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Those of you who are interested to submit papers for our Journal and Bulletin Please forward your papers up to **31st March 2020** to the following **Address:**

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P.O.Box 20930 Code 1000 | Phone : +251-11-5 52 12 48

Email : eacecivil@gmail.com | Web site: www.eacecivil.org

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Message from the President

Distinguished EACE members and other readers,

I would like to express my heartfelt gratitude to those who unreservedly contributed their precious time and energy for the facilitation of the EACE's regular duties and other extraordinary ventures throughout the tenure of the current Executive Committee (EC).The EC has tried to add some more efforts and values which could further advance the contribution of the association to its members and the public at large. The committee was engaged in regular weekly meetings to adequately address and follow up pertinent issues as well as to support some extraordinary initiatives the EACE.

The main activities of the EC and the EACE committees during the past one year were:

- Strengthening cooperation with other professional associations and institutions such as Architects Association of Ethiopia, DC Society of Professionals Association (USA), American Institute of Architects, National Society of Professional Engineers Associations (USA), and Ethiopian Construction Works Corporation (ECWC);
- Taking a big part in the reactivation of the Joint Engineering Professionals' Association (JEEPA);
- New registration as a member of the African Engineers Confederation;
- Coordination of the Ethiopia 2050 Grand Challenges and Opportunities Conference;
- EACE's office rehabilitation and maintenance;
- EEACE's web site redevelopment;
- Participation in the national Occupational Standard and Certification System for Professionals as Permanent NSC and TC member and other various initiatives and workshops.

The main theme of the upcoming workshop of the 22nd General Assembly is " The role of Civil Engineering Profession towards overcoming the expected Grand Challenges Ethiopia faces by the year 2050".

The Civil Engineering profession plays pivotal role in preparation and implementation of any kind of development plan. Therefore, We, civil engineers, are highly indebted in bringing about a positive and determining change in taking out the Ethiopian people from detrimental poverty. We must design and implement projects in absolute professionalism, through ethical manner and with due concern to value for money.

The EACE has exerted its outmost effort in organizing the ETHIOPIA 2050: GRAND CHALLENGES AND OPPORTUNITIES workshop that took place on 19th and 20th December 2019. Our association vows to continue its active participation on the subsequent tasks of promoting and taking forward this Grand Vision in a sustainable manner.

On behalf of the EC and myself, I would like to take this opportunity to urge all EACE members to take their own part in supporting this noble venture and to promote its ideals to the relevant authorities and their peer groups.

Eng. Tesfaye Workineh

President, EACE

Message from the Editorial and Publication Committee

It is with great enthusiasm that the Editorial and Publication Committee of the Association presents this publication to our respected readers. In response to our call for papers, 35 abstracts were submitted where 15 abstracts were accepted for full paper submission after double blind peer review procedure. From accepted 15 abstracts only 10 full papers were submitted and based on the review results, we eventually accepted 8 papers for our publications. We thank all those who submitted their abstracts and congratulate all authors of published papers in our publications. We commend their patience and understanding as the review process was painstaking and rigorous. We thank them for their commitment to scientific research, professional development, and the hard work put into doing the research and writing of the papers.

On that note, we would like to cordially thank our peer reviewers for their effort, contribution and essential service as gatekeepers for the scientific integrity of published research papers. The Committee would also like to use this opportunity to express its heartfelt gratitude to organizations and individuals who sponsored publications of the Association.

It is our strong hope that this publication has its own humble contribution to the advancement of our profession at a national and global context. Hereby, we highly encourage members of the association to use this outlet to publish your papers in the upcoming publications.

"If you want to change the world, pick up your pen and write." Martin Luther

The Editorial and Publication Committee

P.O.Box 20930 Code 1000

Addis Ababa

Acknowledgement

The Editorial and Publication Committee of the Association would like to acknowledge the contribution of those individuals who spared their precious time in reviewing the abstracts and papers submitted to this year's Journal and Bulletin of the Association. The Committee would like to cordially thank the following individuals for their professional contribution in reviewing submitted abstracts and papers.

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Declaration

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All the views and opinions reflected in the articles herein are those of the authors and the Editorial and Publication Committee neither endorses nor opposed any particular outlook or idea that appears in this publication.

Editorial and Publication Committee (EACE)

ETHIOPIAN ASSOCIATION OF CIVIL ENGINEERS-(EACE) CODE OF PROFESSIONAL ETHICS

FUNDAMENTAL PRINCIPLES

Engineers uphold and advance the integrity, honor and dignity of thr engineering profession by:

1. Using their knowledge and skill for the enhancement of human welfare and the
2. Being honest and impartial and Serving with fidelity the public, their employers and clients:
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4. Supporting the professionals and technical societies of their disciplines

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Canon III: engineers shall issue public statements only in an objective and truthful manner

Canon IV: engineers shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest

Canon v: enginners shall build their professional on the merit of the merit of their services and shall not compete unfairly with others

Canon vI: engineers shall act in such a manner as to uphold and enhance the honor, integrity and dignity the engineering profession.

Canon vII: engineers shall continue their professional development through out their careers, and shall provide opportunities for the professional development of those engineers under their supervision.

COST ESTIMATION OF HIGHWAY PROJECTS USING ARTIFICIAL NEURAL NETWORK COUPLED WITH BOOTSRAP & MONTE CARLO SIMULATION

Ezra Kassa, MSc.[1] and Asregedew Kassa, PhD., P.E.[2]

ABSTRACT

Some applications and mathematical models are limited in simulating the complex behavior of problems. However, various studies have shown how Artificial Neural Network (ANN) has significant benefits and makes it a practical tool for solving complex problems in the field of engineering and construction. Although ANN is a powerful computing system, it has its own limitations. For example, ANN is frequently criticized as being "black box". In addition, ANN does not sufficiently incorporate the effect of the learning curve and the time factor in predicting ongoing operations when objective data like historical data and/or information are at hand. This study aims at coupling ANN with bootstrap (BS) resampling to enhance its performance and prediction capability by taking highway project cost data as a case study. The accrued data were collected from Ethiopian Road Authority's (ERA) Procurement Compilation Report (PCR) and Engineering Report, which contain contract cost data and project related parameters. Monte Carlo Simulation is also utilized to assess the capability of ANN in detecting meaningful differences and thereby increase its ability to detect sensitivity in changes when it really exists. A range of parameters were set at different possible scenarios and the outputs were simulated. The study identified that neural network approach when coupled with bootstrap resampling and simulation provided better prediction. The enhanced models showed a far more consistent performance and produced smaller Mean Absolute Percentage Error (MAPE) of 0.18 in comparison with the standard models (0.20). This approach is crucial for addressing the several parameters that can influence construction project costs and in turn develop close-to-accurate cost models in which the developed model can be applicable in estimating costs for future projects.

Key Words: Artificial Neural Network (ANN), Bootstrap, Monte Carlo simulation, Cost Estimation, Road Project

[1] *MSc Graduate, Ethiopian Institute of Architecture, Building Construction and City Development, AAU*
PH: (+251) 921 756924
Email: ezrakassa16@gmail.com
[2] *Assistant Professor, Ethiopian Institute of Architecture, Building Construction and City Development, AAU*
PH: (+251) 941 616582
Email: asregedew@gmail.com

1 Introduction

In the construction industry, the successful application of Artificial Neural Network (ANN) can be observed through cost prediction, optimization and scheduling, risk assessment, claims and dispute resolution outcomes and decision making (Pathak, 2014). ANN's are tools of artificial intelligence which have the ability to model data relationships with no need to assume priori equations or formulas which bind the variables. The potential of ANN is shown especially when the relationship between dependent and independent variables are difficult to model using methods such as regression models, making them beneficial in construction where there are various parameters (MichaB et al., 2018). Although, neural networks overcome the main limitations of traditional regression methods, they have a few limitations of their own: lack of interpretability and the need for a strong signal in the data. The lack of interpretability is the basis for the well-known black box objection to neural networks.

Prior studies have shown how Bootstrap (BS) resampling can enhance the performance of neural networks (Ahiaga, 2014). The bootstrap method is a resampling technique used to estimate statistics on a population by iteratively resampling a dataset with replacement. Thus, this study will couple ANN with bootstrap (BS) resampling to enhance its performance and prediction capability by taking Ethiopian Road Authority (ERA) highway project cost data as case study and validating the model through a Monte Carlo simulation. Monte Carlo simulation is utilized to discover the cause and effect relationship between input and output cost variables of the network.

At early project stages, project characteristics might not be decided for certain as project scope is not well-defined. Therefore, the simulation enables a user to see various outcomes and probabilities associated with it, in which the developed model can be applicable in estimating costs for future projects.

1.1 Problem Statement

One of the challenges of using neural networks is the fact that there are no set rules on the nature of the network architecture, number of neurons or layers to use (Ahiaga, 2014). Unlike regression models, whose equation can be easily interpreted, the model exposes neither the algorithms used, nor the exact data sources. The network parameters (i.e. transfer functions, learning rules, network architecture, weights, etc.) do not show casual explanations, making it difficult to elucidate what is learnt from the neural network model. For that reason, it is frequently criticized as being "black box". The model's inner work is unknown to the user and is therefore subjected to suspicion (ISPA, 2008). This has contributed to the slow applicability in the construction industry (Ayed, 1997). In addition, ANN models do not sufficiently incorporate the effect of the learning curve and the time factor in predicting ongoing operations when the final model outputs are used to analyze the dynamic and stochastic behavior of construction (Kisi, 2015). Therefore, one potential means is to couple neural network with other mathematical procedures to maintain its credibility (Roxas, 2014).

1.2 Research objective

The objective of the study is to improve ANN method by coupling it with Bootstrap resam

pling and Mote Carlo Simulation using actual highway project data of ERA in estimating project costs.

