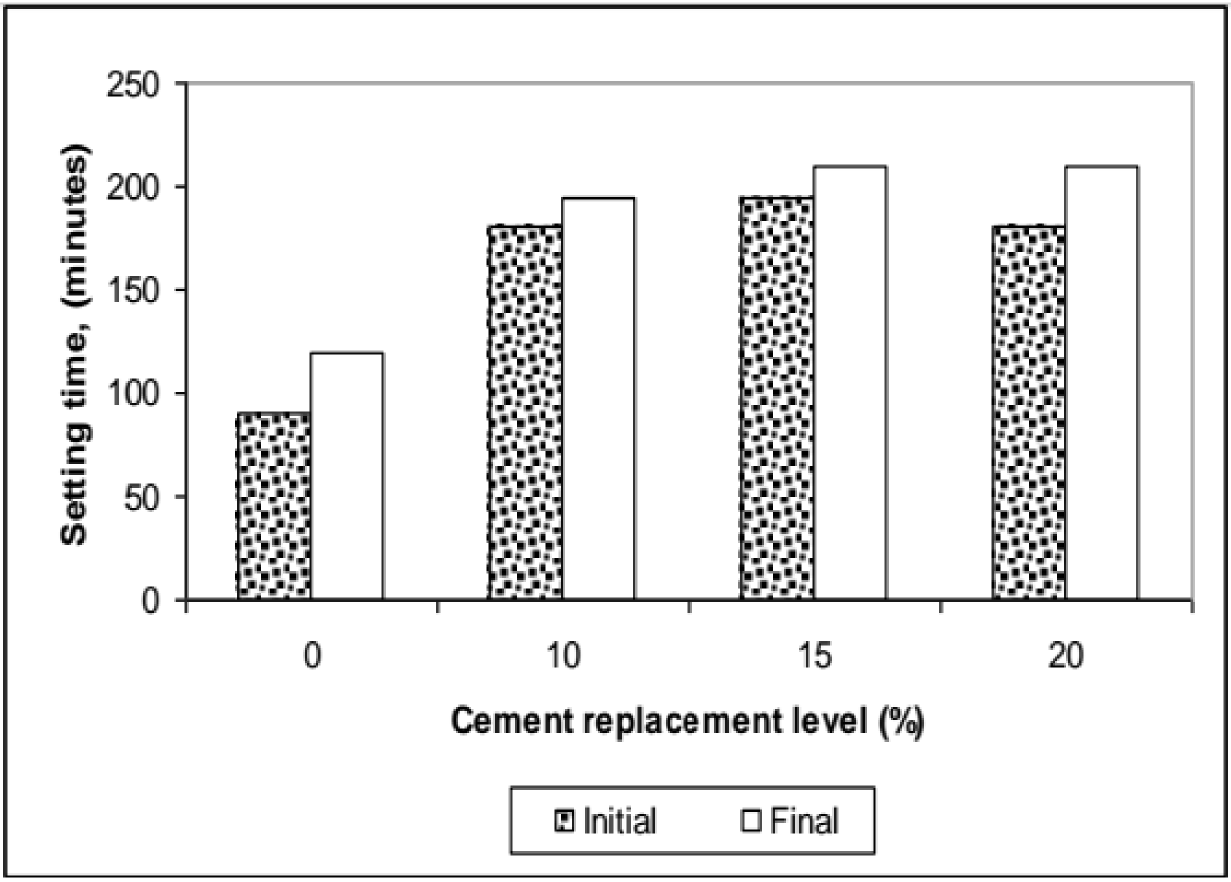


Graph 5 – Standard Consistency of RHA cement paste



Graph 6 – Initial and Final setting time for RHA cement paste

Research paper No 02

- ✓ **Ravinde Kishore 1 a , V. Bhikshma 2 and P. JeeanaPracash 3 was published on Structural Engineering and Construction Study on Strength Characteristics of High Strength Rice Husk Ash Concrete in Department of Civil Engineering, University College of Engineering – Osmania University in Hyderabad, India on (2011) 2666–2672 at The Twelfth East Asia-Pacific Conference. It was conclude followings.**

  i. ***Compressive Strength of Concrete***

- ✓ For the gradeM40 concrete mixture with 15% RHA replacement,

Percentage increase in strength for 7 days to 28 days was 42% and at 90 days maximum compressive strength was 45.04MPa.

- ✓ For the grade M50 concrete mixture with 15% RHA replacement,

At 90 days the maximum compressive strength was 52.50MPa. It was 16%of decrease of the strength compared to the maximum strength of grade M50 concrete mix with 0% replacement of RHA.

Tensile Strength of Concrete

It was observed that decrease of splitting tensile strength as the replacement level increases at 28 days of age for both M40 and M50 grade concrete sample by 5 to 10%. For both M40 and M50 grade of concrete the splitting tensile strengths was recorded as 3.98MPa and 4.19MPa. This research displays that the splitting tensile strength at the 15% replacement of RHA was decreased by 5.1% and 9.1%for both M40 and M50 grade of concrete, when comparing to the conventional concrete.

Flexural Strength and Modulus of Elasticity of Concrete

It was observed that for both M40 and M 50 grade of concretes were decreased the flexural strengths of 15% replacement of rice husk ash with cement. However it was obtained target strength for the 10% replacement. The modulus of elasticity was satisfied with the target strength for all RHA replacements.

Research paper No 03

- ✓ D.V. Reddy, Ph. D, P.E. and Marcelina Alvarez, B.S. were published Marine Durability Characteristics of Rice Husk Ash-Modified Reinforced
- ✓ Concrete for Fourth LACCEI International Latin American and Caribbean Conference for Engineering and Technology (LACCET'2006). Paper was concluded as bellows.

For the fresh /concrete

Followed ASTM standards, C 143, C 138, and C 172,

- ✓ Mixes prepared with different percentages of RHA were compared to mixes containing cement only and the following was found:

Modified Concrete which mixed with RHA has similar to slightly higher slump. Unit weight is also high than which containing cement only.

Modified Concrete which mixed with RHA mixes have the similar to slightly lower air content than conventional concrete. Bellow table shows the related properties.

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Properties of Fresh Concrete

- Bouzoubaa /Fournier, 2001

Rice Husk Ash (%)	Unit Weight (kg/m^3)	Slump (mm)	Air Content (%)
0	2432	120	2.5
7.5	2446	130	1.6
10	2432	150	2.0
12.5	2432	155	1.6

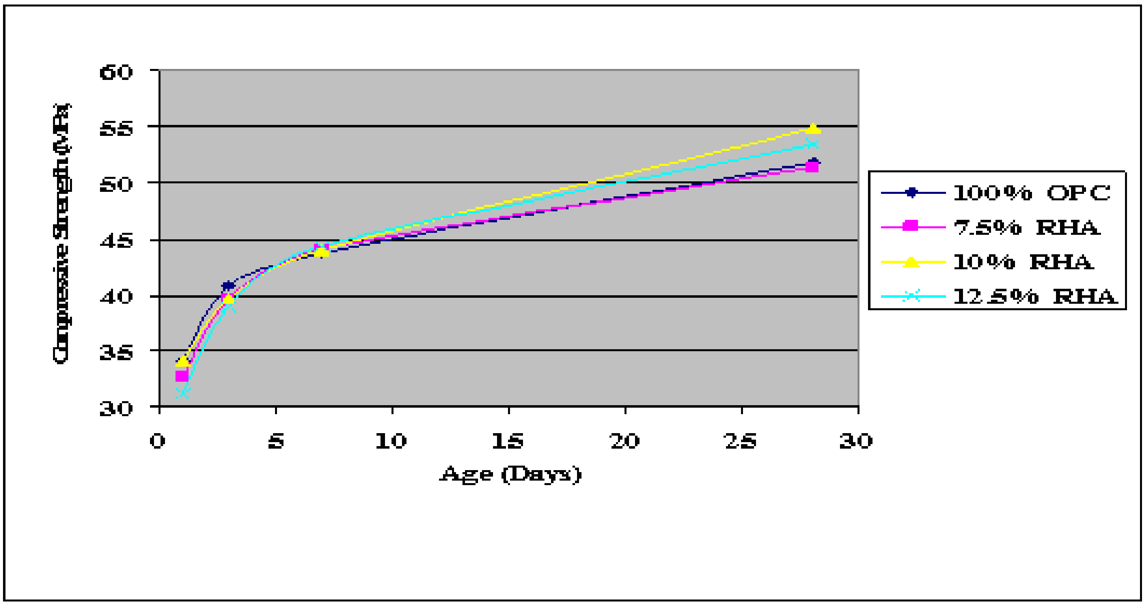
Table 5 – Properties of fresh concrete`

Harden concrete

Use of rice husk ash shows the production of high-performance and also highly durability of concrete as per the several previous papers. The important findings were as bellow.

Compressive Strength

Initial compressive strength of RHAMC, ASTM C 39, is less than normal traditional concrete, but over-all strength of RHA added concrete at 28 days is greater than the normal concrete. Following figure shows the strength difference for the different percentage of RHA.



Graph 7 - Compressive strength with different percentages of RHA

Copied from Bouzoubaa and Fournier, 2001.

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Indirect Tensile Strength

The tensile strength of RHAMC- ASTM C 496 is greater than the normal conventional type of concrete. Table no 6 illustrates the split tensile strength at the age of 28 days of the concrete which containing 10% RHA as the cement replacement material. (Zhang, and Malhotra, in 2002).

Flexural Strength

Flexural strength of R.H.A.M.C concrete, ASTM .C .78, has high value, when comparing the traditional concrete which is containing 0 % of RHA. Below table no 6 shows the Flexural Strength after 28 days of mould which made with concrete containing 10% of RHA as a cement replacement material.

Modulus of Elasticity

The elasticity modulus of RHAMC, ASTM C 469, is mostly alike with the concrete which containing only cement (Which is no RHA presented). Table 6 demonstrates the modulus of elasticity at the age 28 days of mould made adding 10 % of RHA to the concrete.

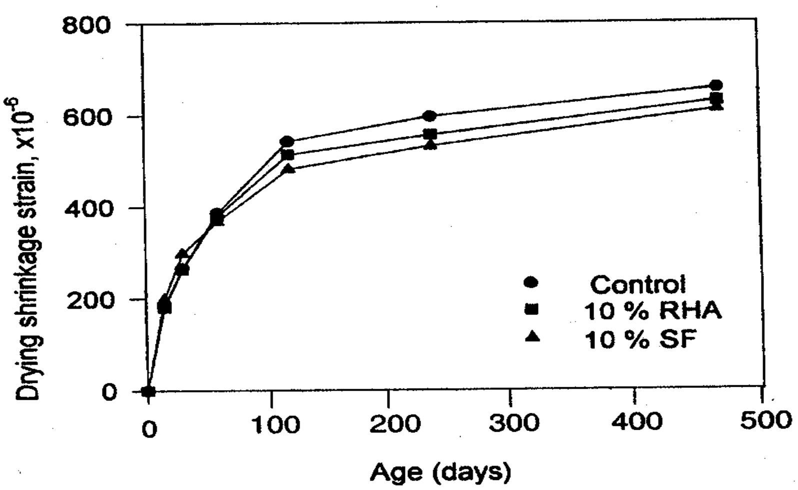
As per the Zhang and the Malhotra in 2002.

Rice Husk Ash (%)	Age (Days)	Splitting tensile (MPa)	Flexural (MPa)	E, modulus (GPa)
0	28	2.7	6.3	29.6
10	28	3.5	6.8	29.6

Table 6 – Splitting tensile, Flexural strength, Elastic modulus of Concrete for the different percentages of RHA

Shrinkage

Drying shrinkage of Rice hush ash cement mortar is having similar value to traditional concrete which is not added RHA. Following Figure demonstrate the relationship between during shrinkage and age as per the Zhang and the Malhotra in 2002.



Graph 8 - Drying Shrinkage of Concrete

Durability

The ability of concrete to withstand firm weakening from freezing and melting, heating and also cooling, as well as durability will depend upon the chemical and environmental condition. Those factors directly depend upon the service life of the concrete. By using the cement replacement material can change the permeability, due to reducing of the permeability will increasing the resistance to the water penetration. It will lead to frost damage, corrosion as well as water related deterioration like sulfate attack and acid attack.

By using such supplementary cement material in the proper amount can prevent damaging alkali-silica reactions as per the Taylor, in 2001. Finally use of high reactive RH Ash can manufacture high strength and also high durable concrete as per the Wada et al in the 2000.

Research paper No 04

- ✓ Alireza. Naji Givi.1, Suraya- Abdul Rashid 2 and Farah Nora A. Aziz 3, Mohamad Amran Mo. hd Salleh. 2 were published on Contribution of Rice Husk Ash to the Properties of Mortar and Concrete Journal of American Science in 2010. Conclusion as below.

