

Malady–Remedy Analysis of Stabilized Mud Blocks Based Structures with Focus on Development of Affordable Hazard-Resistant Housing Strategies

Final Technical Report of the Major Research Project

University Grants Commission, New Delhi

(Reference No. F. No. 42-163/2013 (SR) dt. 26.03.2013)



SUBMITTED BY

Dr. K. MAHENDRAN

Principal Investigator

Centre for Rural Technology

The Gandhigram Rural Institute - Deemed to be University

Gandhigram – 624302, Tamilnadu

April 2019

Acknowledgement

I wish to thank the University Grants Commission, New Delhi for its financial assistance to carry out this research work (Sanction Letter No. F. 42-163/2013 (SR) Dt: 22.03.2013).



K. MAHENDRAN
Dr. K. MAHENDRAN
PRINCIPAL INVESTIGATOR
UGC-MAJOR RESEARCH PROJECT
F.No. 42-163/2013 (SR)
Gandhigram Rural Institute,
Gandhigram- 624 302
Tamilnadu, India.

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UNIVERSITY GRANTS COMMISSION

BAHADUR SHAH ZAFAR MARG

NEW DELHI – 110 002

PROFORMA FOR SUBMISSION OF INFORMATION AT THE TIMES OF SENDING THE
FINAL REPORT OF THE WORK DONE ON THE PROJECT

1. TITLE OF THE PROJECT : **Malady – Remedy Analysis of Stabilized
Mud Blocks Based Structures with
Focus on Development of Affordable
Hazard – Resistant Housing Strategies**

2. NAME AND ADDRESS OF THE PRINCIPAL INVESTIGATOR

Dr. K. MAHENDRAN

Centre for Rural Technology,

The Gandhigram Rural Institute – Deemed
to be University,

Gandhigram – 624302, Tamilnadu

Mobile: +91 9976283987

E-mail: mahendran_gri@rediffmail.com

3. NAME AND ADDRESS OF THE INSTITUTION

The Gandhigram Rural Institute –

Deemed to be University,

Gandhigram – 624302, Dindigul (Dt),

Tamilnadu

4. UGC APPROVAL LETTER NO. AND DATE :

F. No. 42 – 163/2013(SR) dt.22.03.2013

F. No. 42 – 163/2013 (SR) dt.

5. DATE OF IMPLEMENTATION	:	01.04.2013
6. TENURE OF THE PROJECT	:	3 + 1 = 4 years
7. TOTAL GRANT ALLOCATED	:	Rs. 11,21,800/-
8. TOTAL GRANT RECEIVED	:	Rs. 9,66,500/-
9. FINAL EXPENDITURE	:	Rs. 8,87,394/-
10. TITLE OF THE PROJECT	:	Malady – Remedy Analysis of Stabilized Mud Blocks Based Structures with Focus on Development of Affordable Hazard – Resistant Housing Strategies

11. OBJECTIVES OF THE PROJECT :

- To study the properties of soil and available industrial waste materials
- To prepare mud blocks with varying amount of stabilizers added
- To study the performance of the stabilized mud blocks by evaluating the properties such as the compressive strength
- To build structures with those mud blocks and validate their stability and
- To suggest modification in construction aspect with a view to develop affordable hazard-resistant earthen structure for rural housing

12. WHETHER OBJECTIVES WERE ACHIEVED: YES

(GIVE DETAILS)

Totally seven soil samples are collected for this project, the soil samples are collected from Athoor block of Dindigul district in Tamil Nadu State, India. The area of soil collection lies between the geographic co-ordinates of North latitude from 10°14' 50" to 10° 20' 00" and East longitude from 77° 37' 45" to

77° 46' 00". Athoor lies 16 kilometers away from Dindigul. The soil samples were collected at a depth of 2m (approximately) from the ground level and samples were preserved so as to avoid the loss of moisture before the laboratory tests.

The engineering and elemental properties of each soil sample as analyzed based on I.S Codal provisions and EDAX method. The properties of is an important factor to find its suitability for fabricating stabilized mud blocks. The tests like Sieve Analysis, Liquid Limit, Plastic Limit, Shrinkage Limit, and Optimum Moisture Content (OMC) of collected soil samples were studied and the results are recorded. The liquid limits for all samples are ranges from 7.16% to 18.66%, Plastic limits for all samples range from 18.88% to 33.33%. The OMC was found to vary from 7% to 12.50%. These values are playing a significant role in identifying the suitable soil stabilizers. The effect of the stabilizers on the soil in different proportions is explored to identify a durable blocks.

