



# **ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY**

SCHOOL OF CIVIL ENGINEERING AND  
ARCHTECTURE

CONSTRUCTION TECHNOLOGY AND MANAGEMENT  
PROGRAM

## **Assessment on Quality Management Practices of Addis Ababa Housing Development Construction Project**

By  
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Adama, Ethiopia  
March, 2017

# **Assessment on Quality Management Practices of Addis Ababa Housing Development Construction Projects**

*A Thesis Submitted To the School Of Civil Engineering and Architecture*

*In*

*Partial Fulfillment of the Requirements for the Award of Degree Of*

**MASTER OF SCIENCE**

*IN*

**CIVIL ENGINEERING (CONSTRUCTION MANAGEMENT)**

**By**

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March, 2017

## DECLARATION

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I further declare that this is my original work and has not been submitted to any other University or Institution for the award of any degree or diploma; Except where due acknowledgement has been made in the text.

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## C E R T I F I C A T E

This is to certify that the above statement/declaration made by the candidate is correct to the best of our knowledge and believe. This thesis “**Assessment on Quality Management Practices of Addis Ababa Housing Development Construction Project**” has been submitted for examination with my approval.

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## ABSTRACT

*Construction quality management is the process of quality planning, quality plan implementation, quality assurance, quality control, use of quality improvement technique based on quality policy, quality standards and required technical specifications to achieve consumer satisfaction through top management bodies commitment, quality assurance and control team of the contracting parties.*

*Quality of construction should be managed starting from designing to material delivery, at production centers, during the execution of the structure and at the final users or operation stage.*

*Addis Ababa Housing Development Project (AAHDPO) has a life of more than one decade its Construction quality management system is still loose and not well organized, due to this cases quality problems were observed as proved by researchers and residents criticized its quality in public media and this research also found that 33% of respondents proved the quality of AAHDPO house were unsatisfactory. Therefore these research aims to focus on assessing the quality management practices of AAHDPO Construction Projects.*

*This research assessed AAHDPO Quality Management Practices by taking the client, the contractor, the consultant, the Construction MSEs and the Production MSEs professionals as target group to collect data using questionnaire, interviews, focused group discussion and documents related evidences and the collected data were analyzed using descriptive and inferential statistics, with the application of SPSS 20 version and Excel software such as frequency tables, percentages, correlations and the results presented in tables, pie charts and histograms. This research identified the main causes of poor construction quality are structural contractors due to key personnel poor skill in quality management and MSEs work and during the interview part respondents recommended that construction professionals should be project executors/leaders. The impacts of poor quality leads to extension of construction periods as its weighted mean score indicates 3.88 and reduction of productivity with weighted mean score value of 3.77*

**Keywords:** *Construction project, quality management, quality assurance, Quality Control, Condominium houses, practices.*

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## ACRONYMS

|            |                                                        |
|------------|--------------------------------------------------------|
| AAHDPO:    | Addis Ababa Housing Development Project Office         |
| IHDP:      | Integrated Housing Development Program                 |
| AAHDHO:    | Addis Ababa Housing Development Head Office            |
| MSE:       | Micro and Small Enterprises                            |
| HCB:       | Hollow Concrete Block                                  |
| PB:        | Precast Beam                                           |
| HDPO:      | Housing Development Project Office                     |
| AAHDP:     | Addis Ababa Housing Development Project                |
| QA:        | Quality Assurance                                      |
| QC:        | Quality Control                                        |
| ASQ:       | American Society for Quality                           |
| QMS:       | Quality Management Systems                             |
| NBE:       | National Bank of Ethiopia                              |
| MUDHC:     | Ministry of Urban Development Housing and Construction |
| GTZ:       | German Technical Corporation (GTZ)                     |
| GTCO:      | German Technical Co-operation                          |
| U.S.ACE:   | United States Army Corps of Engineers                  |
| RE:        | Resident Engineer                                      |
| PPR Pipes: | polypropylene Random Pipes                             |
| PVC pipes: | polyvinyl Chloride Pipes                               |

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# **CHAPTER ONE**

## **1. Introduction**

### **1.1 Background of the study**

Quality is one of the critical factors in the success of construction projects. Quality of construction projects is linked with proper quality management in all the phases of project life cycle (Ashokkumar, 2014).

Quality management in construction projects means maintaining the quality of construction works at the required standard so as to obtain customers' satisfaction that would bring long term competitiveness and business survival for the companies (Tan & Abdul-Rahman, 2005).

Quality control is critically important to a successful construction project and should be adhered to throughout a project from conception and design to construction and installation. Quality control means making sure things are done according to the plans, specifications, and permit requirements (Zane, 2005).

Quality management is a crucial part of the total project management system regardless of the focus on time, quality, work environment (Lakshmi, 2015).

The best quality, time and cost are the important aspects of successful construction project which fulfills the main goal of construction industry. The quality management system (QMS) in construction industry refers to quality planning, quality assurance and quality control (Mane & Patil, 2015).

This thesis "Assessment of Quality Management Practices in AAHDPO" were conducted based on the day to day increasing end users (household) criticism (Zame & ShegereRadio, 2016) on the quality of condominium buildings on public hearings and the presence of quality problems on AAHDP buildings proved by (Hiwot, 2012) , as she stated:

"Most of the houses as identified by the occupants, observed by the researcher and later confirmed by the consultant and HDPO have defects. Most of the defects are major defects, which need replacement of the whole or some parts."

Defining or proving the presence of defects need to maintain or replace parts or the whole of the building, which is costly and time taking but professionals of the sector have to stress on the preventive techniques of the occurrence of defects that is to improve the quality assurance and quality control techniques of the AAHDPO contracting parties, since our government has an ambitious plan to construct 700,000 low cost houses which is the second huge project requires 67 billion birr to construct the condominium houses for all registrants as stated by (Teklewold, 2013) Governor of the National Bank of Ethiopia (NBE) which is next to Great Renaissance Dam in terms of finance, therefore to continue this huge investment requiring construction project and to satisfy the public housing need, the best way is to practice quality management system in construction projects to resolve quality problems and to meet the needs of the final customer.

Construction emphasizes on process control than product control thus, it is expected that process-oriented quality improvement efforts can be of benefit in all the phases of the construction activity, therefore this research investigated the quality management practice of the AAHDPO, identified sources of quality problems and recommend alternative quality control techniques for AAHDPO condominium housing contracting parties.

## **1.2 Statement of the Problem**

There are significant wastage of time, money and resources in construction projects due to poor quality management procedures (Battikha, 2002). Wastage of the above constraints is due to rework of the defecated works caused by poor quality management system (QMS) employed.

A failure to emphasize the importance of QMS in low-cost housing projects leads to inconsistency and the delivery of sub-standard quality houses (Mkhonto, 2014)

This thesis assessment of quality management practices in AAHDPO was conducted based on:-

- ❖ The quality problems and related issues discussed above in section 1.1.
- ❖ The presence of evacuated residents after the visible slanting of T16-G+4 condominiums building at Jemo site constructed in 2010.
- ❖ As stated on the Ministry of Urban Development and Construction Industry Policy First Draft, (2012), Ethiopian government needs the local construction industry to have productivity and quality improvement revolution to achieve international competitiveness.

When construction contract is awarded, a problem which is always present during the life of the contract is to assure the owner that the contractor's product is meeting the minimum levels of quality established in the contract plans and specifications. Quality assurance is normally accomplished by construction inspection performed by the owner, a representative of the owner, or a neutral third party.

### **1.3 Research Questions**

To undertake this study, the following research questions were formulated:

- 1.3.1 What documented quality control, assurance system and trained personnel involved with quality management in AAHDPO?
- 1.3.2 How AAHDPO construction participant use quality control documents to keep the quality of the houses to satisfy the end users?
- 1.3.3 Which quality management organizational structure was used in AAHDPO?
- 1.3.4 What were the sources of quality problems in AAHDPO?
- 1.3.5 Do construction materials, personnel and construction method employed in AAHDPO comply the contract quality requirements?

### **1.4 General objectives**

The main objective of the study is to assess the quality management practices of Addis Ababa Condominium Housing Construction Project.

### **1.5 Specific objectives**

The specific objectives of this thesis are:-

- 1.6.1 To investigate the practice of quality management system in Addis Ababa condominium housing construction projects.

1.6.2 To identify sources of quality problems in condominium housing construction projects

1.6.3 To recommend alternative quality control techniques for cost effective condominium housing contracting parties

## **1.6 Purpose of the study**

The purpose of the thesis is to study the quality management practices of Addis Ababa Condominium Housing Construction Projects, so as to give tangible feed backs for the contracting parties to improve the existing system in turn to satisfy the customer.

## **1.7 Significance of the study**

The study is significant for professionals and organizations as stated bellow, this study:-

- ❖ indicate the sources of quality problems and quality control documents for practitioners of the profession and/or Construction and Contract administration division heads, Construction officers, Coordinators, Resident Engineers, Site Engineers, Forman's and MSEs on the side of each contracting parties who are currently engaged and who will involve in AAHDPO.
- ❖ Give clear information on the quality control and quality assurance system of AAHDPO Construction Projects.
- ❖ Indicate AAHDPO higher officials the quality management system gaps to take corrective action.
- ❖ Increase the AAHDPO household owners (end users) satisfaction and confidence on their house safety and durability.

## **1.8 Scope of the Study**

This study is intended to assess the quality management practices of AAHDPO construction project. Research data were collected and analyzed on 10/90 and 20/80 types of condominium projects having 25% and more performance progress of under construction projects for the last five years which is intended to construct G+2, G+4 and G+7 buildings. However this study excludes 40/60 condominium housing project due to its short implementation period (since started 2012) and the absences of secondary data.

## **1.9 Limitations of the Research Method**

The research did not cover all construction materials test and approval requirement except basic construction materials, agrostone and PVC window fixing MSEs due to time, budget constraints and insignificant impact on quality. This study were limited only to six branch offices out of eighteen branch offices, since the number of respondents were too large to cover in this time and budget constrained study.

## **1.10 Operational Definitions**

**Construction MSE:-** Micro and Small Enterprises engaged directly on the construction or installation of Electrical, Sanitary and Metal works.

**Production MSE:-**Micro and Small Enterprises engaged on the production of construction components especially on pre-cast beam, ribbed slab blocks and hollow concrete block production.

**Project Execution Participants:-** Contracting parties who will perform their own responsibility as stated on the contract agreement.

**Professionals:-** Persons having construction related specialization for the execution of the project.

## **1.11 Organization of the paper**

The report is presented in a five chapters. Details of these chapters are as follows:

1.11.1 Chapter One - General introduction and background of study

1.11.2 Chapter Two - Review of existing literature on quality management practices in construction.

1.11.3 Chapter Three – Methodology – This part entails a description of the research method used in this study. The chapter focuses on the methods that were employed in conducting the empirical research namely the qualitative and quantitative approaches.

1.11.4 Chapter Four – Analysis of empirical data collected and discussion of results.

1.11.5 Chapter Five – Conclusion of the findings of the research and Recommendations.

## **CHAPTETR TWO**

### **2. LITERATURE REVIEW**

#### **2.1 Introduction**

This chapter focuses on the relevant literature reviews of different scholars on Construction quality management practices in the construction industry, the basic components and participants to achieve the desired customer satisfaction based on preset quality requirements.

#### **2.2 Overview of Quality**

Quality issues have been of great concern throughout the recorded history of humans. During the New Stone Age, several civilizations emerged, and some 4000–5000 years ago, considerable skills in construction were acquired. The pyramids in Egypt were built approximately 2589–2566 BCE. Hammurabi, the king of Babylonia (1792–1750) BCE codified the law, according to which, during the Mesopotamian era, builders were responsible for maintaining the quality of buildings and were given the death penalty if any of their construction collapsed and their occupants were killed (Rumane, 2011).

During the middle Ages, guilds took the responsibility for quality control upon themselves. All craftsmen living in a particular area were required to join the corresponding guild and were responsible for controlling the quality of their own products. If any of the items was found defective, then the craftsman discarded the faulty items, the guilds also initiated punishments for members who turned out defected products (Rumane, 2011).

In the early 19<sup>th</sup> century crafts man model were emerged, in the late 19<sup>th</sup> century Fredrick Taylor's system of "Scientific Management" was born. Taylor's goal was to increase production, during the process he investigated increasing production had a negative effect on quality and to overcome this problem he set out quality control department. At the beginning of the 20<sup>th</sup> century marked the inclusion of process in quality practices. Production quality was the responsibility of quality control departments.

The introduction of mass production and piecework created quality problems, this situation made factories to introduce full-time quality inspectors, which marked the real beginning of inspection quality control and thus the introduction of quality control departments headed by superintendents (Rumane, 2011).

### **2.3 Quality**

Quality may mean different things to different people as stated bellow:- Some take it to represent customer satisfaction, others interpret it as compliance with contractual requirements, yet others equate it to attainment of prescribed standards.

Quality of construction is even more difficult to define. First of all, the product is usually not a repetitive unit but a unique piece of work with specific characteristics. Secondly, the needs to be satisfied include not only those of the client but also the expectations of the community into which the completed building will integrate. The construction cost and time of delivery are also important characteristics of quality”

Construction project quality is defined as, the fulfillment of the owner’s needs per defined scope of works within a budget and specified schedule to satisfy the owner’s/user’s requirements. (Rumane, 2011).

Quality is meeting the requirements of the designer, constructor, and regulatory agencies as well as the owner (Arditi and Gunaydin,1997).

Quality is the responsibility of all participants in a project, including all levels of management and workers in each party. An attitude of achieving quality must be instilled in everyone and perpetuate throughout the work environment. The attitude should not be "what can we do to pass quality control or final inspection?" Instead, it should be "what can we do to improve our work and what is the best way we can furnish a project that meets the needs and satisfaction of the owner?" (Oberlender, 2000)

Quality will not be indicative of special merit, excellence or high status. It will be used solely in its engineering sense in which it conveys the concepts of compliance with a defined requirement, or fitness for purpose, or customer satisfaction (Ashford, 1989).

The quality requirements of the designer, customer/owner or regulatory agencies can be achieved through quality management.

## **2.4 Quality management**

Is maintaining the quality of works or function at the required standard so as to obtain customers satisfaction that would bring long term competitiveness and business survival for the companies (Tan and Rahman, 2005).

According to ISO 900 as cited by (Ian, 2014) Quality management is defined as “coordinated activities to direct and control an organization with regard to quality”. Direction and control with regard to quality generally includes establishment of the quality policy and quality objectives, quality planning, quality control, quality assurance and quality improvement.

## **2.5 Construction Quality Management**

Construction quality management is the performance of tasks, which ensure that construction is performed according to plans and specifications, on time, within a defined budget, and a safe work environment. (U.S.ACE, 2004)

As cited by (Rumane, 2011), the ASQ glossary defines quality management as “the application of quality management system in managing a process to achieve maximum customer satisfaction at the lowest overall cost to the organization while continuing to improve the process.”

## **2.6 Construction Quality Management Systems**

A quality system is “the organizational structure, responsibilities, procedures, processes, and resources for implementing quality management” (Arnold, 1994)

According to Abdul-Aziz (1999), quality systems involve internal and external aspects.

- ❖ **Internal quality system:**-An internal quality system covers activities aimed at providing confidence to the management of an organization that the intended quality is being achieved. This is called a “quality management system”.

Successful implementation of quality management system can contribute to an increase in product quality, improvement in workmanship and efficiency, a decrease in wastage, and increase profit.

- ❖ **External quality system:** - An external quality system covers activities aimed at inspiring confidence in the client that the supplier's quality system will provide a product or service that will satisfy the client's quality requirements. (Mane & Patil, 2015)

Having good Quality Management System mean Quality policy issues are clearly stated, the top management bodies give their full support and commitment to the project quality policy implementation, the project organizational structure clearly incorporates the quality control and quality assurance team with their responsibility in all contracting parties, Quality procedures & issues are planned, and monitored timely to ensure the benefits of all stakeholders of the project.

As stated by Hakim (2006) Quality management system (QMS) is defined as “all activities of the overall management function that determine the quality policy, objectives and responsibilities, and implement them by means such as:-

- i Quality planning
- ii Quality Control (QC),
- iii Quality Assurance (QA) and
- iv Quality improvement within the quality system”. (Mane & Patil, 2015)

## **2.7 Quality planning**

Quality plan is a document setting out the specific quality practices, resources and sequence of activities relevant to a particular product, service, contract or project (Ashford, 1989). It requires regularly updating in the project lifecycle.

Quality planning refers to a set of quality activities that are involved in producing a product, process or service and encompasses prevention and appraisal procedures (Battikha, 2002).

Quality Planning is focused on determination of quality policies, setting quality objectives and specifying necessary operational processes and related resources to fulfill the quality objectives through quality control and assurance system.