2. Methodology: Quasi-Experimental design

The architectural layout of the ANN model followed a pre-experimental approach (a quasi-experimental research design (Thyer, 2016) through collection of specific cost data from Ethiopian Roads Authority (ERA). The accrued data came from ERA's Procurement Compilation Report (PCR) and Engineering Report, which contained contract cost and corresponding parameters. The PCR provided summarized information on a specific highway project, which includes project information, procurement selection method, process of the contract award and other relevant information of the procurement process. Likewise, the Engineering Report portrays key features of the road project. It gives a brief description of the project area, its intended scope of work, etc. The data were originally archived data that made the approach fast and low-cost to (Bärnighausen, 2017).

However, this approach is seriously limited in such a way, without any systematic assessment of the pre-existing data before the intervention, it makes it logically difficult to make any legitimate inferences regarding whether the training set receiving treatment actually had changed. Besides, the independent variables are selected from pre-existing values and not created through manipulation by the researcher, which is attributed for the lower levels of control over the study (Arthur, 2013).

To tackle this problem, Thyer (2016) has put forward some measures to strengthen the internal validity. The first suggestion is to use several different outcome measures that are

reliable and valid. However, one method that judges the best in a uni-dimension is not necessarily the best in terms of other dimensions (Guoqiang, 1998). Because of the limitations associated with each individual measure, multiple performance measures were implemented in this problem. Thus, six different performance measures were adopted to quantify the reliability and the validity of the trained model.

Thyer (2016) also recommends the incorporation of measures that are capable of detecting meaningful differences and changes in lieu of surveys or rating scales. To accommodate this, the use of larger sample sizes increases the ability to detect true differences or changes when they really exist. The mathematical procedure known as bootstrap resampling was one approach that facilitated this intention. Sensitivity analysis was also applied to calibrate the magnitude of each input parameters that were listed in the model using Monte Carlo Simulation technique.

3. Discussion of results

ERA's highway project from 2016-2019 (three years data) was used as objective data for training the model in predicting the cost estimates. To check and prove whether the models are good and the predicted values from the forecast models fit in forecasting future projects, a technique called bootstrap (BS) is used. In addition, in parametric cost estimating models, it is difficult to decide which parameters to measure and how to evaluate their significance to the model (Ayed, 1997). Such uncertainty can be accounted for by conducting a sensitivity analysis. Thus, this study adopted ANN to build a cost estimation model for highway projects

by combining it with Bootstrap and

Monte Carlo Simulation technique to enhance the estimation accuracy of a standard ANN cost model. The developed model evaluates several independent variables in highway projects to recognize the influential parameters in construction cost prediction of road projects.

The primary task in the respective model development was collecting all types of road construction project data. The PCR documents for highway projects, where summarized aspect of the road projects were presented, allowed for collecting 40 projects. After the actual data training stage, the results achieved were then evaluated and presented in a meaningful form to aid decision-making. To implement the study design, the data was first transformed into numerical values and stored in a data-list. The data pertaining to the input parameters for all projects were then entered into a spreadsheet program (Microsoft Excel) and further transformed into numerical values. Accordingly, a three-layer Neural Network was simulated on a spreadsheet format that was easy to use, transparent, and customary to many practitioners in construction

3.1 Training outcomes for the standard ANN model

As mentioned in the previous section, the study adopted six relative measures of accuracy dealing with percentage errors to compute forecasting results of the cost model. After several trials, a network structure with hyperbolic tangent (TANH) activation function on all layers (Model 1 :TANH-TANH) was found to be the best model to estimate the total cost of road projects having an excellent performance on both the training and test cases.

This model was trained using offline (Batch) training and consists of an input layer with 9 nodes, an output layer with 1 node and hidden layer with 8 nodes. "9 nodes" represents the road parameters identified from the sample case studies taken from ERA. These parameters are "Location", "Region", "Class", "Type of project", "Length", "Geometric design standard", "Duration" and "Base year". The remaining one node is the output node which represents "cost of a project" in Ethiopian Birr (ETB).

As shown in Table 1, "Model 1 :TANH-TANH" obtained a satisfactory correlation coefficient, R, values of 0.85 for testing phases. The resulting MAPE of the model is equal to 0.20, which is the smallest value among the entire model tested. It has been shown from the results that the model performs well and no significant difference could be discerned between the estimated output and the desired budget value. An average accuracy of 80% was achieved.

Table 1: Performance Result of Different ANN Models

Model Name	Stopping Iteration Point	Mean Absolute Error (MAE)	Mean Square Error (MSE)	Mean Percentage Error (MPE)	Mean Absolute Perc. Error (MAPE)	Total Accuracy Performance (TAP)	Pearson Correlation
Model 1 :TANH-TANH	14,710	0.242	0.111	-0.085	0.201	0.799	0.850
Model: Mini-Batch 1	1,712	0.408	0.278	-0.103	0.391	0.609	0.577
Model Mini-Batch 2	20,575	0.325	0.215	-0.077	0.369	0.631	0.703
Model Mini-Batch 3	13,450	0.308	0.163	-0.026	0.258	0.742	0.796
Model Mini-Batch 4	48,162	0.886	1.089	0.014	0.886	0.114	0.091
Model Mini-Batch 5	32,045	0.882	1.135	0.379	0.664	0.336	0.050
Model: Mini-Batch 6	48,162	0.505	0.342	-0.016	0.456	0.544	0.571
Model: Mini-Batch 7	19,593	0.879	1.093	0.480	0.606	0.394	0.214
Model 2: Random	304	0.173	-0.202	0.367	0.633	0.701	

3.2 Coupling Bootstrap with the standard ANN model

In this study, the introduction of BS method in the standard ANN cost estimating model has shown to improve the model performance. This involved designating the original dataset to act as the population, then randomly re-sampling it a specific number of times to generate a large number of new samples. A different combination of new sub-samples was then used each time for making simulation on the model before averaging the model performance across the samples. This helped to glean as much information as possible from the entire dataset. 2000 different training, BS sample sets were generated by perturbing the entire dataset for each model using sampling with replacement over a uniform probability distribution. This should ensure that as many information as possible get excavated from the available data.

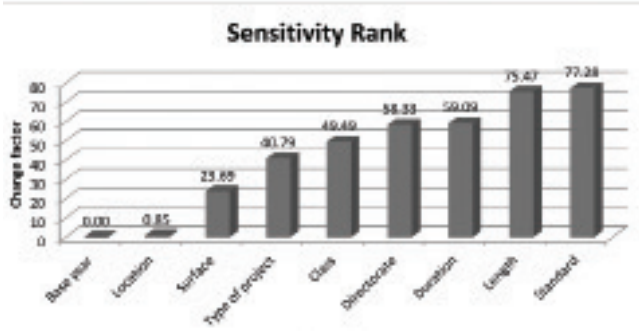
The bootstrapped models showed a far more consistent performance and produced smaller MAPE (0.18) in comparison with the standard models (0.20). It becomes obvious then that the bootstrapped models outperform the standard models. This performance improvement can be attributed to the fact that by using the 2000 bootstrapped sub samples afforded the models a wider learning space than the standard models. Thus, developing a stochastic and point estimating model with the same set of data has become apparent that: the integration of ANN with other soft computing method can indicate a better result when compared with conventional ANNs. Likewise, bootstrap sampling combined with-artificial neural networks is proven as a suitable method to produce a range estimate for highway Projects (Table 2).

Table 2: Range Estimates (Confidence Interval for 2000 BS) in thousand ETB

Test Project Cases	Standard ANN Output	MAX	Confidence Interval				MIN	Actual
			95%	80%	10%	5%		
1	1,462.90	1,669.98	1,483.36	1,479.80	1,442.62	1,439.06	1,268.02	1,193.16
2	473.86	680.95	494.33	490.77	453.59	450.03	278.99	449.72
3	1,462.89	1,669.98	1,483.36	1,479.79	1,442.62	1,439.06	1,268.02	1,580.65
4	473.72	680.80	494.18	490.62	453.44	449.88	278.84	1,159.85
5	1,463.24	1,670.33	1,483.71	1,480.14	1,442.97	1,439.41	1,268.37	1,578.62
6	473.72	680.80	494.18	490.62	453.44	449.88	278.84	421.63
7	473.72	680.80	494.18	490.62	453.44	449.88	278.84	542.49
8	1,462.89	1,669.98	1,483.36	1,479.79	1,442.62	1,439.06	1,268.02	1,835.77
9	1,462.89	1,669.98	1,483.36	1,479.79	1,442.62	1,439.06	1,268.02	1,325.19
10	1,462.89	1,669.98	1,483.36	1,479.79	1,442.62	1,439.06	1,268.02	1,615.64
11	1,462.90	1,669.98	1,483.36	1,479.80	1,442.62	1,439.06	1,268.02	1,593.43
12	1,462.90	1,669.98	1,483.36	1,479.80	1,442.62	1,439.06	1,268.02	2,142.00

3.3 Monte Carlo Simulation Result

The basic concept in conducting the simulation is to capture a meaningful difference when the parameters in the model are shifted slightly by some factor and the corresponding change in the output is reported. The sensitivity of the best model predictions were assessed by variation in the project parameters. Random variations were introduced only in the parameters that the user selects and the sensitivity analysis was conducted by Monte Carlo Simulation. In order not to introduce impractical scenarios into the sensitivity analysis, random variations were limited to a range that is bounded by the maximum and minimum limits. The simulation result is presented in Figure 1.



The sensitivity analysis exhibits that the three independent variables, i.e. Duration, Geometric standard and Length with a change factor of 59.09, 77.27 and 75.46 respectively, represents the highest sensitivity in the analysis. Base year, with a change factor of 0, and location, with a change factor of 0.85, are less significant to actually bring an effect in the developed cost estimation model.

In summary, from prior literature reviews made (Jamous, 2013); Region, Functional class, Geometric design standard and road length are the most frequent parameters used for model development. As expected, these parameters are among the most five top influential parameters which brought a significant change in the performance of the model. Also, just like demonstrated in the Monte Carlo simulation result, project commencement year is seldom used in model development. Hence, the characteristics mentioned in the PCR and engineering report of ERA projects, they closely match with common descriptors of highway projects.

