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Research Findings on Impacts of Material Wastage of Building Construction Project

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Abstract: All over the world, the development of construction related industries depend on the natural and artificial resources. The generation of wastes from the construction industries and its management is a big task for the proponents and stake holders of the industry. The quantity of waste generation from the construction industryis highly related to the construction methods, improper management, the onsite sorting and recycling abilities for construction waste, the levels of education and trainingsgiven to workers and the design concepts. The current research focuses to identify the contributory factors that influences the generation of construction material wastage.In addition, the study aims to deeply analyze the impact of construction material waste on cost at building construction project and recommends the strategies to minimize the construction material wastage. Data collection was done through questionnaire survey and interviews among the different stake holders in building construction (Clients, Consultants, Contractors and other Professionals) in Addis Ababa. Stratified Sampling technique was considered as a tool to opt for the Sites with regards to all the civil engineering professionals, stakeholders like contractors, consultants, and clients.The current study focuses in identifying and analyzing the major impacts of the construction material wastage at building construction site in Kolfe Keranio sub city, Addis Ababa. The outcome of the result would bring strong information to clients, consultants and contractors and other stakeholders in minimizing the overall cost due to material wastage.

Keywords:*Contributory factors, Questionnaire survey, Spearman'srankcorrelation coefficients, Validity and Reliability test.*

1. Introduction

The growth of construction industry, especially in Addis) is mainly due to the growth of Ethiopian economy and population Ababa (Mahilet Reta et.al., 2020. More complex type of buildings arises and the numbers are gradually increasing, now-a-days. The demand for the construction materials are increasing dramatically day by day.The demand for the material resources is increasing day by day due to the growth of construction industries (Subash Thanappan et.al., 2021), [7,8]. On contrary,there are various reasons for the wastage of a fairlymajorfraction of the construction material at building sites (Getachew Araya Kassa, November, 2009).

Although the construction industry rely on both natural and artificial resources and responsible for large quantities of construction wastes, it takes a major role for the economical

growth of any country and thus promoting the comfortable enjoyment of livingwith the promoted infrastructure ofhighways, health centers, educational institutions, and other fundamental facilities.

In spite of losing large amounts of money, time and other resource, there is a lack of the current construction management. Waste generation on construction sites might mostly be relatedto selection of construction methods, selection of construction materials, the accessibility of onsite sorting and recycling facilities of construction wastes, the levels of education and training given to workers, design concepts, and others. The pioneer research found thatmaterial wastes from construction industries signify a comparatively largerfraction of production cost.

2. Material and Methods

The main expansion area of Addis Ababa is considered as the study area,locatedwithinthediverseeconomicactivitiestakingplace,andaplacefordifferentkindsofrealestateprojects under construction.Thetotalpopulationlivedinthissubcityisestimatedabout546,219fromthis220,859are maleand the rest (235,360) are females.

In the current study, a wide range of construction parties are involved in construction ofprojects were targeted in order toevaluate and assess the current situation of wastage of construction materials on selectedbuilding projects.

Both the primary and secondary data collection methods are done and the selected samples include contracting and consultingcompanies of allgradecategory'sthathave a validregistration by Ministry of UrbanDevelopmentandConstruction in Addis Ababa. Both open and close ended formatquestionsare designedtoobtaininformationonofConstructionmaterialwastageofb uilding.

