

Effects of Poor Workmanship on Building Construction and Its Implication to Project Management Practice: A Case Study in Addis Ababa City

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Abstract— The construction of building structure involves very complicated undertakings. It requires a trained workforce at the design stage, approval process, supervision, and construction stages. Inferior quality of workmanship is one of the significant issues facing the workforce to perceive and apply the proper construction methods and techniques following the quality control assurance for building projects. This study considered some of the construction stakeholders participated in the implementation of projects in Addis Ababa City. It focused on assessing and investigating poor workmanship on the quality of projects that included concreting works to accessible ongoing construction sites across the study area. It involved determining the cause of low-level workmanship and identifying factors that would significantly minimize the problems and increase client satisfaction. The study comprised of 20 construction sites, of which 55 questionnaires were collected. The data collected are related to the challenges facing the construction industry and concrete quality as well. The causes and strategies applied to improve construction quality were analyzed using the study's variable. Results indicated that inadequate construction management represented a low level of workmanship and a lack of training rated first with RII of 0.9556. At the same time, the Workers' motivation was placed second with RII 0.775. Hence, it recommends close observation of construction management factors like supervision, training, motivation, and good communication on-site to minimize the cost and effects associated with poor workmanship when implementing building projects.

Keywords—Building industry, Cost, Time, Quality, Construction management factor, Poor workmanship.

I. INTRODUCTION

In today's construction environment, public sector owners are finding themselves under increasing pressure to improve project performance, complete projects faster, and reduce the cost of administering their construction programs. Construction is a vast and an active sector, which is a backbone of the world's economy in general and Ethiopia in particular; mobilizing an enormous amount of various resources and budgets and embracing huge manpower by creating a large job opportunity [1, 2]. Building construction is a challenging project to implement. It requires a trained workforce from inception up to completion. The building design commences with a site survey that indicates proper dimensions of the plot. To develop the plot, the client needs to engage the services of experts in the industry. Typically, the professional or expert building team should comprise an architect, engineers, and a quantity surveyor. These teams design buildings and the surrounding environment and submit them to the appropriate authority for approval [3]. The project quality, cost, and timely delivery of completed structure in the construction industry depend on workmanship. The workman's skill, experience, and personal ability go a long way in determining the workmanship quality, measuring their efficiency and effectiveness. The failure in buildings structure comes in various forms and degrees of severity, the worst of which is a collapse. Poor workmanship makes it difficult for workers to perceive and apply quality control concepts and building production tolerance limits. This results in inferior construction methods and techniques, which may finally lead to building collapse [4].

The construction industries are an intrinsic part of the countries economy and are often seen as a prime mover of economic growth, especially in developing countries. Recently, the Ethiopian construction industry has experienced considerable growth in construction activities [5]. The high urbanization rate shows heightened increasing demand by residential and commercial building space, which has increased the number of construction activities. Due to its relatively labor-intensive nature, construction works provide employment opportunities for many people; skilled, semi-skilled, and unskilled. And concrete is one of the widely used construction material. It is composed of cement, fine and coarse aggregate, water, and other mineral admixtures. And the quality of concrete is mostly affected by the quality of workmanship and the quality of ingredients used [6].

According to previous research conducted by the Building Research Establishment (BRE), 90% of building failures are due to problems in the design and construction stages [7]. These problems include poor communication, inadequate information, inability to check information, inadequate check and controls, lack of technical expertise and skills, and insufficient feedback leading to recurring errors. Most defects in construction projects are due to human error. It means we can say that human error happened due to poor performance in workmanship during the construction of a building. One of the issues of this condition is due to poor quality of workmanship during a construction project. It will affect occupants' quality of life and give a bad image of

Z= value of standard variant at a confidence level

2.5 Data Collection Process

Questionnaires, interviews, and observation are the methods of data collection to be used for this study. The data on the level of workmanship at each sample site, which is the dependent variable, is to be collected through observation with the aid of a checklist while the independent variables, which are the quality management factors, will be collected through questionnaires to be distributed to the parties involved in the construction industry as well as through observation with the aid of checklist. Questionnaires and checklists were the instruments of data collection used. Questionnaires were administered to contractors, consultants, and workers on-site while the checklist was used by the researcher to observe the level of workmanship on sites. For ease of administering the questionnaires and analyzing data, the researcher used a structured (closed-ended) questionnaire developed from the research objectives, which were intended to give information on independent variables related to workers' experience, knowledge, and motivation as tools equipment use [11].

The dependent variable, workmanship, was measured through a checklist. The operational definition of workmanship has been taken as the number of defects on work done. Therefore, the checklist comprises possible and easily identifiable defects on concrete work due to workmanship. These include cracks, the disintegration of concrete, and the detachment of plaster. The researcher went to the sites and observed the workmanship level in the checklist by giving a zero (0) mark where a defect was observed and one (1) mark where a defect was missing.

2.6 Study Variables

A variable is a measurable element that assumes different values among the subject. It is a logical way of expressing a particular aspect of an issue.

2.6.1 Independent variable

An independent variable means that a researcher manipulates to determine its effect or influence on another. Independent variables are selected because they are causative or significant to the research's particle analytical purpose.

In this study, the quality of management factors is considered as independent variables; these include the level of training of workers, Availability of proper tools and equipment, Experience, Supervision, Subcontracting, Workers motivation, Lack of care, Communication on-site, and Clarity in specifications. The measurement of this variable's components was on an ordinal scale, derived from the study's descriptive. An ordinal scale groups subject into categories and rank them according to numerals reflecting the increasing number of characteristics but not at intervals. The digits are used to represent relative position or order among the values of the variables.