Effects of RHA with the properties of concrete and mortar as below.

Pozzolanic reactions in concrete and mortar with RHA

The results from the reaction between RHA and cement produces calcium hydroxide, that amount of RHA in cement paste decreases by 30% after 3 days and amount of RHA will reach zero at 91 days, with compare with the controlled paste it is significantly larger with the hydration time. RHA can be considered as a pozzolanic material. So the additional pozzolana will decreases by the reactions of the formed calcium hydroxide and it will produce C-S-H gel that benefit to increase the strength as well as the durability of the concrete and mortar.

The most important recognized pozzolanic activity in the production of RHA is producing of amorphous phase material substance. RHA can make up approximately 85% to 95% of the weight of amorphous silica material substance in their production. As a result of this feature, RHA is a highly reactive pozzolanic material substance, suitable for use in lime-pozzolana blends and can use as an alternatives to Portland cement.

Replacement of cement with RHA accelerates the initial hydration of C3S (tri-calcium silicate). The rise in the initial hydration rate of C3S gives higher specific-surface with RHA. This is happens because of the fine particles of RHA. Normally small properties of pozzolana consider less reactive with compare of Portland cement. They produce a number of nucleation-cites in cement pastes. Because of this mechanism finer particles fill the pores and it's create more unique and denser paste. One researcher has found that finer particles consist in RHA will increase the reactions and creates calcium hydroxide crystals.

Thermal effect in concrete and mortar with RHA when hardening.

When the process of cement hydration occur thermal reactions will take place. Heat occurs in hydration is an important factor that affects the structure and behaviors of Portland cement. Because of these temperature changes when the hardening process of mortar/ concrete comes it can cause shrinkage crackers or more than that. Sometimes these cracks may appear in structures as well. During the C3S hydration period, cement from pozzolanic materials generally has reduced hydration heat compared with pure cement.

The hydration heat rate of cement added with the pozzolanic material depends mainly on three different factors, C3S hydration, Aluminate-hydration and pozz0lanic-reaction. Similarly, RHA showed an increase in the behavior of hydration heat during the first 12 hours. The incensement of heat of hydration cement combined with rice husk is due to the acceleration of the rice husk ash and due to pozzolanic reaction.

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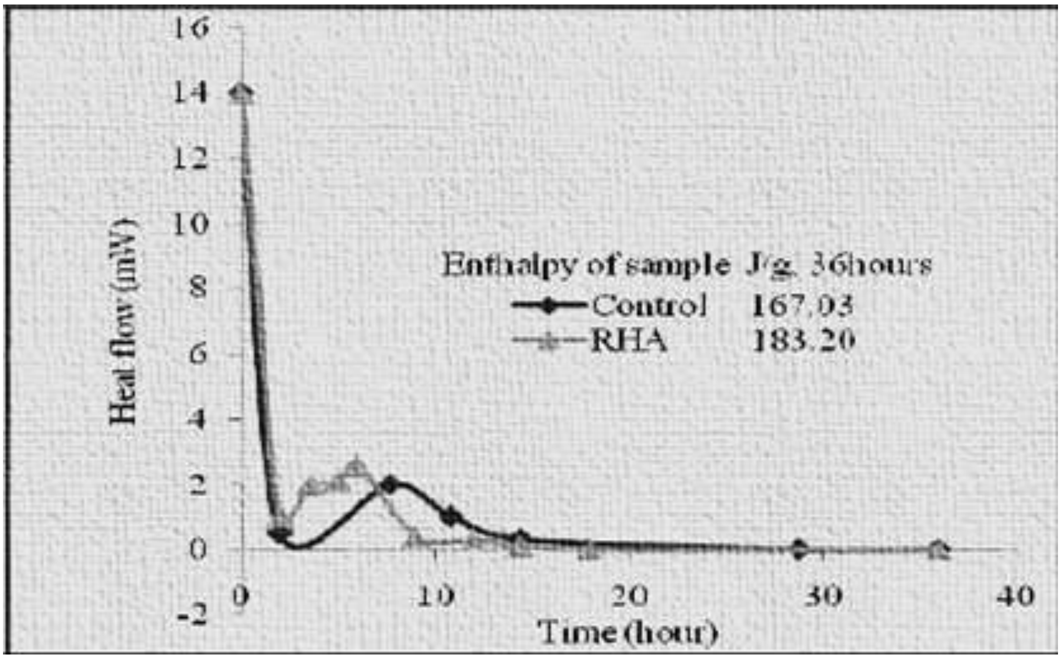
comparis0n between the heat of hydration of control sample and sample the replace with pozzolanic material instead of cement shown in below figure. In below figure results we can identify that cement mixed with RHA has a greater enthalpy compared with control sample.

If summarized the effects of pozzolanic activity and diluti0n effect, the pozzolanic effect likely to rise the heat because of the reactions between the pozzolanic material and calcium hydr0xide. But when consider the diluti0n effect it is likely to gradually reduce the heat as a result of dilution in cement compounds.



Graph 9 - Enthalpy curves of control sample and RHA sample during heat of hydration process

Workability of mortar and concrete with RHA

Normally water demand in concrete or mortar can be vary due to two reasons.

I) workability of concrete depends on distribution of the particles, packing of the particles and the amount of void available in the sample. Normally in a concrete mixture due to less percentage of particle size distribution to achieve required amount of workability high amount of water need to be added to the mixture.

II) In order to achieve an acceptable c0nsistency in cement paste, excessive water content is required for co-operate with hydration of the cement because of the presence 0f dry cement particles.

Studies shows that concrete mixture contents with high amount of fly-ash will reduce 20% of water requirement. As well as with the RHA with concrete mixture water reduction is more than 20%. This is happens because of fine particles 0f RHA absorb with 0ppositely charged Cement particles and it is prevent them with fl0cculation.

This way cement particles are effectively dispersed and trapped in huge quantities of water, which means system will need less water to obtain its' provided consistency. Particle packing also responsible to reducing water amount in plasticizing the system.

In the study, RHA replace with cement on weight basis at 5%, 10%, 15% and 20% were examined. After Based on the results of their tests, the plasticity viscosity growths dramatically with the increase in the amount 0f RHA change.

RHA particles consist a higher surface area than cement and have a better and less reactive capacity. RHA particles fill in the voids created by large cement particles, reduce the friction forces 0f the RHA Portland cement (OPC) system, and its ability to reduce the yield stress and enhance the packing ability.

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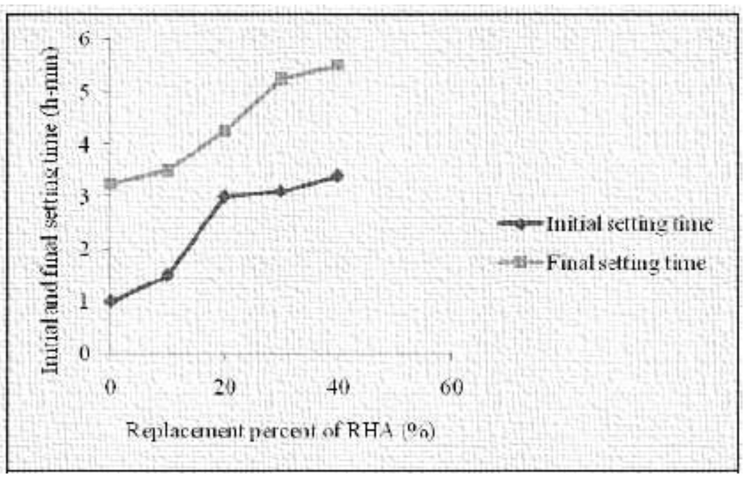
Setting time of mortar with RHA

Initial & final-setting time tests showed different results on test cement paste and rice-husk paste. Studies sh0w that RHA can increased the setting time 0f paste. As with 0ther hydraulic cements, the ash content of rice cement highly depends on specific particle size.

Rice husk ash fine particles exhibits high setting-time performance. Researches havev found that increasing RHA levels in cement mixtures increases initial-setting time compared to test cement paste. In below graph shows initial setting-time and final setting-time cement replace with RHA.



Graph 10 - Initial/final setting time when replace RHA with cement

Compressive in concrete with RHA

Adding RHA as a partial replacement 0f cement increases the compressive strength 0f concrete, but the maximum replacement level of OPC by RHA is increased by 10% to increase maximum l0ng-term strength. Up to 30% have been reported. All of these alternative levels of RHA are in percent by weight of the total binder content.

Researcher has reported a 15% cement replace by RHA can achieve maximum strength on concrete. Another researcher used 30% of RHA replace with cement be consider the optimum content water cement ratio in investigated m0rtars due to maximum amount 0f compressive strength.

In another research has found that achieving maximum pressure strength and reduction of permeability in RHA composite concrete may be due to low porosity, reduction of calcium hydroxide c0ntent and the width 0f the interfacial z0ne between aggregates and paste. After development of higher CS-H gels in concrete with RHA can lead to the development 0f concrete properties due t0 the reaction between RHA and calcium hydr0xide in the hydration of cement.

The literature shows that cement blended with RHA generally exhibits higher c0mpressive strength than OPC compared with RHA blended cement. RHA concrete achieved maximum compressive strength in 91 days with compared to normal concrete that with0ut RHA. The growth in the compressive strength 0f concrete with the remaining RHA can also be happens by the filler effect. As a conclusion concrete can gain a high early strength when it cement blended with RHA.

Tensile and flexural strength in concrete with RHA

One researcher has investigated with 20% of RHA replacement effect the concrete with 03 different sizes of particles. In their case study in concrete tensile strength gradually increased with the replacement of increasing RHA. Results 0f flexural strength and tensile strength tabulated as below table.

	Flexural Strength (MPa)			Tensile Splitting (MPa)		
	Age (days)			Age (days)		
Mix	28	90	180	28	90	180
CM [a]	4.5	4.9	5.1	2.6	2.8	2.9
20F1 [b]	4.9	5.4	5.5	2.9	3.0	3.2
20F2 [c]	5.0	5.4	5.7	3.2	3.3	3.5
20F3 [d]	5.2	5.7	6.1	3.2	3.5	3.9

[a] Control mix
[b] RHA with average particle size of 31.3
[c] RHA with average particle size of 18.3
[d] RHA with average particle size of 11.5

Table 7 – Flexural strength and tensile splitting concrete

From above table results we can notice that when the RHA particles mixed with cement shows the least impr0vemnt in flexural strength and tensile strength. As per the conclusion ,increase of the RHA in the concrete shows Increment in flexural strength and higher strength due to enhanced pozzolanic reaction and the packing ability of fine particles of RHA due to the improved RHA mixing.

Research paper No 05

- ✓ AboshioA/Ogork. E.. N.. and Balami. D.A. of Civil Engineering Department of Faculty of technology at Bayero University, Kano published the Journal of Engineering and Technology (JET) Vol.4, No. 2 August 2009 on Rice husk ash as admixture in concrete. following are the key results of relevant research paper.

Workability of concrete.

Following table shows the result related to workability. Slump test was proceeded to measure the workability. As per the table slump is decreasing the increment of the rice husk percentage. So, conclusion can be made with addition of rice husk will reduce the workability of the concrete as per the Chaiyesena in 1992.

CONCRETE GRADE	ADDITION OF RHA (%)	SLUMP(mm)
20	0	28
	5	24
	10	20
	15	17
30	0	19
	5	17
	10	15
	15	12

Table 8 - Workability

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Moisture content of RHA and cement

As per the test done according to the BS 812 part 109: 1990 by above mentioned paper result can be demonstrate as bellow. The result shows the best moisture content for RHA and the cement. That was 92% and 20% correspondingly.

The Compressive strength of concrete

According to the conclusions taken as per the above-mentioned research paper compressive testing results are shown in the table below. As per records for both the grade of concrete samples (that is grade 20 and grade 30) compressive strengths are increasing when increase the percentages of rice husk ash. It achieves the maximum for the 10 % of RHA. Beyond that point again compressive strengths are getting low.

Table 9 – compressive strengths with RHA percentage

Grade	Age of Concrete (Days)	0% RHA	5% RHA	10% RHA	15% RHA
20	7	18.7	20.21	19.2	13.77
	28	22.9	26.01	24.89	18.34
	56	26.63	29.6	27.12	20.13
30	7	28.3	30.71	29.64	22.8
	28	33.6	39.2	34.5	25.5
	56	36.6	45.04	37.01	32.21

THE METHODOLOGY

Material selection, *process of manufacturing* of the concrete using the rice husk , ash, cements, aggregates (fine and course) and water, as well as the *laboratory experiments* related to this section.