4 Conclusions

Although ANN is a powerful structure, it also comes with some limitations. To keep the internal validity of the experimental design intact, the incorporation of measures that are capable of detecting meaningful differences and changes are highly recommended. This study couples ANN with other mathematical procedures to improve the predictability using case study of highway project cost estimation.

In this study, Bootstrap method is used together with ANN to make project cost predictions especially when a desirable property of the results from estimating can be presented with confidence intervals, a feature not readily available within ANN its self (Table 3).

Table 3: Performance measure of the enhanced ANN model

Performance	MAE	MSE	MPE	MAPE	TAP	Angle difference
BS Model	0.25	0.119	-0.055	**0.189**	0.81	0.849
Standard ANN Model	0.242	0.11	-0.084	**0.201**	0.798	0.849

It is apparent that the point estimate results provide no rational means to assign an individual contingency for each project. Thus, the point estimate provides no improvement to the current state-of-the-practice for assigning contingency. Producing a stochastic estimate visually aided the comparison of expected construction costs for various projects. Hence, a certain contingency premium is added to the base estimate to increase the level of confidence developing a stochastic and point estimating model with the same set of data.

In addition, to evaluate highway project descriptors at inception stage where uncertainties are high, the probability associated with each input were easily outlined by powerful simulation technique. Monte Carlo simulation, in this perspective, helped to assess the risk of undesirable outcomes and the likelihood of desirable outcomes with a piece of historical information at hand (Table 4).

Table 4: Influence rank of input parameters

Rank(from Less sensitive to most sensitive	% Change	Input
1	0.000	Base year
2	0.854	Location
3	23.693	Surface
4	40.790	Type of project
5	49.493	Class
6	58.332	Region
7	59.094	Duration
8	75.468	Length
9	77.277	Standard

This procedure entails the arrangement and representation of the descriptive factors and their associated influence, as required by Neural Network modeling.

5 Recommendation for further studies

While tangible outcomes that indicated ANN based cost prediction can be improved by combining ANN with Bootstrap and Simulations have been achieved from this work, there are key issues that need to be addressed for application in real life context. The following points can be areas of study by which interested researchers could focus.

- The input parameters used in this work are not investigated for external risk that could arise from the dynamic construction environment. The reason is that ANNs is suitable to measure how well, rather than understand the why of a phenomenon. Further research in this area could focus on time-series prediction via ANN to incorporate and withstand the fluctuating nature of construction.
- The stochastic results produced for the standard ANN model was completed manually for 2000 iterations due to time constraint and operational capacity of the computer processer. Future research would conduct more than 2000 iterations of the stochastic estimating method to combine the ANN modeling with bootstrap sampling.

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Assessing the effects of vetiver grass on slope stability using Finite Element Analysis.

Meron Assefa Zegeye[1], Henok Fikre Gebregziabher[2]

Abstract

Vegetation has a good influence on stability of slopes due to its root cohesion that provides additional strength to the soil layer and its hydrological effect involving evapo-transpiration which leads to increase in soil suction and reduction in pore water pressure, consequently increasing the effective soil strength. Vetiveria zizanioides or vetiver grass, one of the famous slope stabilizing plants, has extensively been used in many tropical and subtropical countries. Quantitative studies of how much contribution the grass really provides towards slope stabilization are relatively scarce having focus on engineering methods which are relatively costly and with no ecological benefit.

With the aim of investigating the mechanical behavior of grass stabilized slope, the properties of vetiver grass have been determined from laboratory experiments and incorporated in the nonlinear Finite Element model using PLAXIS 2D software. The parametric studies on different ground types, slope geometric conditions and spatial distribution of vetiver grass confirmed that the effect of the grass is higher on soils of lower cohesion and steeper inclination. It has also been found out that better improvements can be achieved when the grass extends beyond the toe, in excess of the slope face.

Key words: Vetivergrass, Vetiveria zizanioides, slope stability, PLAXIS 2D, parametric study

[1]Meron Assefa Zegeye, MSc Graduate, Ethiopian Construction Design and Supervision works Corporation Building and Urban Design sector, Addis Ababa, Ethiopia, mob:+251910944257, E-mail: merongashe2015@gmail.com

[2] Dr.-Ing. Henok Fikre, Assistant professor, Addis Ababa institute of technology Addis Ababa university, Addis Ababa, Ethiopia, mob:+251940192941, E-mail:henok.fikre@aait.edu.et

Introduction

Vetiver grass is a perennial grass that had been promoted to help conserve the soil and runoff by the World Bank in 1980's. It has been developed to become an important soil bio engineering method (Grimshaw, 1994; Greenfield, 1998). Vetiver grass is a kind of vegetation that is very fast growing and requires low maintenance. The length of vetiver roots was observed to grow up to 2.0-3.5 m (Chinapan et al., 1997).

Ke et al. (2003) tested vetiver on several test sites and got promising results for the use of the plant as a bank protection measure. Verhagen et al. (2008) also conducted different laboratory and model tests on vetiver grass to realize its use in coastal areas and showed that vetiver grass is able to establish a full stop of band erosion caused by rapid draw down.

Jiru and Wari (2019) reviewed the role of vetiver grass for soil and water conservation in Ethiopia. According to their reports, it was introduced to Ethiopia since 1970 to prevent invasion of couch grass in the coffee production area and later for soil and water conservation purposes.

Even though there is a wide range of application of Vetiveria zizanioides in many tropical and subtropical countries (Truong et al., 2008), there is a gap in the level of safety provision about the contribution of the grass towards slope stabilization. This study aims at studying and modeling the effect of vetiver grass on stability of different slopes. The influences of slope geometry and property of underlying soil on the extent of slope stabilization with vetiver grass root are core areas of this research.

Parameterizing the mechanical properties of vetiver grass

Root systems mechanically reinforce soil by transferring shear stress in the soil to tensile resistance in the roots (Fitter 1993), In addition it is asserted that the root architecture, especially the branching pattern has a close relationship with the strength of anchorage (Stokes et al. 1996).The extent of mechanical stabilization of vegetation for slope stability depends on depth of root zone, the root area ratio and root reinforcement.

Depth of root zone is the effective distance beyond which plant roots cause little or no effects on the soil shear strength, which can be determined based on previous experiences (Chinapan et al. 1997).

Root area ratio is the fraction of the total cross-sectional area of a soil that is occupied by roots (Gray and Sotir1996). For the same specimen height, the root area ratio, $[\frac{AR}{A}]$, is equal to the ratio of volume of root and volume of soil.

$$[\frac{AR}{A}]=V_r/V_s=\rho_s m_r/\rho_r m_s \quad \text{..... (1)}$$

where: ρ_r = density of root
ρ_s = density of soil
m_r = mass of root
m_s = mass of soil

With the corresponding unit weights being determined from the laboratory tests, and mass ratio between soil and root is found to be 0.0012, also from laboratory test, the root area ratio has been determined to be:

$$([\frac{AR}{A}]) = 17.1/9.54 * 0.0012= 0.0021$$

Root reinforcement is the term used to express the additional shear strength provided by vetiver grass on the soil. It is quantitatively expressed using the "soil cohesion due to root reinforcement", or "root cohesion". Root cohesion can be determined using the root reinforcement model of Wu et al. (1979), which assumes that the increased soil shear strength can be expressed as an additional cohesion, C_r, calculated as:

$$C_r= 1.2 * T_r \quad \text{..... (2)}$$

and $$T_r= t_R*[\frac{AR}{A}] \quad \text{..... (3)}$$

where: T_r = the total tensile root thread strength per unit area of soil,

t_R = mobilized root tensile stress.

Tensile strength test was conducted at the Ethiopian Conformity Assessment Enterprise laboratory on 20 vetiver grass roots of 20 cm length and 1-2 mm diameter, collected randomly from Debrezeyt agricultural research center. The mean values of the tensile force (t_R), elongation and tensile strength are thus calculated to be 40.8 N, 23.74mm and 23.7 MPa respectively.

The total tensile root thread strength per unit area of soil was determined to be:-

$T_r = t_R * [\frac{AR}{A}] = 23.7 * 0.0021 = 0.05$ MPa

$C_r = 1.2 * T_r = 1.2 * 0.05 = 0.06$MPa = 60 kPa

Wu et al. (1979) assumed that all the roots attain their maximum strength at the same time. But practically, the maximum load that the bundle of root fibers could resist is less than the sum of each of their individual strengths because roots break at different instant depending on the way the load is distributed by all the fibers (Pollen and Simon 2005). Since the Wu et al. (1979) model also does not consider pulling out of root from soil, it over estimates the root cohesion value. To account for this limitation of the root reinforcement model, only 25% of additional root cohesion is added to the soil cohesion for this study. Therefore additional cohesion attained from the root reinforcement is taken to be 15 kPa.

Parametric studies

With the aim of determining the effects of vetiver grass on slopes of different soil types which are prone to failure, Finite Element Analysis have been performed by varying the geometric inputs of the FE model. The root was assumed to propagate 2m below the slope surface since the length of vetiver roots was observed to grow up to 2.0-3.5 m Chinapan et al.(1997) the minimum length is taken. This 2m layer of soil is taken to be the zone of additional cohesion from root reinforcement. Four different types of soils were considered; namely loose sand, soft clay, medium stiff clay, and stiff clay soil whose properties are presented in Table 1, have been adopted from Bowles (1997) and Garg S.K (2014).