Based on the questionnaires' responses and observation, each site was given a score of either zero (0) or one (1) for each of the independent variables' components to indicate its performance in that aspect. For example, a site deemed to have excelled well in supervision would score one (1) for supervision, while an area that has not excelled would score zero (0). It was performed for all the components of the independent variable for every site studied. Every site's cumulative score was assumed from an interval scale and measured quality management factors.

Therefore, a site that has excelled and scored one (1) in each of the independent variable components would have a cumulative total of nine (9). A place that scores zero (0) in every element of the variable would have a cumulative total of zero (0), and its score of an independent variable will therefore be taken as zero (0).

TABLE I

SCORING FOR QUALITY MANAGEMENT FACTORS

Determinant	Maximum Score
Training	1
Supervision	1
Lack of care	1
Experience	1
Availability of tools and equipment	1
Clarity in Specifications	1
Sub-contracting	1
Motivation for workers	1
Communication on site	1
Total	9

2.6.2 Dependent variable

For the dependent variable, their results are presumed to depend upon differences in the independent variables. Dependent variables, therefore, vary as a function of the independent variable. In this study, the construction site's workmanship level would be viewed as the dependent variable because it should change in some relationship to independent variables. It will be measured on an interval scale. Six observable defects have been identified for determining the level of workmanship achieved on site. The marks (0) or (1) on the level of workmanship have been transformed into points such that a site without defects

scores 6 points while a site with all the defects observed gets no point. It means that loss a point for the presence of each of the six defects.

TABLE III
SCORING FOR THE LEVEL OF WORKMANSHIP

Defects	Maximum Score
Cracking	1
Disintegration	1
Deflection	1
Detachment of plaster	1
Inadequate reinforcement cover	1
Brown stains	1
Total	6

2.7 Data Analysis

The questionnaires would be structured questions related to the research work and directed to stockholders, the client, the contractor, and the consultant. They are the major participants of the building projects. The questionnaire is divided into two sections, namely the respondents' profile and prevalence of variation.

Data analyzed using both descriptive and qualitative analyses. Random important indexes (RII) were used for ranking the variables. SPSS Version 21.0 is utilized to analyze the frequency and reliability of the study. The results are exhibited in the form of tables, figures, charts, and graphs.

The answers for the structured part of the questionnaire are based on Likert's-scale of ordinal measures of agreement towards each statement.

- To supply simplicity for the respondent to answer,
- To make an evaluation of the collected data easier.

Likert's-scale is essential to know respondents' feelings or attitudes about something and is utilized for the data analysis. The respondents must indicate how closely their feelings match with the question or statement on a rating scale [12].

$$MS = \frac{\sum[f*s]}{N} \dots\dots\dots (2)$$

Where:

- MS = Mean Score
- f = frequency of responses for each scores.
- S = Scores given to each factor.
- N = Total No. of responses concerning each factor.

The Pearson correlation coefficient is utilized for measuring the differences in ranking between two groups of respondents scoring for various factors (i.e., labor vs. consultants, labor vs. contractors, and consultants vs. contractors).

The Relative Importance Index (RII) [13] was computed using the RII Equation (2).

$$RII = \frac{\sum w}{A*N} \dots\dots\dots(3)$$

Where:

- W = Weight given to each factor by the respondents
- A = Highest weight (i.e., 5 in this case)
- N = the total number of respondents

III.RESULTS AND DISCUSSION

3.1 Questionnaire Response Rate

The data collected includes questionnaires administered to contractors, consultants, and workers on construction sites and data managed using different checklists. In the construction sites identified, the contractor and one of the workers dealing with concreting were interviewed. A checklist was utilized to record the level of workmanship and the level of quality management factors. Out of the 22 sites samples, 18 sites provided a full response, presenting 82%; based on the respondent rate finding, the researcher decided it is reasonable and sufficient to proceed with the analysis. Table III shows the response rate of the questionnaires distributed.

TABLE IIIII

RESPONSE RATE OF THE QUESTIONNAIRE

No.	Respondent	Questionnaire Distributed	Returned Questionnaire		Unfinished Questionnaire		Analyzed Questionnaire	
		No.	No.	Percent	No.	Percent	No.	Percent
1	Contractor	24	22	91.67	2	8.33	18	75.00
2	Consultant	22	19	86.36	3	13.64	17	77.27
3	Workers	24	21	87.50	3	12.50	20	83.33
Total		70	62	88.57	8	11.43	55	78.57

3.2 Contractor's experience, their Position, Consultant experience

Results indicated that 55.6% of the respondents had been in operation for at least 10 years as a contractor, while 33.3% with experience 5-10 years and 11.1% with 1-5 years of experience, while, 33.30% are project managers, and 66.70% are site engineers. On the other hand, table IV shows the practical period of Consultants in the construction industry.

TABLE IVV

PRACTICAL PERIOD OF CONSULTANTS IN THE CONSTRUCTION INDUSTRY

Period (Years)	No. of Respondents	Percentage (%)
1-5 years	8	47.10
6-10 years	9	52.90
> 10 years	0	0.00
Total	17	100.00

The above table indicates that the highest percentage, 52.9%, of the consultants have been practicing for more than 5 years, followed by 47.1% who have practiced for less than 5 years. It was indicated that most architects had gained enough experience in construction matters.