An Energy Dispersive X-rays Analysis (EDAX) analysis was done for the seven samples to determine their elemental composition. The analysis results shows that S2, S3 and S6 samples are rich in Fe, while S1, S4, S5 and S7 samples are rich in silica. Scanning Electron Microscope Images were taken for the study the morphological characteristics of the collected Samples.

Based on the elemental composition various stabilizers will be chosen for the stabilization. The stabilizers are categorized into three as

- i. Organic Stabilizers;
- ii. Inorganic Stabilizers and
- iii. Polymers

Totally nine studies were conducted. The performance of Surkhi stabilized mud blocks along with lime and copper slag were studied. Various mix proportion were evolved and blocks were casted and tested. It has been noted that changes in engineering properties of soil in which liquid limit and plastic limit are in acceptable limit as per Indian standard. The specific gravity of the soil shows that the soil is an organic. Also it has been observed that mud blocks under compression were performed well with 89% of stabilizer. The strength parameters of mud block along with different stabilizers for the Soil sample were studied. The following mix proportions were proposed for casting of stabilized mud blocks. The blocks were prepared separately with Cement, Micro concrete, Piditop as stabilizers. Totally, 18 mixes were proposed and studied. Here the water repellent agent piditop reacted well with the soil. Hence, the blocks with cement and piditop performed well. It was also found that the optimum addition of piditop was 10% to the soil.

The potential of bacteria on stabilized mud blocks were studied. *Bacillus subtilis* a gram positive bacterium was used as a stabilizer. The structural, mechanical and performance characteristics of stabilized mud blocks were studied. It was found that the 8% dosage of bacterial solution was optimum to the mud blocks which performed well in all the aspects.

The possibility of using Lime, Alumina and Terminalia chebula extract as a stabilizer for the preparation of stabilized mud blocks were studied. Mud blocks were cast and depending upon ratio of the additives the mud blocks were designated. The casted blocks were tested after a period of 7 days, 14 days and 21 days of ambient curing. The mud blocks made of fine soil (BLT_(F)) shown good results in compression, water absorption and spray erosion.

Stabilized mud blocks along with metakaolin, GGBS and sand is used to increase the strength and durability of the black cotton soil blocks. The blocks were prepared with various mix proportion and tested for its compressive strength parameters. the use of Hypo sludge with cement and molasses for the preparation of stabilized mud blocks. Laboratory test results show that the physical and the mechanical properties of the red soil were accessed. The Compressive Strength, Modulus of Rupture, and Water absorption tests were performed for this soil with and without Paper Waste, Cement and Molasses. The Natural and Artificial fibres have been used in adobe and other traditional forms of earthen construction for many thousands of years to reduce shrinkage cracking and to improve tensile strength, durability as well as compressibility.

The influences of the geopolymer solution on strength of mud blocks were studied. The effect of industrial byproducts and wastes with geopolymer solution on stabilized mud blocks was also studied. Also, the durability performance of mud blocks to adverse weather was monitored and found satisfactory.

13. ACHIEVEMENTS FROM THE PROJECT :

- All the aspects of objectives were fulfilled
- Man Power trained : 1
- No. of Publications out of Project : International Journals : 3
International/National
Conferences: 4

14. SUMMARY OF THE FINDINGS: (IN 500 WORDS)

The origin and development of stabilized mud block and mud based technology for enhancing the performance of mud blocks was discussed. The discussion on the advantages/ limitations of stabilized mud blocks and the choice of stabilizers to improve the characteristics of stabilized mud blocks were done. Only limited stabilizers were used for the stabilized mud blocks production. The incorporation of Agro wastes and Geopolymer in the evolution stabilized mud blocks is low. From the literature review, the influence of stabilizers and the compaction on the strength and durability behavior on mud blocks are known. Few studies had been focused on the effect of compaction characteristics on the performance of stabilized mud blocks. Still some of the difficulties are prevalent to enhance the strength and durability behavior of stabilized mud blocks that are evident from the literature review. To rectify these maladies, an attempt had been made in this research through modern technologies by using industrial byproducts, Agro wastes and novel construction materials. The various steps involved in the project such as identification of soil, sample collection, and its classification were listed. Also, the usage of various materials as stabilizers were mentioned and the methods of casting and curing were explained. In addition to this, the properties of the soil samples, tests related to the mud block were discussed. Based on the results obtained from this strength and durability studies, the conclusions were arrived in the last chapter. Totally nine different studies with various stabilizers had been discussed. The mix designation table showed the proportioning of the each material with soil clearly. The graph for dry and wet compressive strength of all mix proportions in all studies were discussed to classify the performance of mud blocks based on its compressibility.