Table 1 soil properties used in the analysis

Parameter	Symbol	Unit	Loose sand	Soft clay	Medium stiff clay	Stiff clay
Soil unit weight above phreatic level	$\gamma_{unsaturated}$	kN/m^3	14.5	13	15	17
Soil unit weight below phreatic level	$\gamma_{saturated}$	kN/m^3	18.85	18.2	19.58	20.57
Horizontal permeability	K_x	m/day	0.5	1.00E-09	1.00E-11	1.00E-11
Vertical permeability	K_y	m/day	0.5	1.00E-09	1.00E-11	1.00E-11
Young's modulus	E_{ref}	kN/m^3	25,000.00	7,469.00	15,000.00	25,559.00
Poisson's ratio	v	-	0.25	0.38	0.33	0.3
Cohesion	c'	kN/m^2	1	10	25	50
Friction angle	Φ'	^{o}	30	17.5	19	20
Dilatancy angle	ψ	^{o}	0	0	0	0

Two different scenarios were studied in terms of slope height. In the first case, slope height which gives a stable slope with FOS of around 1.5 is calculated for all soil types.

To calculate the stable height, Taylor's stability chart is used to start with and the exact height is determined by trial and error, using PLAXIS 2D software. Consequently, four different slope heights were determined for the four different soil types as presented in Table 2. The stable height is needed because the grass takes at least 4 - 6 months to develop fully so that the slopes have to stay stable during that period.

Table 2 computed slope heights for different soil types

Soil type	Slope height (m)
Sand	1
Soft clay	4.9
Medium stiff clay	13.5
Stiff clay	21

The second case was developed considering the same slope height for all slopes, in order to do make a more accurate comparison of the effect that the grass provides for slopes with different soil types. A height giving stable loose sand slope (H=1m) is used for this case and all slopes were modeled using this height because it is the smallest and gives a stable slope for all soil types. To study the effect of slope angle, two different slope angles, 45^{o} (1V: 1H) and 26.6^{o} (1V:2H) have been considered. The effect of the grass when it covers the slope face only and when it extends beyond the toe of the slope was also examined. Figure 1 shows the finite element model.

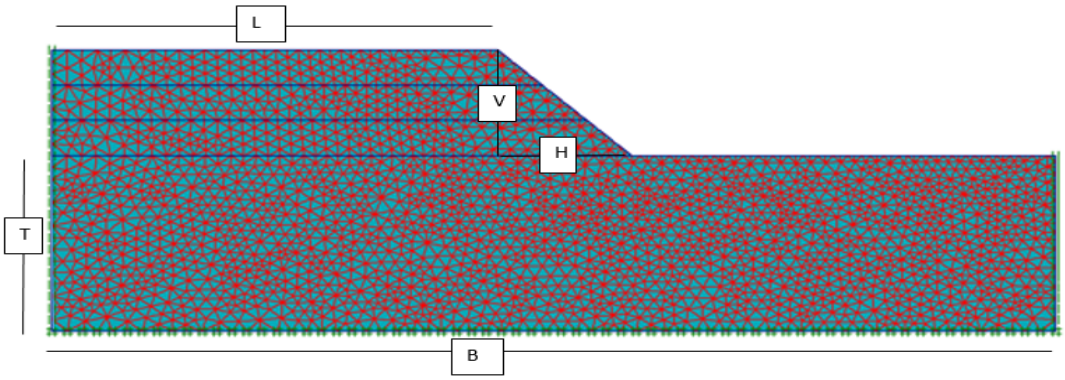


Figure 1 Finite element model.

Table 3 Geometric parameters used for the analyses

Slope	Soil type	L(m)	V(m)	H(m)	B(m)	T(m)
1:1 slope with a slope height of 1m	loose sand	40	1	1	61	20
	soft clay	40	1	1	61	20
	medium stiff clay	40	1	1	61	20
	stiff clay	40	1	1	61	20
1:1 slope with slope different slope height	loose sand	40	1	1	61	20
	soft clay	40	4.9	4.9	64.9	20
	medium stiff clay	40	13.5	13.5	73.5	20
	stiff clay	40	21	21	81	20
1:2 slope with different slope height	loose sand	40	1	2	62	20
	soft clay	40	4.9	9.8	69.8	20
	medium stiff clay	40	13.5	27	87	20
	stiff clay	40	21	42	102	20

Discussion of results

The effects of vetiver grass on slope stability were analyzed by considering factor of safety (FOS) and percentage increase in FOS. The method used to calculate the factor of safety is the Phi-c reduction method implemented in the PLAXIS software in which, PLAXIS reduces the parameters tanΦ and c until failure of the soil occurs, during the calculation process.

Table 4 summarizes the factor of safety values obtained from the finite element analysis computations for different types of ground conditions when the grass extends to different levels beyond the slope face, as compared to that without grass, by considering a similar slope height of 1 m in all cases, so as to avoid the effect of height on the factor of safety.

Table 4. FOSs and percentage increase in FOSs for different spatial arrangement of vetiver grass with 1m slope heights

Soil type	FOS without grass	FOS and % increase in FOS with grass extends to									
		slope face only		1m beyond slope toe		5m beyond slope toe		10m beyond slope toe		model end (20m beyond toe)	
		FOS	% incr. FOS	FOS	% incr. FOS	FOS	% incr. FOS	FOS	% incr. FOS	FOS	% incr. FOS
Loose sand	1.55	3.58	131	4.6	197	4.6	198	4.63	199	4.7	203
soft clay	5.57	7.31	31.3	7.8	40	8.1	49	8.46	52	8.52	53
Medium stiff clay	10.81	12.2	12.4	13.3	23	13.5	25	13.7	26	14.3	32
Stiff clay	19.09	19.6	2.44	19.7	3.1	19.9	4.4	20.2	5.6	20.4	6.7

The contribution of the vetiver grass is evident from Table 4 and the increase in FOS with increasing soil cohesion and area covered by the grass is something one can expect. Since the percentage increase in the FOS is higher for soil with very low cohesion, its application is appreciated in such type of ground conditions. It can also be observed that extending the grass very far away from the slope toe cannot produce significant enhancement in the slope protection. The extent of covering the ground beyond the slope toe can be facilitated by the plots in Figure 2, in which the FOS achieved is presented against the distance covered by vetiver grass.

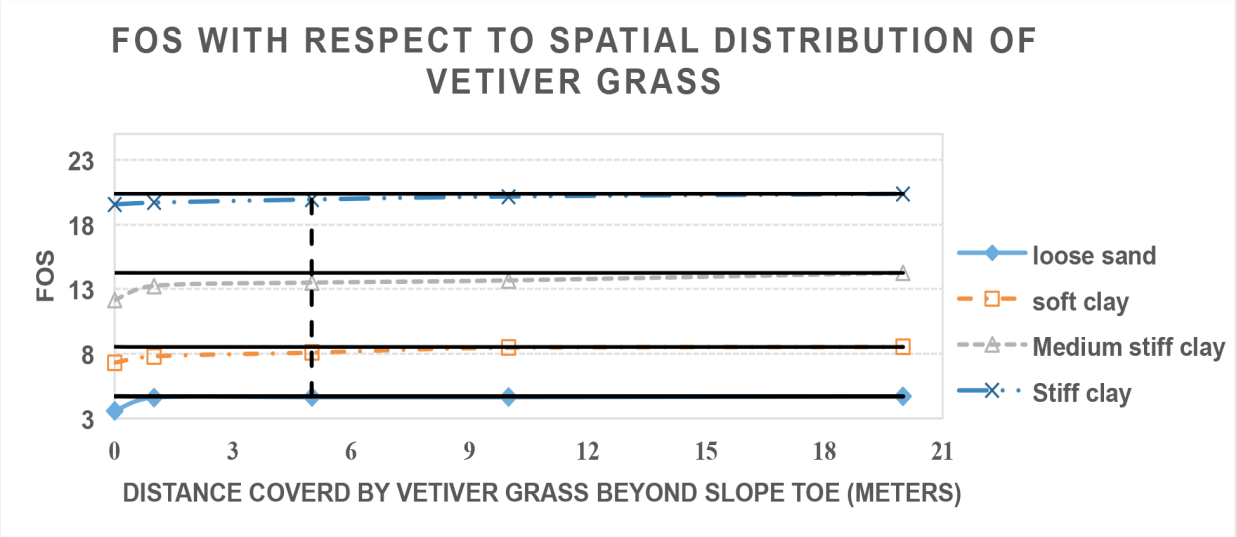


Figure 2 FOS vs. spatial distribution of vetiver grass.

Although the FOS increment is pronounced for the soil types with lower cohesion, the ground improvement seems to be effective only up to a certain distance beyond slope toe, in all the soil types under consideration. The convenient optimum distance beyond the toe after which the slope factor of safety remains constant is found to be 5m.

The other series of computations have been performed by using the stable slope heights determined earlier (Table 2) and keeping two cases of slope angles, and considering the two extreme cases of extending the grass beyond the toe. The summarized FOSs and percentage increases in FOSs are presented in Table 5.

Table 5. FOSs and increase in FOSs for soils with different slope heights

Soil type	Slope height (m)	FOS without grass		FOS and increase in FOS with grass at slope face				FOS and increase in FOS with grass extending 20m beyond toe			
				1V:2H		1V:1H		1V:2H		1V:1H	
		1V:2H	1V:1H	FOS	% Incr. FOS	FOS	% Incr. FOS	FOS	% Incr. FOS	FOS	% Incr. FOS
Loose sand	1	2.19	1.55	4.17	90	3.58	131	5.68	166	4.7	203
Soft clay	4.9	2.11	1.59	2.14	12	1.82	14	2.32	9.7	1.97	23.6
Medium stiff clay	13.5	2.23	1.53	2.25	0.8	1.59	4.4	2.28	1.96	1.72	12.7
Stiff clay	21	1.98	1.57	1.99	0.2	1.58	0.6	1.99	0.7	1.59	1.23

The previous observation of decrement of the % increase in FOS with increase in soil cohesion is evident in Table 5. The expected effects of slope steepening can also be clearly seen from the summarized results. The FOS improvement is high for slope of V: H 1:1 because of its shallow critical slip surface covering relatively larger portion of the root zone. The sleep surfaces

of the two cases of stabilized and unstabilized slope are depicted in Figure 3.