3.3 Age, Education level and Work experience of workers on site

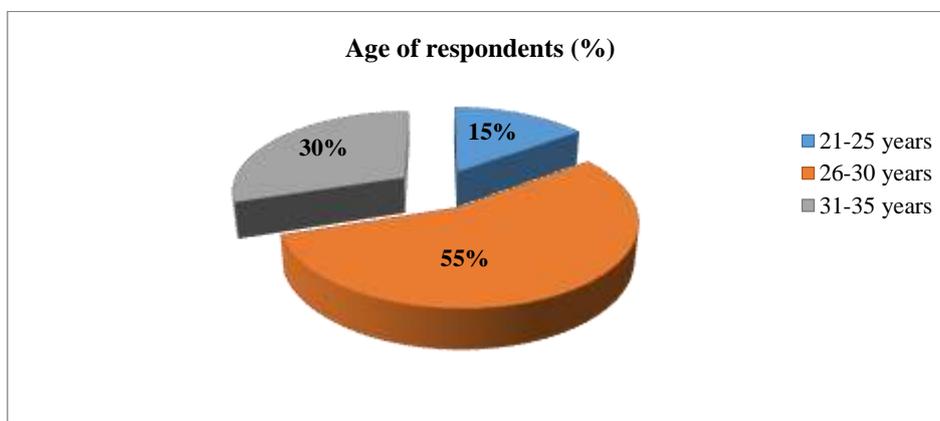


Fig. 2 Average age of workers

It can be seen that more than 50% of the workers under study were over 26 years. And none of them was over 40 years of age. It means that all the workers met the minimum required age of employment and within the young working-age where their productivity is high for manual work.

One of the most interesting scenarios, most of the workers comprised with elementary level of education, as shown in Table V. This will show that lack of education and training could be the most probable issue in the construction projects in the study area.

TABLE V
EDUCATION LEVEL AND WORK EXPERIENCE OF WORKERS ON SITE

Level of Education	No. of Workers	Percentage (%)	Period worked (in years)	No. of Workers	Percentage (%)
Did not attend	2	10.00	< 1 year	0	0.00
Elementary	8	40.00	1-2 years	2	10.00
High School	6	30.00	3-4 years	1	5.00
Diploma	4	20.00	4-5 years	6	30.00
Other	0	0.00	>5 years	11	55.00
Total	20	100.00	Total	20	100.00

The majority of the respondents at 40% had to attain elementary school while none obtained a degree certificate. Those workers achieved elementary and high school composed of 70% of the total. Because of their education level, most of them require training and learning about what will be expected from them according to their duty. Hence the majority has not attained the necessary level of education for the intended work. Besides, from the above table, 55% of the workers had over five years of work experience while none had less than a year of work experience. It shows that the workers have gained enough experience, and they can work under minimum supervision.

3.4 Factors Affecting Construction Workmanship

The study establishes the significant causes of poor workmanship in construction through questionnaires and interviews to answer the research objectives, as attached in appendix A. As stated in the literature part of the study, the researcher identified many factors that affect the quality and productivity of workmanship in the Ethiopian construction industry. One of the questions sought asked the respondents to investigate the cause of poor workmanship on-site and examine how workers judge the quality of workmanship on site, 20% of the respondents noted that it was "average." In comparison, 80% indicated that it would "Good." Because of the following significant factors;

- Poor Project Management
- Lack of Supervision
- Lack of Experience and Training
- Poor Communication
- Lack of Clarity of Specification
- Lack of Motivation for Workers
- Labor Recruiting Criteria

The majority of the 57% blame the contractors for the poor workmanship on sites. 19% of the respondents blame the workers, while only 24% blame the architects. Almost all (90%) the respondents noted they rarely re-do concrete work after it fails on quality, while 10% of the total didn't experience re-do of concrete work. Workers were also asked whether they report on any problems found when concreting or on completed concrete work. 97% of the respondents report the issues of which 60% report to the site agent while 40% report to the foreman.

3.5 Reliability of Variables

In this part of the study, the uniformity of the variables from SPSS scale measurement should be evaluated. Reliability estimates the consistency of the measurements or, more simply, the degree of uniformity of the results obtained from repeated measurements [14]. For this purpose, the quality of data was measured, evaluated, and guaranteed using appropriate techniques.

TABLE VI
CRONBACH'S ALPHA COEFFICIENTS OF THE VARIABLES

No.	Variables	No. of items	Cronbach's Alpha coefficients
1	Construction	10	0.953
2	Labor recruiting	7	0.769
3	Design	5	0.709
4	Lack of Motivation for Workers	5	0.812
5	Training and Experience	5	0.708

The data quality has been assured and measured through an internal validity instrument into correct research instruments to measure the variables during the data collection procedures. Besides, data consistency was checked using a reliability test (Cronbach's Alpha methods). The reliability of data less than 0.6 is considered poor, those in the 0.7 range, acceptable, and those above 0.8 are suitable. The closer the reliability coefficient gets to 1.0, the better. According to this guideline, all the research Cronbach's alpha values are above 0.7, so the result was acceptable.

3.6 Analysis of Factors Affecting Workmanship Quality

The results are directly related to the research's second specific objective and include, Reliability of research instruments based on SPSS scale analysis and combined relative importance index (RII) rank of factors affecting the quality of work and poor workmanship in Ethiopian construction work.