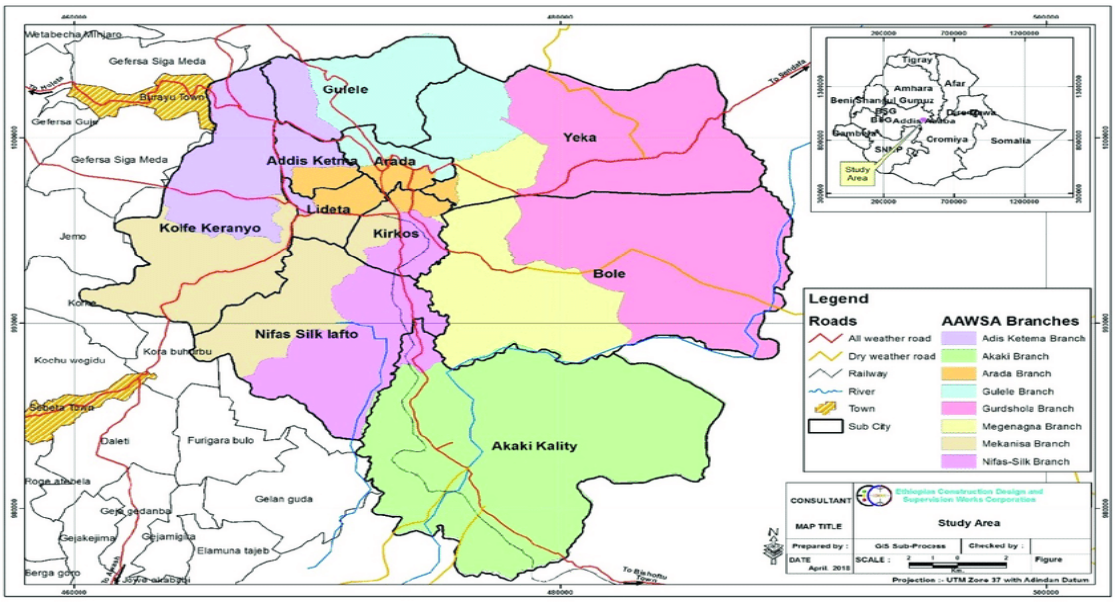

Figure 1: Study Area

The collected data (waste volume) was used to find the contribution ofmaterialwastes tothe producedquantity of cost overruns.

2.1.DataProcessingandAnalysis

Through the site investigation and the collection of data from office records, the collection of primary data was accomplished, and those primary data were helped to identify on material waste and cost overruns in building construction industries. In the current study, bothdescriptivedata andinferentialdata wereused. With the help of measuring instruments (on-site measurement), the total quantity of material wastes on-sitewere notedto correlate it to estimate the amount of cost overruns.

2.2.SoftwarecumInstrument

As discussed before data is collected through different methods like interview, site visit andquestionerssurveythereforeneedtousedifferentinstrumentse.g.Instrumentslikecamera(duringsite visit) ,paper, Copy machine,Printer, Computer etc.(during QuestionnairesSurvey). Collected data are extracted and analyzed using different software like excel, MS Word etc. Allgathered data are feed in excel and give out put in the form of graphs and tables. MS Word is alsousedthroughout theresearch for Typing and drawing purposes.

2.3.ValidityandReliabilityTests

The foremost data collection mechanisms to be engaged in this research are questionnaire andinterview thatareverified for validity and reliability by testing the questionnaire initially withparticular sample respondents and lateraltering the questionnaire and interview questions based on thefeedbacks.

Table 1: Questionnaire survey and its Response rate

No	Stakeholder	Dispersed numbers		Outcome numbers		Botched numbers		Analyzed numbers	
		No.	%	No.	%	No.	%	No	%
1	**Supervisor**	27	28.42	20	21.05	3	3.16	17	17.89
2	**Contractor**	52	54.74	48	50.53	4	4.21	44	46.32
3	**Client**	16	16.84	13	13.68	1	1,05	12	12.63

It found that the perception among the contractors and consultants about its effect are similar. The level of client material supplyby twogroups of respondents is shown in Figure 2. It has been observed that 83.72% of contracting companies and 75%of the consultantshas agreed to supply the client materials, and in turn, increase the quantity of wastage.