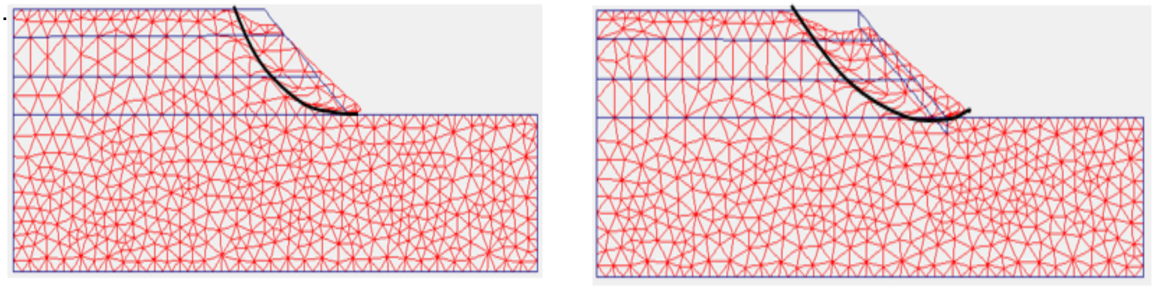


Figure 3.Sliding mass for slope with and without vetiver grass, respectively.

The critical slip surface develops along a soil layer beneath root zone as this soil layer is the top of the weak zone of the slope after introducing root reinforcement within the root zone. In addition to that, to mobilize additional cohesion from root reinforcement within the root zone, the sliding mass has to increase and this is achieved by increasing the depth of critical slip surface. Chok et al (2015) found similar result in terms of critical slip surface location with the presence of vegetation. As the slope is reinforced with vegetation, the critical slip surface goes deeper and shallow planar slide will no longer be critical.

Conclusions

The Finite Element Analysis results conducted by considering different soil types stabilized by vetiver grass, whose mechanical behavior were determined from laboratory experiments, showed its advantages against destabilizing agents such as rain fall and surcharge in addition to preventing soil erosion. The improvement of FOS is not only governed by root cohesion and depth of root zone but is also dependent on underlying soil property, slope geometry and spatial distribution of the grass. It was found out that the improvement is pronounced for soils with smaller cohesion than those with higher strength and stiffness. The stabilization is also found to be better for steeper slopes which are prone to shallow land slide and erosion problems. To achieve safe and more economical results, the grass should extend only 5m beyond the slope toe. The presence of vetiver grass root increases the depth of critical slip surface, requiring higher external force to slide the mass within the critical slip surface. Thus, shallow land slide problem will no longer be critical for slopes with vetiver grass.

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Factors Influencing Completion of Construction Projects the Case of Some Selected Buno Bedele Zone Hospitals

Tomas Tadesse (MA)[1]

Abstract

The construction industry is dynamic in the environment due to the growing uncertainties technology, budgets, and development processes. The main aim of this study was to assess factors influencing the completion of construction projects in some selected Buno Bedele zone hospital. To this end, the descriptive and explanatory design was conducted on 83 respondents taken based on census method, and data were gathered through questionnaire, The validity of the research instruments was confirmed by expert review, while the reliability of the tools was found 0.909 based on Cronbach's alpha. The data were analyzed using descriptive analysis, inferential statistics, regression analysis and correlations involving SPSS version 20. The major findings of the study show that funding, procurement bureaucracy, source of funding and misappropriations of project funds were factors influencing completion construction projects. The study also revealed that there is an influence of stakeholder participation on the completion of projects. The study found there was a statistically significant and positive relationship between the fund, project management, and leadership skills, stakeholder involvement and contract duration and completion of construction projects. The study concludes that adequate resource allocation, strong project leadership and stake holder involvement are essential elements in timely project delivery. Finally, The study recommends project managers should hold stakeholder engagement sessions in the lifetime of the project, contractors should employ the right professional for the right position related to work, Consultant of the project should have to collect sufficient data and detail site investigation and design should be done before tender to avoid future variations and cost estimator should have to consider appropriate risk and factors.

Keywords: fund, leader's skill, stakeholder involvement, and contract duration.

1. Introduction

Project can be viewed as a temporary endeavor to create a unique product, service or result. Construction projects usually include the design and build of a new structure (Majid,2006). The construction industry plays an important role in the growth and development of a country. Throughout the world, the business environment of construction organizations are operating continues to bring a rapid change. The success of any project is highly dependent on its completion time from start to delivery of results. This has a direct bearing on management decisions such as budgets, targets and standards (Serpell, 1998).

The major problem of the construction industry is facing, are the delays and the level of impact these delays on the projects to be delivered in a specified time, within allocated budget and expected quality. The main reason behind this is that construction projects are unique in nature, time-consuming, cost demanding and they are full of uncertainties. As a result, claims and disputes become common phenomena especially on large civil engineering contracts (Osazuwad, 2010).

Delays in the project, completion are a common problem in the construction industry not only with an incalculable cost to society but also with devastating effects on the contracting parties. The impact of delay is that funds committed on projects do not advantages planned recipients and subsequently results in cost and time overrun (Chism and Armstrong, 2010).Construction project completion is affected by many factors. Every investor wants to be sure of the project time and cost. This is because challenges that may affect project completion have far-reaching effects ultimately on the owners' interest. According to Chism and Armstrong (2010) in a study carried in USA declare that in the current economic landscape, project owners are scaling down or eliminating capital construction projects due to lack of financing, uncertainty over costs, and concerns about potential delays that could impact the feasibility basis of projects.

The building industry is important for both the developing and developed economies. It contributes 10% towards GDP for developed economies and more than 4% for the developing countries. The construction time has always been used as one of the benchmarks for assessing the performance of a project and the efficiency of an organization (Gwaya et al, 2014).

2. Statement of the problem

Chan et al, (2008) hold that the most important cause of postponement in the construction sector is financing by the contractor during the project, changes in designs by the owner or his agent during the construction, delays in contractor's payment and non-utilization of professional construction management. The end-users and stakeholders of a project play a fundamentally important role in success or failure of the project (Brennan, 2002).

Construction Management or Construction Project Management is the overall planning, coordination, and control of a project from beginning to completion. It's aimed at meeting a client's requirement in order to produce a functionally and financially viable project (Talukhaba, 2009).

The construction industry in Ethiopia has been developing tremendously since 2001. Studies by Zewdu and Aregaw (2015) indicated that the GDP contribution of the industry has been raised to 5.6% and approaches to the sub-Saharan average (6%). Meanwhile, the Gross Domestic Capital Formation (GDCF), which was about 60 percent in 1996/97, has reached nearly 75% in 2002/03. According to Zewdu and Aregaw (2015), Public construction projects in Ethiopia are parts of the country's development initiative, it shared a considerable amount of the country's scarce financial resources; the sector is the highest recipient of the government budget, Consequently, public construction projects consume an average annual rate of 58.2% of the government's capital budget.In Ethiopia, projects are the life line of construction plan or programs. Failure of projects irrespective of the sector, whether public or private contribute to permanent loss to society and to the economy as whole. Delays and non-completion of projects from initial cost plan has been common on construction sites. However, little or no efforts have been made to curtail the phenomenon. There have been numerous documented studies on failed or stalled construction projects. However, there has been no particular research to address factors influencing completion of construction projects in some selected Buno Bedele Zone hospitals. This research therefore seeks to fill in the gap that exists in the factors influencing completion of construction projects in some selected hospital of Buno Bedele zone.

3. Objectives of the study

3.1 General objective of the study

The main objective of the study was to assess factors influencing completion of construction projects in some selected hospital of Buno Bedele zone.

3.2 Specific objective of the study

- To examine the extent to which leadership support and funding influences the completion of the construction projects in some selected hospital of Buno Bedele zone
- To investigate the extent to which contract duration and stakeholder involvement influences the completion of the construction projects in the study area.

4. Research Methodology

The study was used descriptive and explanatory research design by combining both quantitative and qualitative research approaches to analyze data and obtain adequate information. The target population of the research paper was contractor, sub contractor, and project management core processes their total number is 83. Sampling techniques of the study was census method. The study used primary and secondary source data, primary data was collected by using questionnaires, the questionnaires were prepared thematically on the basis of the research questions and secondary sources of data were books, magazines and the internet that involves; looking into already done materials, document analyses from various published and unpublished documents.

Validity refers to the extent to which an instrument measures what is supposed to measure,

data need not only to be reliable but also true and accurate. If a measurement is valid, it is also reliable (Mugenda and Mugenda, 2003). In the study, the validity of instruments was pre-tested by potential experts and consultant. The reliability of the instrument was measured using Cronbach's alpha test. The internal consistency reliability results in the study were 0.90 that is classified under excellent categories. Analysis of data was done in order to answer research questions of the study. Data collected was sorted, classified and coded then tabulated for ease of analysis. The data was summarized and categorized according to common themes To analyze the data, different kinds of statistical methods including descriptive statistics and inferential statistics was used. Furthermore, descriptive are applied for percentage standard devotion, and mean value was computed using SPSS (20).

5. Results and Discussions

Based on the sample size, questionnaires were prepared and distributed to the participants and from these, only 2 respondents did not return back the questionnaire. Due to this reason 81 (97.5%) of the distributed questioners are collected. According to Mugenda and Mugenda (2003) a response rate of 70% and over is excellent; therefore, this response rate is adequate for analysis and reporting.

The result of background of respondents indicated that majority of the respondents are male with total of 75.3% while the remaining 24.7% were female.With regarding to marital status of the respondent majority of respondent 65.4 % were married, with mention to age most of them are in the age range of 18-30 at 37% and education back ground majority of the employee sample group were first degree holders which represents 64.1% from the total employee participant, in addition majority of respondents have a working experience from 6-10 years which represent 34.5% from employee contributor of research.