## **2.8 Construction Quality Control**

Quality control can be defined as the standard used in the construction or assembly of a building component, it focuses on fulfilling quality requirements (Levy, 2008)

For construction projects, quality control means making sure things are done according to the plans, specifications, standards, codes and permit requirements (Zane, 2005).

Quality control is essentially the process of measuring the preset levels of accuracy or performance of a component, system, process or procedure and making sure that these levels are achieved. The methods used to control quality include dimensional checks, material tests, non-destructive tests, pressure tests, leak tests, performance tests, documentation control etc. Most organizations have their own test procedures and standards as well as having to comply with clients' requirements and a quality control system must be in place to meet all these criteria. (Albert, 2003).

Effective quality control reduces the possibility of changes, mistakes and omissions, which in turn results in fewer conflicts and disputes. Quality controlling is a set of specific procedures involved in the quality assurance process. These procedures include planning, coordinating, developing, checking, reviewing, and scheduling the work.

Quality control involves a universal sequence of steps as follows:

- Choose the control subject, that is, choose the item of work intend to regulate
- Establish method of measurement
- Establish standard of performance, product goal, and process goals/permit requirement
- Measure actual performance
- Compare actual measured performance against standards
- Take action on the difference (Rumane, 2011)

The ISO definition also states that quality control is the operational techniques and activities that are used to fulfill requirements for quality.

Quality is controlled through the following:

- ❖ Timely inspections and testing of works, materials and production plants
- ❖ Review and approval of materials and shop drawings
- ❖ Submittal of certificates of guarantee
- ❖ Involvement of third party for laboratory testing (Daral-handasah, 2006)

## **2.9 Importance Of Quality Control In Construction**

Quality Control (QC) in construction is the process of verifying that the project is built to plan, that the tolerances allowable by industry standard and engineering practices have been met or bettered, and that the finished project (and all phases to get there) meet with the quality standards of the architect, engineer, owner, and general contractor. On construction projects there are dozens of subcontractors, all of which have specific responsibilities. Superintendents and project managers try to maintain high quality standards but they can't be everywhere at once. Required inspections by cities and counties (as well as other jurisdictions, depending on the project) help to ensure safety and code issues. In addition, a good general contractor or developer will have on staff a QC person, someone who is responsible for going through the building or project, ensuring compliance, and maintaining an on-going list of corrective items that must be accomplished before the contractor who installed it is paid or leaves the job. QC technicians generally keep a very detailed binder, separated by areas/rooms/phases of the project with notes of items that must be either verified or corrected, with sign-off as each is accomplished. This binder becomes part of the project record and is an important element to completing the project on time and with expected quality maintained, (Ashokkumar, 2014).

## **2.10 Construction Quality Assurance**

“Quality Assurance (QA) is a program covering activities necessary to provide quality in the work to meet the project requirements. QA involves establishing project related policies, procedures, standards, training, guidelines, and system necessary to produce quality. Quality assurance provides protection against quality problems through early warnings of trouble ahead. Such early warnings play an important role in the prevention of both internal and external problems.” (Ferguson and Clayton, 1988)

Quality assurance is the activity of providing evidence to establish confidence among all concerned that quality-related activities are being performed effectively. All these planned or systematic actions are necessary to provide adequate confidence that a product or service will satisfy given requirements for quality.

Quality assurance covers all activities from design, development, production/construction, installation, and servicing to documentation, and also includes regulations of the quality of raw materials, assemblies, products, and components; services related to production; and management, production, and inspection processes. Quality assurance in construction projects covers all activities performed by the design team, contractor and quality controller/auditor (supervision staff) to meet owners’ objectives as specified and to ensure that the project/ facility is fully functional to the satisfaction of the owners/end users. (Rumane, 2011)

One of the best ways to assure quality in construction projects is to use an inspector. The first step an inspector should take is to become familiar with the plans, specification, and permit requirements to have some common sense. (Zane, 2005)

## **2.11 Quality Improvement**

Is focused on increasing the ability to fulfill the quality requirements (Ian, 2014)

Cianfrani and West (2009) defined quality improvement as a philosophy which emphasizes that quality is the responsibility of every one in an organization; as a process of managing change, as a strategy to improve organizational competitiveness and effectiveness as a value system that emphasizes striving for quality in product or services.

Therefore, construction quality management is the process of quality planning, quality plan implementation, quality controlling, quality assurance, quality improvement techniques based on quality policy, quality standards and required technical specifications to achieve consumer satisfaction. Construction specifications define the qualitative requirements for materials, products, equipment, and execution procedures as well as the level of workmanship.

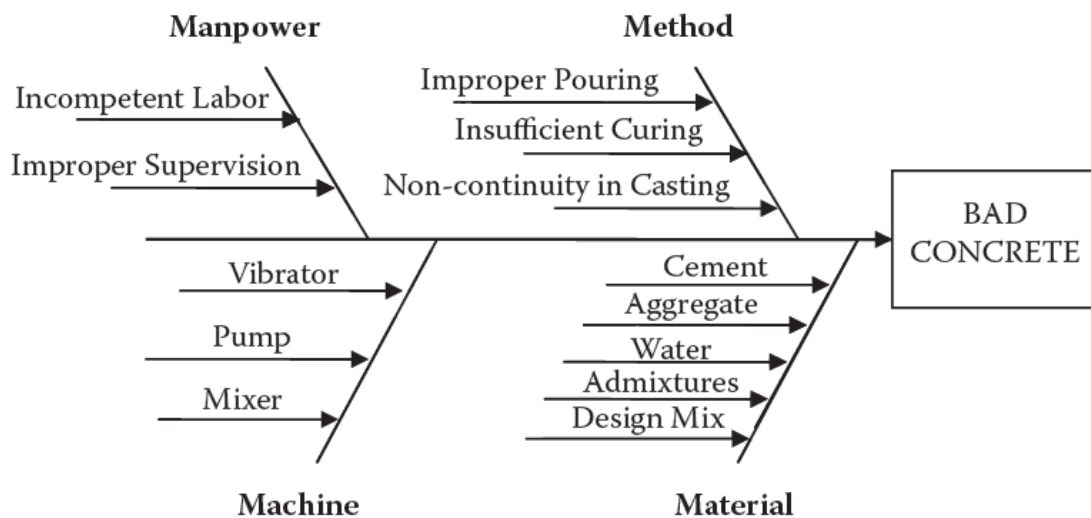


Figure 2.1 Cause-and-effect diagrams for bad concrete (source (Rumane, 2011))

## 2.12 Condominium Housing Construction In Addis Ababa

Cost Effective Condominium Housing Construction In Addis Ababa was launched in 2004 by the then State Minister Arkebe Oqubay, and later Mayor of Addis Ababa who was the driving force behind this program (UNHABITAT, 2010). His main goal was to construct massive low-cost housing units in Addis Ababa. As a starting menu, the City Administration of Addis Ababa, in collaboration with the German Technical Corporation (GTZ) office, commenced the design and construction of a pilot condominium housing project in the neighborhood of Bole Gerji (UNHABITA, 2010).

The purpose of constructing condominium housing in Ethiopia is to enable low-income urban dwellers to acquire homes of their own, alleviation of urban poverty through the participation of Micro and Small Enterprises (MSE) and creation of employment opportunities in the construction sector which can absorb more labor force, changing the image of the city so as to meet international standards, transfer of knowledge and skill to the construction industry, promoting cost efficient housing construction technology, empowering citizens of the city through ownership of houses and tenure security (MUDHC, 2005 E.C).

### **2.13 Quality Management Practices of HDPO**

Cost efficient/low cost housing and condominium housing are phrases interchangeably used in AAHDPO, since condominium houses being constructed are expected to be of low cost or affordable to the low income group and good quality (Kidst, 2014).

Lawale (2011) specify the existence of huge misconception on low cost housing. He asserts that people think low cost housing is only suitable for substandard works constructed by utilizing cheap building materials of lower quality.

However, low-cost housing adopts cost reduction approaches. Cost reduction is achieved through proper management of resources, postponing finishing works and the use of locally available materials along with improved skills and technologies without sacrificing the strength, performance and life of the structure (Lawale, 2011).

Low cost housing technologies (Pre - fabricated slab system/beams and hollow blocks no formwork required) aim to reduce construction cost by using alternatives to the conventional methods and inputs; usage of local building materials, local skills, energy saver and environment-friendly options. Strength and durability of the structure, stability, safety and mental satisfaction are factors that assume top priority during cost reduction. The quality management system also performed by graduates of the country having different work experience in building construction up on the use of technical manual-I and II later prepared as HDPO quality control manual (GTCO, 2003).

The Ethiopian HDPO Quality Control /Management Manual states Quality management as the overall management function that determines and implements the quality policy.

Thus Quality policy of HDPO is stated as: Insure the quality of the houses to be build consistently by preparing accurate and to the standard designs, as poor designs can never result in a high quality product implementing the same with the use of approved material, appropriate equipment and competent workmanship to meet the minimum quality requirements specified therein with a minimum possible cost and without affecting health, safety and environmental consideration (MoUDC, 2012).

As stated in Ethiopian HDPO Quality Control/management Manual, Quality system: - is the organizational structure, responsibilities, procedures, processes and resources for implementing quality management (HDPO, 2003).

The organizational structure of the quality control system of the project office as stated on the quality management manual is as shown below:(the manual were prepared to use for all condominium housing projects in the country supervision since 2003)

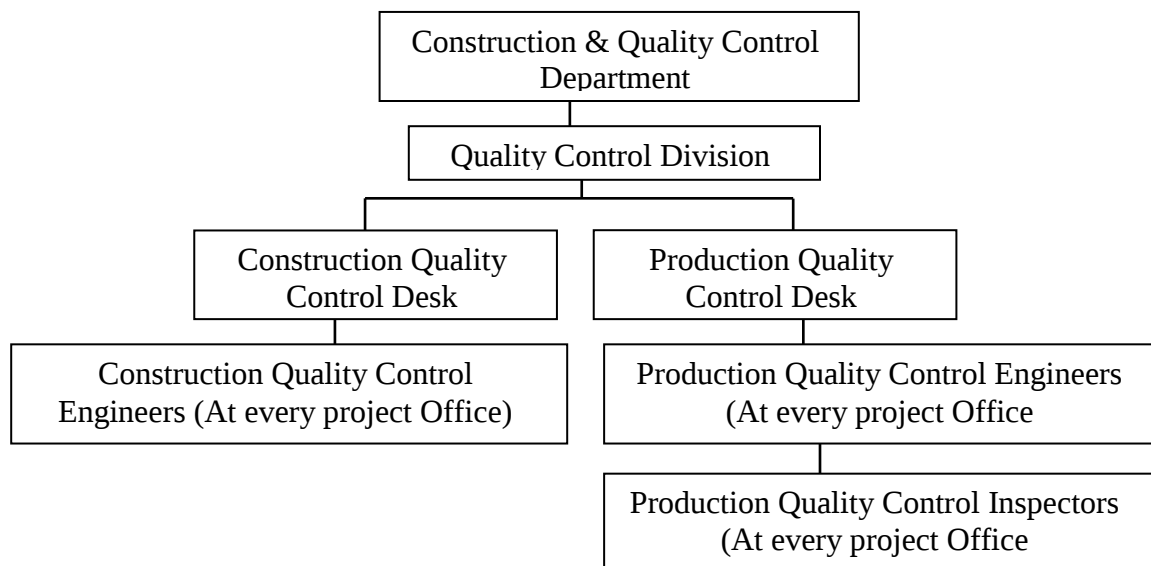


Figure 2.2: HDPO quality control organizational structure (source: manual,2003)

The question of quality in condominium apartments is common in Ethiopia with Medias, and different opinions and suggestions are raised every day at any time who knows the project and even those who have no relation with the project, since the project is set for public use by the government. Therefore, it is very crucial to assess quality assurance and quality control management practices of AAHDPO.

Most occupants believe and say with different discussions (Zame & ShegereRadio, 2016) that cost effective or low cost apartments are constructed as low quality with inferior quality resources to get low cost houses, but;

1. In the case of Ethiopia as cited in UN Habitat (2010) and stipulated in Proclamation No. 272/2003, land is provided free of lease charge for low-cost housing or condominium housing project (Kidst, 2014)
2. The costs for basic infrastructure (the infrastructure works include the water supply, the electricity, the roads and the drainage system) are not included, as they are being covered by the Municipality and in certain cases partially by the beneficiaries.

The project has hence achieved a cost reduction of up to 40-50% (Birr 800 - Birr 900) in comparison to the current construction costs per square meter in Ethiopia. (GTCO, 2003)

The construction cost of a condominium housing unit (in 2011) on the private market was estimated 154/m<sup>2</sup> USD. The cost on the pilot project, was USD 68/m<sup>2</sup>, 12 per cent of this reduction in construction costs was due to the type of technology( Agrostone partion walls, Pre - fabricated slab system/beams and hollow blocks no formwork required) used, and 38 per cent of this reduction was due to the management and level of internal finishes all contributed towards increasing the affordability of the scheme, the design and construction of houses were on the base of Ethiopian Building Code (Mekuria(MHDHCo), 2015).

## **2.14 Construction Quality Standards/Documents**

### **Quality Standards**

From the perspective of a construction company, quality management in construction projects should mean maintaining the quality of construction works at the required standard so as to obtain customers' satisfaction that would bring long term competitiveness and business survival for the companies.

As cited by Rumane(2011) Per Pyzdek states quality standard as "Standards are documents used to define acceptable conditions or behaviors and to provide a base line for assuring that conditions or behaviors meet the acceptable criteria. In most cases standards define minimum criteria; world class quality is, by definition, beyond the standard level of performance. Standards can be written or unwritten, voluntary or mandatory. Unwritten quality standards are generally not acceptable".

Table: 2.1 Common Standards Used in Building Construction Projects (Rumane, 2011) and (MWOUD, 1995)

| No | Work Items | Activity            | International Standards                                                                                                                                                                             | Local Standards                                          |
|----|------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|
|    | Concrete   | Reinforcement       | BS 4449,<br>ASTM A615/A615M                                                                                                                                                                         | EBCS 3<br>(section 3.3)                                  |
|    |            | Cement              | ASTM C150, ASTM C295,<br>ASTM C33                                                                                                                                                                   | -                                                        |
|    |            | Concrete            | ASTM C94, ACI 301,<br>ACI 117                                                                                                                                                                       | EBCS 3<br>(section 3.1),<br>HDPO manual<br>section 3 & 8 |
|    | Finishing  | Tiling              | ANSI A137.1                                                                                                                                                                                         | HDPO manual<br>section 7                                 |
|    |            | Cement plaster      | ASTM C150, ASTM C260,<br>ASTM C897, ASTM C926,<br>ASTM C932, ASTM C1063,<br>ASTM E488, ASTM A641M,<br>ASTM A653M, ASTM C847                                                                         | -                                                        |
|    | Electrical | Wires and<br>cables | BS 6387,BS 6724,BS 6207,<br>BS 7629, BS 4533, BS 6007,<br>BS 6500, IEC 502, IEC 331,<br>BS 6234, BS 6346, IEC 227,<br>IEC 540                                                                       | EBCS 10                                                  |
|    | Plumbing   | Plumbing<br>piping  | ISO 2531, BS 4660, BS 4514,<br>ASTM B88, ASTM B 306,<br>ASTM A6.A8, ASTM 16.22,<br>API 600, ASTM A-74,<br>ASTM A-53, ASTM A-106,<br>ANSI B 16.3, ASTM D1785,<br>ASTM D2729, ASTM D2665,<br>ISO R161 | EBCS 9                                                   |

The required documentation of a quality system ties in closely with the basic functions as aforesaid. The top management's commitment to quality is expressed in a quality policy statement. The quality policy is incorporated and expanded in a quality manual which sets out what management requires its staff to do to assure quality. How it is to be done is detailed in a number of quality procedures and work instructions. What is actually done is evidenced in the various written records. (Chung, 1999) .

## **2.15 Sources of Quality Problems**

The most important factors affecting quality of building construction project during the construction phase are the characteristics of site layout, skill and experience of site staff, characteristics of design documents and using equipment, materials, quality and labor management systems and the owner quick response in making decisions (Amer, 2002)

According to research conducted by the Building Research Establishment (BRE), 90% of building failures are due to problems arising in the design and construction stage the rest 10% are due to unforeseen conditions.

### **2.15.1 Poor Design Quality**

Design drawings are generally incomplete and they are not explicit, requiring a great amount of specifications and they lack constructability. Specifications are difficult to handle and sometimes are ignored. Very often design documents have inconsistencies, errors and omissions, or simply lack of clarity in the presentation. This implies that those should carry out the work do not have the necessary information or have the wrong information to do the job. (Alarcón & Mardones, 1998)

### **2.15.2 Sub Standard Quality Material**

All materials purchased by the contractor or alternatively supplied by the Principal shall be checked for compliance with the specified requirements prior to incorporation in the works (preferably on receipt) and verification shall be noted on the relevant 'Inspection Checklist'.