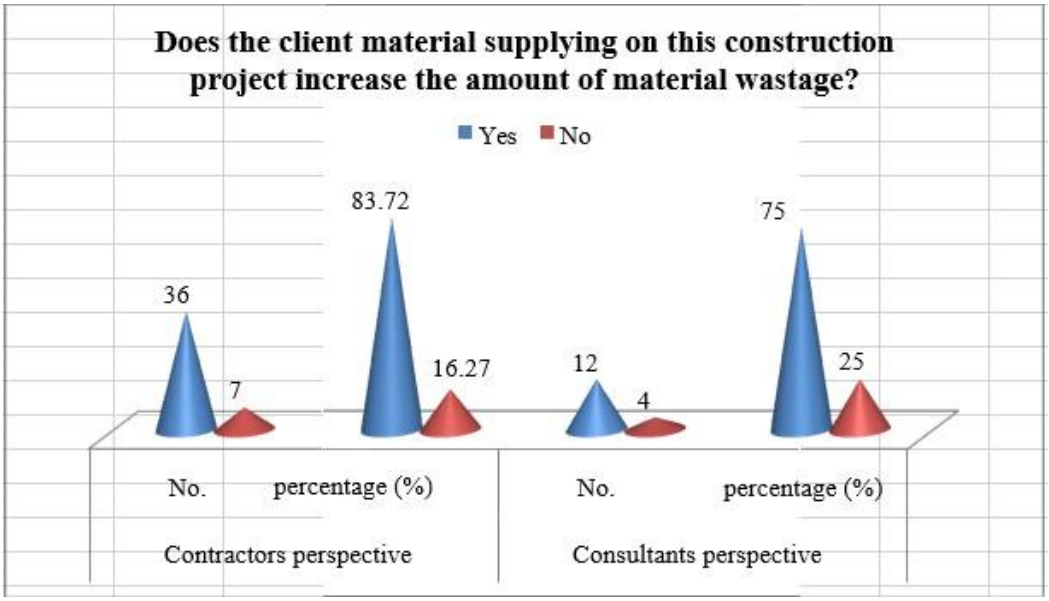

Figure 2: Impact onthe supply of client materials

Table 2: Reason for the material wastage

	Rankand Percentiles			
Reasonsformaterialwastage	Rank	Clients	Consultants	Contractors
Nopropercontrol	1	86.21	74.31	43.16
Clientdoesn’tdeliverygoodquality material	2	12.78	17.01	49.25
Clientsuppliesmaterialinunplanned way	3	1.01	8.68	7.59

Spearmanrankcorrelationcoefficients were employed to check if there anydisparity in ranking amid two groups of respondents.

Table 3: Spearman'srankcorrelation coefficientsfor causesof waste

Items	Rho=1-(6(Σdi^2)) (N(N^2-1))	Critical r value
Concrete waste	0.20	0.410
Mortar waste	0.85	0.410
Reinforcementwaste	0.65	0.410
HC block waste	0.89	0.410

For both group of respondents, therelativemeanandrankingofeachcategoryofwasteforconcreteis shown in Table 4.

Table 4: Relativeweight andrankingof concrete waste

Items	Contractor		Consultant		Clients	
	R.W	Assigned Rank	R.W	Assigned Rank	R.W	Assigned Rank
Designcategory	4.0	1	3.20	4	3.12	5
Procurement category	2.90	6	3.10	5	2.87	6
Handlingand storage category	3.40	5	3.80	3	3.92	2
Operation category	3.50	4	4.31	1	4.08	1
Management category	3.62	3	3.90	2	3.41	4
Supervision category	3.83	2	2.86	6	3.66	3

The finding shows that discordantopinionsonthecategoryofconcrete waste among three differentgroupsofrespondents.

2.4.Levelof contributionof the waste causes forthe generation of waste

Themeanandrankofeachcauseoftheconcretewasteconferringtothecontractors,consultant'sandclie nt'sperceptionare displayedin the Tables5and 6 respectively.

Table 5: Relative weightandranking ofconcretewastecauses -views ofcontractors

Cause	RW	Rank
Changesandrevision on design	4.36	1
Damagetoworkdone	4.11	2
Rework	4.04	3
Delayinperforminginspectionandtesting	3.86	4
Mistakes on drawingsand specification	3.84	5
Clutteredconstructionsite	3.82	6
Overloadingoftransportequipment	3.59	7
Poorcoordinationandcommunication	3.45	8
Poor qualification of employees	4.14	9
Slow response	3.36	10
Lack of attention	3.34	11
Poor qualification of subcontractor's	3.16	11

Using excessive quantity of materials than required	3.04	11
Double handling of materials	2.98	13
Mistakes in quantity surveys	2.93	16
Improper handling of materials	2.76	15
Poor workmanship	2.68	16
Scarcity of Equipment	2.45	17

Table 6: Concrete waste causes

Cause	R.W	Assigned Rank
Damagetoworkdonebyothertrade	4.35	3
Overloadingoftransportequipment	4.40	2
Poorworkmanship	4.53	1
Poorhandling ofmaterials	4.18	6
Rework	4.35	4
Use ofexcessivequantityofmaterials	4.29	5
LackofEquipments	4.10	7
Changesandrevision on design	3.93	8
Errorsinquantity survey	3.82	9
Double handling of materials	3.53	11
Untidy construction site	3.71	10
Low qualification of subcontractors	3.41	13
Use of wrong material	3.47	12
Theft	3.18	14
Lack of response from the consultant engineer	3.06	15

to contractor inquires		
Poor quality of materials	2.88	16
Delay in performing inspection	2.13	18
Mistakes, and inconsistencies on drawings and specification	2.18	17