Materials Required.

While selecting the materials, The quality of the material should be standard to maintain the high performance and achieve the required strength easily. The required list of materials for this study is listed as below.

Rice- Husk- Ash.

Preparation of the RHA ash

Session is heading to come across the commonly used method of rice husk burning and the way of it can use for particular job. Also analyze the advantages which can observe of burned rice husk usage. By investigating in the previous research from other different sources, Prepared specimens before and the strength tests range, it clears we can use rice husk ash instead of cement. Furthermore, burn rice - husk - ash is used as a cement replacement material. Raw rice husks can be obtained from the paddy mills in the rural areas in Sri Lanka. After done burning six hours of rice husk at the temperature of 700 Celsius through a furnace gas we can achieve required type of husk ash. There are many alternative methods to consume burn rice husk in Sri Lanka. Those are, as a byproduct of brick industry and pottery industry. In Some area of Sri Laka rice husk and saw dust are using for burning

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process of bricks and potteries. So that burnt husk we can obtain from these industries. Obtaining rice husk ash from the brick industry and the pottery industry is the most effective and low-cost method than the manufacturing of rice husk ash. In my study rice husk as is obtain from brick industry and pottery industry. Collected RHA should be free from debris as well as it should be proper size range. For this study particle size going to be used is in between 75 μm and 150 μm. So collected RHA sieve and obtained the required RHA sample.

American standard sieves (ASTM) are using for the sieving required rice husk ash quantity. The normal apparatus has a range of size from 20 micrometers to 200 millimeters. And it's diameter changers from 203mm to 305 mm.

Fig (1) Sieve the RHA

Fig (2) Sieved RHA

The table below represents the chemical compositions and physical properties of the rice husk ash.

Compound	Weight percentage, (%)
Chemical Test	
Silicon oxide (SiO_2)	90.00
Aluminum oxide (Al_2O_3)	0.39
Ferum oxide (Fe_2O_3)	0.37
Calcium oxide (CaO)	0.46
Magnesium oxide (MgO)	0.88
Potassium oxide (K_2O)	3.10
Na_2O	0.07
Phosphorus oxide (P_2O_5)	1.60
MnO	0.039
LOI	3.03
Physical Test	
Density (g/cm^3)	2.5
Specific surface area (m^2/kg)	11770
Setting time (minutes)	
10%RHA	195
15%RHA	210
20%RHA	210

Table 10 - chemical compositions and physical properties of RHA *Sand*

The Sand sample used for this study must be clean and sharp and should be taken from rivers and not recommending the sea sand. That should be clay free, loam free., dirt. free and free fromany other organic and chemical substances. The size of the sand should be less than 3 mm. American standard sieves (ASTM) can be used for separating the required sand sample,

Fig (3) Sieved River sand sample

Cement

Modern cements are often called OPC or ordinary Portland cement. In this study, I plan to use common type of cement and it should be well standard and free from lumps. Cement sample should follow the Sri Lankan standards.

Water

Water should be fresh, colorless, odorless and tasteless and also free from organic and inorganic matters. That kind of drinkable water (drinkable water) should use for the concret mixing purpose. In Sri Lanka ordinary tap water can be used for the mixing of concrete which supply from National water supply and drainage board.

The Coarse Aggregate

The Coarse aggregates are the granular material produce from gravel, sand, crushed rock ect. Size of the coarse aggregate should be more than 5 mm. As well as aggregate should be free from debris. For obtaining the particular aggregate sample American standard sieves (ASTM) can be used as usual.

Fig (4) Sieved Aggregated Sample

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Manufacturing Concrete Samples

Select the proportion of Ingredients:

1. Select the proportion of Ingredients:

When selecting the proportion of the ingredient the main criteria is achieving the desired strength of the block. In this study different percentages of burnt rice husk are using instead of cement as partial replacement material. Generally, four (4) different rice husk ash percentages (that is 5% of RHA, 10% of RHA, 15% of RHA and 20% of RHA) are select for my further learning. Grade 20 concrete is using for this study. When produce M20 grade concrete, concert block should achieve the 20N/mm2 of compressive strength within the 28 days after mixing and casting. Generally M20 grade concrete has mix ratios of 1:1.5:3 (that is cement, sand and aggregate).

Samples	Cement	RHA	Sand	Aggregate
1	1	0	1.5	3
2	0.95	0.05	1.5	3
3	0.9	0.1	1.5	3
4	0.85	0.15	1.5	3
5	0.8	0.2	1.5	3

Table 11 – Mixed design of concrete

Mix the ingredients:

Blending of cement, sand, aggregates, RHA and water should be done very carefully. Machine mixing is the preferable method. First cement, aggregates and RHA are mixed thoroughly in dry state and then gradually adding the water. Separate mix design should prepare separately and water cement ratio is keeping as 0.5. Water - cement ratio is more serious for the workability of concrete sample. As the water - cement ratio is the utmost critical criteria on the workability care should make when adding the water to the mixture. Water cement ratio should same for each case.

Fig (5) Selected Sand, RHA and Cement quantities

Casting, vibration, and placing.

The molds are subsequently filled with mixed concrete mixture. For different concrete samples, five concrete molds are being cast. For concrete mixtures to reach their strengths, compaction is crucial. Concrete vibrates until the block is uniform. Particles should not separate while compacting. Thus, the right approach should be used to attain the necessary strength. The primary goal of this research is to examine thermal performance. Thus, particular consideration is given to that.

Fig (6) casting the concrete cubes.

Curing:

Next,After 24 hours blocks are unmolding and immerse in curing tank until the test are performed. Generally, blocks are testing at several age stages, those are after 7 days secondly 14 days thirdly 21 days and finally 28 days. The Curing process is the most crucial process of this activity, the reason is that the strength is gained by the concrete blocks mainly be influenced by the curing.

Fig (7) Curing the test cubes for 14 days.

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Tests are being conducted.

According to my literature review, we can vary the following qualities between traditional and RHA concrete. Compressive strength, significant mass reduction, flexural strength, workability, thermal performance, moisture movement, water absorption, modulus of elasticity, etc. I'm learning a lot about temperature performance in my research, and I analyze the results and write a thorough report about it.

Workability

The ease and consistency of freshly mixed concrete are determined by its workability. Following mixing, each concrete sample is subjected to the concrete slump test, which determines if the addition of rice husk ash has altered the workability's behavior. The water-to-cement ratio of the concrete mixtures determines the concrete sample's workability.

1. Slump Test – most common method.
2. 'Compaction' – The Factor Testing method
3. 'Vee-bee' Consisto meter Testing method

The slump test is performed for his study, and normally this is appropriate for concrete with high workability. For my study, workability should be 25 millimeters to 50 millimeters, and I am proposing the slump test.

Instrument required for workability Test

- Iron Pan to mix Concrete.
- Slump cone
- Spatula for mixing purpose
- Trowels
- Tamping Rod
- Graduated Cylinder

Fig (8) Doing the slump test.

Thermal Performance

In my study thermal performance is going to determine for the 5 types of concrete samples as below.

1. Standard conventional block – No rice- husk - ash added. This is the control sample.
2. Block, which containing 5% of RHA
3. Block, which containing 10% of RHA
4. Block, which containing 15% of RHA
5. Block, which containing 20% of RHA

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Procedure:

- 5 no's of concrete blocks are making as below.

Making concrete cubes using fresh concrete

- *Equipment required.*
  - ✓ Sample tray
  - ✓ 5 concrete moulds with the sides of 150. millimeter x 150. millimeter x 150. Millimeter each .
  - ✓ Scoop
  - ✓ Spanners
  - ✓ Mason trowel or steel float
  - ✓ Standard compacting rod (16 mm diameter with 60 cm long)
  - ✓ Cleaning tags
  - ✓ Curing tank

Method

- ✓ Moulds should be clean and free from hardened concrete. Internal surfaces should be oiled or greased and mould should prevent leakage when filling concrete.
- ✓ Then moulds are filling by three equal layers of fresh concrete.
- ✓ After filing first layer proper compacting is giving by using standard compacting rod (16 mm diameter with 60 cm long).
- ✓ 35 numbers of blows are given for first layer, and second layer was filling to the mould.
- ✓ Then again 35 blows were given to the second layer, and rod should be passed through the second layer and comes to the middle of first layer.
- ✓ Then third layer was poured to the mould and again 35 blows are given to the third layer until the rod reaches the middle of the second layer.
- ✓ Finally top surfaces were cleaned and finished properly.
- ✓ Then cubes were labeling as mentioning the rice husk percentages.
- ✓ After completing the molding works 15 mm diameter hole was made in the middle of the concrete block as below.

Fig (9) making the holes on the blocks.

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- ✓ After finishing the casting, of concrete cubes remain for 24 hours for hardening. Next day remove the mould.
- ✓ Then all the cubes are curing in a curing tank for about 14 days.
- ✓ Then cured and finished cubes are taken out at the same time and keep 24 hours in the same atmospheric condition before thermal testing is proceeding.

Place all the blocks outside to receive the direct sunlight as figure.

Fig (10) Keep the concrete blocks outside to achieve the direct sun light.

- Drilled hole should be covered with plastic cover with regiform layer as it is good thermal insulating material. Most important thing is there should be same whether condition for all the blocks.
- Temperature measurements of surface of the blocks, atmospheric temperature, as well as the temperature of the inside of the block are taken continuously as below.

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Fig (11) Temperature measuring of inside the blocks.

Fig (12) Temperature measuring the surface of the concrete blocks

Fig (13) Atmospheric temperature measuring.

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- All the temperatures are recorded as given table.

	Temperature																	
	Time	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	10:00 PM	12:00 AM	2:00 AM	4:00 AM	6:00 AM
Samples																			
1	Outside																		
	Inside																		
2	Outside																		
	Inside																		
3	Outside																		
	Inside																		
4	Outside																		
	Inside																		
5	Outside																		
	Inside																		

Table 12 – Temperature Vs Time

Other all following mention properties are analyzing using previous researches and made conclusion about the most suitable concrete sample with com paring the thermal performance.

Compressive strength,

Substantial reduction in mass,

Flexural Strengths.

Water absorption.

Moisture movement.

Modulus of elasticity.

Analysis and Discussion of results

Description

In this study rice husk ash is used as cement replacement material. There are some previous researches regarding the RHS usage most of them were analyzed the properties like compressive strength, workability, Substantial reduction in mass, flexural Strength, water absorption, Moisture movement, Modulus of elasticity ect. So analyzing all above, this paper is evaluated how different percentages of rice husk ash added to concrete mixture influence its thermal performance. Five concrete samples were tested with different percentages of rice husk ash. Especially thermal conductivity and workability were tested during this study. Five concrete samples were prepared in this study by replacing RSH for cement o % of cement, 5 % of cement, 10 % of cement, 15% of cement, and 20% of cement. Then thermal performance is measured for each and every block type. By analyzing data obtaining finally select the most suitable percentage of RHA for the concrete mixture.

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Observations and data analysis on thermal performance.

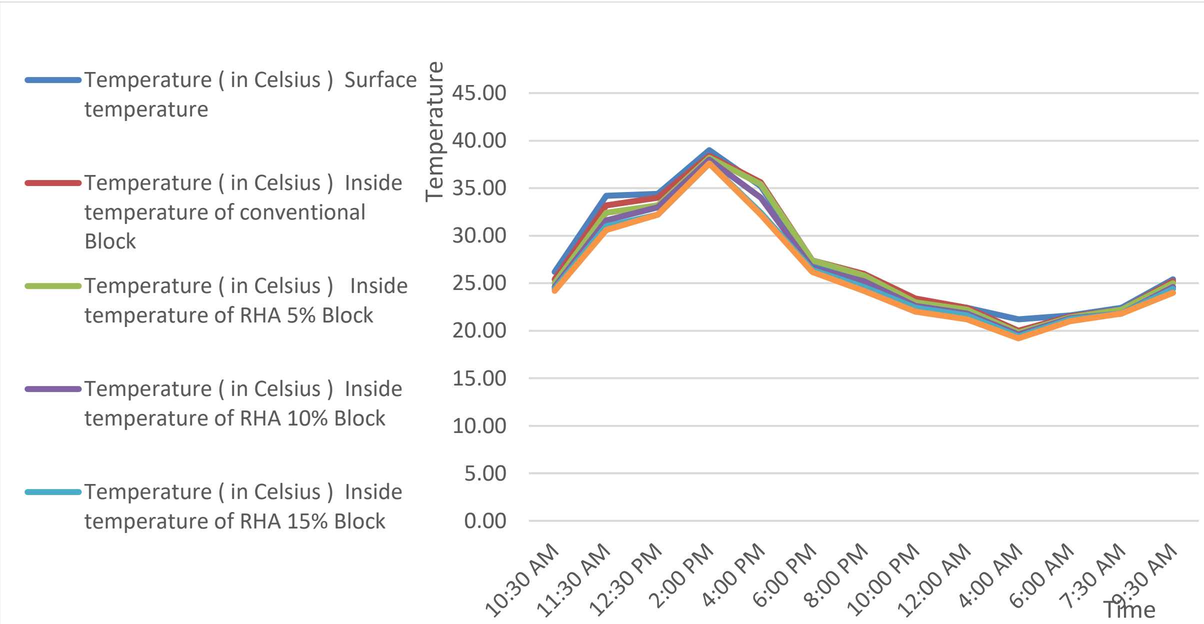
Following tables show how temperature changes with the time. Temperatures are measured on the external surfaces of the concrete cube as well as the internal temperatures of five samples of blocks within seven days.