All materials shall be handled and stored in a manner that prevents damage or deterioration and verification that none has occurred shall be noted on the relevant 'Inspection Checklist'. (Bennett, 2003)

### **2.15.3 Poor Workmanship**

The most important aspect of a quality management in construction project is the workmanship; unfortunately, poor quality workmanship can destroy projects already put in place (Iwaro & Mwasha, 2012). Poor workmanship is one of the serious issues facing local contractors in most developing countries (Moavenzadeh & Rossow, 1995)

A study by (Kasim, 2009) on building defects in Malaysia found that poor workmanship is the major contributor to poor quality of construction, and further recommended that contractors have to provide workers with necessary experience and skills.

### **2.15.4 Poor Construction Method**

Construction methods are reflected in the concentration of technical solution, process, testing methods, and arrangements of construction procedures for construction adopted by construction contractors. (Cheng Hu)

### **2.15.5 Poor Quality Management**

Lack of adequate planning, scheduling, materials management, quality control and quality assurance are chronic problems of construction (The Business Roundtable, 1982b). The effects of these problems are well known and include low productivity, poor safety, inferior working conditions, and inadequate quality (Koskela, 1993).

Quality management principles and tools are not strongly embedded in conventional construction management practice. As a result, rework, on many cases, is accepted as an inevitable feature of the construction process increasing the likelihood of project time and cost overruns, and ultimately leading to client dissatisfaction (Alwi et al, 2009).

## **CHAPTER THREE**

### **3.0 RESEARCH METHODOLOGY**

#### **3.1 Introduction**

This chapter presents the summary of the research design and methodology adopted to carry out the study in acquiring the necessary information to answer the research questions. It specifically presents the research instruments, describes research approach and techniques, clearly identifies the study population and presents sampling techniques in terms of sample size and selection, validity and reliability of the research, data collection methods and data analysis methods.

The research design, the approach taken, the particular data collection methods chosen and the means of analysis, are all considered the part of this thesis's methodology, and are set out in the following sections.

#### **3.2 Research Design**

The first stage in this study involved by the researcher were studying and understanding the research problem related to quality management practices of Addis Ababa 10/90 and 20/80 housing projects. Studying the target area/population were the second stage considered in this study. This research utilized questionnaire, interview and focused group discussion (FGD) as primary and literature review as secondary data sources. The researcher analyzed the data collected through questionnaire, interview and FGDs by descriptive statistics using percentage, ranked mean score and correlation from SPSS 20 version and Excel Software. The data analyzed through the above tools presented in tables, pie charts and histograms with clarification of results obtained.

### 3.3 Population and Sample Size

#### 3.3.1 Research Population

A research population can be defined as the totality of a well-defined collection of individuals or objects that have a common, binding characteristics or traits.

Therefore the population of this research includes the AAHDHO and all 18 branches of AAHDPO Client, Contractor and Consultant Professionals and MSEs (Sanitary, Electrical, Metal Work, and Production Centers), which is very large (Since there are one AAHDHO, 18 AAHDPO branch offices having one Construction & Contract administration division head & a minimum of six Construction & Contract administration officers, two consultants having one coordinator, average of three Resident Engineers and a minimum of twenty three Site Inspectors in each consultant office, a minimum of thirty four contractors having one site engineer and one Forman for each contractor, and fifteen Electrical, fifteen Sanitary, twelve metalwork construction MSEs, ten HCB, and eight pre-cast production MSEs in each project site having a minimum of five members in each MSE, there for the total population is more than nine thousand as shown bellow on table: 3.1

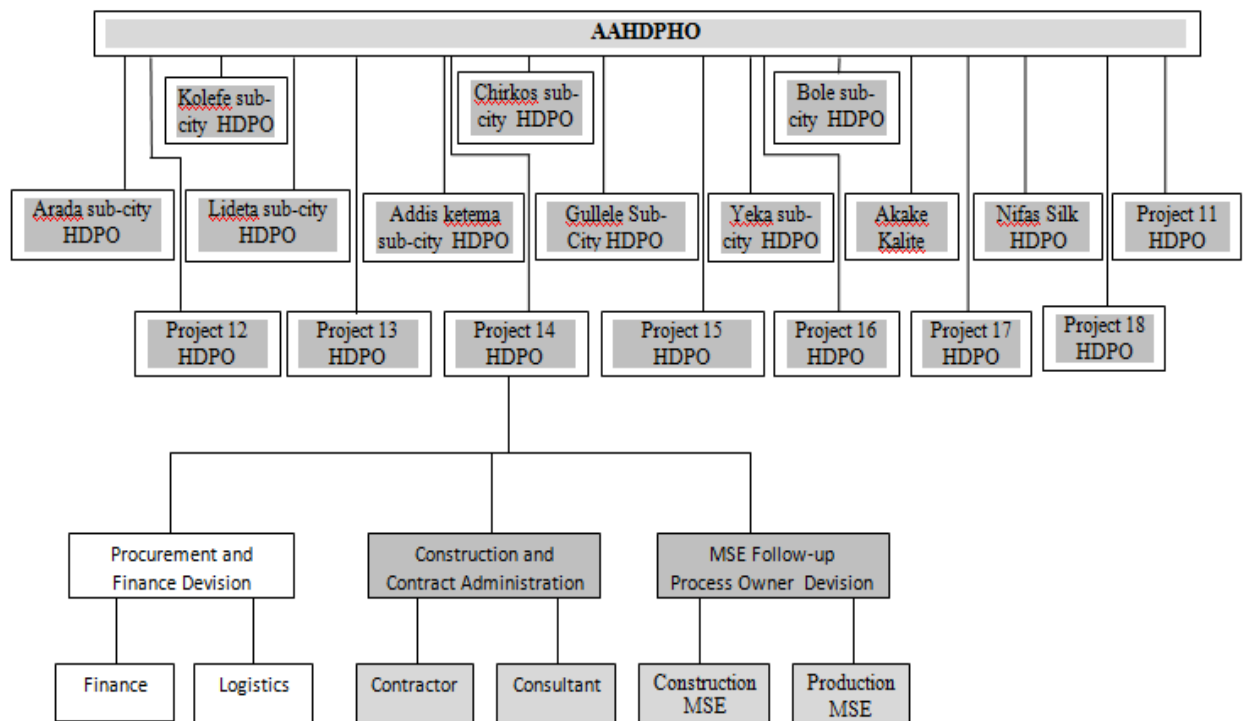


Figure 3.1: AAHDP Organizational Structure

Table:3.1 Population Size

| Project Execution Participants | N <sup>o</sup> of Offices | N <sup>o</sup> of Professionals in each office | Project Site (N <sup>o</sup> of MSEs) | Sub Total         |
|--------------------------------|---------------------------|------------------------------------------------|---------------------------------------|-------------------|
| AAHDHO                         | 1                         | 7                                              | 1                                     | 7                 |
| AAHDP Branch Offices           | 18                        | 7                                              | 1                                     | 126               |
| Contractors                    | 18                        | 68                                             | 2                                     | 2,448             |
| Consultants                    | 18                        | 27                                             | 2                                     | 972               |
| Sanitary MSEs                  | 18                        | 5                                              | 15                                    | 1,350             |
| Electrical MSEs                | 18                        | 5                                              | 15                                    | 1,350             |
| Metal work SMEs                | 18                        | 5                                              | 12                                    | 1,080             |
| HCB Production MSs             | 18                        | 5                                              | 12                                    | 1,080             |
| PB Production SMEs             | 18                        | 5                                              | 8                                     | 720               |
| <b>Total Population</b>        |                           |                                                |                                       | <b>&gt; 9,133</b> |

### 3.3.2 Sampling

Sampling is a process of selecting a portion of the population to represent the total population and the findings from the sample represents the rest of the group.

Sample size of the population was determined in 95% confidence level as follows.

$$n = n_0 / (1 + (n_0/N))$$

-----Sample size determination equation--3.1

#### Where

n- Is the required sample size

N- Is total population

n<sub>0</sub>- is the sample size without considering the finite population correction factor

$$n_0 = s^2 / v^2$$

-----Sample size without correction factor ...equation--3.2

$$s^2 = p(1 - p)$$

-----The variance of the population, elements ...equation--3.3

**p**= 0.5 proportion of the population elements that belong to the defined category for 95% confidence level.

**v**= 0.05 which is 5% standard error margin for population

In this study both probability and non-probability sampling techniques were used, six AAHDPO branch offices were selected randomly out of those eighteen branch offices and all members of the respective branch offices professionals are selected purposely based on Sample equation--3.1 as shown on table:3.2 bellow.

Table: 3.2 Sample Size

| Sample offices                                                      | N <sup>o</sup> of offices | Population of six Branch Offices | N <sup>o</sup> of Samples Based on Equation (3.1) | Sample Areas (profession)  | N <sup>o</sup> Of Samples |
|---------------------------------------------------------------------|---------------------------|----------------------------------|---------------------------------------------------|----------------------------|---------------------------|
| AAHDHO                                                              | 1                         | 7                                | 7                                                 | Construction Division Head | 1                         |
|                                                                     |                           |                                  |                                                   | Construction Officers      | 4                         |
|                                                                     |                           |                                  |                                                   | Electrical                 | 1                         |
|                                                                     |                           |                                  |                                                   | Sanitary                   | 1                         |
|                                                                     |                           |                                  |                                                   | Sub-Total                  | 7                         |
| AAHDP Branch Office                                                 | 6                         | 42                               | 30                                                | Construction Division Head | 6                         |
|                                                                     |                           |                                  |                                                   | Construction Officers      | 12                        |
|                                                                     |                           |                                  |                                                   | Electrical                 | 6                         |
|                                                                     |                           |                                  |                                                   | Sanitary                   | 6                         |
|                                                                     |                           |                                  |                                                   | Sub-Total                  | 30                        |
| Contractor                                                          | 6                         | 408                              | 80                                                | Site Engineer              | 40                        |
|                                                                     |                           |                                  |                                                   | Forman                     | 40                        |
|                                                                     |                           |                                  |                                                   | Sub-Total                  | 80                        |
| Consultants                                                         | 6                         | 162                              | 62                                                | Coordinator                | 6                         |
|                                                                     |                           |                                  |                                                   | RE                         | 12                        |
|                                                                     |                           |                                  |                                                   | Site Inspector             | 20                        |
|                                                                     |                           |                                  |                                                   | Electrical Inspector       | 12                        |
|                                                                     |                           |                                  |                                                   | Sanitary Inspector         | 12                        |
|                                                                     |                           |                                  |                                                   | Sub-Total                  | 62                        |
| Construction MSE                                                    | 6                         | 90                               | 47                                                | Electrical                 | 47                        |
|                                                                     |                           | 90                               | 47                                                | Sanitary                   | 47                        |
|                                                                     |                           | 72                               | 42                                                | Metal                      | 42                        |
|                                                                     |                           | Sub-Total                        | 136                                               |                            |                           |
| Production MSE                                                      | 6                         | 72                               | 42                                                | HCB                        | 42                        |
|                                                                     |                           | 48                               | 32                                                | Precast                    | 32                        |
|                                                                     |                           |                                  | Sub-Total                                         | 74                         |                           |
| Total                                                               |                           |                                  |                                                   |                            | 389                       |
| Considering 10% contingency for non respondents the total sample is |                           |                                  |                                                   |                            | 429                       |

### 3.4 Instrumentation

This study utilized four research instruments to assess the quality management practices of AAHDPO and to identify the causes of poor quality management. One of the instruments were gathering the relevant information through questionnaires, out of 429 questioners distributed to six branch office client, contractor, consultant, construction MSEs & production MSEs and the head office 389 respondents which accounts 90.7% were collected/returned back appropriately as shown in Table 3.3 bellow. Tailored interviews were also used to seek information from those in higher echelons in their respective divisions of two branch office professionals, as a second instrument. The third instrument were focused group discussion (FGD) among professionals Client (construction and contract administrator), Contractor, (site engineers), Consultant (coordinators and resident engineers) and MSE (Construction MSEs and production MSEs) representatives in two selected project sites who were not selected for interview independently in their respective sites) as primary data sources and the fourth instrument were document analysis on quality assurance and quality control management practices of AAHDPO as secondary data source in addition to related literatures. To elaborate, questioner survey was carried out on the selected six (6) branch offices client professionals in addition to the head office professionals, contractors, consultants, construction MSEs and production MSEs, professionals of AAHDPO.

The respondents were asked to express their perception, practice and knowledge with close and open ended questions about quality management practices of AAHDPO, the stage at which most quality problems occur, construction material quality control and assurance practice, contract specification (quality control and assurance documents) related, personnel (workmanship) quality management practices, construction process and method adopted , major causes of poor quality management practices, quality improvement method employed, symptoms of the impact of quality management problem and at last the respondents view on the quality of completed low cost houses in AAHDPO.

In this regarded a five likert scale

- i. 1= Strongly disagree,
- ii. 2=Disagree,
- iii. 3=No opinion,
- iv. 4=Agree,
- v. 5=Strongly agree, and

On the three likert scale measurement

- i. 1=Disagree,
- ii. 2=No opinion,
- iii. 3=Agree and yes/no scales were used and respondents answer their agreements by ☒ mark for close ended questions. In addition the contents of interviews, FGDs and archival document assessment were done based on the objectives of the study as stated above.

Table 3.3: Details of the responsiveness of the questionnaire respondent

| Company                         | Gulelle Sub-city |                  |                    | Project-13       |                  |                    | Addis ketema Sub-city |                  |                    | Project-12       |                  |                    | Arada Sub-city   |                  |                    | Project-11       |                  |                    | Total             |                   |                    |
|---------------------------------|------------------|------------------|--------------------|------------------|------------------|--------------------|-----------------------|------------------|--------------------|------------------|------------------|--------------------|------------------|------------------|--------------------|------------------|------------------|--------------------|-------------------|-------------------|--------------------|
|                                 | Distributed      | Returned         | %age Returned      | Distributed      | Returned         | %age Returned      | Distributed           | Returned         | %age Returned      | Distributed      | Returned         | %age Returned      | Distributed      | Returned         | %age Returned      | Distributed      | Returned         | %age Returned      | Distributed       | Returned          | %age Returned      |
| <b>AAHDHO</b>                   |                  |                  |                    |                  |                  |                    |                       |                  |                    |                  |                  |                    |                  |                  |                    |                  |                  |                    | <b>8</b>          | <b>7</b>          | <b>87.5</b>        |
| <b>AABHDPO</b>                  | 6                | 5                | 83.3               | 6                | 5                | 83.3               | 6                     | 5                | 83.3               | 5                | 5                | 100                | 5                | 5                | 100                | 5                | 5                | 100                | <b>33</b>         | <b>30</b>         | <b>90.9</b>        |
| <b>Contractor</b>               | 15               | 15               | 100                | 15               | 13               | 86.7               | 15                    | 14               | 93.3               | 14               | 12               | 85.7               | 15               | 13               | 86.7               | 14               | 13               | 92.9               | <b>88</b>         | <b>80</b>         | <b>90.9</b>        |
| <b>Consultant</b>               | 11               | 10               | 90.9               | 11               | 10               | 90.9               | 11                    | 10               | 90.9               | 12               | 11               | 91.7               | 12               | 11               | 91.7               | 11               | 10               | 90.9               | <b>68</b>         | <b>62</b>         | <b>91.2</b>        |
| <b>Electrical MSEs</b>          | 9                | 8                | 88.9               | 9                | 8                | 88.9               | 8                     | 7                | 87.5               | 8                | 8                | 100                | 9                | 8                | 88.9               | 9                | 8                | 88.9               | <b>52</b>         | <b>47</b>         | <b>90.4</b>        |
| <b>Sanitary MSEs</b>            | 9                | 8                | 88.9               | 9                | 8                | 88.9               | 8                     | 7                | 87.5               | 8                | 8                | 100                | 9                | 8                | 88.9               | 9                | 8                | 88.9               | <b>52</b>         | <b>47</b>         | <b>90.4</b>        |
| <b>Metal work MSEs</b>          | 8                | 7                | 87.5               | 8                | 7                | 87.5               | 8                     | 7                | 87.5               | 7                | 7                | 100                | 8                | 7                | 87.5               | 7                | 7                | 100                | <b>46</b>         | <b>42</b>         | <b>91.3</b>        |
| <b>HCB Production MSEs</b>      | 8                | 7                | 87.5               | 8                | 7                | 87.5               | 8                     | 7                | 87.5               | 7                | 7                | 100                | 8                | 7                | 87.5               | 7                | 7                | 100                | <b>46</b>         | <b>42</b>         | <b>91.3</b>        |
| <b>Pre-cast production MSEs</b> | 6                | 5                | 83.3               | 6                | 6                | 100                | 6                     | 6                | 100                | 6                | 5                | 83.3               | 6                | 5                | 83.3               | 6                | 5                | 83.3               | <b>36</b>         | <b>32</b>         | <b>88.9</b>        |
| <b>Total</b>                    | <b><u>72</u></b> | <b><u>65</u></b> | <b><u>90.3</u></b> | <b><u>72</u></b> | <b><u>64</u></b> | <b><u>88.9</u></b> | <b><u>70</u></b>      | <b><u>63</u></b> | <b><u>90.0</u></b> | <b><u>67</u></b> | <b><u>63</u></b> | <b><u>94.0</u></b> | <b><u>72</u></b> | <b><u>64</u></b> | <b><u>88.9</u></b> | <b><u>68</u></b> | <b><u>63</u></b> | <b><u>92.6</u></b> | <b><u>429</u></b> | <b><u>389</u></b> | <b><u>90.7</u></b> |

### **3.5 Data Collection Method**

In this research both primary and secondary data collection methods were employed.