Similarly the modulus of rupture for all mix proportions in each study were discussed, it showed the flexural behavior mud blocks. From the erodibility curve the rate of erosion of mud block per minute were discussed. The water absorption graph illustrated the durability performance of mud blocks in all studies at different mix proportions. With respect to the above quality measuring parameters of the stabilized mud block, the mud block masonry units were evolved. That too from the above nine studies, well performed mud block from five studies were selected and masonry performance were conducted. All the above the geopolymer stabilized mud block was performed well particularly M20 mix. The compression test was carried out for the stabilized mud block masonry units was determined by 1 m x 1 m bonded units. The compressive load vs. strain curves for the masonry walls are seen. The wall displacements through the height were corrected; they were measured 3 cm far from the wall side surface and due to the bending effect were amplified.

The load system worked well and in all tests the differences among the load cell readings were inferior to 1 kN. The first cracks of the walls were only visible close to the collapse load and the wall failures were characterized by an undesired sudden brittle mode. In all cases, the failures were reached with an approximated strain of 1% and the wall failure stresses were quite the same of the block. Although the brick strengths of the mixture 1 and 4 were almost similar, the wall behavior was slightly different, with wall 4 showing more strength and stiffer than wall 1. Because of the mortar used to cast the bricks of wall 4, it presented the highest stiffness and strength among the walls.

15. WHETHER ANY PH.D. ENROLLED / : YES, One Research Scholar
PRODUCED OUT OF THE PROJECT

16. NO.OF PUBLICATIONS OUT OF : International Journals - 3
THE PROJECT International / National
(PLEASE ATTACH) Conferences – 4



PRINCIPAL INVESTIGATOR
DR. K. MAHENDRAN
PRINCIPAL INVESTIGATOR
UGC-MAJOR RESEARCH PROJECT
F.No. 42-163/2013 (SR)
Gandhigram Rural Institute,
Gandhigram-624 302
Tamilnadu, India.


REGISTRAR 29/4/19
REGISTRAR
Gandhigram Rural Institute
(Deemed to be University)
Gandhigram-624 302.
Dindigul Dist, Tamilnadu.

23236351, 23232701, 23237721, 23234116
23235733, 23232317, 23236735, 23239437



विश्वविद्यालय अनुदान आयोग
बहादुरशाह जफर मार्ग
नई दिल्ली-110 002
UNIVERSITY GRANTS COMMISSION
BAHADURSHAH ZAFAR MARG
NEW DELHI-110 002

F. No. 42-163/2013 (SR)

The Under Secretary (FD-III)
University Grants Commission
New Delhi-110002

22 MAR 2013

Sub:- UGC support for the Major Research Project in Physical Sciences, Bio-Sciences, Maths, Medical, Agricultural Sciences and Engineering & Chemistry to University/College Teachers – Project entitled, “Malady- Remedy analysis of stabilized MUD Blocks based structures with a focus on development of Affordable Hazrd- Resistant housing strategies”

Sir,

I am to refer to your letter forwarding the application of Dr. K. Mahendran of your institution for financial assistance under the above scheme and to convey the Commission's approval & sanction an on account grant of Rs. 6,65,300/- (Rupees: six lakh sixty five thousand three hundred only) to the Registrar, Gandhigram Rural Institute, Gandhigram-624302, TN in r/o Major Research Project of Dr. K. Mahendran, Department of Civil engg for the period of 3 years w.e.f. 1.4.2013 as detailed below:-

