FORM 2

THE PATENTS ACT, 1970

(39 of 1970)

&

The Patent Rules, 2003

7 **COMPLETE SPECIFICATION**

(See section 10 and rule 13)

TITLE OF THE INVENTION

"A NOVEL COMPOSITION FOR COW DUNG BRICKS WITH GUAR GUM, LIME
14 AND CLAY AND METHOD THEREOF"

We, Amity University, Address: E-27, DEFENCE COLONY, NEW DELHI – 110024, INDIA

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The following specification particularly describes the nature of the invention and the manner in which it is performed:

FIELD OF INVENTION:

This invention generally relates to the field of method for making cow dung bricks, and more particularly relates to a novel composition for cow dung bricks with guar gum, lime and clay and method thereof.

BACKGROUND OF THE INVENTION

In the present invention, unique sustainable materials cow dung bricks are introduced made with available plant products like guar gum and lime in a suitable proportion. In earlier pieces of literature, many trials are done to make novel cow dung bricks but due to porosity and microstructures issues, desired results are awaited. To overcome these issues guar gum, and clay is amalgamated in the whole process. Various tests are conducted to evaluate the engineering properties of the new material.

There are few references are made for the present invention, which is given below:

Title: Strength and Durability Properties of Cow Dung Stabilised Earth Brick (https://core.ac.uk/download/pdf/234677669.pdf) disclosing a better compressive strength at the dry state and after 10 minutes of immersion in water was obtained with cow dung stabilisation at content of 20% by weight of earth. Bricks stabilised with 20% Cow dung contents by weight of earth has a dry and wet compressive strength of 6.64 and 2.27MPa respectively. There is an increase of about 25% in the dry compressive strength of bricks stabilised with 20% cow dung content over that of the plain earth brick without stabiliser The 20% cow dung content resulted in lower migration of water into the brick (i.e., lower permeability). Also, the abrasive resistance increased with increase in the cow dung content up to 20%. The highly decreased in compressive strength after 10 minutes of immersion in water, even with optimum Cow dung content, indicated that appropriate building design that would prevent stabilised earth bricks from coming into direct contact with rainwater is important. The study recommends that appropriate

construction specification is necessary to prevent cow dung stabilised earth bricks from coming into any prolonged direct contact with rainwater.

Title: Effect of Cowdung and Coir in Strengthening of Clay Bricks (https://www.sciencedirect.com/science/article/abs/pii/S138589472204356X) which are the core material in building construction are made from clay, which is processed either by sundried or burnt. Coir is a abundantly available natural fiber and is extracted from the husk of coconut fruit. In the work, coir is used to act as reinforcement in the ratios, 5% and 10%. Mixing cowdung to clay improves plasticity, reduces green breakage, and act as internal fuel in fire bricks thereby reducing firing cracks. The various ratios of cowdung used are, 5%, 10%, 15%, 20%, 25%. In good brick material a small quantity of brick not exceeding 5% is desirable. Lime prevents shrinkage of raw bricks.

Title: Vedic External and Internal Plaster (http://www.ijirset.com/upload/2020/april/74_Vedic_NC.PDF) which focus on the study alternation of regular plastering by using Cow Dung Gypsum and Lime is fully replacement for cement in the Plaster. Normally Cow Dung is required much more water content. Gypsum is used to reduce the setting time of the plaster. Now a day the modern construction materials and technologies were well developed. In spite-of quality of materials and availability of materials is less and economically very high. So, in this scenario in our project, we must choose an economically low as it is possible materials like Cow Dung and Lime. These materials are used alternative by cement. We hope that these materials are good quality and durability. Specialty of our project is Self-curing Plaster to prevent cracks in Plaster. Cow Dung has normally collected the more amount of water when we are mixing the ingredients. After applying the finishing process the water will slowly react with the Plaster. The lime has also same property to store the water then it's released when water is required for Plaster. The target will be to obtain light weight samples with better thermal performance which can contribute to improve

the thermal comfort in traditional construction. The major effect of cow dung addition is a significant improvement in the water resistance of adobe which leads to the conclusion that adobes stabilized by cow dung are suitable as building materials in wet climate.