Table 1: Inductor of Fund and Leadership skills on completion of construction projects

No	**Fund factors**	No	Mean	Stand. Devotion
1	Sourcing of project funds influence completion of construction projects.	81	3.8	1.127
2	Budgeting for construction project elements affects completion of construction project.	81	3.81	1.158
3	Adequate funding allocation enhances completion of construction.	81	3.82	1.255
4	Sponsors play a key role on funding for completion of construction.	81	3.73	1.036
Project Management and Leadership Skills factors				
1	Poor knowledge of project management affects project completion.	81	4.24	0.933
2	Supervision during construction is critical to ensure quality products and timely delivery of project.	81	3.60	1.005
3	Effectiveness of construction management will affect the speed of construction.	81	4.01	1.035

According to the findings in table 1,The sourcing of project funds, budgeting for construction project elements, funding schedule, and inadequate funding allocation enhances completion of construction and sponsors were affect the completion of a construction

project at the grand mean score of 3.8,3.81,3.82 and 3.73 respectively. This implies that the financial or fund factors influence completion of construction projects to a great extent.

The other factor is projected management and leader's ability, those are good leadership of the project team, poor knowledge of project management, supervision during construction and effectiveness of construction management were affect the completion of the construction project at grand mean score of 3.83, 4.24, 3.6 and 4.01 respectively. It implies that Good management and leaders skill of the project enhance proper and quick project completion.

Table 2: Indicators on takeholder Involvement and Contract Duration

No	**Stakeholder Involvement factor**	No	Mean	Stand. Devotion
1	Involvement of the stakeholders improves completion of the construction projects.	81	4.07	1.007
2	There is a relationship between involvement of the stakeholders and completion of the construction projects.	81	4.18	1.039
3	Some stakeholders interfere with the hospital project due to vested interest affect project completion.	81	3.9	1.112
4	Poor coordination of the stakeholders can cause delay in project completion.	81	4.06	0.998
Contract Duration Factors				
1	Project Scope affect project completion	81	4.03	1.160
2	Poor contract management, changes in site condition and shortage of material affect project completion.	81	3.84	1.272
3	Contractor's shortage in infrastructure, main supply of resources and clients and consultants affect project completion.	81	4.26	.959
4	The problem of vague work schedule influence project completion.	81	3.67	1.026

As per table 2, The stakeholder involvement factor is; involvement of the stakeholders improves completion of the construction projects, there is a relationship between involvement of the stakeholders and completion of the construction projects, some stakeholders interfere with the hospital project due to vested interest and poor coordination of the stakeholders affect project completion at a grand mean score of 4.07, 4.18, 3.9 and 4.06 respectively. It implies stakeholders have an influence on a project completion they normally benefit from a successful result of a project.

The last factor are contract duration; project scope, poor contract management, changes in site condition, shortage of material contractor's ,shortage in infrastructure, main supply of resources and clients and consultants affect project completion, and problem of vague work schedule influence construction project completion at the grand mean score of 4.03,3.84,4.26 and3.67 respectively. This shows that contract duration factors affect completion construction project in the study area.

Coefficient of Determination

The variation in completion of construction projects needs to be explained by fund, project management and leader's ability, stake holder involvement and contract duration.

Table 3: Coefficient of determination result

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.858[a]	.736	.733	.08389

According to table 3, the independent variables that were studied explain only 73.6% of the completion of projects as presented by the R^2. This, therefore, means that the independent variables only contribute to about 73.6% to the completion of projects while the other factors not studied in this research contribute 26.4 % to the completion of projects hence there is a need to further study the other factors.

Multiple Regression Analysis

Multiple regression analysis was done to determine various factors that influence completion of construction projects.

Table 4:Multiple Regression Analysis

Model	Unstandardized Coefficients	Standardized Coefficients		T		Sig.					
		B	Std. Error	Beta				1V:2H		1V:1H	
				1	.734	.285		2.581	.011	FOS	% Incr. FOS
1		2.19	1.55	4.17	90	3.58	131	5.68	166	4.7	203
	Fund factor	.402	.056	.330	4.663		14	2.32	9.7	1.97	23.6
	Project Management and Leadership ability	.389	.086	.312	3.855	.000	4.4	2.28	1.96	1.72	12.7
	Stake holder involvement	.331	.059	.284	2.782	.006	0.6	1.99	0.7	1.59	1.23
	Contract duration	.309	.074	.209	1.206	.000					
	Dependent Variable: project completion										

According to table 4,taking all factors (fund, Project management, and leadership ability stakeholder involvement and contract duration) constant at zero the completion of construction projects realized would be 0.734. The data findings analyzed also shows that taking all other independent variable at zero. A unit increase fund at beta value .402, which implies that a 1% increase in fund unit will cause a 40.2% increase in project completion. Project management and leadership ability at the beta value of .389 which implies that a 1% increase in project management and leadership ability unit will cause a 38.9% increase in project completion; stake holder involvement unit will cause a 33.1% increase in project completion. Contract duration at a beta value of .309 which implies that a 1% increase in contract duration unit will cause a 30.9% increase in project completion; the statically significance level of this variable is 0.000; this is at 95 percent confidence interval.

Conclusion

In conclusion, adequate fund allocation improves timely project completion however in the study area fund allocation has not been given the necessary attention it necessitates from the only government which does not have consistency. In addition to this project management and leadership ability is the other factors affecting the completion of the construction project. The study also revealed that there is an influence of stakeholder participation on completion of construction projects. This can be taken to mean the extent to which stakeholder participates ensures enhances ownership and sustainability of project. Finally, contact duration is the other factor affecting the completion of construction project in the study area. Based on the correlation analysis the relationship between the fund, project management and leader's skill, stakeholder involvement and contract

duration and completion of construction were strong and positive relationship and the results of regression analysis observed that fund, project management and leaders skill, stakeholder involvement, and contract and completion of construction has a significant positive effect on the completion of construction.

Recommendations

Based on the findings of this study and conclusion made, the study recommends that Project managers should hold stakeholder engagement sessions in the lifetime of the project to ensure that every interested party plays their role in ensuring the construction contract. The project manager as well as a top level management should apply proper project management techniques, such as: proper planning, scheduling and monitoring, proper cash flow and resource scheduling together with strict monitoring. The contractors should employ the right professional for the right position related to work, i.e. on project manager position the contractor should assign a person who has experience and specializes on construction technology and management, construction engineering and management, and related professionals. Consultant/supervisor of the project should have to collect sufficient data and survey, and detail site investigation and design should be done before tender to avoid future variations and during cost estimation process the estimator should have to consider appropriate risk factor and escalation factor, because during the construction period the cost of construction materials, tools, labors, equipment etc. may vary from time to time.

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Production of Roof Ceiling Boards from Wasted Paper

Tamire chaka , Shanbel Tadesse , Amanuel Wondu, Nebiyu Mohammed , Nowiwerk Abera.Moges Getahun.

ABSTRACT

The need for human being is shelter. In the entire world the population is increasing day to day for that the human need shelter for living.

Building is permanent or temporary structure enclosed with in exterior wall, roofs, and including all attached structures that cannot be removed without cutting in to ceiling, floors or walls. Building serve societal needs primarily as shelter from weather, security, living space, privacy, to store belongings and to comfortably live and work now a day. The house construction of our country is very difficult due to many reason one of those are the cost of finishing materials. Among the finishing materials, roof ceiling is one of them. Most of the product is imported from abroad having a high cost.

This research work investigated the potential applicability of waste paper in the production of ceiling boards with focus on achieving: environmental sustainability, safe disposal of waste paper and more cost effective production of materials. The main aim was to provide locally produced and environmental ceiling board that are cost effective. Four mix designs were formulated and used for the casting (1:0:6, 1:1:5, 1:2.5:3.5 and 1:2:4) Ordinary Portland cement, Sawdust and waste paper ratios respectively, varying in regards of the weight of the waste paper components. exhausted Cereal powder (maize, barely, sorghum, wheat) was added to the mix as an additive to aid binding. The mix design was satisfactory for the production of roof ceiling prototype having size of 40cm in length, 40 cm in width and 1.5 cm in thickens, and laboratory experiments were conducted to determine the properties and suitability of the produced boards. Properties such as water absorption, abrasion, modulus of rupture, pull-out and cutting test, and flexural strength and ultimate loads were considered for comparison. The boards with 1:2:4 mix ratios displayed the best results of the test properties hence, its mechanized manufacturing was recommended.

Key words: Wasted Paper; Cereal Powder Additive; OPC; Ceiling Board; Water Absorption, Flexural Strengt

1. INTRODUCTION

Waste includes all items that people no longer have any use for, which they either intend to get rid of or have already discarded. Those wastes are hazardous both to man and the environment. Majority of these waste emanate from households, commercial activities, and industries giving rise the waste production. Then the need for proper management is of greater essence in other to prevent the harmful effects of some of these wastes. Paper is an essential commodity in line with its socio-economic importance in the overall development of the country. which is directly linked with the industrial and educational growth in the country. This increase in both industrial and education sector development, as well results to increase in demand of paper in the country. With this excessive demand of paper, its abuse is inevitable hence the need of waste paper management. For once a substance or an object has become a waste, it will remain a waste until it has been fully recovered and no longer poses a potential threat to the environment or to human health. Among many methods of waste management, recycling and prevention is the best method of waste paper management. Waste paper is the unneeded by products (used paper) that discarded away or dispose to the community. This waste paper can pollute our environment while burning. Waste paper has usually nothing to contribute to the environment other than pollution, so we need to minimize this pollution by recycling the waste paper. Recycling paper is a method of recovering waste paper and remaking them into new paper products. The recycling of waste paper is the process by which waste paper is turned in to new paper product. Waste paper can be recycled into useful materials like paper boards, roof ceiling etc. Paper waste prevention is a practice of reducing or eliminating paper use; so that the potential for paper to be ineffectively used or disposed is prevented. The use of waste paper to produce paper products is a good economical across the world. The reuse of waste paper is a waste minimization strategy which includes reclaiming activities as various human activities result to the production of significant amounts of waste of different materials.