S.No	ITEMS	AMOUNT APPROVED	GRANT RELEASED AS Ist INSTALMENT	Category
A.	Non - Recurring		1,25,000/-	SC
1.	Books & Journals	25,000/-		
2.	Equipment (Fabrication of equipment for spray treating soils)	1,00,000/-		
B.	Recurring		5,40,300/-	
1.	Honorarium to Retd. Teacher @ Rs. 12, 000/- p.m.	nil		
2.	Project Fellow @14,000/- p.m. for initial 2 years and Rs. 16,000/- p.m. from the third year onwards.	5,28,000/-		
3.	Chemical/ Glassware / Consumable	1,00,000/-		
4.	Hiring Services	1,60,000/-		
5.	Contingency	50,000/-		
6.	Travel/Field Work	75,000/-		
7.	Special Need	nil		
8.	Overhead Charges @ Rs. 10% approved recurring Grant (Except Travel & Field Work)	83,800/-		
	Total (A + B)	11,21,800/-	6,65,300/-	

The acceptance Certificate in prescribed format (Annexure-1 available on the UGC web-site) may be sent to the undersigned within one month from the issue of the award letter failing which the project may be treated as cancelled.

If the terms & conditions are acceptable, as per guideline which are available on UGC web-site www.ugc.ac.in the Demand Draft/ Cheque being sent may be retained. Otherwise the same may be returned in original to the UGC by Registered Post in variably with in 15 days from the receipt of the Demand Draft/Cheque in favour of Secretary, UGC, New Delhi.

Principal Investigators should ensure that the statement of expenditure & utilization Certificate to the effect that the grant has been utilized for the purpose for which it has been sanctioned shall be furnished to the University Grants Commission in time.

The first instalment of the grant shall comprise of 100% of the Non –Recurring including Over Head Charges, and 50% of the total Recurring grant.

1. The sanctioned amount is debit to the Major Head 1.a (iii) (k) (31) Rs. 5,40,300/- & 1.a (iii) (k) (35) Rs. 1,25,000/- and is valid for payment during financial year 2012-13.
2. The amount of the Grant shall be drawn by the Under Secretary (drawing and Disbursing Office), University Grants Commission on the Grants-in-aid Bill and shall be disbursed to and credited to the University/College, **Gandhigram Rural Institute, Gandhigram-624302, TN** through Cheque/Demand Draft/ Mail Transfer.
3. The Grants is subject to the adjustment of the basis of Utilization Certificate in the prescribed performa submitted by the University/Colleges/institution.
4. The University/College shall maintain proper accounts of the expenditure out of the grants which shall be utilized only on approved items of expenditure.
5. The Utilization Certificate of the effect that the grant has been utilized for the purpose for which it has been sanctioned shall be furnished to the University Grants Commission as early as possible after the close of the current financial year.
6. The assets acquired wholly or substantially out of University Grant Commission's grant shall not be disposed or encumbered or utilized for the purposes other than those for which the grant was given, without proper sanction of the University Grants Commission and should, at any time the College/University ceased in function such assets shall revert to the University Grant Commission.
7. A Register of assets acquired wholly or substantially out of the grant shall be maintained by the University/College in the prescribed form.
8. The grantee institution shall ensure the utilization of grant-in-aid for which it is being sanctioned/paid. In case non-utilization/part utilization, the simple interest @ 10% per annum as amended from time to time on unutilized amount from the date of drawl to the date of refund as per provisions contained in General Financial Rules of Govt. of India will be charged.
9. The interest earned by the University/College/Institute on this grants in aid shall be treated as additional grant and may be shown in the Utilization Certificate/Statement of expenditure to be furnished by grantee institution.
10. The University/College/Institute shall follow strictly all the instructions issued by the Government of India from time to time with regard to reservation of posts for Scheduled Castes/Scheduled Tribes/OBC/PH etc.
11. The University/College shall fully implement to Official Language Policy of Union Govt. and comply with the Official Language Act, 1963 and Official Languages (Use for Official purposes of the Union) Rules, 1978 etc.
12. The sanction issues in exercise of the delegation of powers vide Commission Office Order No. 25/92 dated May 01, 1992.
13. An amount of Rs. ----- out the grant of Rs. ----- sanctioned vide letter No. F. 42-163/2013 (SR) dated has been utilized by University/College/Institution for the purpose for which it was sanctioned. Utilization Certificate for Rs. ----- has already been entered at S. No. ----- now we may enter Utilization Certificate for Rs. ----- S. No. ----- and in the U. C. Registrar at page No. -----.
14. It is also certified from the B.C.R. that the funds are available under the scheme. Entered in BCR at S.No. 34/74
The above grant is sanctioned against the budget provision of Rs. during the current financial year leaving a balance of Rs. ----- under the head of Account 1.a (iii) (k) (31) Rs. 5,40,300/- & 1.a (iii) (k) (35) Rs. 1,25,000/-
15. The funds to the extent are available under the Scheme.
16. The University/Institution/College is strictly following the UGC regulations on curbing the menace of ragging in Higher Educational Institutions, 2009.