Cow dung bricks are light in weight as compared to normal red bricks and fly ash bricks which can be helpful in construction for seismic zones. Cow dung brick have more heat insulating properties as compared to normal red brick and fly ash brick and act as coolant for room. Layers formed by the help of fibers resist maximum heat present outside and tries to maintain temperature of brick constant so that in winter warmness and in summer coolness will remain inside room. Water absorption capacity of cow dung brick is less as compared to normal red brick and fly ash brick which shows that cow dung brick has less voids present inside them due to layer formation as seen in earlier studies. Cow dung brick have capacity to withstand in rainy season as other bricks can, due to its less volumetric change expansion and contraction will be near to normal red brick and fly ash brick. Efflorescence test shows that cow dung brick has 'slight' chances of reacting with salt as normal red brick is showing in the experiment but in fly ash brick efflorescence has not been seen. By performing compressive strength test, water absorption test and efflorescence test over cow dung brick it has been seen that results are satisfactory according to other bricks. Cost analysis of cow dung brick has been done with respect to red brick and fly ash brick and found that cow dung brick is cheap than red brick and same as fly ash brick cost.

Accordingly, there remains a need in the prior art to provide a novel composition for cow dung bricks with guar gum, lime and clay and method thereof. Therefore, it would be useful and desirable to have an improved technique and method with better synergistic effects and efficacy to meet the above-mentioned needs, therefore overcome the aforesaid problem and shortcomings.

SUMMARY OF THE INVENTION:

In the view of the foregoing disadvantages inherent in the known types of conventional brick preparation methods and techniques, are now present in the prior art, the present invention discloses a novel composition for cow dung bricks with guar gum, lime and clay and method thereof, which has all the advantages of the prior art and none of the disadvantages.

In an important aspect of the present invention, the cow dung bricks mixed with just 5% guar gum and 10% lime produced a water absorption value of 18% and compressive strength of nearly 14 MPa with almost zero efflorescence, which is quite surprising then earlier made cow dung bricks. On performing microstructural analysis very few micro-cracks are found with improved grain size, and enhanced porosity and swell strength making them a sustainable material. The investigations reveal that with the addition of guar gum and lime resulted in packing voids in cow dung bricks giving improved water absorption capacity along with higher strength which helps in achieving better performance quality parameters for cow dung bricks with sustainable materials. The addition of sand, citric acid, and clay is further making the composite mass a well-packed material for still better shape, easy dryness, and enlarged size.

Total volume of the mould materials is 3200grams

(220mmx105mmx75mm size of mould taken)

1. Cow dung -- (75% of this) (2400gm)
2. Lime --- (10%) (320 gram)
3. Gypsum (3%) (96gram)
4. Citric acid powder (lemon juice or powder)(0.5%) (16gram)
5. Guar gum powder (1.5%) (48gram)
6. Sand (5%). (160 gram)
7. Clay (5%) (160gram)

In this respect, before explaining at least one object of the invention in detail, it is to be understood that the invention is not limited in its application to the details of set of rules and to the arrangements of the various models set forth in the following description or illustrated in the drawings. The invention is capable of other objects and of being practiced and carried out in various ways, according to the need of that industry. Also, it is to be understood that the phraseology and terminology employed herein are for the purpose of description and should not be regarded as limiting.

These together with other objects of the invention, along with the various features of novelty which characterize the invention, are pointed out with particularity in the disclosure. For a better understanding of the invention, its operating advantages and the specific objects attained by its uses, reference should be made to the accompanying drawings and descriptive matter in which there are illustrated preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and objects other than those set forth above will become apparent when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawings wherein:

Figure 1 illustrates a hand mixing for preparing cow dunk bricks;

Figure 2 illustrates putting prepared materials in moulds for preparing cow dunk bricks;

Figure 3 illustrates fresh molded bricks for preparing cow dunk bricks;

Figure 4 illustrates sun dried bricks associated with present invention;

Figure 5 illustrates samples for testing the prepared cow dunk bricks;

Figure 6 illustrates compressive testing of prepared cow dunk bricks;

Figure 7 illustrates sample for water absorption test of prepared cow dunk bricks;

Figure 8 illustrates testing for efflorescence for prepared cow dunk bricks; and

Figure 9 illustrates cost analysis for the prepared cow dunk bricks, in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

In the following detailed description, reference is made to the accompanying drawings which form a part thereof, and in which is shown by way of illustration specific embodiments in which the invention may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the invention, and it is to be understood that the embodiments may be combined, or that other embodiments may be utilized and that structural and logical changes may be made without departing from the spirit and scope of the present invention. The following detailed description is, therefore, not to be taken in a limiting sense, and the scope of the present invention is defined by the appended claims and their equivalents.