#### **3.5.1 Primary Data Source collection**

Descriptive survey were used to collect primary data (using questionnaires, interview and contracting parties group discussion) in this study to meet the objectives of the study, namely to assess the practice of quality management system in AAHDPO cost effective condominium housing construction projects, to identify sources of quality problems in cost effective condominium housing construction projects, to investigate the impact of quality control and quality assurance management techniques on cost effective condominium housing construction projects during the execution of projects on the quality of completed structures. Since, the primary purpose of a descriptive survey research is to describe the situation, preferences, practices, opinions, concerns or interests of the phenomenon (Polit, 1993). Naoum (2007) added that the descriptive survey aims to answer such questions as: How many? Who? What is happening? Where? and When? It deals with counting the number of respondents with certain opinions/attitudes towards a specific object as cited by (Ian, 2014).

#### **3.5.2 Secondary Data Sources collection**

Secondary sources of information were collected from technical specifications, manuals, reports, inspection certificates, site books, quality policies, books, newspapers, journals and from internet.

### **3.6 Data Processing**

The researcher utilized the mean score, percentage of frequency & correlation methods for the data analysis and organized in away stated bellow to identify the respondent's perception towards the quality management practices of AAHDPO through the use of Excel 2007 and SPSS 20 version software.

### a. Mean score

❖ Is the sum of all the values in a set, divided by the number of values

$$\bar{X} = \frac{X_1 + X_2 + X_3 + \dots + X_n}{n} = \frac{\sum cX}{n} \dots \dots \dots \text{equation 3.4}$$

### b. Correlation

**Pearson Product Moment Correlation:** Pearson's  $r$  summarizes the relationship between two variables that have a straight line or linear relationship with each other. If the two variables have a straight line relationship in the positive direction, then  $r$  will be positive and considerably above 0. If the linear relationship is in the negative direction, so that increases in one variable, are associated with decreases in the other, then  $r < 0$ . The possible values of  $r$  range from -1 to +1, with values close to 0 signifying little relationship between the two variables.

The Pearson correlation coefficient  $r$  can be defined as follows.

$$r = \frac{S_{xy}}{\sqrt{S_{xx}S_{yy}}} \dots \dots \dots \text{equation 3.5}$$

Where,  $S_{xx} = \sum (x_i - \bar{x})^2$ ,  $S_{yy} = \sum (y_i - \bar{y})^2$  and  $S_{xy} = \sum (x_i - \bar{x})(y_i - \bar{y})$ .

$S_{xx}$  is the value of x axis, it is weighted as 1 to 5 and  $S_{yy}$  is the number of respondents for each value. And the  $S_{xy}$  is the multiplication of  $S_{xx}$  and  $S_{yy}$ .

### Interpretation of Correlation Values

Correlation coefficient of +1 means perfect positive correlation.

Correlation coefficient between 0.75 and 1 means high degree correlation.

Correlation coefficient between 0.5 and 0.75 means moderate correlation.

Correlation coefficient between 0.25 and 0.5 means low degree correlation

Correlation coefficient between 0 and 0.25 means absence of correlation

Correlation coefficient close to 0 means no correlation.

Correlation coefficient of -1 means perfect negative correlation (Altman, 1991)

### 3.7 Data Presentation

The data analyzed through the above tools presented in tables, pie charts and histograms in addition to clarification for results obtained with the aid of excel and SPSS 20 software.

### 3.8 Physical Work Progress of Projects Assessed in this study

Table 3.4: Work progress of projects under study

| Physical Progress of Projects During the Research Period<br>December 30/2016 |        |
|------------------------------------------------------------------------------|--------|
| Gullele Sub-City                                                             | 35.13% |
| Project 13                                                                   | 33.7%  |
| Arada sub-city                                                               | 28.43% |
| Project 11                                                                   | 70.62% |
| Addis Ketema Sub-city                                                        | 97.63% |
| Project 12                                                                   | 57.94% |

(Source: Branch office monthly work progress report)

Work progress of all project sites selected for this study was greater than 25%.

## **CHAPTER FOUR**

### **4 DATA ANALYSIS, RESULT, DISCUSSION AND PRESENTATION**

#### **4.1 Data Analysis**

This thesis utilized both descriptive and inferential statistics specially mean score, percentage and correlations with the application of Excel and SPSS 20 software to analyze data collected through questioner, focus group discussion and interviews, which were presented in the form of tables, pie charts and Histograms.

The variables considered for this study were the knowledge and perceptions of professionals on the side of AAHDPO client office, consultant office, contractors office, construction MSEs and production MSEs who were directly engaged in the execution of the project either to perform quality assurance and/or quality control duties in the delivery of the final products. These variables were considered with reference to the study objectives and the research questions.

##### **4.1.1 Over view**

The study was aimed to assess quality management practices and sources of poor quality management in AAHDPO. Thus respondents were main players in the construction/execution phase of the project, includes AAHDPO as client, main contractors, consultants, Construction MSEs and production MSEs as sub-contractors.

Among 18 project branch offices, six projects under study were more than 25% work progress during questioner distribution, main contractors having BC/GC-6 grade and above were participated in 10/90 & 20/80 AAHDPO, construction MSEs participated in this study include electrical installation work, sanitary installation work and metal (roof truss, door, window & handrail) work and pre-cast beam & HCB production MSEs included, graduated in first degree, diploma, level- IV and Level-III.

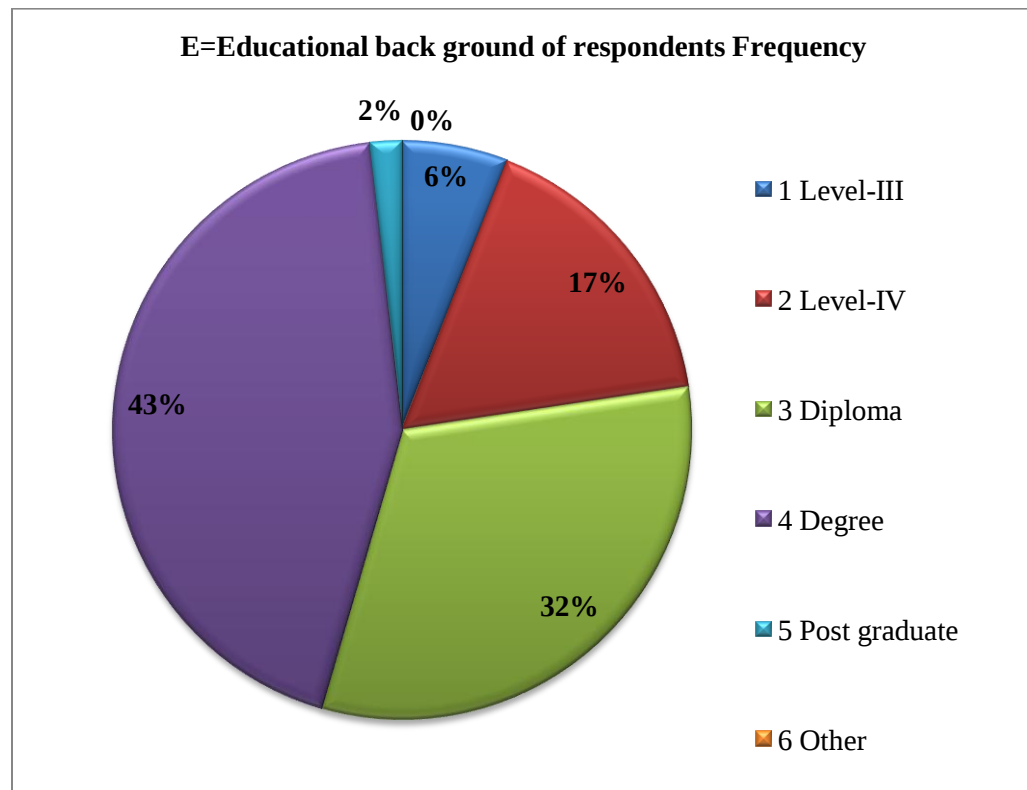
## 4.2 Results and Interpretation

### 4.2.1 Respondents and Firm's profile

#### 4.2.1.1 Educational Background

The frequency percentages depicted bellow on Table 4.1 and pie chart 4.1 are computed by SPSS 20 and Excel 2007 software respectively to get general information about the respondent's educational background. The 43% of the total respondents were first degree graduates in different universities whereas 32% diploma, 17% level-IV, 6% level-III respondents were Technique College graduates the rest 2% were postgraduates.

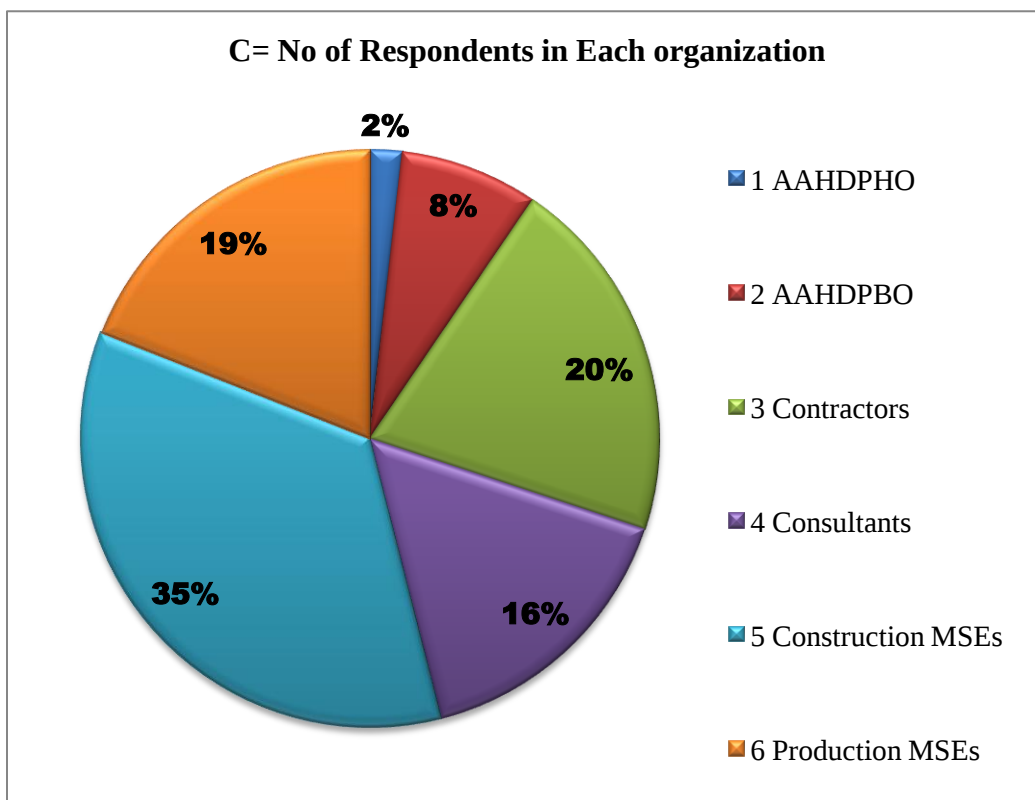
Pie Chart 4.1: Respondents Educational Background



#### 4.2.1.2 Type of organization

Respondents who participated in this study were key personnel of the contracting parties (Client, Contractor, Consultant, Construction MSEs and Production MSEs) directly participated in the execution/construction phase of 10/90 and 20/80 low cost housing projects in AAHDPO. The 35% of total respondents were construction MSEs (12% electrical, 12% sanitary & 11% metal work), 20% contractors, 19% production MSEs (11% HCB & 8% Pre-cast beam production), 16% consultants and 10% client (8% branch office & 2% head office) respondents the composition of respondents based on their organization are shown below on pie chart 4.2.

Pie chart 4.2 Respondents Organization



#### 4.2.1.3 Reliability testing

Cronbach's alpha coefficient is used to test the reliability, it varies from 0 to 1; the closer the coefficient to 1, the more reliable the scale. The Cronbach's alpha coefficient of scale should be above 0.7; however, it is common to find low Cronbach's alpha coefficients, for example, 0.5 for scales with fewer than ten items. The reliability of a scale varies depending on the sample that is used (Pallant, 2005). The lower the number of items, the more likely the reliability coefficient will be lower. For this study the overall Cronbach's alpha coefficient for all scaled questions was 0.972 which satisfies the reliability test requirements as shown in the Table 4.1 below.

| Case Processing Summary                                        |                       |                       |       |
|----------------------------------------------------------------|-----------------------|-----------------------|-------|
|                                                                |                       | Number of Respondents | %     |
| Cases                                                          | Valid                 | 389                   | 100.0 |
|                                                                | Excluded <sup>a</sup> | 0                     | 0     |
|                                                                | Total                 | 389                   | 100.0 |
| a. List wise deletion based on all variables in the procedure. |                       |                       |       |

| Reliability Statistics |                           |
|------------------------|---------------------------|
| Cronbach's Alpha       | Number of Items/questions |
| 0.972                  | 206                       |

Table 4.1 Reliability Testing

#### 4.2.4 Assessing Quality Management Practices of AAHDPO

Based on the objectives of this research, twelve questions were designed to assess the quality management practices of AAHDPO on five likert measurement scale 1=Strongly Disagree, 2=Disagree, 3=No opinion, 4= Agree and 5= Strongly Agree, at which construction participants indicate their awareness and implementation level of quality management techniques.

#### 4.2.5 Quality Management System Awareness and Practices of AAHDPO

Awareness is the first stage to practice or to perform a certain action of work, there for this section of the questioner aimed to assess the respondents knowledge in their organization about quality management techniques and then there practice on a scale of 1= strongly disagree, 2= disagree, 3=no opinion, 4= agree and 5= strongly agree.

From Table 4.7 and Figure 4.6 shown below out of twelve quality management awareness and practice questions, respondents ranked first their awareness and practice on quality control with a value of 3.79 weighted average mean value, which shows agreed on the five likert scale they are aware and practicing quality control techniques in AAHDPO in their response. AAHDPO contracting parties agreed as they are using at least one of quality management techniques by ranking it second next to their awareness on quality control with 2.77 weighted average mean value, the third ranked with respondents based on weighted mean value of 3.63 is their awareness on organizational quality mission and policies that is again they agreed. Performing tests under the supervision of RE and Outlining inspection & test activities specific to the housing acceptance criteria ranked as fourth and fifth with weighted average mean score of 3.62 and 3.60 respectively.

Quality management techniques ranked from sixth to twelve scored weighted average mean below 3.5 indicates that respondents had no opinion on their awareness and practice on such techniques, the least prioritized quality management techniques practiced in AAHDPO based on the weighted mean value were awareness and practice on updating regularly quality management plans.