SK
(Dr. (Mrs.) Urmila Devi)
Joint Secretary

Copy forwarded for information and necessary action for:-

1. The Registrar, **Gandhigram Rural Institute, Gandhigram-624302, TN**,
Acknowledgement for the receipt of DD / Cheque / Mail Transfer for Rs. 6,65,300/- may be sent to the Under Secretary, Finance Division III, UGC,
2. **Dr. K. Mahendran**, Principal Investigator, Department of Rural Technology Centre
Gandhigram Rural Institute, Gandhigram, 624302, TN
3. office of the Director General of Audit, Central Revenues, A. G. C. R. Building, I. P. Estate, New Delhi.
4. The Registrar,

[Signature]
(Pranod Sharma)
Section Officer



UNIVERSITY GRANTS COMMISSION
BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002
SC

PFMS

FD Diary No. 1235

Dated : 21.06.2016

F.No.42-163/2013 (SR)

August 2016

The Under Secretary (FD-III)
University Grants Commission
Bahadur Shah Zafar Marg
New Delhi - 110002

(27) AUG 2016

Sub: Release of Grant-in aid to **Gandhigram Rural Institute, Gandhigram - 624 302, Tamil Nadu** for the year 2016-17 under plan in respect of Major Research Project entitled **Malady.....strategies"** awarded to **Dr. K. Mahendran, Department of Civil Engineering**, tenure of project from **01.04.2013 to 31.03.2017**.

Sir,

I am directed to convey the sanction of the University Grants Commission for payment of grant of **Rs. 3,01,200/- (Rupees Three Lakh One Thousand Two Hundred Only)** as **2nd installment** for the year 2016-17 towards Major Research Project to **The Registrar, Gandhigram Rural Institute, Gandhigram - 624 302, Tamil Nadu** for the plan expenditure to be incurred during 2016-17.

I am also directed to say that the tenure of the above project has been extended by the UGC upto 31.03.2017 without any additional financial assistance for the extended period.

Name of the Item	Amount Allocated	Head of Account	Grant now Being Sanctioned	Grant already Released	Total Grant
Books & Journal	25,000/-	3.B(56).35	.....	25,000/-	25,000/-
Equipment	1,00,000/-		.....	1,00,000/-	1,00,000/-
Honorarium	.....		.....	.....	.....
Project fellow	5,28,000/-	3.B(56).31	2,11,200/-	2,64,000/-	4,75,200/-
HRA	.....		.....	.....	.....
Chemicals	1,00,000/-		40,000/-	50,000/-	90,000/-
Contingency	50,000/-		20,000/-	25,000/-	45,000/-
Hiring Services	1,60,000/-			80,000/-	80,000/-
Travel/field work	75,000/-		30,000/-	37,500/-	67,500/-
Overhead Charges	83,800/-		.....	83,800/-	83,800/-
Additional Grant	.....		.....	.....	.....
Total	11,21,800/-		3,01,200/-	6,65,300/-	9,66,500/-

1. The sanctioned amount is debit able to Major Research Project head Sector 3.B(56).31 and is valid for payment during the financial year 2016-17 only.

2. The amount of the Grant shall be drawn by the Under Secretary (Drawing and Disbursing Officer) UGC on the Grants-in-aid bill and shall be disbursed to and credited to **The Registrar, Gandhigram Rural Institute, Gandhigram - 624 302, Tamil Nadu** through Electronic mode as per the following details:-

(a)	Bank Name & Address of Branch	Canara Bank, GRU Branch
(b)	Account No	8500101010000
(c)	Type of Account : SB /Current /Cash Credit	SB
(d)	IFSC Code	CNRB0008500
(e)	MICR Code	620015024
(f)	Whether Bank Branch is RTGS or NEFT enabled : RTGS / NEFT /Both	YES
(g)	Name & Address of Account Holder	The Registrar, Gandhigram Rural Institute, Gandhigram - 624 302, Tamil Nadu.