The present invention describes a novel composition for cow dung bricks with guar gum, lime and clay and method thereof.

Best mode of the present invention to enable the person ordinarily skilled in the art

In accordance with various preferred embodiments of the present invention, the cow dung bricks mixed with just 5% guar gum and 10% lime produced a water absorption value of 18% and compressive strength of nearly 14 MPa with almost zero efflorescence, which is quite surprising then earlier made cow dung bricks. On performing microstructural analysis very few micro-cracks are found with improved grain size, and enhanced porosity and swell strength making them a sustainable material. The investigations reveal that with the addition of guar gum and lime resulted in packing voids in cow dung bricks giving improved water absorption capacity along with higher strength which helps in achieving better performance quality parameters for cow dung bricks with sustainable materials. The addition of sand, citric acid, and clay is further making the composite mass

a well-packed material for still better shape, easy dryness, and enlarged size.

METHOD

Referring to **Table 1**, The cow dung taken has these properties.

Table 1: Cow dung properties.

Properties	**Cattle manure**
Bulk density (kg/m^3)	750
Moisture content (%)	58.30
Water holding capacity (g water/g dry sample)	3.00
Porosity (%)	41.57
pH	8.1
Total organic matter	31.3
Total nitrogen	0.93
Total phosphorus	0.21
Total potassium	0.17
C/N Ratio	19.53:1

- Lime taken – if more than 5% lime taken, then bricks formation becomes tough task, they break and do not join.
- Citric acid – providing workability to make bricks with ease.
- Guar gum—gives (1.5%) gives water absorption and grease repulsive property.
- Sand—passing 300mm sieve is taken.
- Drying –for 12 days in sunlight

Working Procedure

Referring to **Table 2, 3, 4, 5, 6, 7 and 8**, 2400 cow dung is added with 16-gram citric acid and 320-gram lime and mixed thoroughly for about 20 minutes. This mixture is hand pressed and mixed in a large plate or bowl (**as shown in Figure 1**). Then 48 grams guar gum is added from top with hand as topping. This is evenly mixed with no added water at all. Now 96 grams gypsum is evenly sprayed with hands on the surface of the materials. This material is mixed thoroughly for

consistency. This mass is now taken over with 160 grams of clay evenly sprayed and then mixed for extra moisture absorption. Mould shape – cuboids' (internal size=230x110x90mm).

Referring to **Figure 2**, the materials is taken in mould, and pressed with hand pressure to fill thoroughly and dropped for settling at bottom. Trowel pressing is done for smooth surface and even surface is produced by lifting and dropping the brick a few times inside the mould. After this the molded brick is laid in sunlight for 12-15 days for proper drying and regular turning up and down (**as shown in Figure 3**). This shall be avoided with bright sunlight drying to get rid of warping or surface cracks. Cloudy or moist days can take longer drying (**as shown in Figure 4**). Cow dung bricks are kept for 24 hours immersed into water and then cleaned with cloth for moisture. Then applied with mortar (one part cement and one part sand) and tested under compression testing machine (**as shown in Figure 5 and Figure 6**).

Table 2: Compressive strength values.

Sample	**Cow dung bricks**
Sample 1	12.78
Sample 2	13.14
Sample 3	14.05
Sample 4	13.43
Sample 5	13.27

Table 3: Water absorption as observed in lab for cow dung bricks (**as shown in Figure 7**).

Sample	**Dry weight (kg)**	**Wet weight (kg)**	**Water absorption (%)**
Sample 1	0.636	0.752	18.24

Sample 2	0.630	0.741	17.56
Sample 3	0.692	0.811	17.20
Sample 4	0.634	0.752	18.63
Sample 5	0.554	0.654	18.05

Table 4: Water absorption percentage (%).