3.6.1 From Contractor

A. Poor workmanship experience on site

In reply to the queries as to whether the contractors experience a problem of poor workmanship, 16 contractors (88.9%) said that they experience the problem. Out of this, 27.8% cited that they often experience it, but 61.1% cited that they rarely experience it. Only 11% of contractors said that they do not experience the problem of poor workmanship. It shows that the problem of poor workmanship is experienced in most of the construction sites.

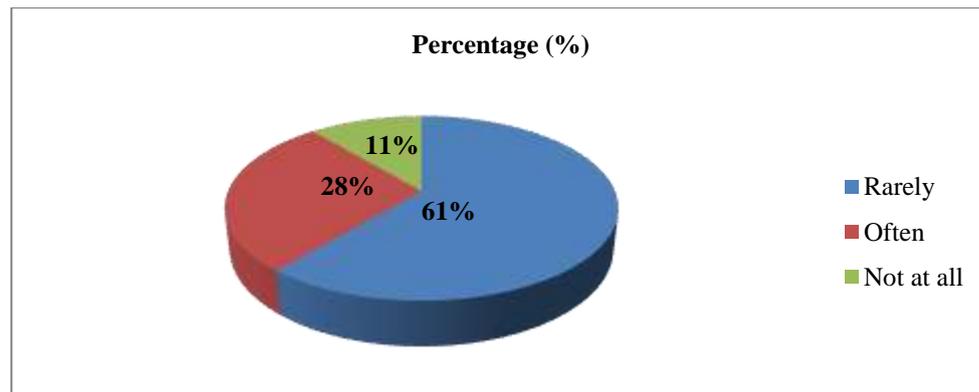


Fig. 3 Frequency of poor workmanship

B. Causes of Poor Workmanship during Construction

Respondents requested to rate the causes of poor workmanship in order of importance, starting with 1 as very list importance and 5 as highly important. In this section, it was calculated the significant factor for each cause to rank them.

TABLE VII
CAUSES OF POOR WORKMANSHIP

Causes	Rating					RII	Rank
	1	2	3	4	5		
Project Management	0	1	2	5	10	0.8667	3
Sub-contracting	2	7	8	1	0	0.4889	10
Experience	0	2	4	4	8	0.8000	5
Carelessness(During Concreting)	0	0	6	7	5	0.7889	6
Tools & Equipment	0	5	6	4	3	0.6556	9
Specification Clarity	0	0	9	9	0	0.7000	8
Motivation	0	0	2	4	12	0.9111	2
Communication	0	3	6	4	5	0.7222	7
Training & experience	0	0	0	4	14	0.9556	1
Close supervision	0	0	2	10	6	0.8444	4

The average RII value was calculated for each of the causes depending on the responses. The reasons with the highest RII value indicated the most important cause. In contrast, the one with the lowest RII value showed the least important factor, as shown in Table VII.

The result showed that the essential factor in improving the quality of workmanship as respondents' evidence, affirming a need for improvement for workers' training and learning, and worker's motivation is highly essential factors ranked 1st and 2nd with 0.955 and 0.9111, respectively.

C. Pearson Correlation Factors

Contractors were also asked whether it is possible to achieve low quality in construction. All of the contractors said no, citing the reason as: Workers are apt to making errors; Counterfeit materials are common in the construction industry, and the Nature of construction projects is unpredictable.

The above questions were asked to see if contractors believed that it is possible to work towards defects prevention rather than rectification and achieve continuous improvement. The construction industry is an assembly industry, which means that quality depends on many parties, not just on the contractor alone and other external factors. Unless all these conditions work together unto the good, poor workmanships will always be there.

TABLE VIII
PEARSON CORRELATIONS BETWEEN CONSTRUCTION FACTORS

		Mgt.	Sub-contractor	Experience	Carelessness	Equipment	Specification	Motivation	Communication	Training	Supervision
Mgt.	P. Correlation	1	-.386	.538*	-.215	.624**	-.126	.797**	.317	.051	.067
	Sig. (2-tailed)		.114	.021	.391	.006	.618	.000	.201	.842	.792
	N	18	18	18	18	18	18	18	18	18	18
Sub contractor	P. Correlation	-.386	1	-.208	.042	-.365	.292	-.473*	.076	.136	-.090
	Sig. (2-tailed)	.114		.409	.870	.137	.240	.047	.763	.589	.722
	N	18	18	18	18	18	18	18	18	18	18
Experience	P. Correlation	.538*	-.208	1	.135	.707**	.105	.616**	.248	.000	-.168
	Sig. (2-tailed)	.021	.409		.593	.001	.677	.007	.321	1.000	.506
	N	18	18	18	18	18	18	18	18	18	18
Carelessness	P. Correlation	-.215	.042	.135	1	.497*	-.071	-.254	.108	.305	.592**
	Sig. (2-tailed)	.391	.870	.593		.036	.779	.309	.669	.219	.010
	N	18	18	18	18	18	18	18	18	18	18
Equipment's	P. Correlation	.624**	-.365	.707**	.497*	1	-.160	.639**	.298	.270	.245
	Sig. (2-tailed)	.006	.137	.001	.036		.527	.004	.230	.278	.328
	N	18	18	18	18	18	18	18	18	18	18
Specification	P. Correlation	-.126	.292	.105	-.071	-.160	1	-.162	-.157	-.267	.000
	Sig. (2-tailed)	.618	.240	.677	.779	.527		.520	.534	.284	1.000
	N	18	18	18	18	18	18	18	18	18	18
Motivation	P. Correlation	.797**	-.473*	.616**	-.254	.639**	-.162	1	.297	-.152	-.158
	Sig. (2-tailed)	.000	.047	.007	.309	.004	.520		.231	.548	.532
	N	18	18	18	18	18	18	18	18	18	18
Communication	P. Correlation	.317	.076	.248	.108	.298	-.157	.297	1	.182	.046
	Sig. (2-tailed)	.201	.763	.321	.669	.230	.534	.231		.470	.855
	N	18	18	18	18	18	18	18	18	18	18
Training	P. Correlation	.051	.136	.000	.305	.270	-.267	-.152	.182	1	.189
	Sig. (2-tailed)	.842	.589	1.000	.219	.278	.284	.548	.470		.453
	N	18	18	18	18	18	18	18	18	18	18
supervision	P. Correlation	.067	-.090	-.168	.592**	.245	.000	-.158	.046	.189	1
	Sig. (2-tailed)	.792	.722	.506	.010	.328	1.000	.532	.855	.453	
	N	18	18	18	18	18	18	18	18	18	18

