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Usability of interlocking compressed earth block in housing projects in Nigeria

Ernest Ituma Egba¹, Jibrin Hassan Suleiman², Ezekiel Babatunde Ogunbode^{3,*},
Najiyu Abubakar⁴ and Muhammad Muhammad Inti⁵

¹Faculty of Education, Ebonyi State University, Abakaliki

²School of Technical Education, Federal College of Education (Technical), Gombe

³School of Environmental Technology, Federal University of Technology, Minna

⁴Faculty of Engineering, Kano State University of Science and Technology, Wudil

⁵Faculty of Technology Education, Abubakar Tafawa Belewa University, Bauchi

*Corresponding E-mail: letschartup@gmail.com (Tel: +2348059956964)

Abstract

Previous studies indicated high cost of walling materials for housing project. As a result, the use of interlocking compressed earth block as an alternative walling material has been proposed. Accordingly, this paper presented the analysis on the usability of interlocking compressed earth block for housing project. Three research questions and hypotheses each were formulated to guide the study. The population of the study consisted of all building site supervisors and building workers from selected states and geopolitical zones in Nigeria. The sample size comprised of 150 respondents which was made up of 25 site supervisors 125 site workers. A structured questionnaire was used for data collection. The statistical mean, standard deviation, and t-test were used to analyse the data. The analysis revealed that both the site supervisors, and workers were comfortable with the handling of the blocks during block laying process.

Keywords: Interlocking Block, Compressed Earth Block, Housing Project

Introduction

Through the ages, mankind has devised several means of providing a comfortable house as a basic necessity of life. Recent studies suggested that all aspects of housing project from conception to delivery have become expensive trades (Ogunsemi, 2010; Adedeji, 2010; and Arayela, 2005). Different design principles, construction practices, technologies and building materials have been employed in the building industry for housing project involving high material and construction costs (Oladipo & Oni, 2012; and Danso & Manu, 2013). The case is more serious in the developing country like Nigeria that experiences dwindling economy. The situation has warranted the search for affordable construction material. One of the most recommended affordable construction material is the interlocking compressed earth block (Amado, Pinto & Santos, 2007; Adedeji, 2008; Raheem, Bello & Makinde, 2010; Ferguso, 2008; Chweiduk, 2003; and Calkins, 2009).

In this paper, the ease of use of interlocking block for housing project in Nigeria was analysed. The specific objectives were outlined namely; to evaluate the efficiency of use of interlocking block during block laying process, to assess the proficiency of use of interlocking block at finishing stage, and to determine the effectiveness in working on interlocking block during repair and maintenance. Also, null hypotheses were articulated to evaluate the significant difference in the opinion of the respondents on the usability of interlocking blocks for housing project.

Research questions

1. What is the workers' efficiency of use of interlocking compressed earth block during block laying process?
2. What is the workers' proficiency of use of the interlocking block at finishing stage?
3. What is the workers' effectiveness of the use of the interlocking block during repair and maintenance?

Hypotheses

- H₀₁: There is no significant difference between the respondents' opinions on the workers' efficiency of use of interlocking compressed earth block during block laying process.
- H₀₂: There is no significant difference between the respondents' opinions on the workers' efficiency of use of interlocking block at finishing stage.
- H₀₃: There is no significant difference between the respondents' opinions on the workers' efficiency of use of interlocking during repair and maintenance.

Methodology

The study used the survey research design. Five out of the six geopolitical zones in Nigeria namely; North West, North East, North Central, South West, and South East were used as the area of study. The population of the study was the building site supervisors, the building skilled men, and the building labourers. A structured questionnaire with 18 item statements was administered to 150 respondents (25 supervisors and 125 workers) that were randomly selected from the five geopolitical zones in the country. The Cronbach's alpha reliability coefficient of 0.842 was achieved from the research instrument. The variables, namely; gender, age and status as disclosed in table 1 were used to conduct the study. 120 survey answers were returned, justified and used in the data analysis. The five point Likert scale was used to scale the responses. The statistical mean, standard deviation and t-test were applied for the data analysis. The relationship of the construct of the dependent variables was estimated through correlation analysis. While the regression analysis was used to determine the relationship between the variables on the usability of interlocking compressed earth block in housing project.