Sample	**Cow dung bricks**
Sample 1	18.24
Sample 2	17.56
Sample 3	17.20
Sample 4	18.63
Sample 5	18.05

Table 5: Efflorescence test results (**as shown in Figure 8**).

Sample	**Cow dung bricks**
Sample 1	NIL
Sample 2	NIL
Sample 3	NIL
Sample 4	SLIGHT
Sample 5	NIL

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Table 6: Sample Description-Cow Dung Bricks Is- 3495 (Part 1,2 &3):1992 (Ra :2019)

S.no.	Sample description	Surface area of bricks (cm^2)	Load (KN)	Compressive strength (MPa)	Average compressive strength (MPa)
1	Cow dung bricks-1	191.10	244.4	12.78	13.33
2	Cow dung bricks-2	190.19	250.0	13.14	
3	Cow dung bricks-3	189.00	265.7	14.05	
4	Cow dung bricks-4	187.79	252.3	13.43	
5	Cow dung bricks-5	191.10	253.7	13.27	

S.no.	Sample description	Efflorescence test result	Water absorption (%)	Avg.water absorption
1	Cow dung bricks-1	NIL	18.24	17.93
2	Cow dung bricks-2	NIL	17.56	
3	Cow dung bricks-3	NIL	17.20	
4	Cow dung bricks-4	SLIGHT	18.63	
5	Cow dung bricks-5	NIL	18.05	

Table 7: Sample Description-Fly Ash Bricks IS- 3495 (PART 1,2 &3):1992 (RA :2019)

S.no.	Sample description	Surface area of bricks (cm^2)	Load (KN)	Compressive strength (MPa)	Average compressive strength (MPa)
1	Fly ash bricks-1	189.00	193.0	10.21	10.20
2	Fly ash bricks-2	189.90	204.0	10.74	
3	Fly ash bricks-3	191.10	208.9	10.93	
4	Fly ash bricks-4	190.80	177.1	9.28	
5	Fly ash bricks-5	186.90	185.5	9.92	

S.no.	Sample description	Efflorescence test result	Water absorption (%)	Avg.water absorption
1	Fly ash bricks-1	NIL	22.56	22.02
2	Fly ash bricks-2	NIL	22.14	
3	Fly ash bricks-3	NIL	22.82	
4	Fly ash bricks-4	NIL	20.75	
5	Fly ash bricks-5	NIL	21.86	

Table 8: Sample Description-Fly ash bricks IS- 3495 (PART 1,2 &3):1992 (RA :2019)

S. no.	Sample description	Surface area of bricks (cm^2)	Load (KN)	Compressive strength (MPa)	Average compressive strength (MPa)
1	Burnt clay	231.00	209.3	9.06	

	bricks				
2	Burnt clay bricks	232.05	188.7	8.13	9.21
3	Burnt clay bricks	231.00	205.6	8.90	
4	Burnt clay bricks	233.20	231.2	9.91	
5	Burnt clay bricks	232.05	233.7	10.07	

S.no.	**Sample description**	**Efflorescence test result**	**Water absorption (%)**	**Avg.water absorption**
1	Burnt clay bricks	NIL	20.57	21.40
2	Burnt clay bricks	SLIGHT	22.10	
3	Burnt clay bricks	NIL	21.63	
4	Burnt clay bricks	NIL	21.78	
5	Burnt clay bricks	NIL	20.95	

COST ANALYSIS

Referring to **Figure 9**, graphical representation associated with cost analysis of prepared cow dung bricks.

COST FACTORS FOR COW DUNG BRICKS

7 Cow dung, lime, clay, citric acid powder, guar gum powder, gypsum, sand.

COST FACTORS FOR RED CLAY BRICKS

Clay, sand, water.