Table 4.2: Mean score values of respondents in their category and ranks of awareness level on quality management techniques

| Question                                                                                              |        | Client     |      | Contractor |      | Consultant |      | Construction MSE |      | Production MSE |      | Weighted |      |
|-------------------------------------------------------------------------------------------------------|--------|------------|------|------------|------|------------|------|------------------|------|----------------|------|----------|------|
| Is your company aware and practices the following quality management techniques? (Mkhonto, July 2014) | Code   | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank | Mean Score       | Rank | Mean Score     | Rank | Mean     | Rank |
| Quality control                                                                                       | QA1.3  | 3.41       | 2    | 3.81       | 4    | 4.10       | 2    | 3.84             | 2    | 3.81           | 3    | 3.79     | 1    |
| Using quality management techniques                                                                   | QA1.6  | 3.41       | 2    | 3.73       | 7    | 3.89       | 7    | 3.99             | 1    | 3.82           | 1    | 3.77     | 2    |
| Organizational quality mission and Policies                                                           | QA1.7  | 3.46       | 1    | 3.85       | 1    | 3.92       | 6    | 3.10             | 4    | 3.82           | 1    | 3.63     | 3    |
| Performing tests under the supervision of RE                                                          | QA1.12 | 3.41       | 2    | 3.49       | 11   | 3.97       | 5    | 3.57             | 3    | 3.69           | 5    | 3.62     | 4    |
| Outlines the inspection and test activities specific to the housing acceptance criteria               | QA1.9  | 3.35       | 5    | 3.84       | 2    | 4.16       | 1    | 2.93             | 8    | 3.72           | 4    | 3.60     | 5    |
| Quality planning                                                                                      | QA1.1  | 3.16       | 9    | 3.69       | 8    | 3.98       | 4    | 2.96             | 7    | 3.55           | 6    | 3.47     | 6    |
| Quality improvement                                                                                   | QA1.4  | 3.19       | 8    | 3.83       | 3    | 3.79       | 9    | 2.98             | 6    | 3.46           | 8    | 3.45     | 7    |
| Quality assurance                                                                                     | QA1.2  | 3.14       | 11   | 3.74       | 6    | 3.85       | 8    | 3.06             | 6    | 3.42           | 10   | 3.44     | 8    |
| Submitting test results and samples to the RE                                                         | QA1.11 | 3.32       | 6    | 3.76       | 5    | 3.66       | 11   | 2.88             | 10   | 3.43           | 9    | 3.41     | 9    |
| Works commenced when test results required by the Specification have been approved                    | QA1.10 | 3.08       | 11   | 3.64       | 9    | 4.10       | 2    | 2.68             | 11   | 3.50           | 7    | 3.40     | 10   |
| Quality management systems                                                                            | QA1.5  | 3.08       | 11   | 3.61       | 10   | 3.74       | 10   | 2.90             | 9    | 3.36           | 11   | 3.34     | 11   |
| Updating regularly quality management plans                                                           | QA1.8  | 3.32       | 6    | 3.49       | 11   | 3.15       | 12   | 2.38             | 12   | 3.19           | 12   | 3.10     | 12   |

#### 4.2.5.1 Comparison of Contracting Parties Response on Quality Management Techniques

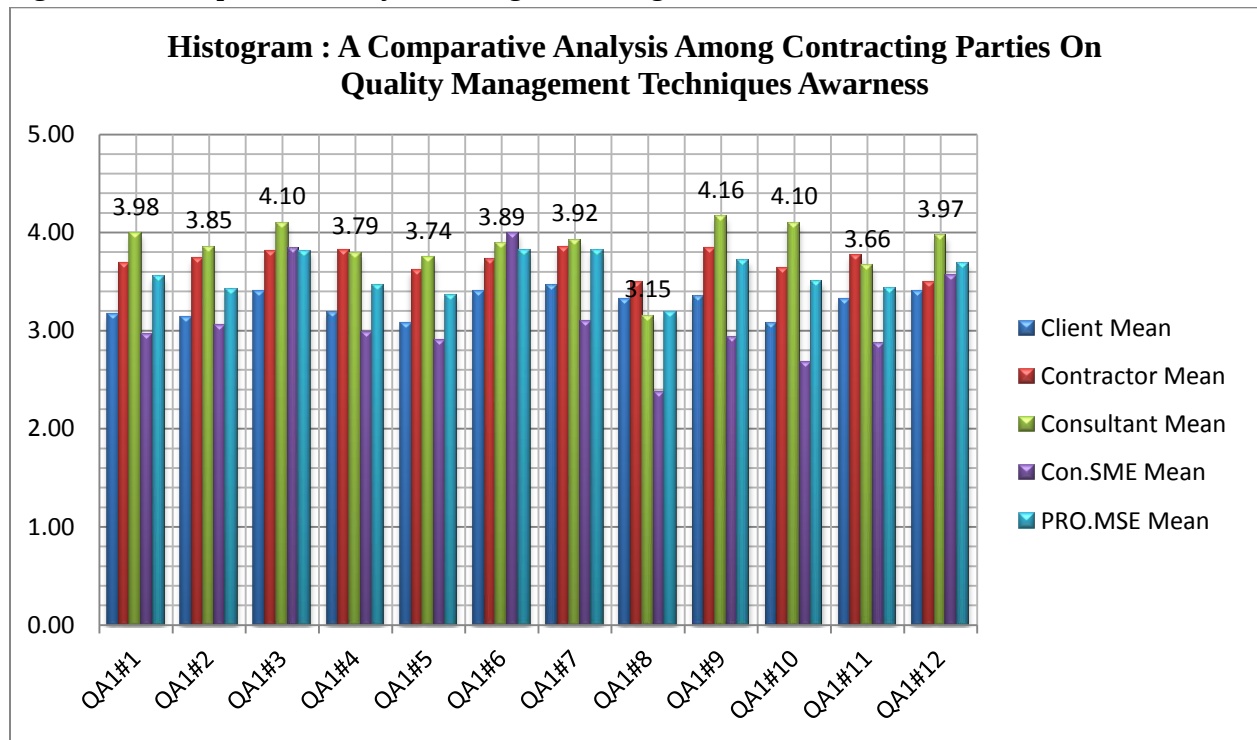
Contracting parties in Addis Ababa Low cost Condominium Housing 10/90 and 20/80 Projects are, Addis Ababa Housing Development Office(Client), Contractors(contractor), Consultants(Contract administration and supervision service), Construction MSEs(Sub-contractors on Electrical Installation, Sanitary Installation and Metal works) and Production MSEs (Hollow concrete block and Pre-cast beam production work).

Table 4.3 Correlation between respondents on quality management techniques awareness

|                                                              | Correlation | Client | Contractor | Consultant | Construction MSE | Production MSE |
|--------------------------------------------------------------|-------------|--------|------------|------------|------------------|----------------|
| Client                                                       | Pearson     | 1      | 0.359      | 0.247      | 0.579*           | 0.548          |
| Contractor                                                   | Pearson     | 0.359  | 1          | 0.529      | 0.322            | 0.529          |
| Consultant                                                   | Pearson     | 0.247  | 0.529      | 1          | 0.552            | 0.759**        |
| Construction MSE                                             | Pearson     | 0.579* | 0.322      | 0.552      | 1                | 0.796**        |
| Production MSE                                               | Pearson     | 0.548  | 0.529      | 0.759**    | 0.796**          | 1              |
| *. Correlation is significant at the 0.05 level (2-tailed).  |             |        |            |            |                  |                |
| **, Correlation is significant at the 0.01 level (2-tailed). |             |        |            |            |                  |                |

The SPSS 20 version software output of Pearson correlation on Table 4.3 above shows the client has low degree of agreement with the contractor (0.359), absence of correlation with the consultant (0.247), moderate response agreement with the construction MSEs (0.579) and with production MSEs (0.548) were observed. There was moderate agreement between contractor respondents with consultants (0.529) and with production MSE respondents (0.529) but low degree of agreement with construction MSE respondents (0.322) knowledge on quality management techniques. There was moderate degree agreement between consultants and construction MSEs (0.532) but high degree of agreement with production MSE respondents (0.759) observed. Strong agreement/relationship between the two MSE respondents (0.796) was observed. The weighted mean values of twelve questions response by client (3.28), Contractor (3.71), Consultants (3.86), Construction MSEs (3.1) and Production MSEs (3.57) also supports the above discussion on quality management techniques awareness among respondents. In other words the client and the construction MSE respondents had no opinion on the presence/absence of quality management techniques awareness.

Figure 4.3: Comparative analysis Histogram of Organizations Awareness



#### 4.2.6 Construction Stages at Which Most Quality Problems Occur In AAHDPO

Quality problems occur in any stage from setting out to finishing work if proper quality control methods are not followed and construction resources quality are not as per specifications and standards.

The surveyed AAHDP construction firms as presented in Table 4.4 below with a measurement scale of 1 to 5 identified most quality problems occur in the construction phase of Compaction (under hard core, grade beams, masonry & around footings) and during sub structure concreting work stages as ranked both first based on weighted mean value 3.79 showing the respondents agreement on the five likert scale questioner. Sanitary installation work, selected material fill quality and Electrical installation works ranked 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> with weighted mean value of 3.76, 3.73 & 3.68 respectively were construction stages in AAHDPO most quality problems observed. Respondents agreed on the existence of quality problems at the stages of super structure concreting, foundation depth determination and roof construction with weighted mean value of 3.63, 3.63 & 3.54 respectively, but respondents had no opinion on the rest eight construction stages, since the weighted mean values are less than 3.5 as detailed.

**Table 4.4: Mean Score Values and Ranks of Construction Stages at Which Most Quality Problems Occur In AAHDPO**

| Question                                    |        | Client     |      | Contractor |      | Consultant |      | Construction MSE |      | Production MSE |      | Weighted |      |
|---------------------------------------------|--------|------------|------|------------|------|------------|------|------------------|------|----------------|------|----------|------|
| When do most quality problems occur? during | Code   | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank | Mean Score       | Rank | Mean Score     | Rank | Mean     | Rank |
| Compaction                                  | QA2.6  | 3.76       | 1    | 3.68       | 4    | 3.76       | 1    | 3.83             | 7    | 3.91           | 3    | 3.79     | 1    |
| Sub Structure Concreting                    | QA2.4  | 3.46       | 5    | 3.69       | 2    | 3.63       | 2    | 4.27             | 1    | 3.92           | 1    | 3.79     | 1    |
| Sanitary installation work                  | QA2.11 | 3.62       | 3    | 3.83       | 1    | 3.35       | 5    | 4.10             | 4    | 3.88           | 4    | 3.76     | 3    |
| Selected material fill                      | QA2.5  | 3.65       | 2    | 3.64       | 5    | 3.60       | 3    | 3.82             | 9    | 3.92           | 1    | 3.73     | 4    |
| Electrical installation work                | QA2.10 | 3.46       | 5    | 3.60       | 6    | 3.31       | 6    | 4.21             | 2    | 3.80           | 5    | 3.68     | 5    |
| Super Structure Concreting                  | QA2.3  | 3.49       | 4    | 3.69       | 2    | 3.40       | 4    | 4.01             | 5    | 3.58           | 8    | 3.63     | 6    |
| Foundation depth determination              | QA2.7  | 3.38       | 8    | 3.59       | 8    | 3.18       | 9    | 4.19             | 3    | 3.80           | 5    | 3.63     | 7    |
| Roof construction                           | QA2.16 | 3.41       | 7    | 3.59       | 8    | 3.19       | 9    | 3.83             | 7    | 3.66           | 7    | 3.54     | 8    |
| Fixing metal doors and windows              | QA2.13 | 3.14       | 12   | 3.60       | 6    | 3.18       | 9    | 3.60             | 10   | 3.55           | 9    | 3.41     | 9    |
| Plastering work                             | QA2.9  | 3.19       | 10   | 3.35       | 12   | 3.13       | 11   | 3.84             | 6    | 3.46           | 10   | 3.39     | 10   |
| Setting out of the building                 | QA2.1  | 3.19       | 10   | 3.33       | 13   | 3.34       | 6    | 3.62             | 11   | 3.32           | 13   | 3.36     | 11   |
| Fixing PVC windows                          | QA2.14 | 3.08       | 13   | 3.41       | 11   | 2.84       | 13   | 3.08             | 13   | 3.24           | 13   | 3.13     | 11   |
| Terrazzo and Screed work                    | QA2.12 | 3.19       | 10   | 3.54       | 10   | 3.19       | 7    | 3.20             | 11   | 3.39           | 11   | 3.30     | 12   |
| Masonry work                                | QA2.8  | 3.32       | 9    | 3.19       | 13   | 3.10       | 12   | 3.12             | 12   | 3.26           | 12   | 3.20     | 13   |
| Excavation                                  | QA2.2  | 3.14       | 13   | 3.04       | 16   | 3.23       | 8    | 2.68             | 11   | 3.36           | 12   | 3.09     | 15   |
| Glazing                                     | QA2.15 | 2.92       | 16   | 3.14       | 15   | 2.79       | 16   | 3.04             | 16   | 3.08           | 16   | 2.99     | 16   |

#### 4.2.6.1 Comparison of Contracting Parties Response on the Occurrence of Quality Problems at Different Construction Stages

As indicated on Table 4.5, the Pearson correlation between the client and contractor (0.359), the client with construction MSE (0.493) indicates low degree of agreement, the client and consultant (0.035) weak degree of agreement, but the client respondents agreed moderately with production MSE (0.679) respondents. The contractor respondents were agreed moderately with consultants (0.668) and production MSEs (0.513), but there was negatively weak agreement with construction MSE (-0.168) respondents. The consultant respondents moderately agreed with production MSE respondents (0.589) and negative weak agreement with construction MSEs (-0.119) were observed. The two MSEs were moderately agreed (0.569) in their response.

Table 4.5: Correlation between respondents on the occurrence of quality management problems at different construction stages

|                                                              | Correlation | Client  | Contractor | Consultant | Construction MSE | Production MSE |
|--------------------------------------------------------------|-------------|---------|------------|------------|------------------|----------------|
| Client                                                       | Pearson     | 1       | 0.359      | 0.035      | 0.493            | 0.679**        |
| Contractor                                                   | Pearson     | 0.359   | 1          | 0.668**    | -0.168           | 0.513*         |
| Consultant                                                   | Pearson     | 0.035   | 0.668**    | 1          | -0.119           | 0.589*         |
| Construction MSE                                             | Pearson     | 0.493   | -0.168     | -0.119     | 1                | 0.569*         |
| Production MSE                                               | Pearson     | 0.679** | 0.513*     | 0.589*     | 0.569*           | 1              |
| *. Correlation is significant at the 0.05 level (2-tailed).  |             |         |            |            |                  |                |
| **. Correlation is significant at the 0.01 level (2-tailed). |             |         |            |            |                  |                |

## B. Material Quality Management Practice in AAHDPO

Construction materials are very important resources in the construction industry for the construction of projects, and therefore should be tested for quality since they can affect the quality of the whole project. It should be tested during commencement, when there exists change of material source and when the engineer hesitates on the quality of material.

### 4.2.7 Material Test at Commencement of Work in AAHDPO

**Table 4.6: Mean Score Values and Ranks of Construction Materials Test at Commencement in AAHDPO**

| Question                                                   |       | Client     |      | Contractor |      | Consultant |      | Construction MSE |      | Production MSE |      | weighted |      |
|------------------------------------------------------------|-------|------------|------|------------|------|------------|------|------------------|------|----------------|------|----------|------|
| Test at commencement of materials were done in AAHDPO? for | Code  | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank | Mean Score       | Rank | Mean Score     | Rank | Mean     | Rank |
| Aggregate                                                  | QB1.2 | 2.54       | 1    | 2.55       | 2    | 2.32       | 6    | 2.72             | 3    | 2.55           | 2    | 2.54     | 1    |
| Reinforcement bars                                         | QB1.4 | 2.35       | 2    | 2.59       | 1    | 2.40       | 5    | 2.73             | 2    | 2.65           | 1    | 2.54     | 1    |
| Hollow Concrete Blocks                                     | QB1.6 | 2.35       | 2    | 2.46       | 4    | 2.53       | 1    | 2.70             | 4    | 2.55           | 2    | 2.52     | 3    |
| Selected fill materials                                    | QB1.5 | 2.32       | 5    | 2.55       | 2    | 2.44       | 2    | 2.76             | 1    | 2.46           | 4    | 2.51     | 4    |
| Ribbed Slab Blocks                                         | QB1.7 | 2.35       | 2    | 2.43       | 5    | 2.44       | 2    | 2.70             | 4    | 2.30           | 6    | 2.44     | 5    |
| Sand                                                       | QB1.3 | 2.24       | 6    | 2.38       | 6    | 2.44       | 2    | 2.65             | 6    | 2.41           | 5    | 2.42     | 6    |
| Pre-cast beams                                             | QB1.8 | 2.03       | 7    | 2.03       | 8    | 2.19       | 7    | 1.82             | 7    | 2.05           | 7    | 2.02     | 7    |
| Cement                                                     | QB1.1 | 1.97       | 8    | 2.18       | 7    | 2.06       | 8    | 1.82             | 7    | 1.97           | 8    | 2.00     | 8    |

From Table 4.6 the weighted mean value of reinforcement bars 2.54, aggregates 2.54 both ranked 1<sup>st</sup>, hollow concrete blocks 2.52 ranked 3<sup>rd</sup> and Selected fill materials 2.51 ranked 4<sup>th</sup> from those eight short listed basic construction materials selected by the researcher to study were scored greater than 2.5 weighted mean value which means respondents agreed on the presence of commencement test based on three likert scale measurements 1= disagree, 2= no opinion and 3= agree for those construction materials. Respondents had no opinion on the rest four construction materials on the presence or absence of commencement tests based on the weighted mean value scored ranging from  $1.5 < \text{weighted mean} < 2.5$ .