Table 1.: General Characteristics of the Respondents

Variables	Category	Person (%)	
General Characteristics:	Gender	Male	92 (76.67)
		Female	28 (23.33)
		Total	120(100.0)
	Age	≥ 40 years	51(42.50)
		< 40 years	69(57.50)
		Total	120(100.0)
	Status	Supervisors	20(16.67)
		Workers	100(83.33)
		Total	120(100.0)

Results, findings and discussion

Table 2. Mean Rating and Standard Deviations of the Respondents on the Efficiency of Use of Interlocking Blocks During Block Laying Process

S/N	Item Statements	\bar{X}	SD	Remarks
1	Eased block delivery by the labourers	3.82	0.91	Accepted
2	Horizontal block alignment process is easy	3.60	1.01	Accepted
3	Interlocking block joining procedure is friendly	3.47	1.05	Accepted
4	Interlocking block laying process is fast compared to other types of block	3.95	0.97	Accepted
5	Vertical block alignment saves time	3.58	1.12	Accepted
6	It gives room for workers to get more pay	4.02	1.04	Accepted
Grand mean		3.74		Accepted

Tables 2, 3 and 4 showed the mean rating and standard deviations of the respondents on the efficiency of use of interlocking compressed earth block during block laying process, proficiency of use of the interlocking block at finishing stage, and the effectiveness of the use of the interlocking block during repair and maintenance respectively. It was observed from Table 2 that both the site supervisors, and workers were comfortable with the handling of the blocks during block laying process. The result implied that the use of interlocking compressed block enabled maximum construction work output. The finding was in line with the submission of Adedeji (2010) that shorter time of construction is a benefit of the use of interlocking block. Furthermore, Table 2 revealed that small quantity of mortar was used to plaster interlocking blocks.

Table 3: Mean Rating and Standard Deviations of the Respondents on the Proficiency of Use of Interlocking Block at Finishing Stage

S/N	Item Statements	\bar{X}	SD	Remarks
1	Plastering work is easy	2.88	1.11	Rejected
2	Electrical work on interlocking blocks is easy	2.46	1.20	Rejected
3	Plumbing work on the interlocking blocks saves time	2.72	1.14	Rejected
4	Decoration works on interlocking blocks save time	2.68	0.96	Rejected
5	Plastering interlocking blocks saves mortar	3.24	1.15	Accepted
6	Plastering interlocking blocks saves labour	3.02	1.02	Accepted
Grand Mean		2.85		Rejected

Table 3 showed that the waste of old blocks during repair and maintenance works was minimised. The finding was in agreement with Assiamah, Abekan and Agyeman (2016) that the use of interlocking block reduced construction material. Nevertheless, the respondents were of the opinion that it was difficult to carry out electrical and plumbing works, as well as decoration and paint works on the block walls as a result of high stiffness of the block. It was also hard to scrap away loose debris of the dilapidated blocks during repairs and maintenance works.

Table 4. Mean Rating and Standard Deviations of The Respondents on The Effectiveness in Working on Interlocking Blocks During Repair and Maintenance

S/N	Item Statements	\bar{X}	SD	Remarks
1	Scraping away loose debris from the dilapidated portion of the wall is an easy task	2.79	1.06	Rejected
2	Cutting doorway, window-way, and other openings through interlocking wall is an easy task	2.63	1.01	Rejected
3	Repair and maintenance of electrical and plumbing works on interlocking block are easy	2.55	0.91	Rejected
4	Waste of old blocks are minimised during repair and maintenance	3.17	1.19	Accepted
5	Repair and maintenance of plastered wall save time	2.94	1.04	Rejected
6	Dismantling and replacing interlocking block during repair is an easy task	3.24	1.18	Rejected
Grand mean		2.89		Rejected

Table 4 indicated shorter time of construction and minimised construction cost as the benefits of interlocking block over the sandcrete block. Assiamah, Abekan and Agyeman (2016) carried out a comparative study on interlocking blocks and sandcrete blocks for material, human and monetary consumption in construction of walls in housing project.