COST FACTORS FOR FLY ASH BRICKS

Fly ash, cement, sand, water**.**

CALCULATION FOR MAKING 1000 BRICKS

Cow dung brick

Material cost:

Per cow dung brick weight 2.5kg in wet condition

For 1000 brick we need=2.5*1000= 2500kg

Per meter cube weight of cow dung= 750kg/m^3

We need cow dung in meter cube= 2500/750=3.33m^3*35.29=117.50ft^3

Cow dung- 75%=a trolley contains 200ft^3 and rate of trolley is 2000rs=2000/200=10 rs per ft^3

Rate of cow dung=117.5*10=**1175rs**

Lime 10%= rate of lime for 1 ton weight=3500rs/1000=3.5rs per kg

Wet lime weights 300gm which is 2.25 times less than dry lime=300/2.25=133.33gm for one brick.

For 1000 bricks=133.33*1000/1000=133.33kg*3.5=**466.65rs**

Clay 5%=approximate **100rs** (cost is negligible)

Citric acid 0.5%= rate is 50rs per kg and for one brick=1.53gm is needed

For 1000 bricks=1.53*1000/1000=1.53kg*50=**76.5rs**

Guar gum powder 1.5%= rate is 120rs per kg and for one brick=4.5gm is needed.

For 1000 bricks=4.5*1000/1000=4.5kg*120=**540rs**

Gypsum 3%= rate is 300rs per bag of 25kg=300/25=12rs per kg and for one brick=8gm is needed.

For 1000 bricks=8*1000/1000=8kg*12=**96rs**

Sand 5%= approximate **100rs** (cost is negligible)

Labor cost:

Mixing of brick material=1men*300=**300rs**

One labour can mould=750 bricks in a day

Moulding of brick=1.5men*300=**450rs**

Stacking of brick=1men*300=**300rs**

Equipment cost:

Mixing cost in equipment= consider **100rs**

Red Brick

7 *Material cost:*

Clay price for one trolley=800rs=200ft^3/35.29=5.66m^3

Per meter cube=500 bricks so=500*2=1000bricks

Per meter cube rate of clay=800/5.66=142rs*2*0.75=**213rs**

Water 25-30%= consider **200rs**

Sand for moulding purpose= consider **100rs**

Coal for fuel purpose=4236 kg is needed for drying

14 37750bricks=4236*1000/37750=112gm per brick

Cost of hard coal (anthracite)= 12600rs per 1 ton= 12.6rs per kg*0.112*1000bricks= **1411rs**

Labour cost:

Digging of 2m^3 clay=2*35.29=70.58ft^3*6rs per ft^3=**423.5rs**

Cleaning of clay=1 men*300rs=**300rs**

Weathering and blending (spreading) of clay=1 men*300rs=**300rs**

21 Tempering of clay= consider **100rs**

Moulding of bricks=1.5men*300=**450rs**

Drying of bricks=1men*300=**300rs**

Burning of bricks (loading and unloading of bricks) = 1.5men*300= **450rs**

Equipment cost:

Rent of kiln= consider **100rs**

Mixing cost= consider **100rs**

Fly Ash Bricks

Material cost:

Fly ash 60%= 9000rs per 17m^3=9000/17=529.5rs per m^3*2*0.6= **635.40rs**

Sand 30%=13000rs per 17m^3=13000/17=764.70rs*0.3= **229.40rs**

Cement 10%=1440kg per m^3*2= 2880*0.10=288kg/50= 5.76bag*300rs per bag= **1728rs**

Labour cost:

Mixing of brick material=1men*300= **300rs**

One labour can mould=750 bricks in a day

Moulding of brick=1.5men*300= **450rs**

Stacking of brick=1men*300= **300rs**

Equipment cost:

Mixing cost in equipment= consider **100rs**

Table 9. Analysis of rate of all bricks.

Items	**Cow dung brick (Rs)**	**Red brick (Rs)**	**Fly ash brick (Rs)**
Material cost	2554	1924	2760
Labour cost	1050	2023	1050
Equipment cost	100	200	100
Total cost	3704	4147	3742

Cost of 1000 cost of cow dung bricks is nearer to fly ash bricks but less than red bricks that is a good indicator for a healthy environment and a best way of saving the soil and helping in disposing the waste material by a proper way.

It is to be understood that the above description is intended to be illustrative, and not restrictive. For example, the above-discussed embodiments may be used in combination with each other. Many other embodiments will be apparent to those of skill in the art upon reviewing the above description.