#### 4.2.7.1 Comparison Analysis between Contracting Parties On Material Test At Commencement

Based on Pearson correlation shown bellow on Table 4.7, client respondents had low agreement with the contractor ( $p=0.309$ ) and the construction MSEs ( $p=0.465$ ), weak agreement with the consultant ( $p=0.081$ ) and moderate agreement with the production MSEs ( $p=0.670$ ). Contractors had strong agreement with consultant respondents ( $p=0.801$ ) and moderate agreement with construction MSEs ( $p=0.570$ ) & production MSEs ( $p=0.745$ ). Consultants agreed moderately with construction MSEs ( $p=0.716$ ) and had strong agreement with production MSEs ( $p=0.772$ ). Pearson correlation ( $p=0.844$ ) indicates high degree of agreement among the two MSE respondents.

Table 4.7: Correlation between Contracting Parties on Material Test at Commencement

|                                                             | Correlation | Client | Contractor | Consultant | Construction MSE | Production MSE |
|-------------------------------------------------------------|-------------|--------|------------|------------|------------------|----------------|
| Client                                                      | Pearson     | 1      | 0.309      | 0.081      | 0.465            | 0.670          |
| Contractor                                                  | Pearson     | 0.309  | 1          | 0.801*     | 0.570            | 0.745*         |
| Consultant                                                  | Pearson     | 0.081  | 0.801*     | 1          | 0.716*           | 0.772*         |
| Construction MSE                                            | Pearson     | 0.465  | 0.570      | 0.716*     | 1                | 0.844**        |
| Production MSE                                              | Pearson     | 0.670  | 0.745*     | 0.772*     | 0.844**          | 1              |
| * Correlation is significant at the 0.05 level (2-tailed).  |             |        |            |            |                  |                |
| ** Correlation is significant at the 0.01 level (2-tailed). |             |        |            |            |                  |                |

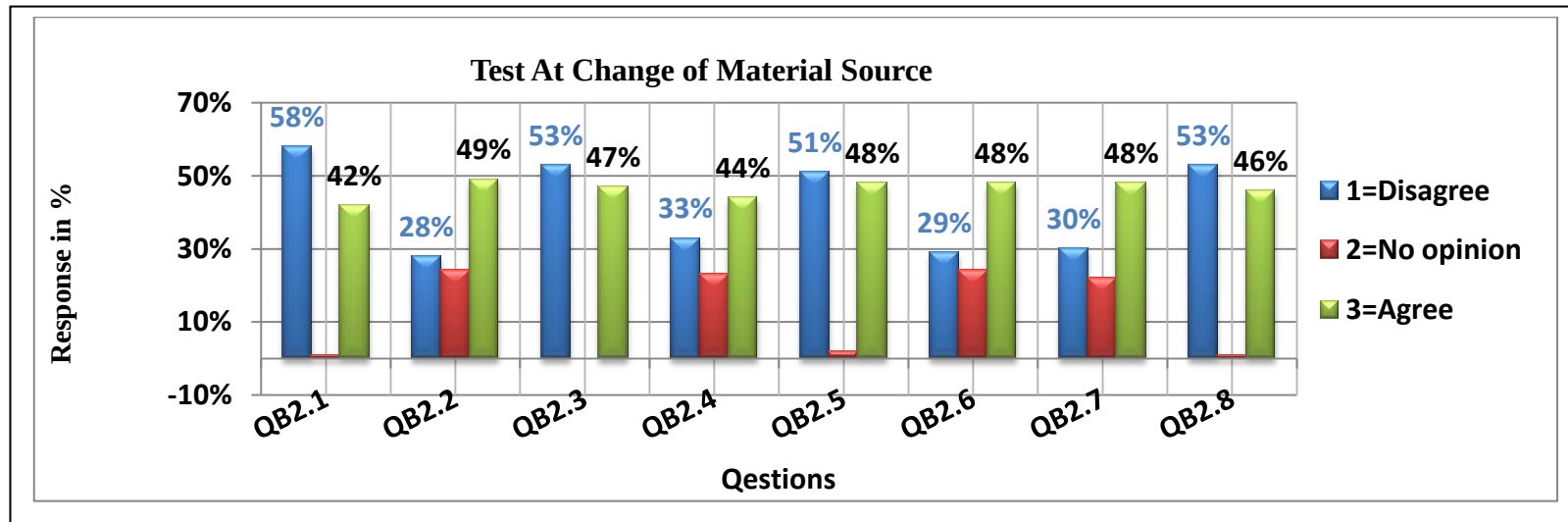
#### **4.2.8 Test during change of material source in AAHDPO**

The analysis of weighted mean score obtained from respondents measurement using three likert scales of 1= disagree, 2= no opinion and 3= agree shown on Table 4.8 indicates that the weighted mean score value of the eight short listed materials were in between 1.5 and 2.5 which in turn dictates no material were tested when change of quarry or source were observed in AAHDPO, But when we see percentages on Table 4.6 Cement, Sand, Pre-cast beams and Selected fill materials were not tested when material sources changed with a percentage value of 58%, 53%, 53% and 51% respectively respondents put their position on disagreed whereas materials Aggregate, Hollow Concrete Blocks, Ribbed Slab Blocks and Reinforcement bars scored 49%, 48%, 48% and 44% values respectively were tested when there exist material source change, since respondents put their perception on agreed scale of measurement.

Table 4.8: Mean Score Values and Ranks of Construction Materials Test at Change of Quarry/Source in AAHDPO

| Question                |       | Client     |      | Contractor |      | Consultant |      | Construction MSE |      | Production MSE |      | Weighted |      |
|-------------------------|-------|------------|------|------------|------|------------|------|------------------|------|----------------|------|----------|------|
|                         | Code  | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank | Mean Score       | Rank | Mean Score     | Rank | Mean     | Rank |
| Aggregate               | QB2.2 | 2.46       | 1    | 2.33       | 1    | 2.39       | 3    | 1.93             | 1    | 2.31           | 1    | 2.28     | 1    |
| Hollow Concrete Blocks  | QB2.6 | 2.30       | 3    | 2.29       | 3    | 2.50       | 1    | 1.91             | 3    | 2.30           | 2    | 2.26     | 2    |
| Ribbed Slab Blocks      | QB2.7 | 2.32       | 2    | 2.30       | 2    | 2.42       | 2    | 1.93             | 1    | 2.20           | 4    | 2.24     | 3    |
| Reinforcement bars      | QB2.4 | 2.24       | 4    | 2.26       | 4    | 2.24       | 5    | 1.87             | 4    | 2.22           | 3    | 2.17     | 4    |
| Selected fill materials | QB2.5 | 2.05       | 5    | 2.04       | 6    | 2.31       | 4    | 1.75             | 5    | 1.99           | 6    | 2.03     | 5    |
| Pre-cast beams          | QB2.8 | 2.03       | 6    | 2.00       | 7    | 2.10       | 7    | 1.65             | 8    | 2.20           | 4    | 2.00     | 6    |
| Sand                    | QB2.3 | 1.97       | 7    | 2.20       | 5    | 2.23       | 6    | 1.72             | 7    | 1.84           | 8    | 1.99     | 7    |
| Cement                  | QB2.1 | 1.92       | 8    | 2.00       | 7    | 1.74       | 8    | 1.75             | 5    | 1.89           | 7    | 1.86     | 8    |

Figure 4.4: Histogram on %age of Response on Tests at Change of Material Quarry/Source



#### 4.2.8.1 Comparison Analysis between Contracting Parties on Tests at Change of Material Source

The client respondents had low agreement with contractor ( $p=0.309$ ) & construction MSE respondents ( $p=0.465$ ), weak agreement with consultant ( $p=0.081$ ) and were agreed moderately with production MSE respondents ( $p=0.670$ ) based on the Pearson correlation as shown bellow on Table 4.14. The contractor respondents were agreed moderately with construction MSEs (0.570) & production MSEs (0.745) and had strong agreement with consultant respondents (0.801) as the Pearson p values shown in the table 4.14. Consultants had moderate agreement with construction MSEs (0.716) and strong agreement with production MSEs ( $p=0.772$ ).

The Pearson correlation of construction MSEs with production MSEs (0.844) indicates strong agreement with each other.

Table 4.14: Correlation between Contracting Parties on Material Test at Change Of Material Source

|                                                             | Correlation | Client | Contractor | Consultant | Construction MSE | Production MSE |
|-------------------------------------------------------------|-------------|--------|------------|------------|------------------|----------------|
| Client                                                      | Pearson     | 1      | 0.309      | 0.081      | 0.465            | 0.670          |
| Contractor                                                  | Pearson     | 0.309  | 1          | 0.801*     | 0.570            | 0.745*         |
| Consultant                                                  | Pearson     | 0.081  | 0.801*     | 1          | 0.716*           | 0.772*         |
| Construction MSE                                            | Pearson     | 0.465  | 0.570      | 0.716*     | 1                | 0.844**        |
| Production MSE                                              | Pearson     | 0.670  | 0.745*     | 0.772*     | 0.844**          | 1              |
| * Correlation is significant at the 0.05 level (2-tailed).  |             |        |            |            |                  |                |
| ** Correlation is significant at the 0.01 level (2-tailed). |             |        |            |            |                  |                |

#### 4.2.9 Submitting Material Sample To The Consulting Engineer

Table 4.10: Mean Score Values and Ranks of Material Samples Submitted To the Consultant in AAHDPO

| Question                                                           |        | Client     |      | Contractor |      | Consultant |      | Construction MSE |      | Production MSE |      | Weighted |      |
|--------------------------------------------------------------------|--------|------------|------|------------|------|------------|------|------------------|------|----------------|------|----------|------|
| Material samples submitted to the consulting engineer for approval | Code   | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank | Mean Score       | Rank | Mean Score     | Rank | Mean     | Rank |
| Electrical Wires and Cables                                        | QB3.14 | 2.43       | 3    | 2.30       | 9    | 2.32       | 6    | 2.67             | 1    | 2.46           | 1    | 2.44     | 1    |
| Rectangular Hollow Section Metals                                  | QB3.9  | 2.27       | 9    | 2.43       | 4    | 2.27       | 8    | 2.67             | 1    | 2.26           | 3    | 2.38     | 2    |
| L-T-Z Hollow Section Metals                                        | QB3.10 | 2.27       | 9    | 2.50       | 1    | 2.26       | 10   | 2.60             | 3    | 2.26           | 3    | 2.38     | 3    |
| Electrical fittings                                                | QB3.16 | 2.62       | 1    | 2.46       | 2    | 2.34       | 5    | 2.01             | 7    | 2.23           | 7    | 2.33     | 4    |
| PPR Pipes                                                          | QB3.12 | 2.32       | 8    | 2.23       | 11   | 2.40       | 3    | 2.40             | 4    | 2.30           | 2    | 2.33     | 5    |
| Conduits                                                           | QB3.15 | 2.51       | 2    | 2.45       | 3    | 2.35       | 4    | 1.91             | 11   | 2.26           | 3    | 2.30     | 6    |
| Door locks                                                         | QB3.11 | 2.24       | 11   | 2.31       | 8    | 2.42       | 1    | 2.32             | 5    | 2.16           | 11   | 2.29     | 7    |
| PVC pipes                                                          | QB3.13 | 2.41       | 4    | 2.38       | 6    | 2.42       | 1    | 1.94             | 10   | 2.18           | 8    | 2.26     | 8    |
| Ribbed Slab Blocks                                                 | QB3.7  | 2.38       | 6    | 2.40       | 5    | 2.26       | 10   | 2.02             | 6    | 2.18           | 8    | 2.25     | 9    |
| Hollow Concrete Blocks                                             | QB3.6  | 2.41       | 4    | 2.29       | 11   | 2.32       | 6    | 1.99             | 8    | 2.18           | 8    | 2.24     | 10   |
| Pre-cast beams                                                     | QB3.8  | 2.19       | 13   | 2.38       | 6    | 2.26       | 10   | 1.98             | 9    | 2.26           | 3    | 2.21     | 11   |
| Sand                                                               | QB3.3  | 2.22       | 12   | 2.16       | 13   | 2.27       | 8    | 1.76             | 13   | 2.05           | 12   | 2.09     | 12   |
| Aggregate                                                          | QB3.2  | 2.35       | 7    | 2.13       | 14   | 2.10       | 13   | 1.74             | 14   | 1.86           | 16   | 2.04     | 13   |
| Selected fill materials                                            | QB3.5  | 2.03       | 15   | 2.18       | 12   | 2.10       | 13   | 1.87             | 12   | 1.95           | 13   | 2.02     | 14   |
| Reinforcement bars                                                 | QB3.4  | 2.19       | 13   | 2.08       | 15   | 2.10       | 13   | 1.71             | 15   | 1.95           | 13   | 2.00     | 15   |
| Cement                                                             | QB3.1  | 2.00       | 16   | 2.03       | 16   | 2.02       | 16   | 1.69             | 16   | 1.89           | 15   | 1.92     | 16   |

Table 4.11: %age of Material Samples Submitted to the Consultant before Bulk Delivery in the Project.

| Question | %age of responses |                   |              |
|----------|-------------------|-------------------|--------------|
|          | Disagree<br>(1)   | No Opinion<br>(2) | Agree<br>(3) |
| QB3.1    | 56%               | 1%                | 43%          |
| QB3.4    | 52%               | 3%                | 46%          |
| QB3.2    | 51%               | 1%                | 47%          |
| QB3.5    | 50%               | 0%                | 50%          |
| QB3.3    | 48%               | 1%                | 51%          |
| QB3.6    | 31%               | 21%               | 49%          |
| QB3.8    | 31%               | 21%               | 49%          |
| QB3.7    | 30%               | 19%               | 50%          |
| QB3.13   | 30%               | 21%               | 49%          |
| QB3.15   | 30%               | 19%               | 51%          |
| QB3.16   | 28%               | 19%               | 53%          |
| QB3.11   | 22%               | 27%               | 51%          |
| QB3.12   | 22%               | 23%               | 55%          |
| QB3.14   | 18%               | 16%               | 66%          |
| QB3.10   | 17%               | 23%               | 60%          |
| QB3.9    | 15%               | 27%               | 59%          |

From Table 4.10 above the weighted mean value describes respondents had no opinion on any of the material samples submission to the consultant which means neither agreed nor disagreed, since the mean score calculated ranges in between 1.5 and 2.5.

Therefore it is better to check the respondents perception using percentage of frequency on Table 4.12, this table indicates the majority of respondents 56%, 52% and 51% of the total respondents disagree on submission of Cement, Reinforcement bars and Aggregate samples respectively to the consulting engineer for approval before bulk delivery to the projects and reference during claims. Except selected fill material and materials discussed above most material samples were submitted to the consulting Engineer.

#### 4.2.9.1 Comparison Analysis Between Contracting Parties On Materials Samples Submitted To The Consultant Before Bulk Delivery In The Project.

The Pearson correlation shown bellow on table 4.12 indicates client respondents had low agreement with contractors ( $p=0.359$ ) & construction MSEs ( $p=0.493$ ), weak agreement with consultants ( $p=0.035$ ) and moderate agreement with Production MSEs ( $p=0.679$ ). Contractors moderately agreed with consultants ( $p=0.668$ ) & production MSEs ( $p=0.513$ ), but negatively weak agreement with construction MSEs ( $p= -0.168$ ). The consultant had negatively weak agreement with construction MSEs ( $p= -0.119$ ) and moderate agreement with production MSEs ( $p=0.589$ ). The Construction MSEs moderately agreed with production MSEs ( $p=0.569$ ).