Table 7: Relativeweight andrankingof concretewastecauses-viewofclients

Cause	R.W	Assigned Rank
Poorworkmanship	4.50	1
Damagetoworkdone	3.75	9
Rework	4.33	2
Mistakesinquantitysurvey	4.25	3
Overloadingoftransportequipment	4.00	6
Improperhandling ofmaterials	4.16	4
Delay in performing inspection	3.25	14
Multiplehandling ofmaterials	3.92	7
Changesandrevision on design	3.84	8
Cluttered site	3.67	10
Poor qualification of subcontractor’s	3.50	11
Use of wrong material	3.42	12
Lack of Equipment	3.33	13
Mistakes, and inconsistencies in drawings and specification	3.08	15
Lack of response from the consultant engineer to contractor inquires	2.58	16

Useexcessivequantityofmaterialsthan required	4.08	5
Poor quality of materials	2.55	17
Theft	2.42	18

Figure3: Budgebeam

Figure4: Budgeshearwall

During the revision on design, the strategies implemented by respondents are shown in Figure 5.Alloftherespondentsundergoatleastcorrectingdetailingproblemsonthedesigndrawingduringadesignrevisionperiod.Nevertheless,theoutcomeindicatesthe lack of practice by the firm on the dimensional coordination, standardization and material selection to reduce the generation of wastages.

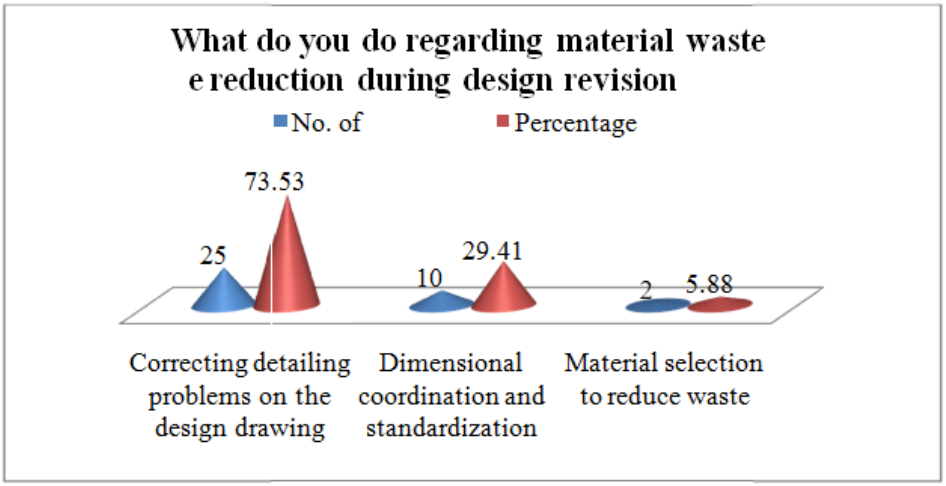

Figure 5: Strategiesemployedduringdesignrevisionbyconsultants

3. Conclusions

Thesurvey reveals that the levelofmaterialswasteinconstructionprojectsislegitimatelyhigh.It also displays that the cost effect extent upto 10 % of the project cost. The supply of poor quality material hasaugmented thegeneration ofmaterial wastage.The rework and damage to the work done by othertrade are amongst the top five major causes of concrete wastage in the sites is another major cause for wastages. Similarly,the use of excessive quantities of materials, multiple handling, rework, poor workmanship, damageto work done are the majorportentous causes of mortar waste in the study area. The waste generation on site is directly related to the design process. The majorcausesfor the wastage of hollowconcreteblockaremainly due to the lowqualitymaterials,improperstorageofmaterials, poor workmanship, improper handling of materials and lack of attention.On the contrary, the poorperformanceoftheconstructionsupervisorsinstandardizationandmodularization of design during a design revision period is consequentlyincreasingthe generationofwastages in excess.

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