*. Correlation is essential at the 0.05 level (2-tailed).

** . Correlation is si at the 0.01 level (2-tailed).

D. Frequency of Inspection

The quality by strict supervision at a construction site is one of the criteria of contemporary practices in the construction sector. Daily supervision should be carried out by the contractors or subcontractors to identify workmanship problems, and the remedial work can be executed immediately. Besides, when executing the supervision, contractor supervisory staff must possess the knowledge, expertise, and capabilities to efficiently administer the construction work and superintend the craft worker. Most of the firms indicated that statutory bodies inspected works occasionally, although this was seen to depend more on the site's location. 50% of the respondents noted that the work inspection was carried out by themselves in most ongoing construction sites. In comparison, 38.9% indicated that architects did inspect those sites. Still, while conducting this research, the researcher got 11.1% of the study sites even supervised by foreman only—inspection of works to ensure that quality work is in place.

F. Effect of Poor Workmanship on Concrete Quality

The use of batching boxes for measuring concrete ingredients was the most common, with 72.2% of the respondents using it. However, 11.1% of the sites used batching plants or equipment, while only 16.67% of the locations used manual methods of measuring the ingredients. Mixing of concrete was mostly using concrete mixers with 72.22%, while only 27.78% used hand mixing up concrete. It could be attributed to the ready availability of concrete mixers for hire and the labor intensiveness that concrete requires.

TABLE IX-A
MEASURING OF INGREDIENTS

Measurement of Ingredients	No. of Sites	Percentage (%)
Manual	3	16.67
Batching Box	13	72.22
Batching Plant	2	11.11
Precast Concrete	0	0
Total	18	100.00

TABLE IX-B
MIXING OF CONCRETE

Mixing of Concrete	No. of Sites	Percentage (%)
Hand Mixed	5	27.78
Concrete Mixers	13	72.22
Ready Mix Concrete	0	0.00
Total	18	100.00

The literature review established that manual methods of measuring and mixing concrete lead to the low work quality. It is due to the carelessness of workers of sub-standard tools and equipment they use. Of all the sites studied, only 27.78% did not carry out any test on freshly mixing concrete. The slump test was the most common test used in the sites with 72.22%. No site carried out a test on already cast concrete. The majority of the sites (63%) delivered their concrete into position using hoists and cranes, while only 37% had it manually.

3.6.2 Responses from the Consultant

A. Frequency of inspection

A sample of 22 consultants was chosen; in each firm selected, only one of the architects was asked, and 17 out of 22(77.27%) provided full responses while 5 of the 22 (22.72%) had not completed on-time and, therefore, not be used for analysis. The response rate of 71.27 % gave an adequate basis for data analysis.

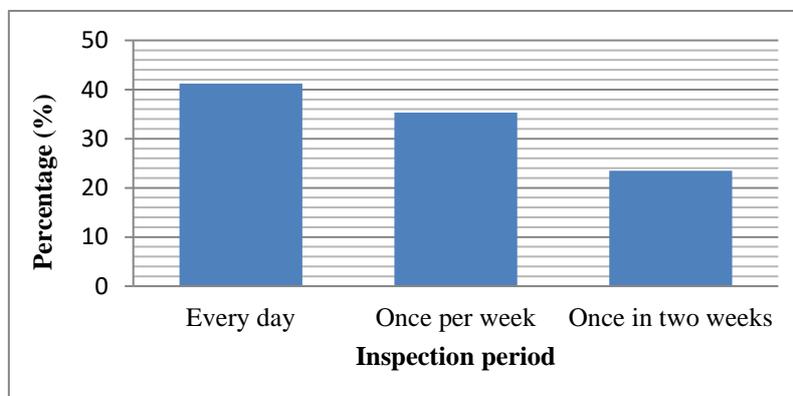


Fig. 4 Inspection rate of consultants

The above chart indicates that 41.2% of the architects have been inspecting their site one per week, followed by 35.3% inspected every day. It shows that in most construction sites, there is no daily inspection. It leads to poor workmanship and quality too. The architects said that these inspection was more crucial during sensitive works, which deserve high-quality control measures.

B. Poor workmanship experience

Regarding how the architects judge the quality of workmanship on most construction sites, 64.7% responded it was good, while 35.3% was average. It means that the level of workmanship is not to required standards in many construction sites. All the respondents replied that all stakeholders are responsible for the quality of work.

Likewise, all the architects acknowledge that they cause re-done based on poor workmanship, but this is rare. They noted that workers should be supervised to ensure that work execution is to the required standard, and if this is well done, there is no point at which work will be done on account of poor workmanship.