Waste materials can be used directly or recycled to produce the same or another product. This has the benefit of not only reducing the amount of waste paper but can also provide significant cost reduction for the production of roof ceiling.

1.1. STATEMENT OF THE PROBLEM

Where do we begin to solve the affordable housing problem? Among the most basic of human is a place to call home .One of the biggest issues, all over the world is addressing affordable housing. This fact is strengthening in developing countries like Ethiopia .As many developing countries,

Ethiopia is facing a lot of problems a high population growth with a huge release of wastes and erosion caused by deforestation can be considered the most serious one the need for housing is increasing with the increment of populations.

A challenge facing the Ethiopian government and society is thus to give a growing population opportunities to obtain decent ,suitable and affordable housing because conventional and modern housing components or

their constitutes are imported ,their prices are beyond the reach many, their manufacturing plants and transportation consumes lots of energy and also characterized by high carbon emission in their production and their high costs and low affordability are still major challenges .With the current trend of the economic growth in Ethiopia , the construction sector is in need of transformation to meet the national demand especially of housings.

The other challenges, the country facing is a high volume of waste released to the environment .Among the waste, paper waste takes the second largest volume .According to the World Bank report, global waste to grow by 70 percent by 2050 unless urgent action is taken. [12]. One way to overcome this challenge is to adapt and study on the use of locally available materials and wastes as alterative construction materials for production of roof ceilings.

This paper aims in producing roof ceiling majorly from waste papers. This wasted paper is obtained in office, municipality office, colleges, lower grade school, higher educational level and the like by product (waste) paper. The problem and the local availability of the raw material enforced us to produce a new finishing material (roof ceiling).

2. MATERIALS AND METHODS

2.1. Instruments

This research was done by using different instruments for the production of the board from the initial to the product (ceiling board)

Balance: It was used for measuring all measurable ingredient quantities of the produced board and was applicable in electric power and battery source.

Meter: it was used to measure the every dimension of the prototype.

Container: This instrument was used for soaking the waste paper. The container could be used up to 0.385$m^3$of waste paper.

Sieve: The sawdust was allowed to pass through 2.36mm sieve. This was done to get rid of some unwanted materials such as stones, pieces of metals and woods,etc

Measuring cylinder: It was used to measure the amount of fluid ingredient (water and cereal powder paste)

Stove: This instrument was used for boiling the cereal powder to form paste and the stove was applicable by electric power.

Mixer: An electric power machine rotated an average of three revolutions per second used for mixing the ingredients.

Molding equipment: Those instruments were used for casting the mixed paper in the desired shape and size. The mold was fixed by metal (40cm*40cm*1.5cm) and flat timber (15cm*15cm*1.5cm) length, width, depth respectively.

Oven: Drying instrument used to remove moisture in the sample and know the amount of water has been contained in the sample. It adjust its temperature according to variation of room temperature and amount of power supply to the machine at 105±5o^c

2.2 Materials

Waste Paper: Waste papers were collected and unwanted materials such as stencil papers, office pins, cenotaph, etc...,
were carefully removed manually from the sample papers. The paper served as sources of main constituent for the

composite. The paper samples were shredded manually. They were then soaked in water at room temperature for about three hours

Cement: The cement used in the mixture was ordinary Portland cement (OPC) and used as a binder when it was mixed with water to form paper-cement paste.

Saw-dust: Saw-dust samples were collected from saw mill, timber shade. The samples were dried in the open at room temperature. It was then sieved through 2.36mm sieve. This was done to get rid of some unwanted materials such as stones, pieces of metals,

woods and etc… Saw-dust serves as both filler and source of fiber in the matrix.

The sawdust was also soaked in water to allow for softening before further processing. The saw-dust was also soaked for about three hours in a separate container. After soaking and pounding, the pulp was collected in a container to ensure an eventual proper and uniform mixing with the pulp.

Water: to accomplish every activity of the product

Cereal powder paste: the cereal powder was manually cleaned and boiled using stove at 100 o^c for ten minutes then this would form jelly like character and used as a binding agent called paste. The paste would be used according to the sample mix ratio .The paste would be effective when mixed with other input ingredients at a temperature of 60^{o}c.

2.3 Methods

2.3.1 The Process for the Production of Ceiling Board

Saw-dust and cement were mixed at arbitrarily selected ratios. A known weight of the mashed waste paper and the cereal powder paste were mixed. Selected ratios of Saw-dust and cement were mixed. The paste-paper mix was mixed with cement-sawdust mix in a bucket. It was stirred to a homogenous mix. A mold of size 400x400 mm with a thickness of 15mm was cleaned and oiled lightly with petroleum lubricant. The mix was casted into the mold with manual compaction by hand and rod in three layers each of five mm thickness. A trowel was used to trim and smooth the exposed top surface. Four mix ratio samples of the ceiling boards each having three specimens were produced. Removing the molds from the samples could be followed by attaining seven days strength. This was done due to the reason that, the samples have gained enough strength to support themselves at the end of seventh day air drying. The moisture content was measured from the ratio of the weight of the moist sample to the weight of dry sample, and the value was 75%.

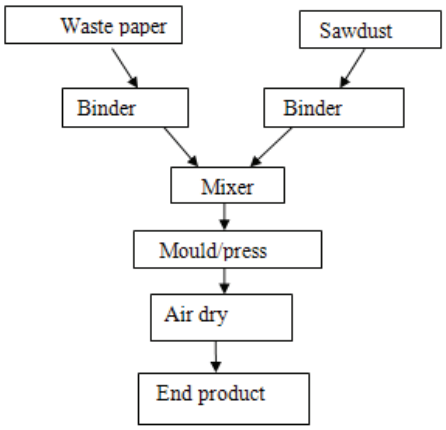


figure 1 Process of production

2.3.2 Pilot Tests

Accordingly, conducted both physical and mechanical properties test that could be done. As described above, we used ordinary Portland cement (OPC), waste paper (WP), cereal powder paste (P) and saw-dust (S) The arbitrarily testing ratio for each of the materials described in the ratio of OPC : S : WP.

a) Physical property tests

These test methods covered some of the physical tests of waste paper ceiling board; Machines aid and manually testing procedure were used for those properties tests.

I. Water absorption

The entire sample at the end of soaking in water and before soaking was weighted as W_2 and W_1 respectively. Its variation with different mix ratio was conducted as [10];

$$WA = \frac{(W2 - W1)}{W1} * 100\%$$



Figure 2 Water absorption

Abrasion test

Abrasion Test tends us to know the ability of a ceiling board to resist the relative movement of the board in contact with other solid bodies. For the purpose of this test, a dried sample of the board was weighed (W_1). A hard shoe brush was used to rub against the two surfaces of the board. 50 strokes of forward and backward movements each were made against the surfaces. The flaked particles from the surfaces were collected and weighed. The flaked board was also weighed (W_2). This procedure was repeated for all the four samples of three specimens. Flaking concentration (Fc) was determined using the expression in;

$$FC = 100\% - \frac{(W1-W2)}{W1} * 100$$



Figure 3 Abrasion test

II. Density (D)

The average density of sample was tasted

$$D = \frac{\text{weight}}{\text{volume}}$$

b) Mechanical property tests

The mechanical properties have been conducted were flexural strength test, MOR test, MOE test, and pull out and cutting test [6].The tests were summarized according to the respective mixing ratios.

I. Flexural strength test

Flexural properties of each ceiling boards were evaluated by supporting the specimens

near the ends and applying a transverse

load midway between the supports [7]. The testing result were recorded just when the board fails to resist those loads presented below according to the mixing ratio. The four samples had different mixing ratio and the respective flexural (bending) strength of each sample was tasted and described.

II. Modulus of rupture (MOR)

This was used to determine the peak load that can carried, it is calculated with the formula [8]

$$MOR = \frac{P.L.C}{6.I} \quad ,$$

Where:

$I = \frac{b.h^3}{12}$, I is moment of inertia in mm^4

P is the applied load in N

L is length of the sample in mm

C is half of the thickness of the sample in mm

b is width of the sample in mm

h is thickness of the sample in mm

All parameters remain the same as above and c=half thickness of the board

III. Pull-out and cutting test

This test was run to perform the fixing capacity of the board when nailing by hammer. Four specimens of each three specimens had a size of 15cm x 7.5cm x 0.15cm were prepared with the same

dosage used in the manufacture of

prototype boards. These specimens, after 7 days open air hardening were subjected to the pull-out test.

Nails of 2.50 mm in diameter and 32 mm in length were introduced into the specimens, shown in the fig. below. Two nails were inserted in the lateral face, two on the longitudinal side, and one at each end side of the piece. Beside the pull-out test cutting the sample using saw was also conducted. Accordingly the entire sample had different mixing ratio and had different strength that have been observed by visualization the effects. The effect of both pull-out and cutting test was summarized as follows.

IV. Impact test

This measures the amount of energy absorbed by a material during failure. This test was needed whenever something from the roof could be dropped to the ceiling panel for instance Un- bolted purlin, cracked side wall etc...And so the ceiling should resist such kinds of sudden loads. This test was carried out using spherical steel ball which is used for loss angels abrasion test those ball have different failure loads. According to the NTC 4335 standards have been conducted for impact load dropped from a height of one meter above the sample by suspending the ceiling[8]. And different failure load was observed for each sample and specimens.

Energy absorbed=mgh.