3. The Grant is Subject to the adjustment on the basis of Utilization Certificate in the prescribed proforma submitted by the University / Institution.
4. The University / Institution shall maintain proper accounts of the expenditure out of the Grants, which shall be utilized, only on the approved items of expenditure.
5. The University / Institution may follow the General Financial Rules, 2005 and take urgent necessary action to amend their manuals of financial procedures to bring them in conformity with GFRs, 2005 and those don't have their own approved manuals on financial procedures may adopt the provisions of GFRs, 2005 and instructions / guidelines there under from time to time.
6. The Utilization Certificate to the effect that the grant has been utilized for the purpose for which it has been sanctioned shall be furnished to UGC as early as possible after the close of current financial year.
7. The assets acquired wholly for substantially out of University Grants Commission's Grant shall not be disposed or encumbered or utilized for the purposes other than those for which the grants waayanands given without proper sanction of the UGC and should at any time the University ceased to function, such assets shall revert to the University Grants Commission.
8. A Register of Assets acquired wholly or substantially out of the grant shall be maintained by the University in the prescribed proforma.
9. The grantee institution shall ensure the utilization of grants-in-aid for which it is being sanctioned/ paid. In case of non-utilization / part utilization thereof, simple interest @ 10% per annum, as amended from time to time on the unutilized amount from the date of drawal to the date of refund as per provisions contained in General Financial Rules of Govt. of India, will be charged.
10. The University / Institutions shall follow strictly the Government of India / UGC guidelines regarding implementation of the reservation policy [both vertical (for SC, ST & OBC) and horizontal (for persons with disability etc.)] in teaching and non-teaching posts.
11. The University / Institution shall fully implement the Official Language Policy of Union Government and comply with the Official Language Act, 1963 and Official Languages (Use for Official Purposes of the Union) Rules, 1976 etc.

12. The sanction is issued in exercise of the delegation of powers vide UGC Order No. 69/2014 [F.No.10-11/12 (Admn. IA & B)] dated 26/3/2014.
13. The University / Institution shall strictly follow the UGC Regulations on curbing the menace of Ragging in Higher Education Institutions, 2009.
14. The University / Institution shall take immediate action for its accreditation by National Assessment & Accreditation Council (NAAC).
15. The accounts of the University / Institution will be open for audit by the Comptroller & Auditor General of India in accordance with the provisions of General Financial Rules, 2005.
16. The annual accounts i.e. balance sheet, income and expenditure statement and statement of receipts and payments are to be prepared strictly in accordance with the Uniform Format of Accounting prescribed by Government.
17. The grantee institution shall remit the amount the grants-in-aid and/or interest through e-mode (RTGS/NEFT) directly to UGC account as per following bank details:-

Account Holder	Secretary, UGC, New Delhi-110 002
Name of Bank & Address	Canara Bank, UGC Office, New Delhi-110 002
A/C No.	8627101002123
Type of A/C	Savings
IFSC Code	CNRB0008627
MICR Code	110015170

18. An amount of Rs. 6,34,949/- out the grant of Rs. 6,65,300/-..... Sanctioned vide letter No. F. No. 42-163/2013 (SR) dated 22-03-2013 has been utilized by University/College/Institution for the purpose for which it was sanctioned. Utilization Certificate for Rs NIL..... has been entered at S. No..... now we may enter Utilization Certificate for Rs...6,34,949/-S. No...[7]... and in the U.C. Register at page No. 84...
19. Funds to the extent of Rs are available under the scheme or BE / RBE of the year 2016-17.
20. These issues with the concurrence of IFD vide Diary No 1004 (IFD) dated 23/05/2016.
21. This issues with the approval of Joint Secretary (MRP) vide Diary No. 54817 dated 30/05/2016.

Your faithfully,

(G.S. AULAKH)
UNDER SECRETARY

Copy forwarded for information and necessary action for :-

1. The Registrar, Gandhigram Rural Institute, Gandhigram - 624 302, Tamil Nadu.
2. Office of The Finance Officer, General of Audit, Central Revenues, AGCR Building, I.P. Estate, New Delhi.
3. Accountant General, State Govt. of Gandhigram Rural Institute, Gandhigram - 624 302, Tamil Nadu.
Dr. K. Mahendran, Department of Civil Engineering
Gandhigram Rural Institute, Gandhigram - 624 302, Tamil Nadu.
4. The Registrar, Gandhigram Rural Institute, Gandhigram - 624 302, Tamil Nadu.
5. Guard file.