The benefits and advantages which may be provided by the present invention have been described above with regard to specific embodiments. These benefits and advantages, and any elements or limitations that may cause them to occur or to become more pronounced are not to be construed as critical, required, or essential features of any or all of the embodiments.

The foregoing examples are but a few of the total possible formulations which may be developed using the basic ingredients and it should be understood the recitation of these compositions is not intended to limit in any way the scope of this invention.

While the present invention has been described with reference to particular embodiments, it should be understood that the embodiments are illustrative and that the scope of the invention is not limited to these embodiments. Many variations, modifications, additions and improvements to the embodiments described above are possible. It is contemplated that these variations, modifications, additions and improvements fall within the scope of the invention.

We Claim:

1. A method for manufacturing cow dung bricks comprising the steps of:

    a) A step of mixing cow dung, citric acid, and lime to create a homogeneous mixture;

    b) Adding guar gum and gypsum evenly to the mixture;

    c) Incorporating clay into the mixture to enhance moisture absorption;

    d) Forming the mixture into desired brick shapes;

    e) Drying the formed bricks in sunlight for a specific duration; and

    f) Testing the dried bricks for properties, including compressive strength and water absorption.

2. The method as claimed in claim 1, wherein the cow dung comprises cattle manure with the following properties: a) Bulk density in the range of 745-750 kg/m^3; b) Moisture content in the range of 55.00%-58.30%; c) Porosity in the range of 40.00%-41.57%; d) pH level in the range of 8.0-8.1; e) Total organic matter content in the range of 30.00%-31.3%; f) Total nitrogen content in the range of 0.80%-0.93%; g) Total phosphorus content in the range of 0.20%-0.21%; and h) Total potassium content in the range of 0.15%-0.17%.

3. The method as claimed in claim 1, wherein the citric acid is added to provide workability for creating bricks with ease.

4. The method as claimed in claim 1, wherein the guar gum, added in the range of 1.3%-1.5%, imparts water absorption and grease repulsive properties to the bricks.

5. The method as claimed in claim 1, wherein sand passing through a 300mm sieve is included as a component of the mixture.

6. The method as claimed in claim 1, further comprising immersing the formed cow dung bricks in water for time period range of 22-24 hours and subsequently applying mortar (comprising one part cement and one part sand) to test the bricks under a compression testing machine.

7 7. The method as claimed in claim 1, wherein the bricks exhibit improved properties including reduced water absorption, enhanced compressive strength, and minimal efflorescence, making it suitable for construction applications.

8. The method as claimed in claim 1, wherein the cost of production is competitive with conventional bricks while utilizing sustainable materials and reducing environmental impact.

9. The method as claimed in claim 1, wherein the bricks further comprise of a
14 microstructure with improved grain size, reduced micro-cracks, enhanced porosity, and enhanced swell strength.

10. The method as claimed in claim 1, wherein the bricks are used as a sustainable construction material for building applications, contributing to environmental conservation and cost savings in the construction industry.

Dated this 20th day of September 2023

21 AMITY UNIVERSITY
Name of Applicant

Signature:
Name: R. Adm. R.C. Kochhar (Retd.)

ABSTRACT

A NOVEL COMPOSITION FOR COW DUNG BRICKS WITH GUAR GUM, LIME, CLAY AND METHOD THEREOF

The present invention describes a novel composition for cow dung bricks with guar gum, lime and clay and method thereof. In the present invention, the cow dung bricks mixed with just 5% guar gum and 10% lime produced a water absorption value of 18% and compressive strength of nearly 14 MPa with almost zero efflorescence, which is quite surprising then earlier made cow dung bricks. On performing microstructural analysis very few micro-cracks are found with improved grain size, and enhanced porosity and swell strength making them a sustainable material. The investigations reveal that with the addition of guar gum and lime resulted in packing voids in cow dung bricks giving improved water absorption capacity along with higher strength which helps in achieving better performance quality parameters for cow dung bricks with sustainable materials.