Where; m=mass of spherical wheel

g=acceleration due to gravity ($9.81 m/s^2$)

h=1m height above the suspended sample

3. RESULTS AND DISCUSSIONS

All tests outcome were conducted in accordance to the research design described. Now, laboratory test outcomes were presented for both physical and mechanical property of ceiling board. Various percentage tests have been considered in order for focusing the thesis with the improved property of samples which satisfied for the production of

ceiling board. And those test outcomes were evaluated and compared with standards and previous research results. So the applicability of this ceiling board could be identified for use of as construction material.

a) Physical property tests

I Water absorption (WA) value of the tests

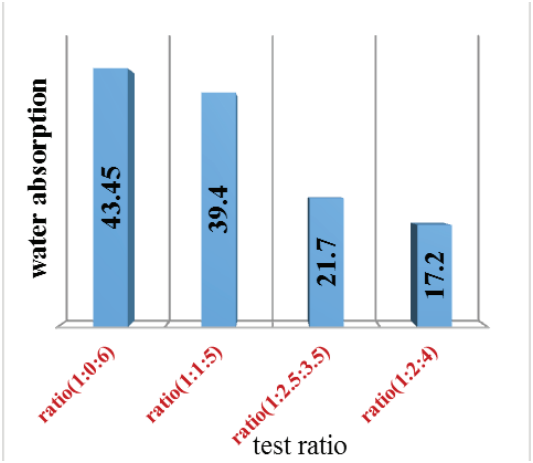


chart 1. water absorption test result

Out of the four samples tested for water absorption, it was found that test 4 with the mix ratio of 1:2:4 absorbed the least quantity of water and its average percentage water absorptive was 17.2% unlike the other tastes. Based on the results shown, it was noted that the mixing proportion has significant effect on the water absorption. This shows that more water is absorbed with decreasing quantity of cereal paste. Hence, there is a need to treat the mix with cereal powder paste to be used in ceiling boards in order to reduce its affinity for water.

According to the water absorption of previously produced ceiling type fiber cement flat sheet, trilite board ,and waste paper ceiling with rice husk <35%,<35%,16.83-18.3% respectively. Therefore, test 4 with mixing ratio of 1:2:4 (cement: sawdust: waste paper) had water absorption of 17.2% which had comparatively best result than the above described ceiling types. [3]

II. Abrasion test result

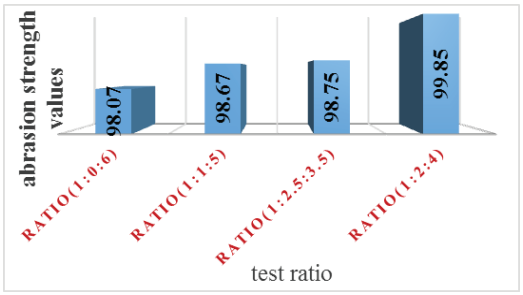


Chart 2 . Abrasion test result

According to the Abrasion strength of previously produced ceiling type fiber cement flat sheet, trilite board, and waste paper with rice husk ceiling 99.31%, 98.6%, and 98.07% to 99.85% respectively. So, the mean values of the abrasion strength obtained from the experimental board samples ranged from and from this study test number 4 had strength of 99.85 %.This showed that the ceiling boards with this mixing ratio, the quantity of the sawdust was in optimized ratio and the additive agent, cereal powder paste resist the board for prone to flaking. From the above graph indication, our study result had optimized value. [2]

III. Density test result

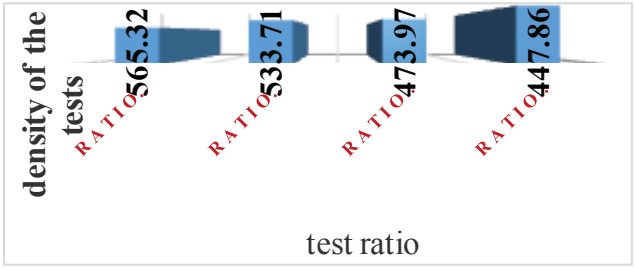


chart 3 Density test result

It was observed that the density of the samples decrease as the composition of paper decrease. The density of sample 1, which is purely made of waste paper (100% pulp), is 565.32 kg/ m^3, while that of sample 4, which is

80% paper and 20% sawdust, is 447.86 kg/ m^3. This indicated that wood waste and the waste paper had the minimum density as compared with using paper waste only. But, using more than the specified ratio of sawdust, the density of the board would increase due to higher density of wood than paper.

b) Mechanical property tests

I. Flexural strength test

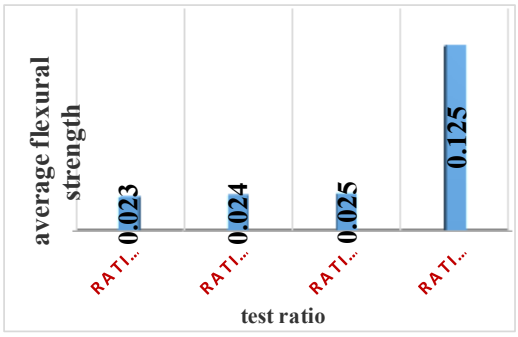


Chart 3 Flexural strength test

The highest flexural strength value 0.125 N/ mm^2 was achieved on the board sample with mix ratio 1:2:4. Other values are 0.023 N/mm^2, 0.024 N/mm^2 and 0.025 N/mm^2 for samples produced from mixes 1:0:6, 1:1:5 and 1:2.5:3.5 respectively. It was found that sample 1 failed on the application of more than 37.441N load, sample 2 failed after the load applied was more than 39.669N, sample three failed after the load applied was more than 42.24N, and sample 4 failed on the application of load more than 200.60 N. Test 4 indicated the ability of ceiling board to withstand flexural stresses during the handling or use of the material. . Based on the results shown, it was noted that the mixing proportion has significant effect on flexural strength test. This showed that as the amount of waste paper and sawdust increase the flexural strength of ceiling board decrease [7].

I. Pull-out test and cutting test results

Table 1 effect of crack and fracture

Test	1	2	3	4
Mix ratio	1:0:6	1:1:5	1:2.5:3.5	1:2:4
Pull-out effect				
(crack occur-rence)	Oc-curred	Occurred	Partially Occurred	Didn't. Occurred
Cutting effect				
(frac-ture occur-rence)	Oc-curred	Occurred	Partially Occurred	Didn't. Occurred

This indicated the ability of ceiling board to withstand Crack and fracture during the handling or use of the material, from the above result test 4 resisted fracture and crack while cutting and nailing the ceiling board. This was achieved due to the optimal amount of sawdust with additive cereal paste in the sample.

Therefore, the ease of handling of the plates was noted, given their low weight and flexibility of assembly with screws, without generating fractures at the edges.

II. Impact strength (Nm)

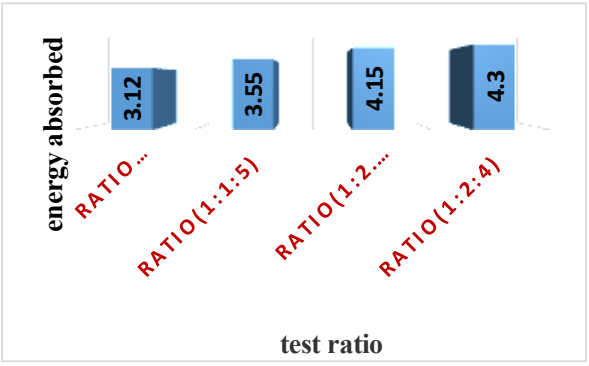


chart 4. Impact strength (Nm)

According to the Impact strength (Nm) of previously produced ceiling type fiber cement flat sheet, trilite board, and waste paper with rice husk ceiling 5.2-6, 4.9-4and 4.29-4.31 respectively.

It was observed that our research study board had an average impact strength value of 4.3 Nm which in turn indicated that it had optimized value among the three tests conducted. This was due to the presence of 20% of sawdust and 80 % of paper with cereal powder paste gave best outcome and increasing the amount of sawdust would decrease the result. And it was observed that the test outcome had optimized result than the other type of ceilings described in the above [4]

III. Modulus of rupture (MOR)

The results of the flexural strength test were used to compute both the MOR of the boards as a result the modulus of rupture just before fail when load was applied during flexural test was recorded for each tests conducted and test four (4) shows higher average result, 0.783 N/mm^{2}the optimized value was due to the presence of 20% of sawdust in the mix, this sawdust

increase the bondage of the mix when additive agents (paste) were used because sawdust have course texture and would increase the binding capacity ,which intern increase the sample strength and MOR value. Therefore, from the values of MOR it can be seen that the maximum MOR is satisfactory with the ASTM 208-72 requirement of not exceeding 2 N/ mm^2 [9]

4. CONCLUSION

From the results of the boards produced from waste paper, it was found that the boards had a good impact strength, abrasion strength, flexural strength, MOR, pull out and cutting strength, density, and a special water resistant property which can find usage in humid areas because of its low value of percentage water absorption. So, this study concluded that the board attained good physical and mechanical properties as compared to other previously manufactured ceilings.

The paper ceiling board attained its optimum value of the specified physical and mechanical tests with a mixing of ordinary Portland cement, sawdust and waste paper in ratio of 1:2:4 respectively. All the test outcome were the 7 days air dry value but, as the day increase up 28 days the maximum test value would be obtained.

From the research low cost composite ceiling boards has been made from environmental waste materials (sawdust) and waste paper which were considered and treated as waste materials exposed for disposal. This composite material compared favorably with other commercially available ceiling board materials. This study has equally shown that waste materials has been recycled into ceiling boards which can still be useful to man thereby protecting the environment to an extent, from waste disposal challenges.

5. RECOMMENDATION

It is highly recommended that production factories for composite ceiling boards be established as part of the entrepreneurship development programs of our higher institutions creating jobs for both skilled and

unskilled personnel in the midst of locally available raw materials.

Further researches have to be done for determining the chemical properties of those ingredients while mixing. And thermal

conductivity test have to be done.

To meet the demand of consumers, machineries that can produce large amount of ceiling have to be implanted.

Finally, by studying further tests and increasing the amount of the additive partition wall board and paper brick with the optimized ratio (1:2:4) of constituent materials will be produced.

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Contact person

1) Tamire chaka ; Sodo Buee, Ethiopia

Mobile 0964095274

E-mail tamichaka@gmail.com

2) Shanbel Tadesse ; Sodo Buee, Ethiopia

Mobile 0919400888

Information for Authors

Overview

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