(ARUN KUMAR SINHA)
(SECTION OFFICER)

UNIVERSITY GRANTS COMMISSION
UTILIZATION CERTIFICATE – From.03.05.2013 to 31.03.2017

It is certified that the amount of **Rs.8,87,394/-** (Rupees Eight lakhs eighty-seven thousand three hundred and ninety-four only) out of the grant of **Rs.9,66,500/-** (Rupees Nine lakhs sixty-six thousand and five hundred only) Sanctioned to Dr.K.Mahendran, Professor and PI, Rural Technology Centre by the University Grants Commission vide its letter No.41-163/2013/(SR),dated.22.03.2013 towards **UGC-MRP on "Malady-Remedy analysis of stabilized MUD Blocks based structures with a focus on development of Affordable Hazrd-Resistant housing strategies"** under UGC-MRP scheme has been utilized for the purpose for which it was sanctioned and in accordance with the terms and conditions as laid down by the commission.

If as a result of check or audit objection some irregularities are noticed at a later stage, action will be taken for refund, adjustment or regulation.

Signature

Registrar / Principal with seal

V. P. [Signature]
REGISTRAR
Gandhigram Rural Institute

Signature

Finance Officer with seal

[Signature]
Special Officer (Finance)
Gandhigram Rural Institute

Signature

Principal Investigator with seal

[Signature]
Dr. K. MAHENDRAN
PRINCIPAL INVESTIGATOR
UGC-MAJOR RESEARCH PROJECT
F.No.42-163/2013 (SR)
The Gandhigram Rural Institute,
(Deemed to be University)
Gandhigram - 624 302
Tamilnadu, India.

Signature, Chartered Accountant
with seal and Registrar No.

(If the accounts were audited prior to the
audit of Statutory Auditors)

For A.V. SUBRAMANIAN & CO.,
CHARTERED ACCOUNTANTS



[Signature]

C.A. J. Sumathi
M.No.029617 Partner
ICAI: FRN : 010643S

Note: The University/ Institution will submit an audited statement of accounts, duly audited by the Statutory Auditors of the University / Institution as soon as the accounts of the University / Institution are audited.

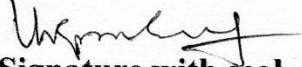
UNIVERSITY GRANTS COMMISSION
BAHADUR SHAH ZAFAR MARG
NEW DELHI – 110 002.

EVALUATION CERTIFICATE

It is certified that the report entitled “Malady–Remedy Analysis of Stabilized Mud Blocks Based Structures with Focus on Development of Affordable Hazard-Resistant Housing Strategies” by Dr.K. Mahendran, Professor & Director, Centre for Rural Technology, the Gandhigram Rural Institute – Deemed to be University has been evaluated to the University Grants Commission, New Delhi for final support under the scheme of Major Research Project (F. No. 42-163/2013 (SR)).

Details of Expert Committee

The objectives mentioned in the proposal were completed. The results are published in International Journals and National/ International conferences. Overall, the outcome of the project is good. The report is as per the guidelines.


Signature with seal
Dr. S.N. RAMASWAMY, M.E., Ph.D.,
Principal,
Anjalai Ammal Mahalingam Engineering College
Kovilvenni - 614 403.

UNIVERSITY GRANTS COMMISSION
BAHADUR SHAH ZAFAR MARG
NEW DELHI – 110 002.

EVALUATION CERTIFICATE

It is certified that the report entitled “Malady–Remedy Analysis of Stabilized Mud Blocks Based Structures with Focus on Development of Affordable Hazard-Resistant Housing Strategies” by Dr.K. Mahendran, Professor & Director, Centre for Rural Technology, the Gandhigram Rural Institute – Deemed to be University has been evaluated to the University Grants Commission, New Delhi for final support under the scheme of Major Research Project (F. No. 42-163/2013 (SR)).

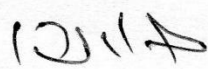
Details of Expert Committee

The objectives mentioned in the Research proposal entitled “Malady–Remedy Analysis of Stabilized Mud Blocks Based Structures with Focus on Development of Affordable Hazard-Resistant Housing Strategies were completed successfully.

The obtained results are published in peer reviewed international journals with good impact factor.

Overall, the outcome of the Research Project is very good.

The report is as per guidelines.


Signature with seal

Dr.R. Vel Kennedy M.Tech..Ph.D.
Professor in Civil Engineering
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