Day 1 (21 / July / 2019)

Time	Temperature (in Celsius)					
	Surface temperature	Inside temperature of conventional Block	Inside temperature of RHA 5% Block	Inside temperature of RHA 10% Block	Inside temperature of RHA 15% Block	Inside temperature of RHA 20% Block.
10:30 AM	26.20	25.40	25.00	24.60	24.40	24.20
11:30 AM	34.20	33.20	32.40	31.60	31.00	30.60
12:30 PM	34.40	34.00	33.20	33.00	32.20	32.20
2:00 PM	39.00	38.40	38.20	38.00	37.60	37.60
4:00 PM	35.20	35.60	35.40	34.00	32.40	32.20
6:00 PM	27.00	27.40	27.40	26.60	26.40	26.20
8:00 PM	25.50	26.00	25.80	25.20	24.60	24.20
10:00 PM	23.00	23.40	23.00	22.60	22.40	22.00
12:00 AM	22.40	22.40	22.20	21.80	21.60	21.20
4:00 AM	21.20	20.00	19.80	19.60	19.40	19.20
6:00 AM	21.60	21.50	21.40	21.30	21.20	21.00
7:30 AM	22.40	22.20	22.20	21.80	21.80	21.80
9:30 AM	25.40	25.20	25.00	24.60	24.40	24.00

Table 13 – Observations of Day 1

Graph (11) is showing how the internal temperature of five concrete blocks (that is conventional block, 5 % RHA added concrete block, 10 % RHA added concrete block,15 % RHA added concrete block,20 % RHA added concrete block) are change with the external surface temperature for the day 01.



Graph (11) Time Vs Temperature

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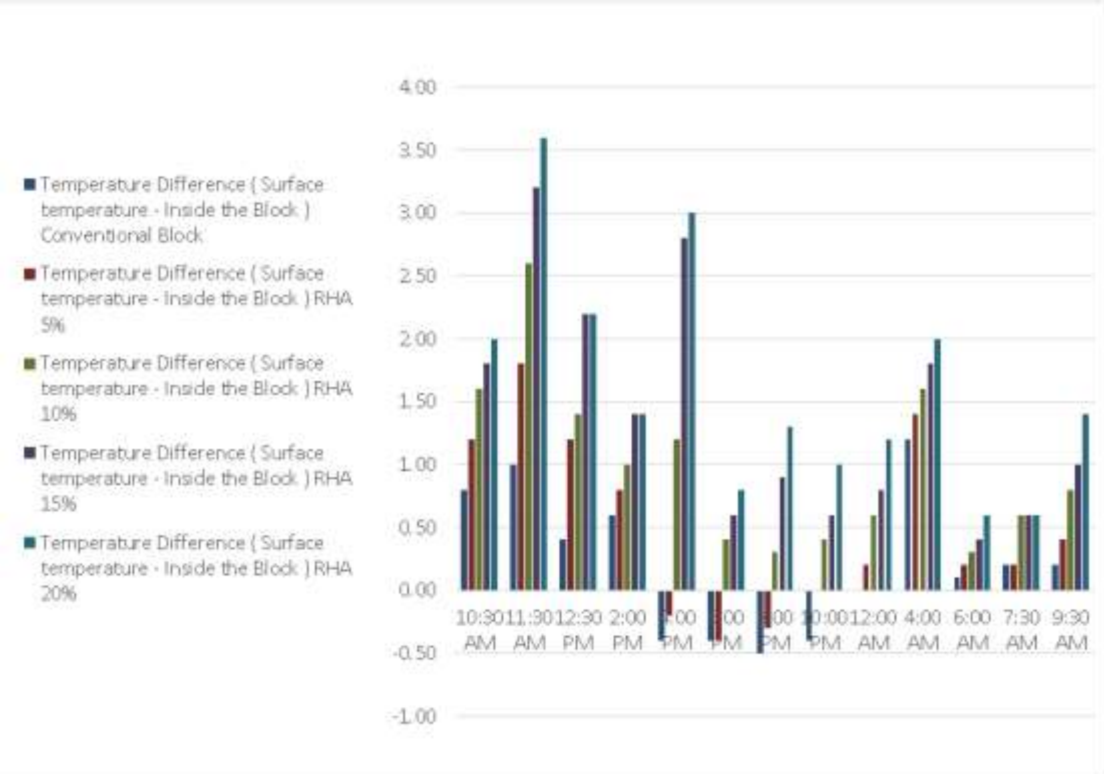
Graph (12)Below graph is showing the temperature differences of Surface temperature and inside temperature of specific concrete block for the day 1 (that is conventional block, 5 % RHA added concrete block, 10 % RHA added concrete block,15 % RHA added concrete block,20 % RHA added concrete block)



Graph(12) – Temperature difference Vs Time

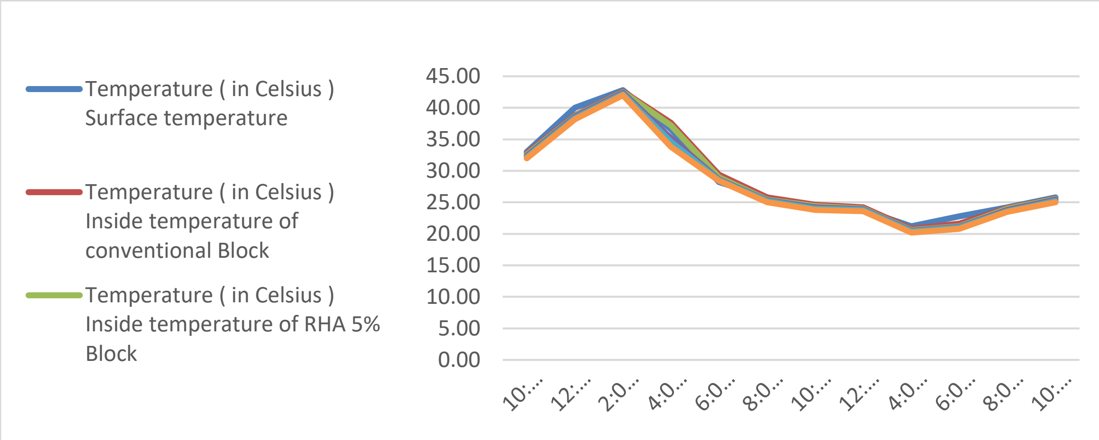
Day 2 (22 / July / 2019)

Time	Temperature (in Celsius)					
	Surface temperature	Inside temperature of conventional Block	Inside temperature of RHA 5% Block	Inside temperature of RHA 10% Block	Inside temperature of RHA 15% Block	Inside temperature of RHA 20% Block.
10:30 AM	33.00	32.80	32.60	32.40	32.20	32.00
12:00 PM	40.00	38.80	38.70	38.60	38.40	38.20
2:00 PM	42.80	42.60	42.50	42.40	42.20	42.00
4:00 PM	36.60	37.60	37.20	35.20	34.60	33.80
6:00 PM	28.20	29.40	29.00	28.60	28.50	28.40
8:00 PM	25.80	25.80	25.40	25.30	25.20	25.00
10:00 PM	24.00	24.60	24.40	24.20	24.00	23.80
12:00 AM	23.80	24.20	24.00	23.90	23.80	23.60
4:00 AM	21.20	20.80	20.60	20.50	20.40	20.20
6:00 AM	22.80	21.60	21.20	21.10	21.00	20.80
8:00 AM	24.20	24.10	24.00	23.80	23.60	23.50
10:00 AM	25.80	25.60	25.50	25.40	25.20	25.00

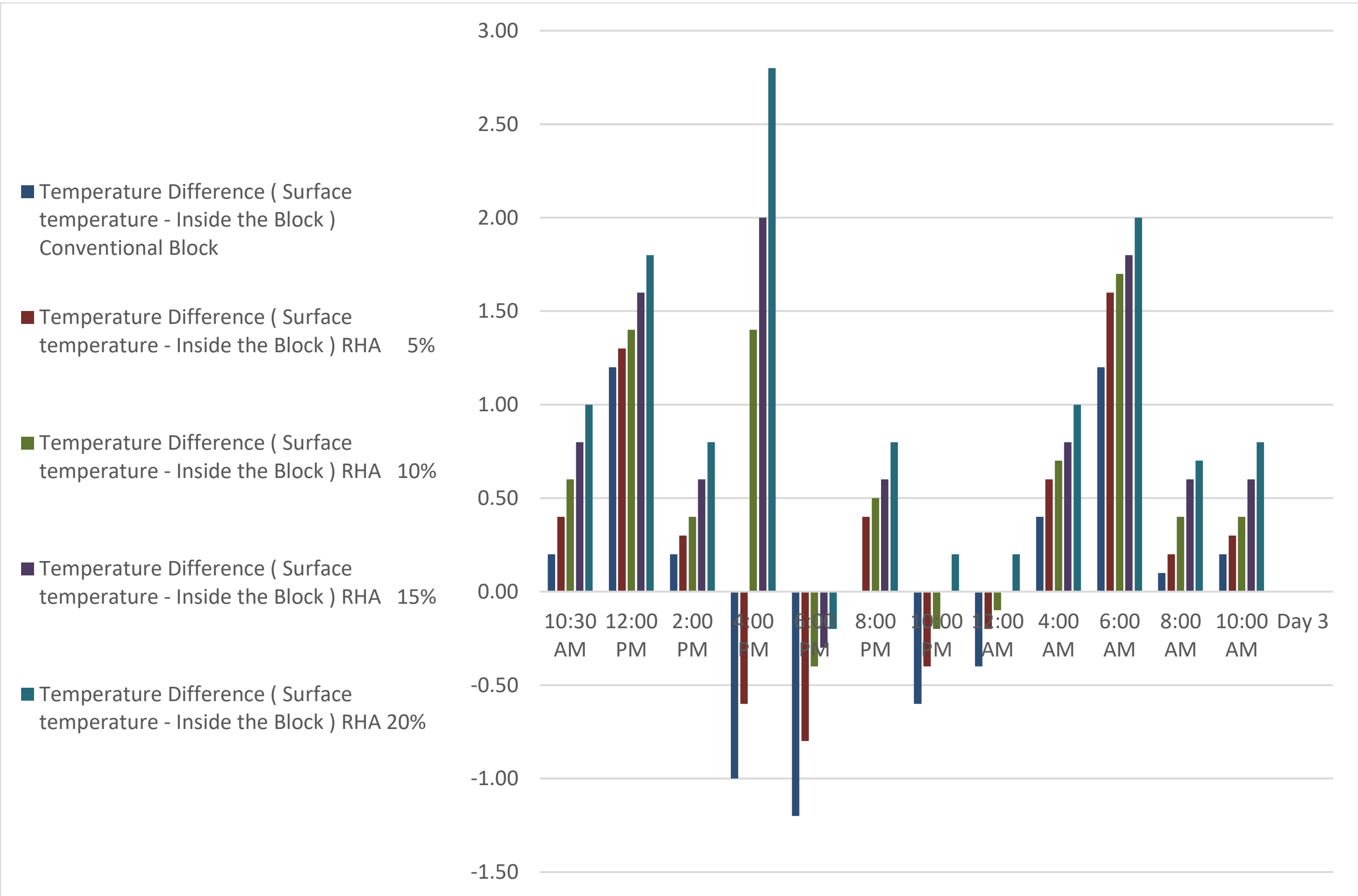
Table 14 – Observations of Day 2

Graph (13)Bellow graph is showing how the internal temperature of five concrete blocks (that is conventional block, 5 % RHA added concrete block, 10 % RHA added concrete block,15 % RHA added concrete block,20 % RHA added concrete block) are change with the external surface temperature for the day 02.