Table 4.12: Correlation between Contracting Parties on Material Sample Submission

|                                                             | Correlation | Client  | Contractor | Consultant | Construction MSE | Production MSE |
|-------------------------------------------------------------|-------------|---------|------------|------------|------------------|----------------|
| Client                                                      | Pearson     | 1       | 0.359      | 0.035      | 0.493            | 0.679**        |
| Contractor                                                  | Pearson     | 0.359   | 1          | 0.668**    | -0.168           | 0.513*         |
| Consultant                                                  | Pearson     | 0.035   | 0.668**    | 1          | -0.119           | 0.589*         |
| Construction MSE                                            | Pearson     | 0.493   | -0.168     | -0.119     | 1                | 0.569*         |
| Production MSE                                              | Pearson     | 0.679** | 0.513*     | 0.589*     | 0.569*           | 1              |
| * Correlation is significant at the 0.05 level (2-tailed).  |             |         |            |            |                  |                |
| ** Correlation is significant at the 0.01 level (2-tailed). |             |         |            |            |                  |                |

38% of the total respondents agreed on testing instruments and measuring tools were calibrated and records maintained regularly.

| N <sup>o</sup> | Testing instruments and measuring tools                        | 1         |      | 2         |      | 3         |      | 4         |      | 5         |      | Invalid   |      |
|----------------|----------------------------------------------------------------|-----------|------|-----------|------|-----------|------|-----------|------|-----------|------|-----------|------|
|                |                                                                | Frequency | %age | Frequency | %age | Frequency | %age | Frequency | %age | Frequency | %age | Frequency | %age |
| 3.17           | Testing instruments & measuring tools are calibrated regularly | 24        | 6.17 | 76        | 19.5 | 80        | 20.6 | 148       | 38   | 61        | 15.7 | 0         | 0    |

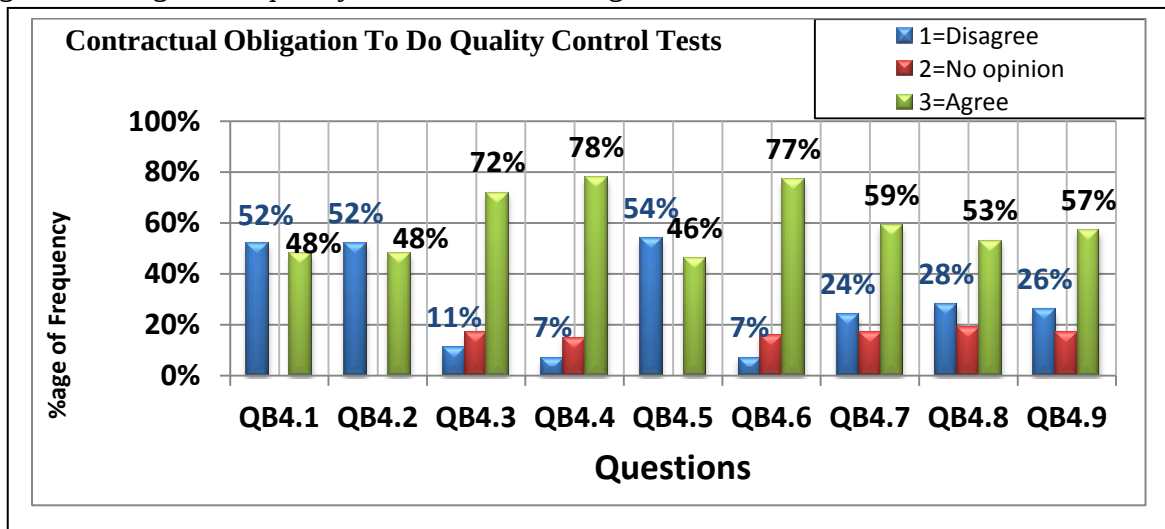
#### 4.2.10 Contractual Obligation to Perform Quality Control Tests

Table 4.13: Mean Score Values and Ranks of Contractual Obligations to Perform Quality Tests In AAHDP

| Question                                                                                       |                         | Client     |      | Contractor |      | Consultant |      | Construction |      | Production |      | Weighted |      |   |
|------------------------------------------------------------------------------------------------|-------------------------|------------|------|------------|------|------------|------|--------------|------|------------|------|----------|------|---|
|                                                                                                |                         |            |      |            |      |            |      | MSE          |      | MSE        |      |          |      |   |
| There are clearly stated obligations in AAHDPO contract agreement to perform quality tests of: | Code                    | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank | Mean Score   | Rank | Mean Score | Rank | Mean     | Rank |   |
|                                                                                                | Concrete                | QB4.4      | 2.57 | 1          | 2.75 | 1          | 2.66 | 2            | 2.79 | 2          | 2.66 | 1        | 2.69 | 1 |
|                                                                                                | Selected fill materials | QB4.6      | 2.57 | 1          | 2.69 | 2          | 2.71 | 1            | 2.79 | 2          | 2.65 | 2        | 2.68 | 2 |
|                                                                                                | Sand                    | QB4.3      | 2.24 | 6          | 2.64 | 3          | 2.56 | 4            | 2.82 | 1          | 2.43 | 4        | 2.54 | 3 |
|                                                                                                | Pre-cast beams          | QB4.9      | 2.51 | 3          | 2.46 | 4          | 2.48 | 6            | 2.04 | 4          | 2.53 | 3        | 2.41 | 4 |
|                                                                                                | Hollow Concrete Blocks  | QB4.7      | 2.49 | 4          | 2.39 | 5          | 2.60 | 3            | 1.99 | 5          | 2.41 | 5        | 2.37 | 5 |
|                                                                                                | Ribbed Slab Blocks      | QB4.8      | 2.46 | 5          | 2.33 | 6          | 2.53 | 5            | 1.96 | 6          | 2.31 | 6        | 2.32 | 6 |
|                                                                                                | Aggregate               | QB4.2      | 2.03 | 7          | 2.20 | 8          | 1.94 | 8            | 1.78 | 7          | 2.03 | 7        | 1.99 | 7 |
|                                                                                                | Cement                  | QB4.1      | 1.97 | 8          | 2.18 | 9          | 1.94 | 8            | 1.78 | 7          | 2.03 | 7        | 1.98 | 8 |
|                                                                                                | Reinforcement bars      | QB4.5      | 1.86 | 9          | 2.23 | 7          | 2.16 | 7            | 1.69 | 9          | 1.84 | 9        | 1.96 | 9 |

From Table 4.13 the weighted mean values for Concrete (2.69), Selected fill materials (2.68) and Sand (2.54) ranked 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> respectively are  $> 2.5$  indicates respondents agreement on the presence of contractual obligation to perform quality control tests, but the weighted mean values for other construction materials surveyed are in between 1.5 and 2.5 which indicates respondents had no opinion on the presence or absence of contractual obligations for quality control tests. In this case we need to investigate further the respondents perception using percentage of frequency as shown on Figure 4.5 bellow, in addition to concrete, selected material fill and sand majority of respondents 59%, 57% and 53% agreed on the presence of quality test obligations in the contract document for hollow concrete blocks, pre-cast beams and ribbed slab blocks respectively, but there is no testing obligation in the contract document for reinforcement bars, cement and aggregate with %age of frequency 54%, 52% and 52% respectively.

Figure 4.5 %age of frequency on Contractual obligation for test



#### 4.2.10.1 Comparison Analysis on Contractual Obligations to Perform Quality Tests

The Pearson correlation shown bellow on Table 4.14 indicates, the client had low agreement with the contractor ( $p=0.351$ ) & the construction MSEs (0.423) and has weak correlation/agreement with the consultant respondents and moderate agreement with production MSEs ( $p=0.684$ ). The contractor had strong agreement/correlation with the consultant ( $p=0.825$ ), low agreement with construction MSEs ( $p=0.483$ ) and strong agreement with production MSEs (0.761). The consultant had moderate agreement ( $p=0.588$ ) with construction MSEs and strong agreement with production MSE respondents ( $p=0.780$ ). Construction MSEs and production MSEs strongly agreed with each other ( $p=0.779$ ).

Table 4.14: Correlation on Contract Document Related Issues

|                                                             | Correlation | Client             | Contractor          | Consultant          | Construction<br>MSE | Production<br>MSE  |
|-------------------------------------------------------------|-------------|--------------------|---------------------|---------------------|---------------------|--------------------|
| Client                                                      | Pearson     | 1                  | 0.351               | 0.151               | 0.423               | 0.684 <sup>*</sup> |
| Contractor                                                  | Pearson     | 0.351              | 1                   | 0.825 <sup>**</sup> | 0.483               | 0.761 <sup>*</sup> |
| Consultant                                                  | Pearson     | 0.151              | 0.825 <sup>**</sup> | 1                   | 0.588               | 0.780 <sup>*</sup> |
| Construction<br>MSE                                         | Pearson     | 0.423              | 0.483               | 0.588               | 1                   | 0.779 <sup>*</sup> |
| Production<br>MSE                                           | Pearson     | 0.684 <sup>*</sup> | 0.761 <sup>*</sup>  | 0.780 <sup>*</sup>  | 0.779 <sup>*</sup>  | 1                  |
| * Correlation is significant at the 0.05 level (2-tailed).  |             |                    |                     |                     |                     |                    |
| ** Correlation is significant at the 0.01 level (2-tailed). |             |                    |                     |                     |                     |                    |

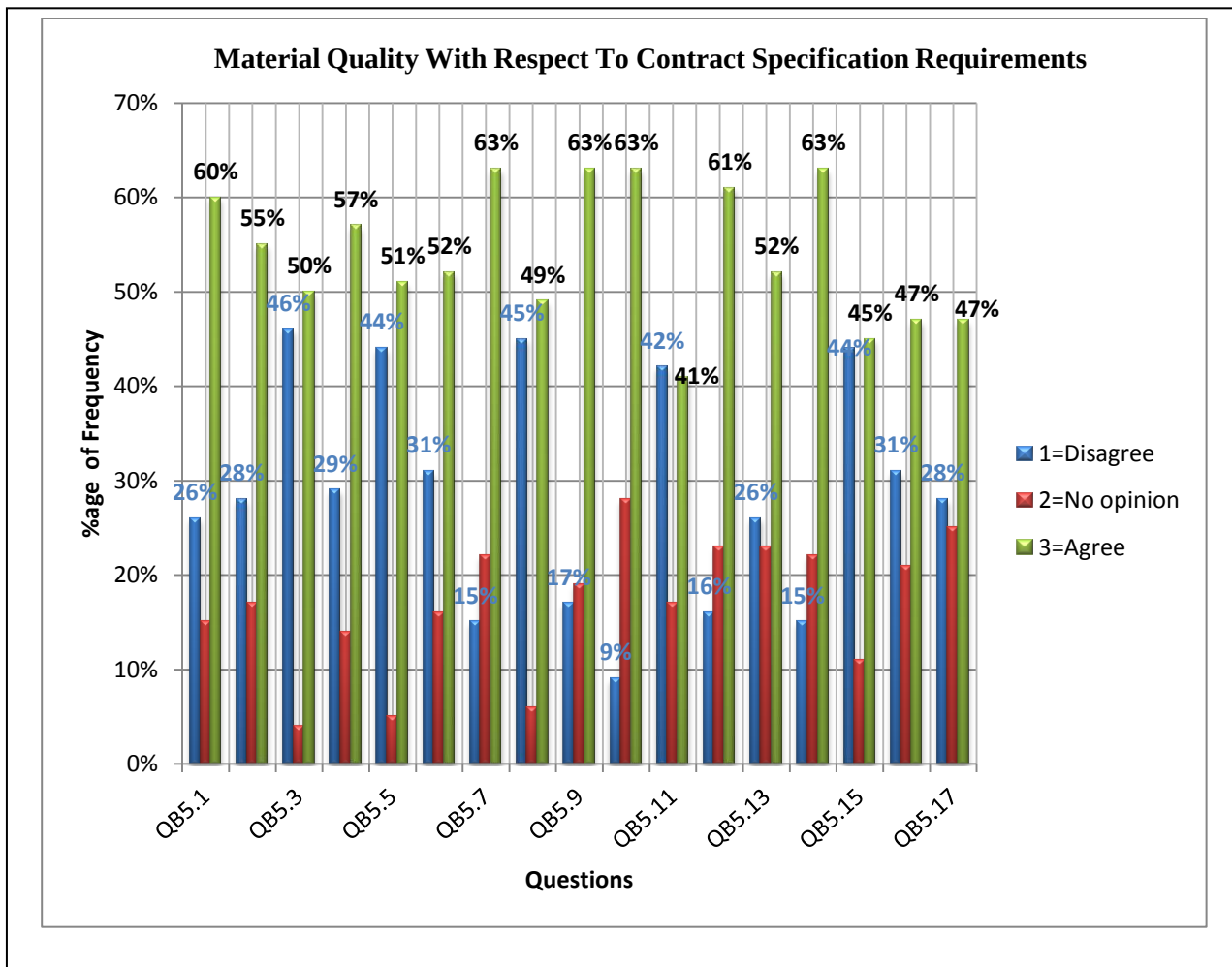
#### 4.2.11 Contract Specification and Quality Requirements

Respondents had no opinion on materials delivered to AAHDP construction projects comply the contract specification and quality requirements or not, since the weighted mean value of all short listed materials selected for this survey lays in between 1.5 and 2.5 as shown above on Table 4.15. But when the researcher investigates respondents perception on percentage of frequency on Figure 4.9 except door locks, all materials surveyed or listed on table 4.8 comply the contract quality requirements without considering respondents agreement (frequency) in percent were < 50% as Pre-cast beams (49%), Water Closets (47%), Kitchen Sinks (47%) and Terrazzo tiles (45%).

Table 4.15: Mean Score Values and Ranks of Construction Materials Comply Contract Specification

| Question                                                              |        | Client     |      | Contractor |      | Consultant |      | Construction MSE |      | Production MSE |      | Weighted |      |
|-----------------------------------------------------------------------|--------|------------|------|------------|------|------------|------|------------------|------|----------------|------|----------|------|
| Materials comply the contract specification and quality requirements? | Code   | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank | Mean Score       | Rank | Mean Score     | Rank | Mean     | Rank |
| Rectangular Hollow Section Metals                                     | QB5.9  | 2.30       | 9    | 2.58       | 2    | 2.45       | 9    | 2.77             | 1    | 2.38           | 5    | 2.49     | 1    |
| L-T-Z Hollow Section Metals                                           | QB5.10 | 2.35       | 3    | 2.53       | 3    | 2.50       | 5    | 2.71             | 2    | 2.35           | 7    | 2.49     | 2    |
| PPR pipes and Fittings                                                | QB5.12 | 2.35       | 3    | 2.40       | 9    | 2.47       | 7    | 2.60             | 4    | 2.47           | 2    | 2.46     | 3    |
| Reinforcement bars                                                    | QB5.4  | 2.43       | 2    | 2.65       | 1    | 2.60       | 2    | 2.13             | 7    | 2.36           | 6    | 2.44     | 4    |
| Electric Wires                                                        | QB5.14 | 2.32       | 7    | 2.33       | 11   | 2.52       | 3    | 2.59             | 5    | 2.39           | 4    | 2.43     | 5    |
| Ribbed Slab Blocks                                                    | QB5.7  | 2.24       | 11   | 2.46       | 5    | 2.21       | 13   | 2.71             | 2    | 2.42           | 3    | 2.41     | 6    |
| Cement                                                                | QB5.1  | 2.35       | 3    | 2.45       | 6    | 2.61       | 1    | 2.06             | 8    | 2.49           | 1    | 2.39     | 7    |
| Aggregate                                                             | QB5.2  | 2.51       | 1    | 2.43       | 7    | 2.37       | 10   | 2.01             | 10   | 2.35           | 7    | 2.34     | 8    |
| PVC pipes and Fittings                                                | QB5.13 | 2.35       | 3    | 2.41       | 8    | 2.50       | 5    | 2.03             | 9    | 2.28           | 9    | 2.32     | 9    |
| Hollow Concrete Blocks                                                | QB5.6  | 2.32       | 7    | 2.49       | 4    | 2.31       | 11   | 2.14             | 6    | 2.14           | 12   | 2.28     | 10   |
| Kitchen Sinks                                                         | QB5.17 | 2.27       | 10   | 2.38       | 10   | 2.47       | 7    | 1.98             | 11   | 2.23           | 10   | 2.26     | 11   |
| Water Closets                                                         | QB5.16 | 2.22       | 12   | 2.30       | 12   | 2.52       | 3    | 1.96             | 12   | 2.20           | 11   | 2.24     | 12   |
| Door locks                                                            | QB5.11 | 2.16       | 13   | 2.24       | 14   | 2.31       | 11   | 1.56             | 17   | 1.86           | 16   | 2.03     | 13   |
| Terrazzo tiles                                                        | QB5.15 | 2.14       | 14   | 2.15       | 15   | 2.05       | 15   | 1.78             | 16   | 1.97           | 15   | 2.02     | 14   |
| Selected fill materials                                               | QB5.5  | 1.92       | 15   | 2.28       | 13   | 2.00       | 17   | 1.85             | 15   | 1.99           | 14   | 2.01     | 15   |
| Sand                                                                  | QB5.3  | 1.81       | 17   | 2.15       | 15   | 2.06       | 14   | 1.88             | 14   | 2.03           | 13   | 1.99     | 16   |
| Pre-cast beams                                                        | QB5.8  | 1.86       | 16   | 2.10       | 17   | 2.03       | 16   | 1.96             | 13   | 1.86           | 16   | 1.96     | 17   |

Figure 4.6: %age Histogram of Response on Materials Quality With respect To Specifications



#### 4.2.11.1 Comparison Analysis on Materials Complying Contract Specification & Requirements

As shown bellow on Table 4.16: the Pearson correlation indicates client respondents were moderately agreed with contractor respondents ( $p=0.539$ ) & with construction MSEs ( $p=0.566$ ), strongly agreed with the production MSEs (0.814) and had low agreement/correlation with the consultant ( $p=0.335$ ). The contractor had low agreement with consultant respondents (0.440), weak agreement with the construction MSE respondents (0.171) and moderate agreement with the production MSEs ( $p=0.658$ ). Consultant respondents had negative weak agreement with construction MSE respondents ( $p= -0.139$ ) (opposite/when one increase the other decrease) and low agreement with production MSEs ( $p=0.438$ ) and the construction MSEs moderately agreed with the responses of the production MSE respondents (0.688).