C. Causes of poor workmanship during Design & Supervision

This section, the significance factor for each of the respondents' criteria was computed, and this was used in arranging them in order of preference. The element with the highest RII value shows the most preferred factor, while the one with the lowest RII value shows the least preferred aspect. Form the above table; the preference criteria are as follows (starting with the most preferred).

TABLE X
CAUSE OF POOR WORKMANSHIP

Factors	Rating					RII	Rank
	1	2	3	4	5		
Lack of proper communication	0	0	0	8	9	0.90588	2
Insufficient details	0	0	3	14	0	0.76471	3
Many variations	0	0	6	11	0	0.72941	4
Insufficient Supervision	0	0	0	7	10	0.91765	1
Poor design	0	0	14	2	1	0.64706	5

D. Person correlation factors

The correlation is applied between the design factors. Table XI shows the different factors as correlated indicating how it was measured the strength and direction of a linear relationship between the different factors. Values always range between -1 (strong negative relationship) and +1 (strong positive relationship). Values at or close to zero imply weak or no linear relationship. As it can be observed, there was strong correlations between the different factors.

TABLE XI
PEARSON CORRELATIONS BETWEEN DESIGN FACTORS

		Poor communication	Insufficient detail	Many variation	Insufficient supervision	Poor design
Poor Communication	Pearson Correlation	1	.491*	.290	-.070	-.241
	Sig. (2-tailed)		.045	.259	.788	.350
	N	17	17	17	17	17
Insufficient detail	Pearson Correlation	.491*	1	.304	.240	-.649**
	Sig. (2-tailed)	.045		.236	.354	.005
	N	17	17	17	17	17
Many variation	Pearson Correlation	.290	.304	1	-.118	-.133
	Sig. (2-tailed)	.259	.236		.653	.612
	N	17	17	17	17	17
Insufficient supervision	Pearson Correlation	-.070	.240	-.118	1	.142
	Sig. (2-tailed)	.788	.354	.653		.587
	N	17	17	17	17	17
Poor design	Pearson Correlation	-.241	-.649**	-.133	.142	1
	Sig. (2-tailed)	.350	.005	.612	.587	
	N	17	17	17	17	17

*. Correlation is essential at the 0.05 level (2-tailed).

**.. Correlation is essential significant at the 0.01 level (2-tailed).

3.6.3. Responses from Workers on Site

The third category of questionnaires was administered to the workers on the identified sites. Only one worker involved in concreting per site was interviewed; hence, they formed 20 workers. The questionnaires were designed to establish their experience, education level, career development, tools, the equipment they used, the challenges they faced, and how they perceived quality on site.

A. Quality of work on site

One of the questions sought to examine how workers judge the quality of workmanship on site; 20% of the respondents noted that it was "average," while 80% indicated that it would "Good." The majority of the 57% blame the contractors for the poor workmanship on sites. 19% of the respondents blame the workers, while only 24% blame the architects. Almost all (90%) the respondents noted they rarely re-do concrete work after it fails on quality, while 10% of the total didn't experience re-do of concrete work. Workers were also asked whether they reported any problems found when concreting or on

completed concrete work, and 97% of the respondents said the issues of which 60% report to the site agent while 40% report to the foreman.

To improve the quality of workmanship, the respondents recommended the following (in the order of importance).

- a. Contractors to enhance supervision.
- b. Workers to be employed based on skill and experience.
- c. Workers' welfare to be enhanced by increasing their pay.
- d. Provision of proper tools and equipment.

B. Challenges faced by workers when working

Respondents must rank the challenges they faced while executing their work in importance, starting with 1 as very list importance and 5 as highly important. The researcher calculated the significant factor for each cause to rank them.

TABLE XII
CHALLENGES OF WORKERS WHICH CAUSE POOR WORKMANSHIP

Factors	Rating					RII	Rank
	1	2	3	4	5		
Lack of proper tools & equipment	0	6	4	10	0	0.6400	5
Low payment	0	0	0	5	15	0.9500	1
Being over-worked	0	0	2	6	12	0.9000	2
Poor communication	0	2	4	14	0	0.700	3
Mistreatment on site	0	0	7	13	0	0.7300	4

The researcher computed the random importance index value for each of the causes depending on the responses. The grounds with the highest RII value indicate the most important reason, while those with the lowest RII value indicate the least important factor. From the table above: the causes can be ranked as follows;

1. Low payment,
2. Being overworked,
3. Poor communication,
4. Mistreatment on site,
5. Lack of proper tools and equipment.

The information shows that the essential factor to be considered during the study on quality of workmanship 75% of the respondents noted one of the significant challenges was getting low payment, 60% felt overworked. Those two factors determine motivation hence production. Quality of workmanship to be achieved on-site will thus depend on these two factors. Mistreatment on site and poor communication were considered significant, with 70% and 65%, respectively. Lack of proper tools and equipment were cited as moderately necessary, with 50% of the respondents indicating this.

C. Factors that hinder workers from seeking further training

One question sought to examine the workers' wish on their employment; 63% acknowledged that they would like to earn a regular income, 56% intended to gain wider experience, and acquire more skills. None of them was for the idea of working under no supervision.

It shows that workers would not mind the level of supervision, which will lead to quality improvement. They need good communication and an attractive salary to overcome poor workmanship challenges.