Graph (13) - Time Vs Temperature



Graph (14)Below graph is showing the temperature differences of Surface temperature and inside temperature of specific concrete block for the day 02 (that is conventional block, 5 % RHA added concrete block, 10 % RHA added concrete block,15 % RHA added concrete block,20 % RHA added concrete block)



Graph (14) - Temperature difference Vs Time

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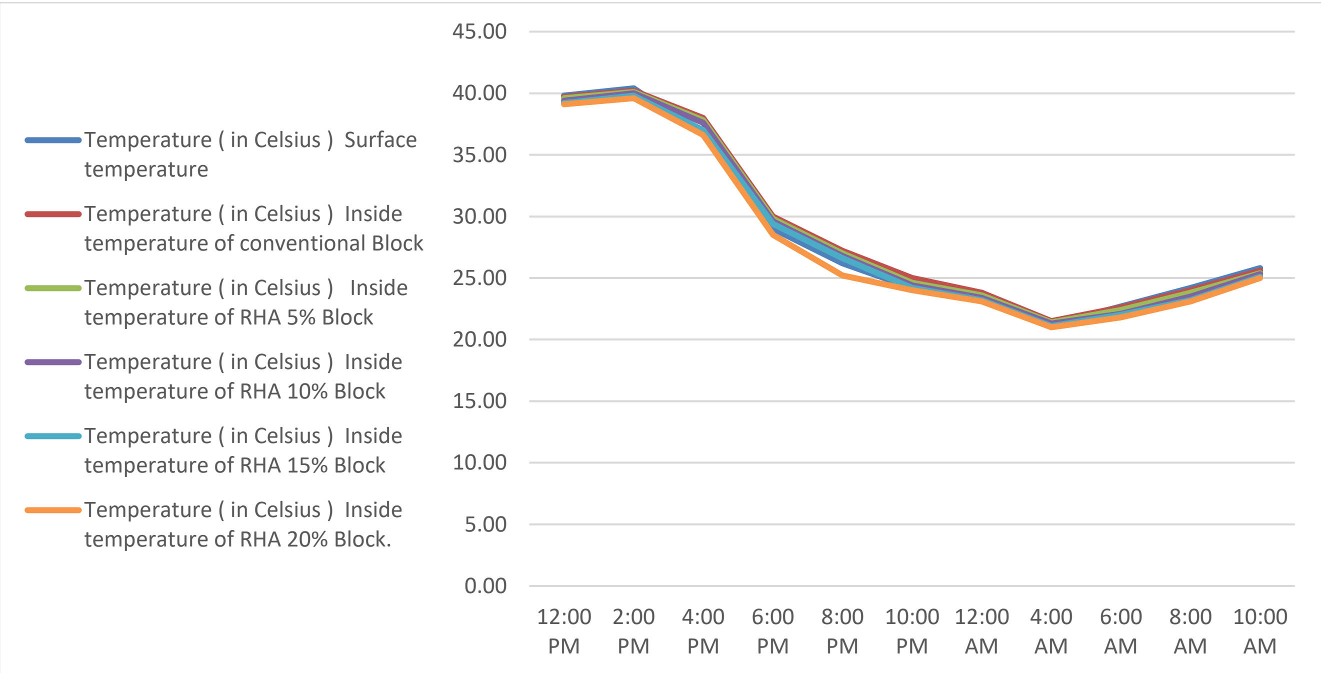
Day 3 (23 / July / 2019)

Time	Temperature (in Celsius)					
	Surface temperature	**Inside temperature of conventional Block**	**Inside temperature of RHA 5% Block**	**Inside temperature of RHA 10% Block**	**Inside temperature of RHA 15% Block**	**Inside temperature of RHA 20% Block.**
12:00 PM	39.80	39.70	39.60	39.40	39.20	39.10
2:00 PM	40.40	40.20	40.10	40.00	39.80	39.60
4:00 PM	36.60	38.00	37.80	37.60	37.00	36.60
6:00 PM	29.00	30.00	29.80	29.60	29.40	28.50
8:00 PM	26.20	27.20	27.00	26.80	26.60	25.20
10:00 PM	24.20	25.00	24.60	24.40	24.20	24.00
12:00 AM	23.80	23.80	23.60	23.40	23.20	23.10
4:00 AM	21.20	21.50	21.40	21.30	21.10	21.00
6:00 AM	22.70	22.60	22.40	22.10	22.00	21.80
8:00 AM	24.20	24.00	23.80	23.50	23.20	23.10
10:00 AM	25.80	25.60	25.40	25.30	25.10	25.00

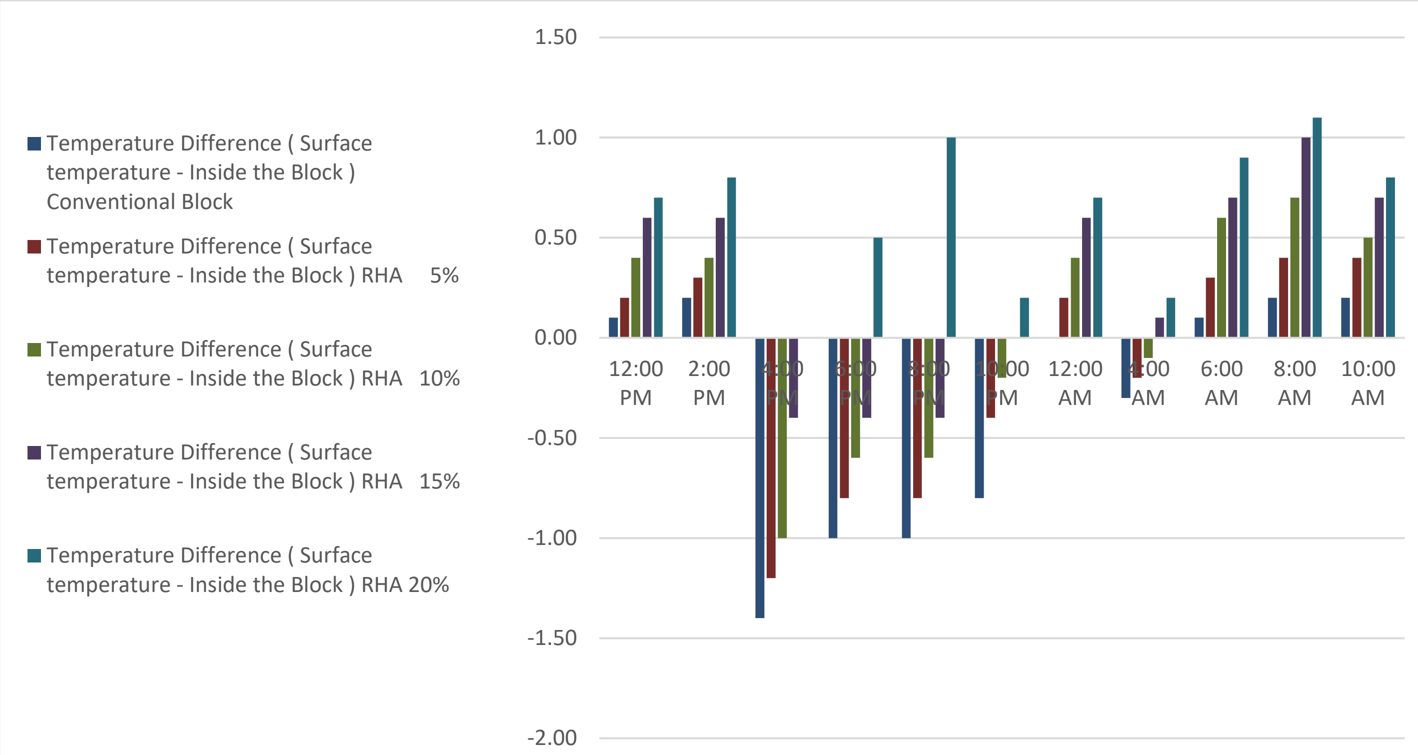
Table 15 – Observations of Day 3

Graph (15)Bellow graph is showing how the internal temperature of five concrete blocks (that is conventional block, 5 % RHA added concrete block, 10 % RHA added concrete block,15 % RHA added concrete block,20 % RHA added concrete block) are change with the external surface temperature for the day 03.



Graph (15)- Time Vs Temperature

Graph (16)Below graph is showing the temperature differences of Surface temperature and inside temperature of specific concrete block for the day 03 (that is conventional block, 5 % RHA added concrete block, 10 % RHA added concrete block,15 % RHA added concrete block,20 % RHA added concrete block)



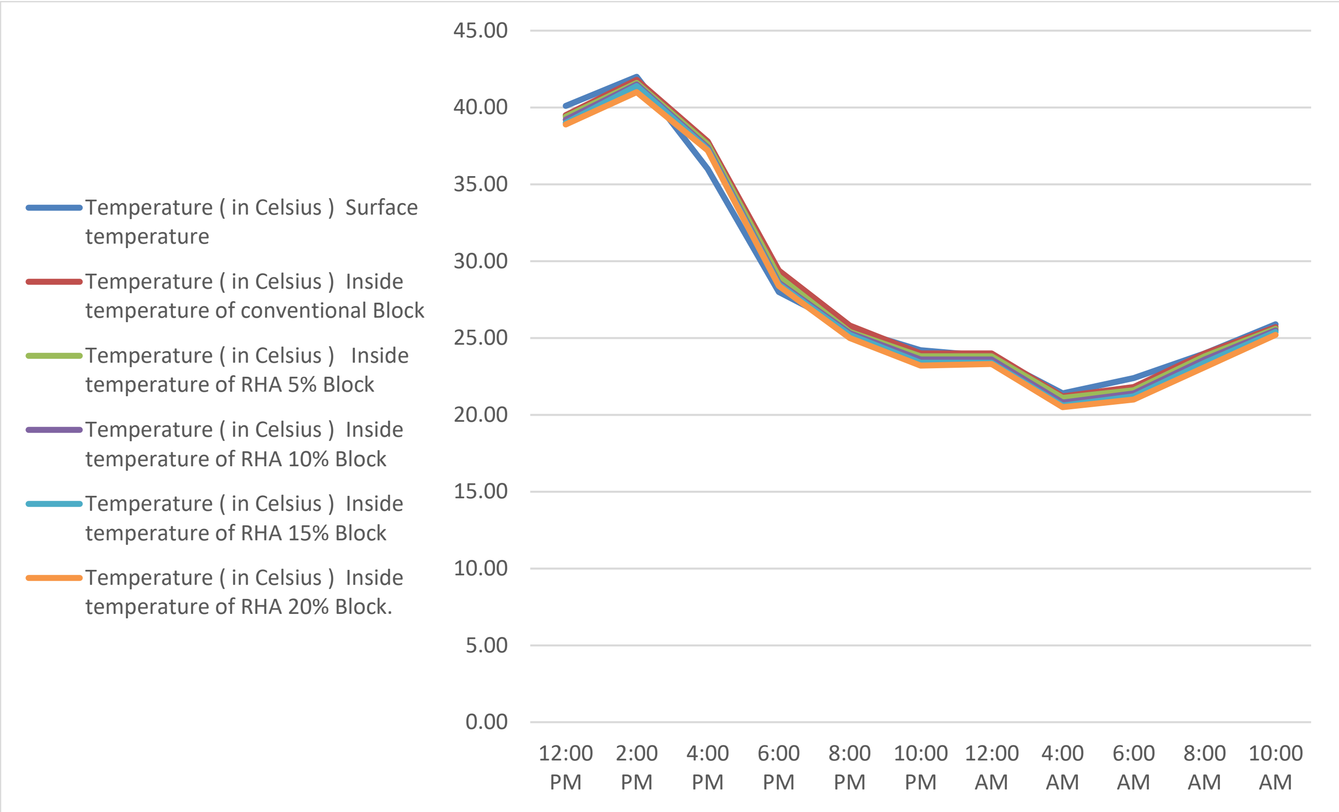
Graph (16) - Temperature difference Vs Time

Day 4 (24 / July / 2019)

Time	Temperature (in Celsius)					
	Surface temperature	**Inside temperature of conventional Block**	**Inside temperature of RHA 5% Block**	**Inside temperature of RHA 10% Block**	**Inside temperature of RHA 15% Block**	**Inside temperature of RHA 20% Block.**
12:00 PM	40.10	39.50	39.40	39.20	39.00	38.90
2:00 PM	42.00	41.80	41.60	41.50	41.40	41.00
4:00 PM	36.00	37.80	37.60	37.40	37.30	37.20
6:00 PM	28.00	29.40	29.00	28.60	28.50	28.40
8:00 PM	25.60	25.80	25.40	25.30	25.20	25.00
10:00 PM	24.20	24.00	23.80	23.60	23.40	23.20
12:00 AM	23.80	24.00	23.80	23.60	23.40	23.30
4:00 AM	21.40	21.20	21.10	20.80	20.60	20.50
6:00 AM	22.40	21.80	21.60	21.40	21.20	21.00
8:00 AM	24.00	24.00	23.80	23.60	23.40	23.10
10:00 AM	25.90	25.70	25.60	25.50	25.40	25.20