Accompanied Drawing **[Figure. 1-9]**

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Figure 1



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Figure 2

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Figure 3



7 **Figure 4**

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Figure 5



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Figure 6

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Figure 7



Figure 8

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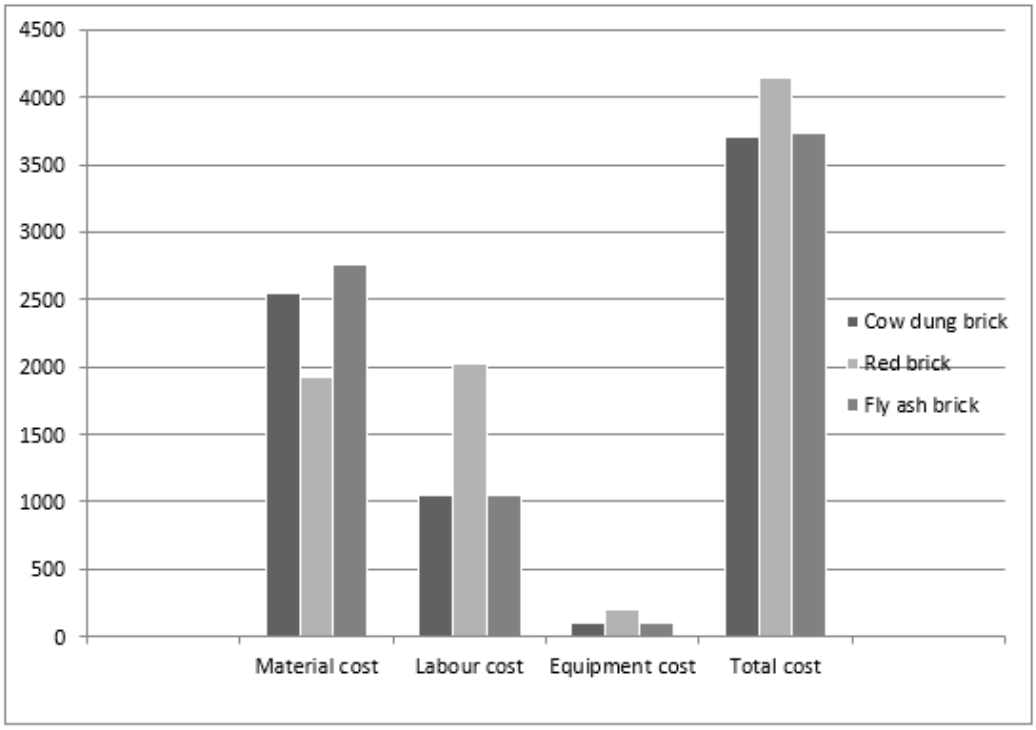

Figure 9

7 **Dated this 20th day of September 2023**

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FORM- 5

THE PATENTS ACT, 1970
(39 of 1970)
&
The Patents Rules, 2003
DECLARATION AS TO INVENTORSHIP
[See Section 10(6) and Rule 13(6)]

1. NAME OF THE APPLICANT~~(S)~~

~~I/~~ We, Amity University, Address: AMITY UNIVERSITY UTTAR PRADESH SECTOR-125, NOIDA-201313

hereby declare that the true and first inventor~~(s)~~ of the invention disclosed in the complete specification filed in pursuance of my ~~/ our~~ application numbered **202211054025** dated **21-09-2022** is/are

2. INVENTOR(S)

(a) NAME	**(b) NATIONALITY**	**(c) ADDRESS**
Naveen BP	INDIAN	Associate Professor, Department of Civil Engineering, Amity School of Engineering & Technology, Amity University Haryana, Manesar, Gurgaon-122413
Thakur Ramjiram Singh	INDIAN	Department of Civil Engineering, NIIST, NRI Group of Institutions, Bhopal

~~3. DECLARATION TO BE GIVEN WHEN THE APPLICATION IN INDIA IS FILED BY THE APPLICANT(S) IN THE CONVENTION COUNTRY: -~~

N.A.

~~We the applicant(s) in the convention country hereby declare that our right to apply for a patent in India is by way of assignment from the true and first inventor(s).~~

Dated this 20th day of September 2023

AMITY UNIVERSITY
Name of Applicant

Signature:

Name: R. Adm. R.C. Kochhar (Retd.)

To,
The Controller of Patents
The Patent Office, New Delhi