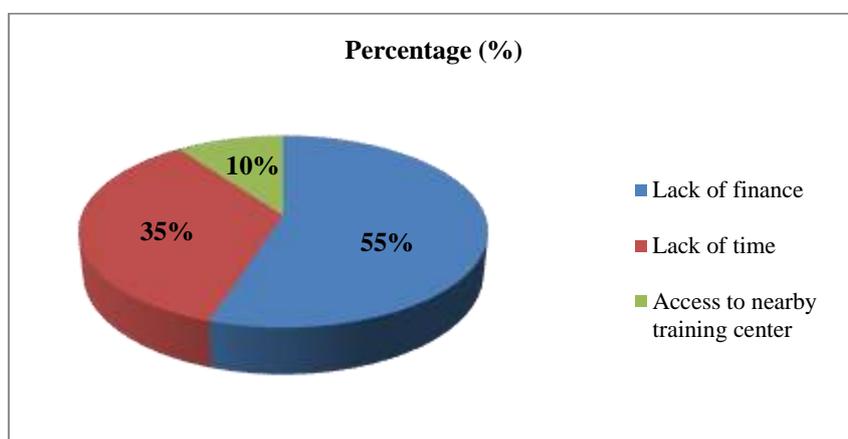


Fig. 5 Factors that hinder workers from seeking further training

From the figure, the major hindrances in seeking further training are lack of finance and lack of time with 55% and 35% respectively. It implies those factors directly related to the factor which affect productivity, and if it increases, it also increases productivity. Lack of required minimum qualification and interest was considered as the least hindrance in seeking further training.

D. Measures to Improving Quality of Workmanship

The respondents were finally requested to give some recommendations to be implemented in the building industry to achieve quality workmanship on site. Most of the respondents gave different opinion; hence the researcher analyzed them as follows:

1. Responses from Contractors and Consultants

TABLE XIII
MEASURES TO IMPROVE THE QUALITY OF WORKMANSHIP

Measures to improve quality of workmanship	Rating					RII	Rank
	1	2	3	4	5		
Train workers in quality issue	0	0	0	4	13	0.7647	2
Cease dependents on inspection by the architects	0	0	10	7	0	0.6824	3
Provide proper tools and equipment	0	4	8	5	0	0.6118	4
Work how to motivate workers	0	0	1	6	10	0.9059	1

The researcher computed the mean for each of the causes depending on the responses. The grounds with the highest RII indicate the most important reason, while those with the lowest RII indicate the least important factor. From the table above: the causes can be ranked as follows;

i. Train workers on the quality issue:

Workers should be well trained on technical issues of construction before they are allowed to work on sites. The respondents proposed introducing more training institutes to handle a large number of workers in the building industry.

ii. Motivate workers:

Being in the right working environment is a motivator for many employees on-site, as indicated in the literature review. Therefore, the respondents advocated for a favorable working atmosphere to be created on-site and maintain better health standards and safety measures. It motivates workers to work to their best, enhancing the quality of workmanship on sites.

iii. Proper supervision:

The statutory bodies should regularly do proper inspections on-site. It should be taken at every stage of construction to ensure quality workmanship on sites. The construction site's location should not determine the number of inspections carried out by statutory bodies.

A. Person correlation factors

Results in Table XIV indicated that there was strong correlation between the different factors on improving factors of workmanship.

TABLE XIV
PEARSON CORRELATIONS IMPROVING FACTORS OF WORKMANSHIP

		Train workers in the quality issue	Inspection By the architects	Provide proper tools & equipment	Motivating workers
Train workers In quality issues.	Pearson Correlation	1	-.099	.236	.256
	Sig. (2-tailed)		.704	.361	.321
	N	17	17	17	17
Inspection By the architects.	Pearson Correlation	-.099	1	.591*	.453
	Sig. (2-tailed)	.704		.012	.068
	N	17	17	17	17
Provide proper tools and equipment	Pearson Correlation	.236	.591*	1	.331
	Sig. (2-tailed)	.361	.012		.195
	N	17	17	17	17
Motivating workers	Pearson Correlation	.256	.453	.331	1
	Sig. (2-tailed)	.321	.068	.195	
	N	17	17	17	17

*. Correlation is essential at the 0.05 level (2-tailed).

2. Responses from Workers

Respondents requested to rate the challenges they faced while executing their work in importance, starting with 1 as very list importance and 5 as highly necessary. The researcher calculated the significant factor for each cause to rank them.

TABLE XV
MEASURES TO MOTIVATE PRODUCTIVITY

Measures to improve poor workmanship	Rating					RII	Rank
	1	2	3	4	5		
Increase payment	0	0	0	3	17	0.9700	1
Employment based on skills	0	0	2	4	14	0.9200	2
Provision of proper tools & equipment	0	3	10	7	0	0.6400	3
Provide training & education	0	1	15	4	0	0.6300	4

The researcher computed the random importance index for each of the causes depending on the responses. The grounds with the highest RII indicate the most important cause, while those with the lowest RII indicate the least important factor. From the table above: the causes can be ranked as follows;

1. Increase payment,
2. Employment-based on the skill,
3. Provide training and education,
4. Proper supervision and control
5. Provision of proper tools and equipment

The information shows that the most crucial factor in improving workmanship quality on-site, increasing payment for workers and employment based on skill, was highly essential to consider with 85% and 70%, respectively. Providing training and learning of workers and proper inspection and control were deemed to be necessary with 85% and 75%, respectively. The provision of appropriate tools and equipment was cited as moderately crucial, with 50% of the respondents indicating this.