Table 16 – Observations of Day 4

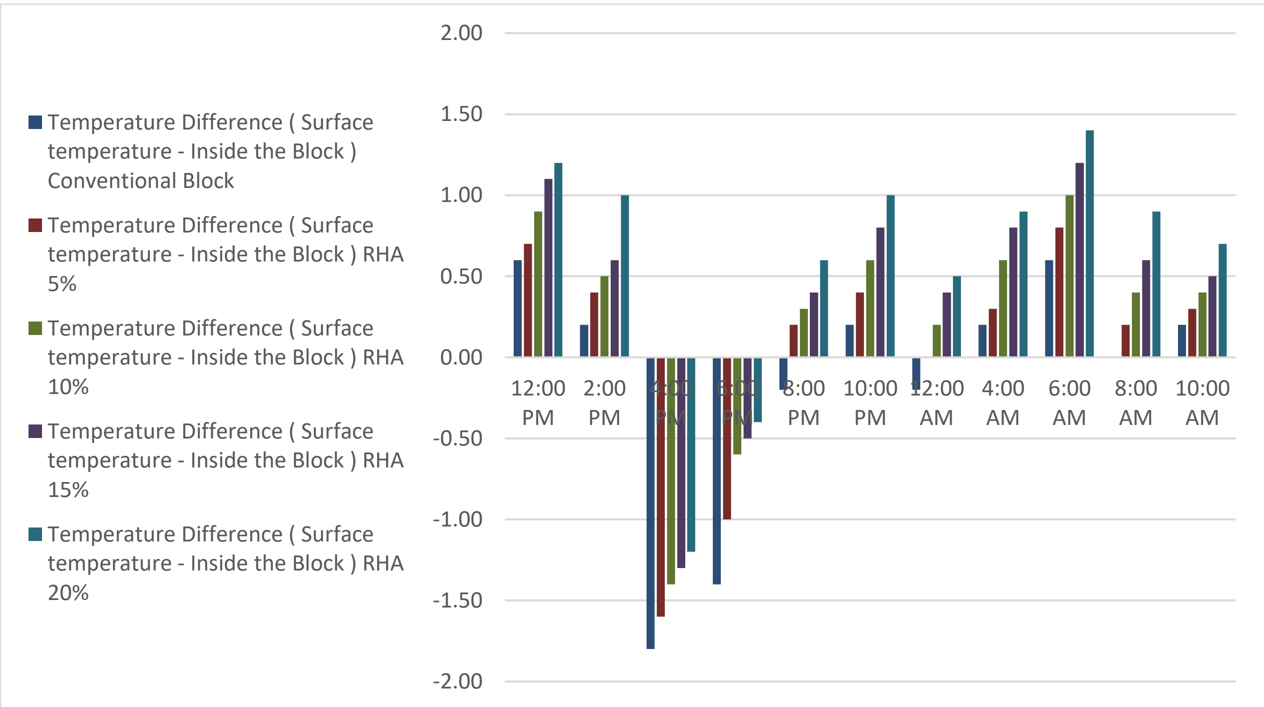
Graph (17)Bellow graph is showing how the internal temperature of five concrete blocks (that is conventional block, 5 % RHA added concrete block, 10 % RHA added concrete block,15 % RHA added concrete block,20 % RHA added concrete block) are change with the external surface temperature for the day 04.



Graph (17) - Time Vs Temperature

Graph (18)

Below graph is showing the temperature differences of Surface temperature and inside temperature of specific concrete block for the day 04 (that is conventional block, 5 % RHA added concrete block, 10 % RHA added concrete block,15 % RHA added concrete block,20 % RHA added concrete block)



Graph (18) - Temperature difference Vs Time

Day 5 (25 / July / 2019)

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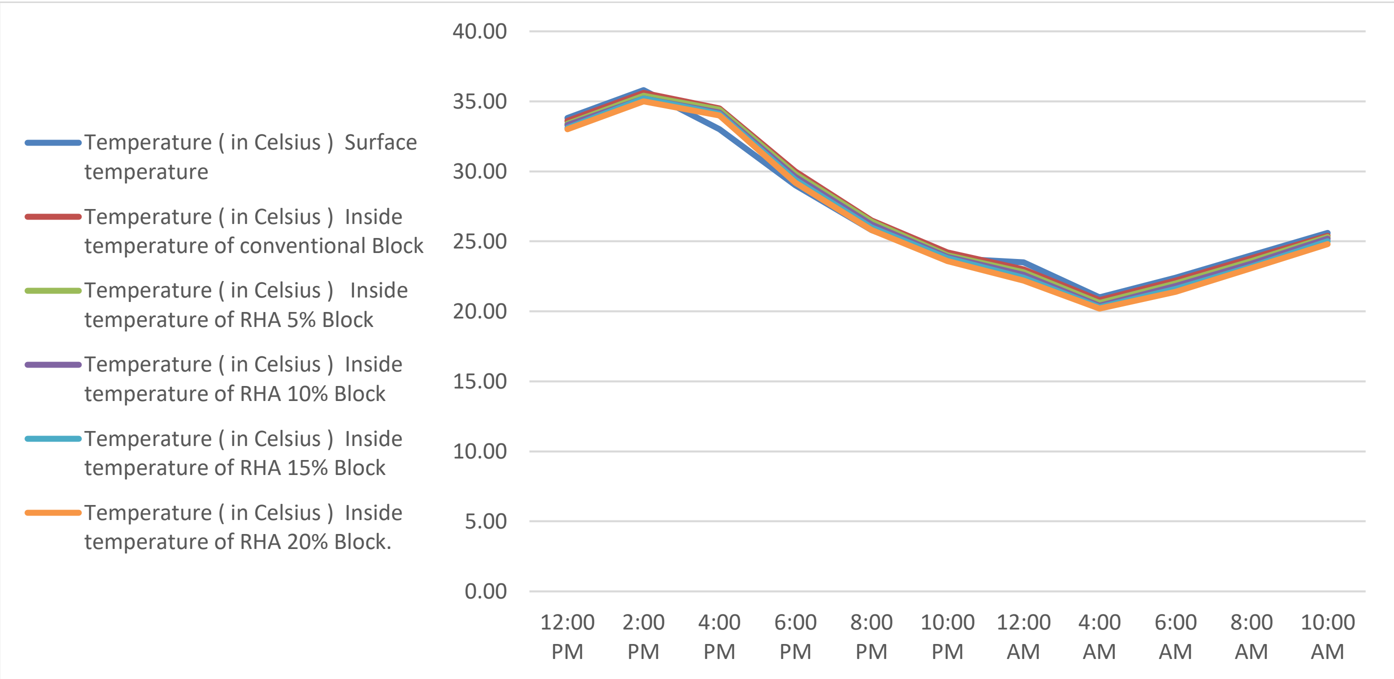
Time	Temperature (in Celsius)					
	Surface temperature	Inside temperature of conventional Block	Inside temperature of RHA 5% Block	Inside temperature of RHA 10% Block	Inside temperature of RHA 15% Block	Inside temperature of RHA 20% Block.
12:00 PM	33.80	33.60	33.40	33.30	33.10	33.00
2:00 PM	35.80	35.60	35.40	35.20	35.20	35.00
4:00 PM	33.00	34.50	34.40	34.20	34.10	34.00
6:00 PM	29.00	30.00	29.80	29.60	29.40	29.20
8:00 PM	25.80	26.50	26.40	26.20	26.00	25.80
10:00 PM	23.80	24.20	24.00	23.90	23.80	23.60
12:00 AM	23.50	23.00	22.80	22.60	22.40	22.20
4:00 AM	21.00	20.80	20.60	20.40	20.30	20.20
6:00 AM	22.40	22.20	22.00	21.80	21.60	21.40
8:00 AM	24.00	23.80	23.60	23.40	23.20	23.10
10:00 AM	25.60	25.40	25.30	25.20	25.00	24.80

Table 17 – Observations of Day 5

Graph (19)Bellow graph is showing how the internal temperature of five concrete blocks (that is conventional block, 5 % RHA added concrete block, 10 % RHA added concrete block,15 % RHA added concrete block,20 % RHA added concrete block) are change with the external surface temperature for the day 05.



Graph (19) - Time Vs Temperature

Graph (20)Below graph is showing the temperature differences of Surface temperature and inside temperature of specific concrete block for the day 05 (that is conventional block, 5 % RHA added concrete block, 10 % RHA added concrete block,15 % RHA added concrete block,20 % RHA added concrete block)

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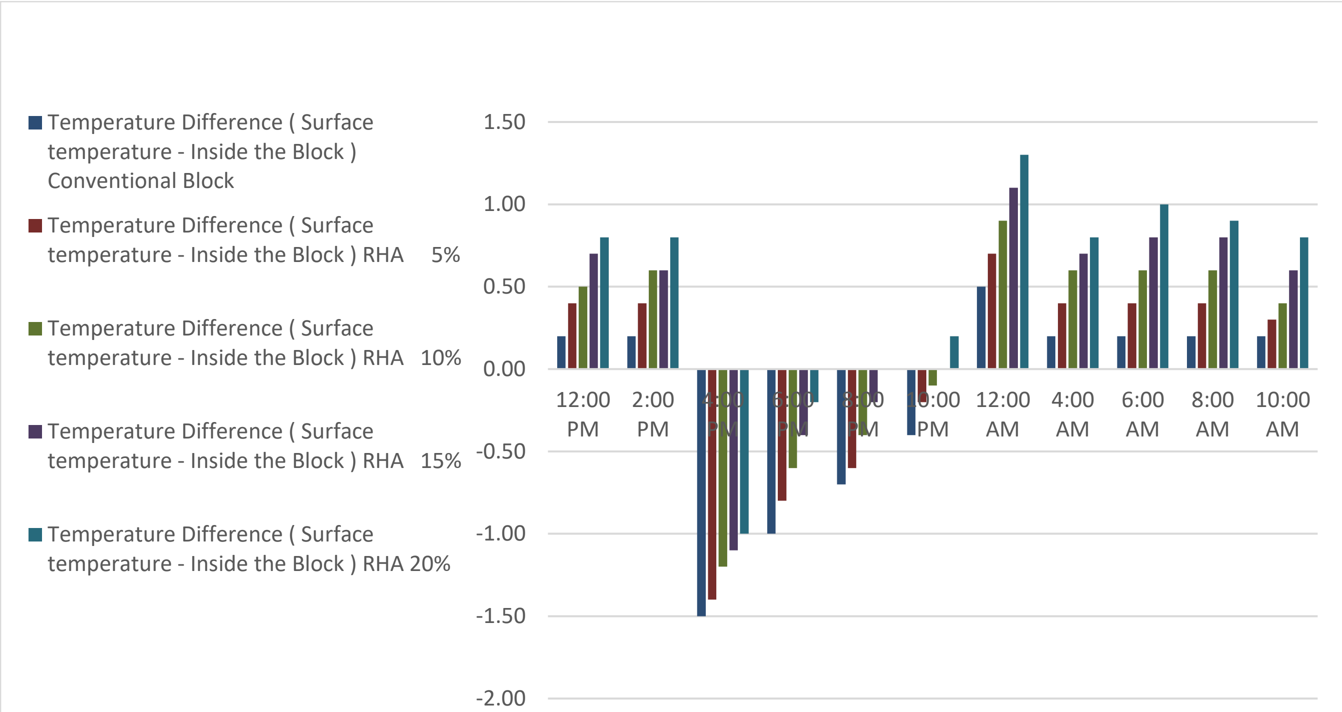

Graph (20) - Temperature difference Vs Time

Day 6 (26 / July / 2019)

Time	**Temperature (in Celsius)**					
Time	**Surface temperature**	**Inside temperature of conventional Block**	**Inside temperature of RHA 5% Block**	**Inside temperature of RHA 10% Block**	**Inside temperature of RHA 15% Block**	**Inside temperature of RHA 20% Block.**
12:00 PM	39.00	38.80	38.60	38.40	38.30	38.20
2:00 PM	40.00	39.80	39.60	39.40	39.20	39.00
4:00 PM	36.40	37.60	37.40	37.20	37.00	36.80
6:00 PM	29.20	32.00	31.80	31.60	31.40	31.20
8:00 PM	26.40	27.00	26.80	26.60	26.40	26.20
10:00 PM	25.00	24.80	24.60	24.40	24.20	24.00
12:00 AM	24.00	23.80	23.60	23.40	23.20	23.00
4:00 AM	21.40	21.20	21.00	20.80	20.60	20.40
6:00 AM	22.00	22.00	21.80	21.60	21.40	21.20
8:00 AM	24.00	23.50	23.40	23.20	23.20	23.00
10:00 AM	25.60	25.40	25.30	25.20	25.10	25.00

Table 18 – Observations of Day 6

Graph (21)Bellow graph is showing how the internal temperature of five concrete blocks (that is conventional block, 5 % RHA added concrete block, 10 % RHA added concrete block,15 % RHA added concrete block,20 % RHA added concrete block) are change with the external surface temperature for the day 06.