Table 5: Test Analysis Between the Variables: Gender, Age, and Status on the Usability of Interlocking Block (@ 95 % confidence level)

	Division	Block laying efficiency	Block finishes proficiency	Block repair & maintenance effectiveness
Gender	Male n = 92 ± (S.D)	3.76 ± (1.02)	2.84 ± (1.10)	2.91 ± (1.03)
	Female n = 28 ± (S.D)	3.71 ± (1.05)	2.87 ± (1.13)	2.85 ± (1.11)
	t-value _{cal.}	0.22	-0.12	-0.25
	t-value _{table}	2.02	2.02	2.02
Age	≥ 40 n = 51 ± (S.D)	3.75 ± (1.13)	2.82 ± (1.08)	2.93 ± (1.11)
	< 40 n = 69 ± (S.D)	3.72 ± (1.01)	2.90 ± (1.12)	2.86 ± (0.99)
	t-value _{cal.}	0.15	-0.39	0.36
	t-value _{table}	1.98	1.98	1.98
Status	Supervisor n = 20 (S.D)	3.78 ± (0.92)	2.91 ± (1.07)	2.94 ± (1.05)
	Workers n = 100 (S.D)	3.73 ± (1.04)	2.83 ± (1.00)	2.85 ± (0.96)
	t-value _{cal.}	0.22	0.31	0.35
	t-value _{table}	2.04	2.06	2.06

Table 5 showed the summary of the mean, standard deviation and t-test results of the study base on the variables namely: gender, age, and status. The study showed that the female gender had a greater feeling on the block finishes proficiency than the male gender; while the opposite was the case for block laying efficiency, and block repair and maintenance effectiveness.

Table 6: Correlation Between the Constructs of Interlocking Block Usability Variables

Task	Block laying efficiency	Block finishes proficiency	Block repair & maintenance effectiveness
Block laying efficiency	1		
Block finishes proficiency	0.494	1	
Block repair & maintenance effectiveness	0.808	0.448	1

Table 6 contains the correlation analysis of the construct of the variables for evaluating the usability of interlocking compressed earth block for housing project. It indicated that block laying efficiency had a higher relationship with block repair and maintenance effectiveness than block finishes proficiency. This is in line with the findings of Adedeji (2012) who examined the benefit of the use of interlocking blocks in housing projects.

Table 7: Regression Analysis Between the Variables of Interlocking Block Usability

Factors	Coefficient	Standard error	t-value	p-value
Intercept	3.143	0.102	30.727	3.7E-102
Gender	-0.769	0.133	-5.794	1.51E-08
Age	1.196	0.129	9.284	1.65E-18
Status	0.947	0.155	6.099	2.78E-09
R = 0.625		0.937	F = 76.163	P = 0.000

The regression analysis amongst the variables on evaluating the usability of interlocking compressed earth block for housing project was shown in figure 7. It showed that age and status variables had more positive influence on the usability of interlocking compressed earth block for housing project than the gender variable. Equation 1 shows the relationship between the variables.

$$Y = 3.143 - 0.769G + 1.196A + 0.947S \quad \dots(1)$$

Where, *G* is gender, *A* is age, *S* is status of the respondent, *Y* = interlocking block usability. Furthermore, the null hypothesis, that there is no significant difference in the opinion of the respondents on block laying efficiency, block finishes proficiency, as well as block repair and maintenance effectiveness was upheld at 95 % confidence level.

Conclusion

Several researches have been conducted to investigate the stability and functionality of the interlocking compressed earth as an alternative walling material to the conventional sandcrete block. Sturm, Ramos and Lourenço (2015) conducted an experiment on interlocking compressed earth blocks to characterize its mechanical properties. They reported that compressed blocks stabilised with cement possessed acceptable mechanical properties for blocks in terms of structural stability and functionality. Specifically, this paper analysed the usability of interlocking compressed earth block for housing project in Nigeria. The study revealed that both the site supervisors, and workers are comfortable with the handling of the blocks during block laying process. It also revealed the use of interlocking compressed earth saved construction material and time.

Recommendations

1. There should be an awareness campaign through workshops, seminars and conferences to sensitize and encourage the building industry on the use of interlocking compressed earth block for housing projects.
2. The practice of the application of interlocking compressed earth block for housing project in Nigeria should be imbibed with all vigour to boost youth empowerment.

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