A. Person correlation factors

In Table XVI shows that there was a significant correlation between the different factors to improve poor workmanship.

TABLE XVI
PEARSON CORRELATIONS BETWEEN FACTOR TO IMPROVE POOR WORKMANSHIP

		Increasing Payment	Employment-based on skill & experience	Tools & equipment.	Provide Training and education.	Proper supervision & control.
Increasing payment	Pearson Correlation	1	.169	-.496*	.132	-.176
	Sig. (2-tailed)		.477	.026	.579	.457
	N	20	20	20	20	20
Employment-based on skill & experience.	Pearson Correlation	.169	1	-.044	-.442	.380
	Sig. (2-tailed)	.477		.852	.051	.098
	N	20	20	20	20	20
Provision of proper Tools & equipment.	Pearson Correlation	-.496*	-.044	1	.062	-.083
	Sig. (2-tailed)	.026	.852		.796	.729
	N	20	20	20	20	20
Provide Training & education.	Pearson Correlation	.132	-.442	.062	1	-.161
	Sig. (2-tailed)	.579	.051	.796		.496
	N	20	20	20	20	20
Proper supervision & control.	Pearson Correlation	-.176	.380	-.083	-.161	1
	Sig. (2-tailed)	.457	.098	.729	.496	
	N	20	20	20	20	20

*. Correlation is essential at the 0.05 level (2-tailed).

E. Level of Workmanship

A checklist was prepared and for each site visited, the presence or absence of defects on concrete work was observed, and zero (0) work was awarded where a defect was observed while one (1) mark and awarded where a defect was not observed. Since there were 6 indicators, a site without any blemish on the variables scored a maximum of 6 points, while a site with faults on all the variables scored (0) marks, the lowest.

TABLE XVII
LEVEL OF WORKMANSHIP ON SITES

Score	Number of Site	Percentage (%)
0	1	5.00
1	3	15.00
2	2	10.00
3	5	25.00
4	4	20.00
5	2	10.00
6	3	15.00
Total	20	100.00

A score of 6 is the highest mark showing no defect: the required level of (high level) workmanship. Only 5% met this requirement showing that the level of workmanship is low. Ninety-five percent of the sites have at least a defect on the subject. It is important to note that only 5 percent of all the places visited scored zero. This indicates that the majority of sites need improvement in workmanship.

F. Summary of Findings

The researcher has established that the quality of workmanship is not to the required standards. The level of workmanship has been observed to be equally low, with many defects appearing on works. Many factors have been established as the causes of a low level of workmanship. These factors are management-related factors on-site, including inadequate supervision, lack of training, inexperienced workers, unavailability of proper tools and equipment, poor communication on-site, lack of motivation for workers, lack of clarity in specifications, and also, to a smaller extent, due to subcontracting. The level of workmanship is directly proportional to the level of quality management factors. However, lack of proper supervision on site has been noted as the primary cause of poor workmanship compared to the other factors.

IV. CONCLUSIONS

The research objectives had been achieved based on the literature review from articles, journals, and books; findings from a questionnaire survey; and interview results. This study addresses a gap around workmanship and quality for works in the Ethiopian construction industry, specifically within the study area's scope. The study adds data to existing literature concerning current construction trends. The finding has been compared against the set objectives and conclusions made.

In this study, the following major conclusion was drawn based on findings in line with each specific objective. Poor workmanship is one of the significant factors that lead to building defects and failure problems. High rise buildings are the one which experienced most of the defects or failures issues due to poor workmanship. Form questioner survey senior officer of the client, project manager, and resident engineer from the contractor and consultant side reported low quality as a significant cause of poor quality material used. Low quality also led to project cost overrun for all entities participating in project management.

4.1 Findings of the Study

The first objective identified the leading causes of poor workmanship on construction sites. From the results obtained from the respondents, the primary reasons for poor workmanship are:

- i. Lack of training and experience from workers
- ii. Lack of motivation for workers,
- iii. Lack of proper supervision and management skill.
- iv. Lack of care when concreting
- v. Lack of proper tools and equipment
- vi. Lack of clarity in drawing and specifications

The result indicated further that poor workmanship is also resulting from the contractor's speedy construction and shortcuts in construction. Subcontracting has been noted to have less impact on workmanship. However, all respondents acknowledge a lack of supervision as the significant cause of poor workmanship. The second objective established the relationship between the quality management factors (supervision, training, experience, availability of proper tools and equipment), and workmanship. Field data on quality management factors and workmanship on site were analyzed through software called SPSS and correlation, reliability was cross-checked, and a positive relationship was established. The third objective was to identify the responsible authorities' measures in ensuring a good quality of work. For this study, the responsible authorities have been taken as the consultants (architects), consultants (engineers), and statutory bodies. Regarding measures taken by the architects against contractors for poor quality work, 89% of the architects noted that contractors are forced to re-do the work at their own cost, and 63% of the respondents also indicated that they determined whether the contact persists, and they seek damages if there is any delay to be incurred.

4.2 Implication of the Findings

From the study's findings and analysis, it can be concluded that the quality of workmanship on construction sites is relatively poor. The study has summarized all the causes of poor workmanship, that is, quality management factors. All these elements have a positive influence on the level of workmanship. The finding implies that a low level of workmanship on Ethiopia construction

projects will continue unless the quality management factors are enhanced (supervision, training, availability of proper tools, and equipment, among others). Therefore, to reverse the trend, all efforts should be aimed at providing and improving the content and context of these factors to enable acceptable quality of works on sites.

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