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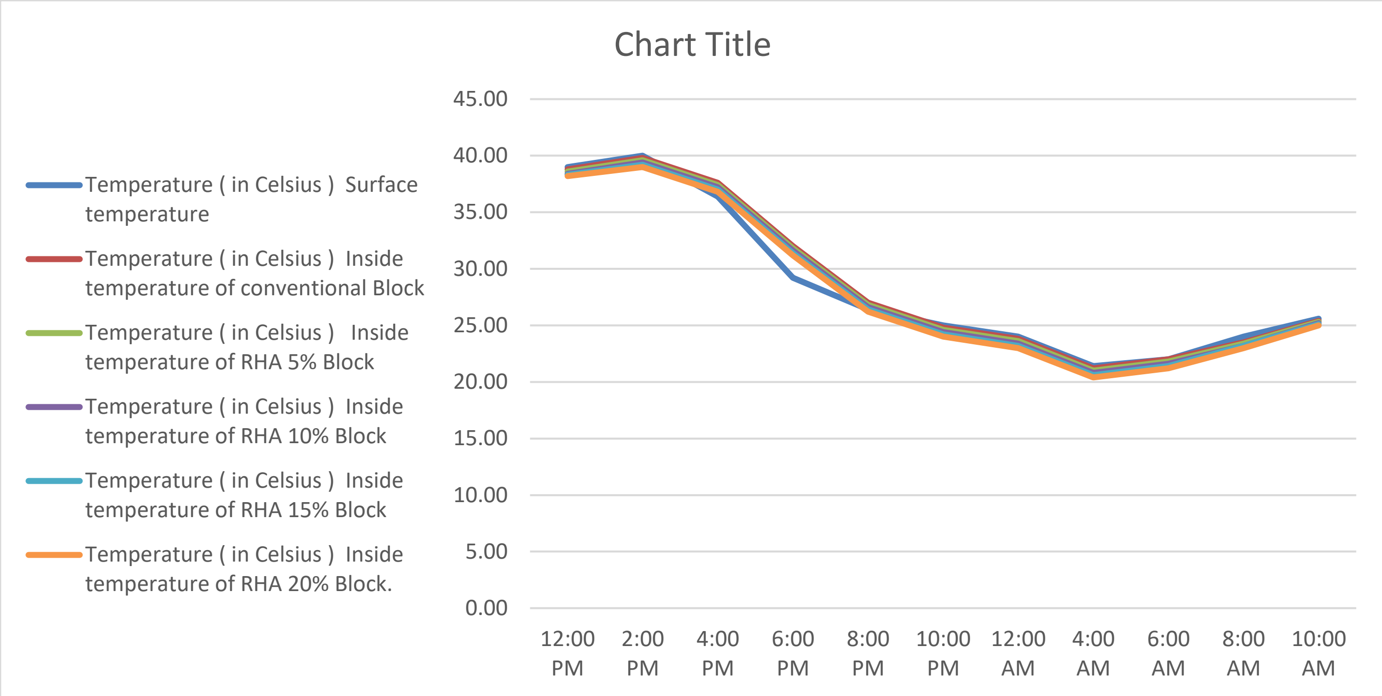
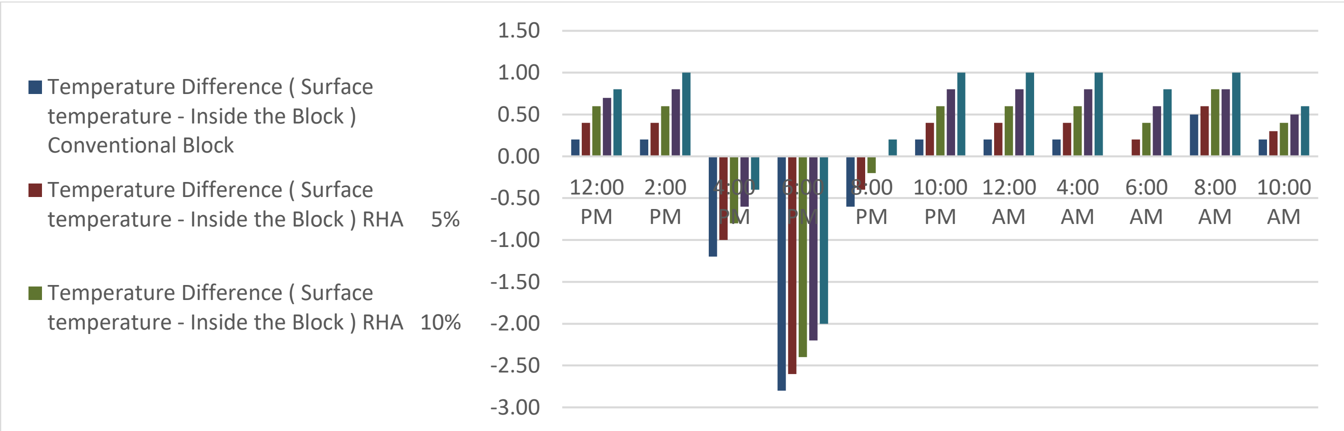


Graph (21) - Time Vs Temperature

Graph (22)Below graph is showing the temperature differences of Surface temperature and inside temperature of specific concrete block for the day 06 (that is conventional block, 5 % RHA added concrete block, 10 % RHA added concrete block,15 % RHA added concrete block,20 % RHA added concrete block)



Graph (22) - Temperature difference Vs Time

Day 7 (27 / July / 2019)

Time	Temperature (in Celsius)					
	Surface temperature	**Inside temperature of conventional Block**	**Inside temperature of RHA 5% Block**	**Inside temperature of RHA 10% Block**	**Inside temperature of RHA 15% Block**	**Inside temperature of RHA 20% Block.**
12:00 PM	39.70	39.60	39.40	39.30	39.00	38.80
2:00 PM	40.00	39.80	39.60	39.40	39.20	39.00
4:00 PM	36.50	37.00	36.80	36.60	36.40	36.00
6:00 PM	29.20	31.00	30.80	30.60	30.40	30.20
8:00 PM	26.00	27.50	27.30	27.40	27.20	27.00

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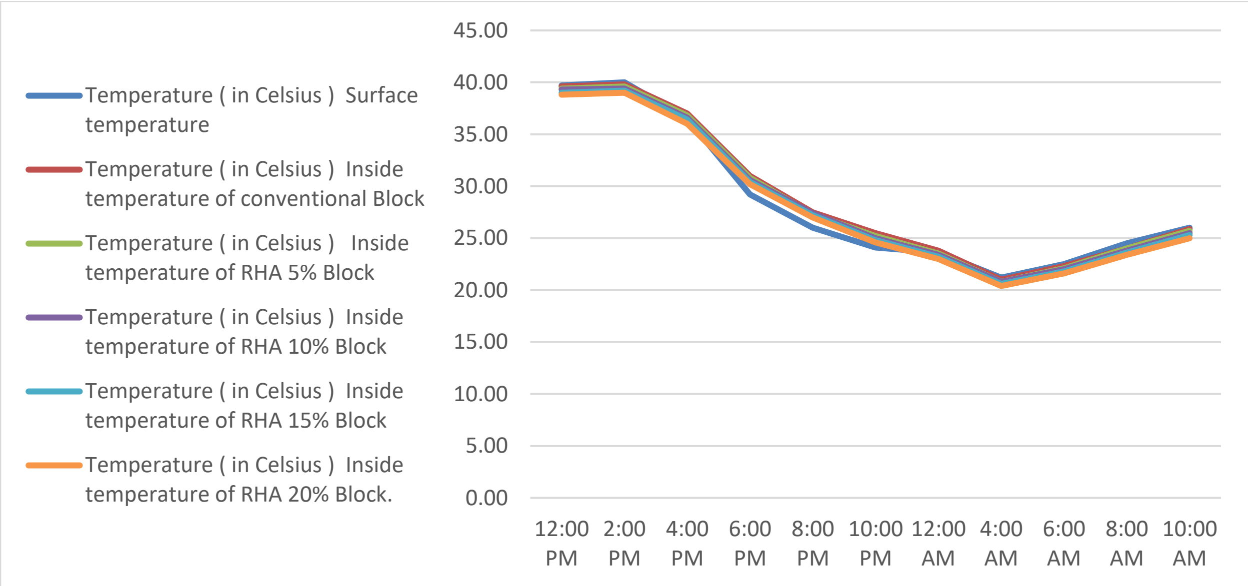
10:00 PM	24.10	25.50	25.20	25.00	24.80	24.60
12:00 AM	23.60	23.80	23.50	23.40	23.20	23.00
4:00 AM	21.20	21.00	20.80	20.80	20.60	20.40
6:00 AM	22.50	22.30	22.10	22.00	21.80	21.60
8:00 AM	24.50	24.00	24.00	23.80	23.60	23.40
10:00 AM	26.00	25.90	25.70	25.50	25.30	25.00

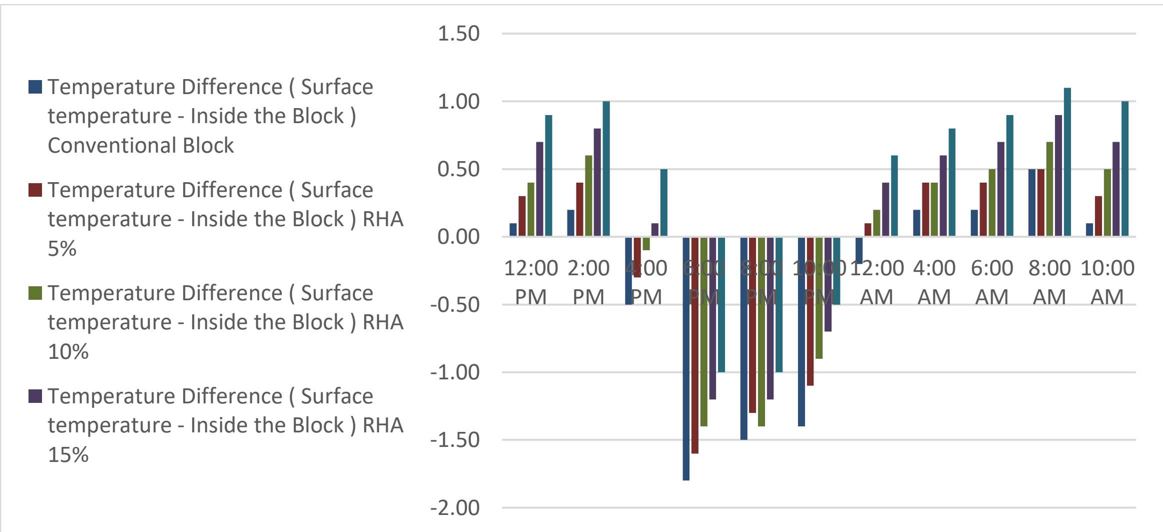
Table 19 – Observations of Day 7

Graph (23)Bellow graph is showing how the internal temperature of five concrete blocks (that is conventional block, 5 % RHA added concrete block, 10 % RHA added concrete block,15 % RHA added concrete block,20 % RHA added concrete block) are change with the external surface temperature for the day 07.



Graph (23) - Time Vs Temperature

Graph (24)Below graph is showing the temperature differences of Surface temperature and inside temperature of specific concrete block for the day 07 (that is conventional block, 5 % RHA added concrete block, 10 % RHA added concrete block,15 % RHA added concrete block,20 % RHA added concrete block)



Graph (24)- Temperature difference Vs Time

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Observations and data analysis of workability of the concrete.

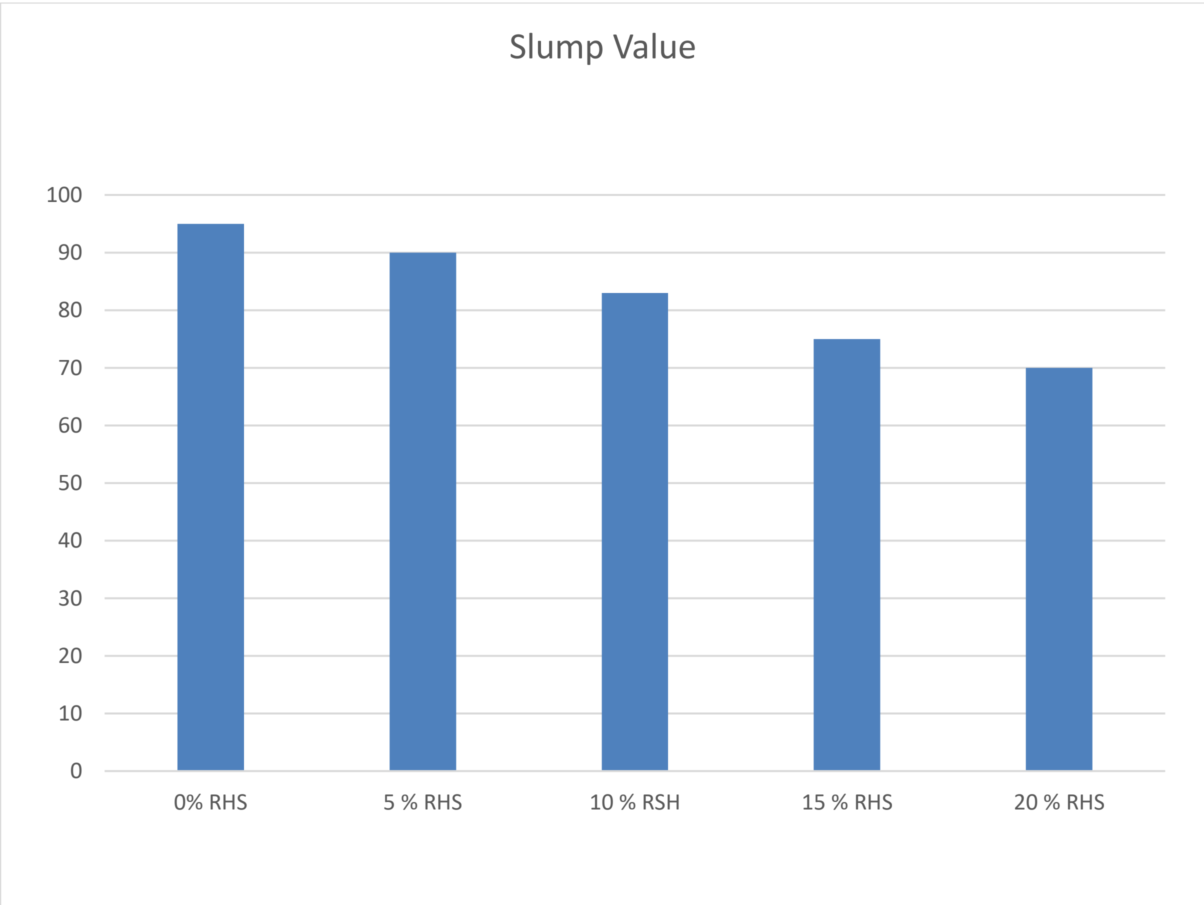
Slump test was proceed to evaluate the workability of the concrete samples and record the data. Recorded date is as below.

Workability of the concrete sample

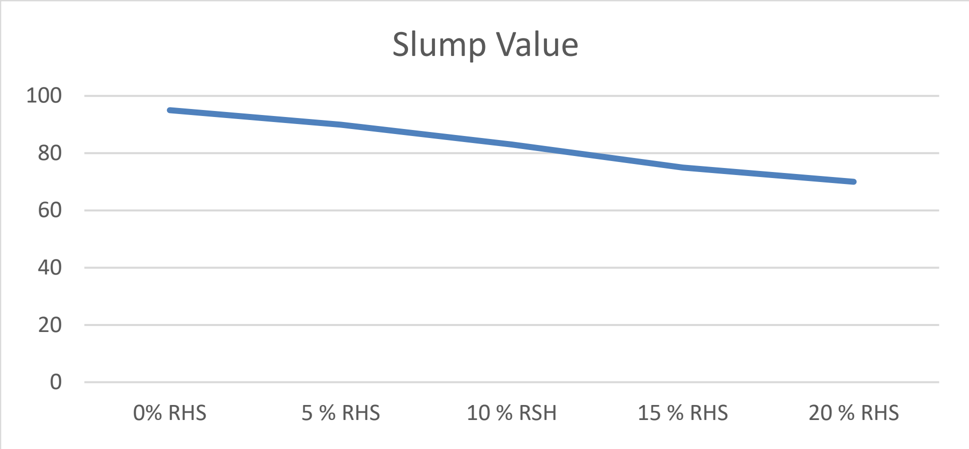
Concrete Samples	**Slump Value**
0% RHS	95
5 % RHS	90
10 % RSH	83
15 % RHS	75
20 % RHS	70

Table 20 – Slump regains of concrete

Following graphs are show the relation between the percentages use of rice husk ash and the slump values.



Graph 25 – Slump value with RHA percentage



Graph 26 - Slump value with RHA percentage

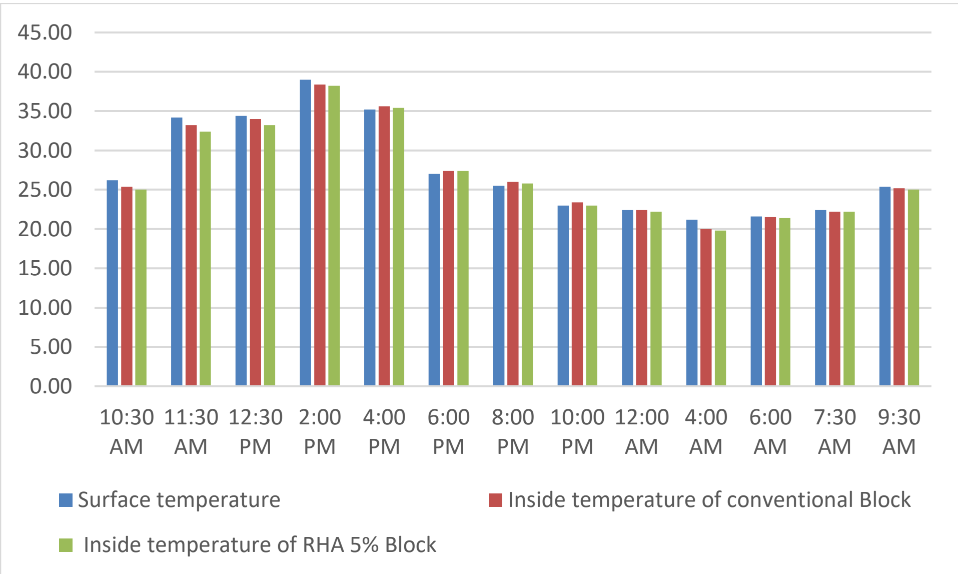
DISCUSSION

Five numbers of concrete cubes were casted with the different parentages of rice husk ash. Percentages of RHA were 0 % for the conventional block, 5% for second one, 10 % for third cube 15 % for fourth cube and 20 % for the last cube. Then cubes were cured 14 days continuously in a curing tank. After taking out the cubes, next day onwards cubes were placed directly exposed to the sunlight and temperature of atmosphere , external surfaces and the internal surfaces of the cubes were measured in a seven days and record the temperatures as above table.

As per the collected data and graphs drawn above, it is clear that internal temperature of the conventional concrete block is slightly higher than the rice husk ash concrete block. Furthermore it was observed that morning 6:00 am to evening 4:00 pm always internal temperatures were less than the surface temperature of the concrete cubes.

After 4:00 pm outside temperature getting decrease and internal temperature of the blocks were higher than the temperature of the external surface.

It was clearly shows from below graphs.



Graph 27 - Summery

As per the most of the cementitious materials change the thermal properties in concrete, the rice husk also change the thermal properties of concrete mixture like thermal conductivity (k), Specific heat capacity (c), thermal diffusivity (□), and also thermal effusivity (□). By observing the results gained from the experiment it is clear the internal temperature of the rice hush ash added concrete change with the internal temperature of the conventional block. When considering the thermal conductivity, it is the measure of the quantity of heat which flows through a material per unit time. Thermal conductivity of many materials is change with its presence of impurities. As well as it can be found as below equation.

This equation is use for calculating thermal conductivity and it is called Fourier's Law for the heat conduction or the equation of thermal conduction.

$$\frac{Q}{t} = \frac{kA\Delta T}{d}$$

- *Q* is the transfer of heat within time *t*
- *k* is the thermal conductivity coefficient of the specific material
- *A* represent the area through which heat is flowing.
- *ΔT* is the temperature difference in between the materials or within the material.
- *d* represent the thickness of the material

As per the above equation, thermal conductivity can find as below equation.

$$k = \frac{Qd}{tA\Delta T}$$

So, it is clear thermal conductivity depends upon the temperature difference, and it is inversely proportional to the temperature difference. When the temperature difference is increasing the thermal conductivity of the material is getting decrease.

So, it is clear that thermal conductivity of the concrete with rice hush ash is getting lower than the conventional concrete sample. So, rice hush ash can be used for the concrete as the cement replacement material to reduce the temperature of the inside of the building. With the increment of rice hush ash percentage continuously reduce the thermal transmittance of the concrete. As per the literature review of this paper compressive strength of the concrete achieved its optimum value for the 15 % of rice husk ash percentage. As well as other properties like Substantial reduction in mass, flexural Strength, water absorption, Moisture movement, Modulus of elasticity also gets its optimum at the 15 % of rice husk ash percentage. So most suitable rice husk percentage is identified as 15% of cement weight.

Slum test was done when mixing and casting of concrete and observation were recorded. When considering the workability it is very much clear the workability is decreasing gradually from 95 mm to 70 mm. so conclusion can made when the workability of concrete reduces with the addition of rice husk ash.

CONCLUSION

- With the addition of RHA thermal conductivity of the concrete with rice hush ash is getting low than the conventional concrete sample.
- The workability of the concrete decreases from 90 mm to 70 mm for the relevant percentages of concrete. That is the addition of rice husk ash reduces the workability of the concrete sample.

- In line with research papers considered as percentages increase, the compressive strengths also increased. However 15 % rice husk ash percentage is seems to be a good fit.
- Water absorption percentage is reducing due to the addition of RHA
- Modulus of elasticity is increasing due to addition of RHA 0% to the 15% after that the
- Modulus of elasticity again getting decrease.
- Standard Consistency with setting time is increasing with the addition of RHA.
- Tensile Strength of Concrete is decrease as the replacement level of rice husk ash is increasing
- Weight density of concrete is reducing by 72-75% due to the addition of RHA. So, RHA added concrete can be used effectively as the light weight concrete for the construction works especially for the structures where the weight of structure is of supreme importance.

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REFERENCES

1. E.B Oyetola and M. Abdullahi, The use of rice husk ash in low cost sandcrete block production, Journal Article / Leonardo Electronic Journal of practice and technology, 08/01/2006, Department of civil engineering federal university of technology P.M.B.65, Minna.
2. S.D Nagrale, Dr Hemant Hajare, R.M Pankaj, Journal Article, Internal journal of internal research, Utilization of rice husk ash, 04/August 2012.
3. Ravende Kishore, V. Bhikshma and P. Jeevana Prakash, Study on strength characteristics of High Strength rice Husk ash concrete published by journal article, 2012.
4. G.L Oyekan and O.M Kamiyo, published by journal of engineering and technology research volume 3(3) pp.88-98, March 2011. A study on the engineering properties of sandcrete blocks produced with rice husk ash blended cement.

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5. Alireza Naji Givi, Suraya Abdul Rashid, Farah Nora A. Aziz, Mohamad Amran Mohd Salleh by journal of American science, the contribution of rice husk ash to the properties of mortar and concrete. On 2010.
6. Ramadhansyah Putra Jaya, Mohd Rosli Hainin, Mohd Haziman Wan Ibrahim, Fadzli Mohamed Nazri, Mohd Fadzil Arshad, Khairunisa Muthusamy published internal journal – Integrate engineering – Vol 10. No. 4 (2018) P, Physical Properties and chemical properties of rice husk ash concrete under sea water. 22 March 2018.
7. Farah Alwani Wan Chik, Badorul Hisham Abu Bakar, Megat Azmi Megat Johari & Ramadhansyah Putra Jaya. Published IJRRAS 8 (1) July 2011 on PROPERTIES OF CONCRETE BLOCK CONTAINING RICE HUSK ASH SUBJECTED TO GIRHA.
8. Aboshio A, Ogork E.N and Balami D.A. Civil Engineering Department of Faculty of technology, Bayero University published, Journal Of Engineering And Technology (J.E.T) Vol. 4. No. 2. August 2009 on rice husk ash as Admixture. In