Table 4.16: Correlation on Contract Document Related Issues

|                                                             | Correlation | Client  | Contractor | Consultant | Construction MSE | Production MSE |
|-------------------------------------------------------------|-------------|---------|------------|------------|------------------|----------------|
| Client                                                      | Pearson     | 1       | 0.539*     | 0.335      | 0.566*           | 0.814**        |
| Contractor                                                  | Pearson     | 0.539*  | 1          | 0.440      | 0.171            | 0.658**        |
| Consultant                                                  | Pearson     | 0.335   | 0.440      | 1          | -0.139           | 0.438          |
| Construction MSE                                            | Pearson     | 0.566*  | 0.171      | -0.139     | 1                | 0.688**        |
| Production MSE                                              | Pearson     | 0.814** | 0.658**    | 0.438      | 0.688**          | 1              |
| * Correlation is significant at the 0.05 level (2-tailed).  |             |         |            |            |                  |                |
| ** Correlation is significant at the 0.01 level (2-tailed). |             |         |            |            |                  |                |

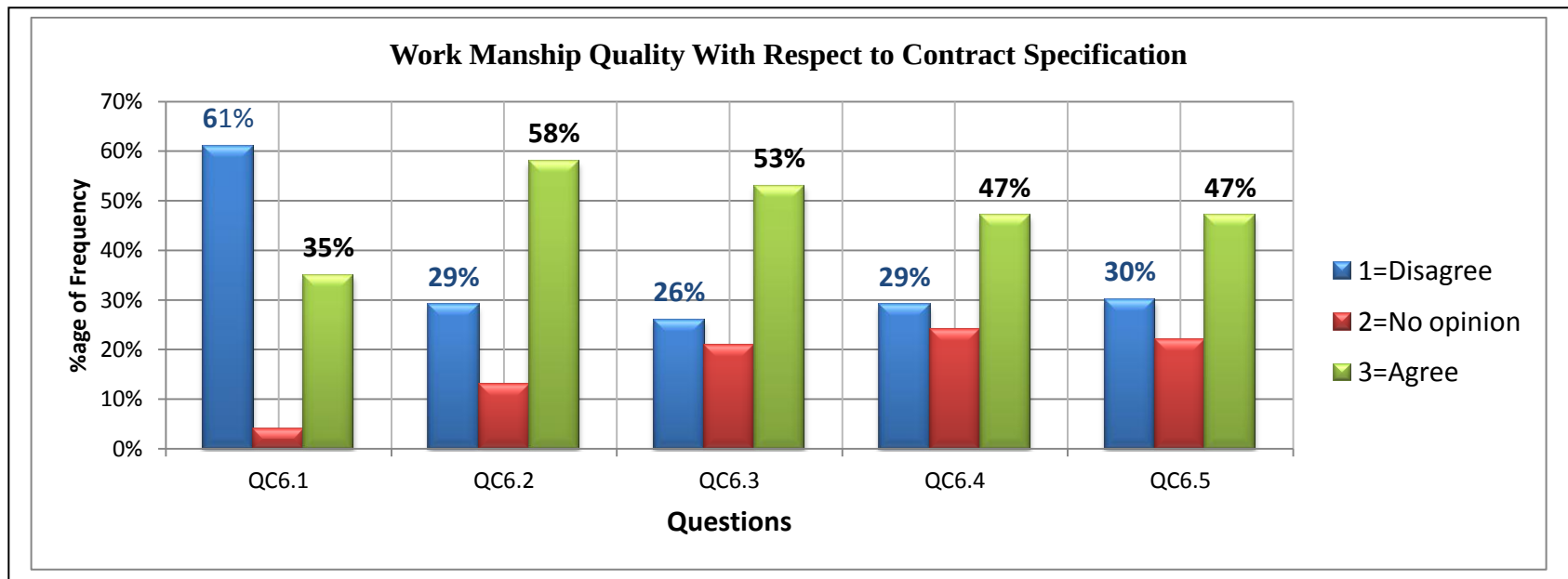
#### 4.2.12 Workmanship Quality Management

Even though based on the weighted mean values consultant key personnel(2.38), client key personnel(2.33), construction MSEs(2.2), production MSEs(2.2) and contractor key personnel (1.97) ranked 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> respectively as shown on Table 4.17 bellow it didn't indicate the respondents disagreement and agreement clearly all grouped as no opinion. Therefore we need to check the respondents frequency for additional investigation as detailed on Figure 4.7, from the figure bellow the majority of respondents (61%) disagreed on the presence of contractor key personnel complying the specification requirement, but 58%, 53%, 47% & 47% respondents agreed on the presence of consultant key personnel, client key personnel, construction MSEs and production MSEs key personnel fulfilling the contract requirements respectively.

Table 4.17: Mean Score Values and Ranks Of Workmanship Comply Contract Specification

| Question                                            |       | Client     |      | Contractor |      | Consultant |      | Construction MSE |      | Production MSE |      | Weighted |      |
|-----------------------------------------------------|-------|------------|------|------------|------|------------|------|------------------|------|----------------|------|----------|------|
| Workmanship in AAHDPO comply the contract agreement | Code  | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank | Mean Score       | Rank | Mean Score     | Rank | Mean     | Rank |
| Consultant key personnel                            | QC6.2 | 2.32       | 2    | 2.44       | 1    | 2.79       | 1    | 2.02             | 3    | 2.32           | 1    | 2.38     | 1    |
| Client key personnel                                | QC6.3 | 2.57       | 1    | 2.40       | 2    | 2.35       | 2    | 2.06             | 1    | 2.27           | 2    | 2.33     | 2    |
| Construction MSEs                                   | QC6.4 | 2.19       | 3    | 2.40       | 2    | 2.23       | 4    | 2.04             | 2    | 2.15           | 4    | 2.20     | 3    |
| Production MSEs                                     | QC6.5 | 2.19       | 3    | 2.35       | 4    | 2.26       | 3    | 2.02             | 3    | 2.18           | 2    | 2.20     | 4    |
| Contractor key personnel                            | QC6.1 | 1.95       | 5    | 2.29       | 5    | 2.00       | 5    | 1.80             | 5    | 1.84           | 5    | 1.97     | 5    |

Figure 4.7: %age Histogram of Response on Workman ship Quality With respect To Specifications



#### 4.2.13.1 Comparison Analysis on Workmanship Complying Contract Specification & Requirements

The Pearson correlation on Table 4.18 shown below indicates the client had moderate agreement with the contractor respondents ( $p=0.707$ ) and strong correlation/agreement with the consultants ( $p=0.826$ ), construction MSEs ( $p=0.956$ ) and with production MSE respondents ( $p=0.961$ ). The contractor had low agreement with consultants ( $p=0.401$ ) and production MSEs ( $p=0.549$ ) but moderate agreement with construction MSEs ( $p=0.555$ ). The consultant had strong correlation agreement with the construction MSEs ( $p=0.801$ ) & the production MSEs ( $p=0.937$ ), but the two MSEs strongly agreed with each other ( $p=0.918$ ).

**Table 4.18: Correlation on Workmanship Quality Related Issues**

|                                                             | Correlation | Client  | Contractor | Consultant | Construction MSE | Production MSE |
|-------------------------------------------------------------|-------------|---------|------------|------------|------------------|----------------|
| Client                                                      | Pearson     | 1       | 0.707      | 0.829      | 0.956*           | 0.961**        |
| Contractor                                                  | Pearson     | 0.707   | 1          | 0.401      | 0.555            | 0.549          |
| Consultant                                                  | Pearson     | 0.829   | 0.401      | 1          | 0.801            | 0.937*         |
| Construction MSE                                            | Pearson     | 0.956*  | 0.555      | 0.801      | 1                | 0.918*         |
| Production MSE                                              | Pearson     | 0.961** | 0.549      | 0.937*     | 0.918*           | 1              |
| * Correlation is significant at the 0.05 level (2-tailed).  |             |         |            |            |                  |                |
| ** Correlation is significant at the 0.01 level (2-tailed). |             |         |            |            |                  |                |

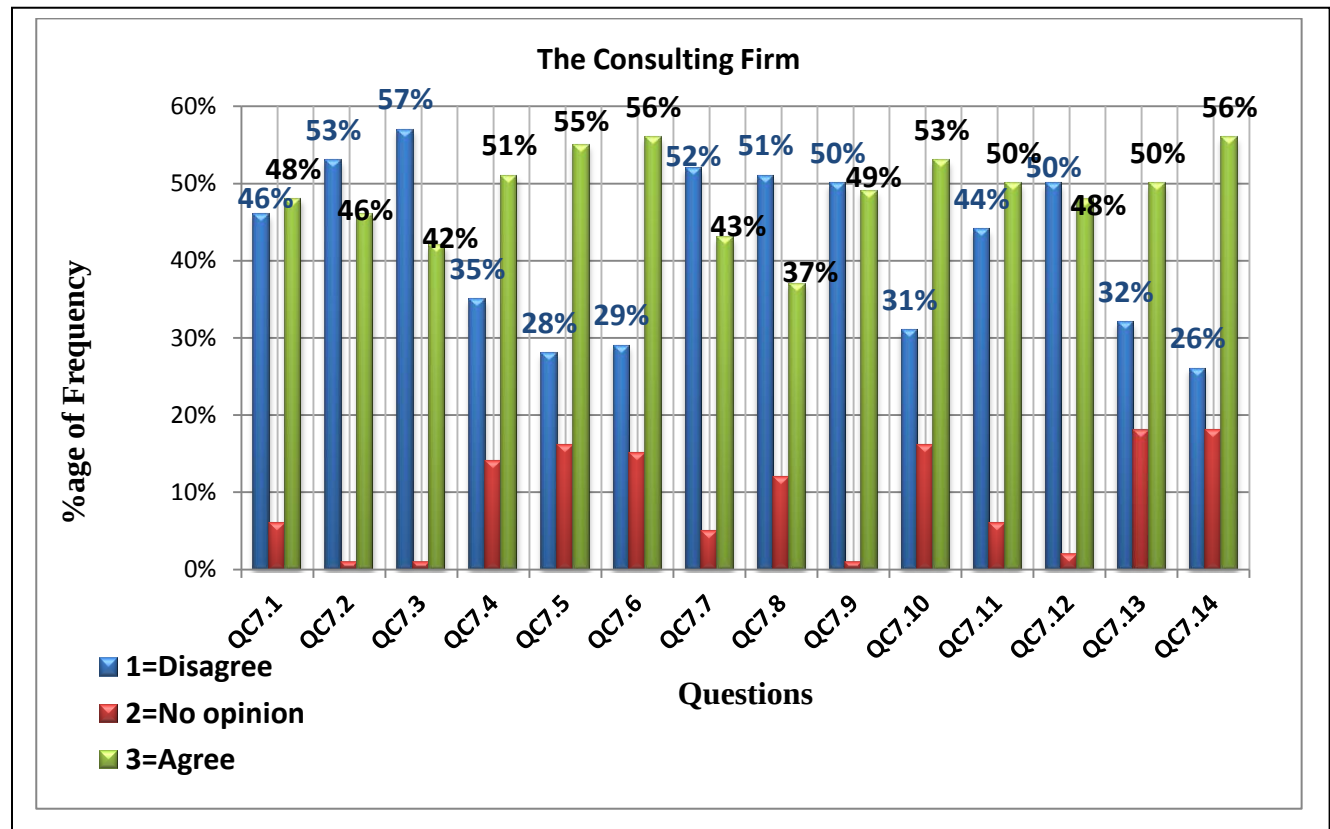
#### 4.2.13 Consulting Firm in AAHDPO

The consulting firm has the required skill to read, interpret designs and specifications, key personnel to communicate, supervisors follow clearly stated acceptance criteria for casted concrete structures, experienced key personnel in quality management, production quality control engineers who fulfill minimum requirements ranked 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 3<sup>rd</sup> and 5<sup>th</sup> as shown on Table 4.19 based on the weighted mean values of 2.4, 2.39, 2.36, 2.36 and 2.35 respectively and list ranked for the presence of trained key personnel in quality management(14<sup>th</sup>), qualified quality control personnel(13<sup>th</sup>), motivated personnel to assure conformance/compliance of works(12<sup>th</sup>), favorable organizational structure for quality management and(11<sup>th</sup>).

Table 4.19: Mean Score Values and Ranks on the Assessment of the Consulting Firm

| Question                                                                             |        | Client     |      | Contractor |      | Consultant |      | Construction MSE |      | Production MSE |      | Weighted |      |
|--------------------------------------------------------------------------------------|--------|------------|------|------------|------|------------|------|------------------|------|----------------|------|----------|------|
| The consulting firm has                                                              | Code   | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank | Mean Score       | Rank | Mean Score     | Rank | Mean     | Rank |
| the required skill to read, interpret designs and specification                      | QC7.5  | 2.49       | 2    | 2.48       | 1    | 2.81       | 2    | 1.71             | 8    | 2.54           | 1    | 2.40     | 1    |
| key personnel to communicate                                                         | QC7.6  | 2.54       | 1    | 2.39       | 5    | 2.84       | 1    | 1.68             | 11   | 2.51           | 2    | 2.39     | 2    |
| experienced key personnel in quality management                                      | QC7.4  | 2.43       | 3    | 2.45       | 2    | 2.60       | 4    | 1.93             | 2    | 2.39           | 6    | 2.36     | 3    |
| Supervisors follow clearly stated acceptance criteria for casted concrete structures | QC7.14 | 2.30       | 4    | 2.40       | 4    | 2.65       | 3    | 1.99             | 3    | 2.49           | 3    | 2.36     | 3    |
| production quality control engineers which fulfill minimum requirements              | QC7.10 | 2.30       | 4    | 2.44       | 3    | 2.56       | 5    | 1.98             | 3    | 2.47           | 4    | 2.35     | 5    |
| free flow of quality management information                                          | QC7.13 | 2.27       | 6    | 2.35       | 6    | 2.42       | 8    | 1.99             | 2    | 2.41           | 5    | 2.29     | 6    |
| a power/practice to reject inferior quality materials delivered by the client        | QC7.12 | 2.08       | 7    | 2.08       | 11   | 2.08       | 10   | 1.74             | 7    | 2.22           | 7    | 2.04     | 7    |
| the required acceptance criteria for construction materials                          | QC7.1  | 2.03       | 8    | 2.05       | 13   | 2.55       | 6    | 1.60             | 13   | 1.95           | 10   | 2.03     | 8    |
| committed supervisors to reject inferior quality materials/works ethically           | QC7.11 | 1.95       | 10   | 2.06       | 12   | 2.27       | 9    | 1.68             | 11   | 2.19           | 8    | 2.03     | 9    |
| the required acceptance criteria for works under construction                        | QC7.2  | 1.89       | 11   | 2.19       | 7    | 2.45       | 7    | 1.69             | 10   | 1.81           | 13   | 2.01     | 10   |
| favorable organizational structure for quality management                            | QC7.9  | 1.81       | 13   | 2.13       | 9    | 2.08       | 10   | 1.78             | 5    | 2.16           | 9    | 1.99     | 11   |
| motivated personnel to assure conformance/compliance of works                        | QC7.8  | 2.03       | 8    | 2.16       | 8    | 1.97       | 12   | 1.76             | 6    | 1.61           | 14   | 1.90     | 12   |
| qualified quality control personnel                                                  | QC7.7  | 1.70       | 14   | 2.13       | 9    | 1.90       | 14   | 1.71             | 8    | 1.86           | 12   | 1.86     | 13   |
| trained key personnel in quality management                                          | QC7.3  | 1.84       | 12   | 1.90       | 14   | 1.97       | 12   | 1.56             | 14   | 1.89           | 11   | 1.83     | 14   |

Figure 4.8: %age Histogram on Assessment of the Consulting Firm



The analysis on section 4.4.9 above didn't identify respondents agreement/disagreement it puts all as no opinion, therefore we need to clarify further based on frequency table as depicted in Figure 4.8 the majority 55%, 56%, 56%, 51%, 53%, 50%, 48%, 50%, of respondents agreed that the consulting firm has the required skill to read, interpret designs and specifications, key personnel to communicate, supervisors who follow clearly stated acceptance criteria for casted concrete structures, experienced key personnel in quality management, production quality control engineers who fulfill minimum requirements, free flow of quality management information, the required acceptance criteria for construction materials and committed supervisors to reject inferior quality materials/works ethically respectively, On the other hand 50%, 53%, 50%, 51%, 52% and 57% of respondents disagreed on the consulting firm has a power/practice to reject inferior quality materials delivered by the client, the required acceptance criteria for works under construction, favorable organizational structure for quality management, motivated personnel to assure conformance/non conformance of works, qualified quality control personnel and trained key personnel in quality management respectively.

#### 4.3.13.1 Comparison of Contracting Parties on the Consulting Firm Related Quality Issues

The Table 4.20 below clarifies the respondent's relation and agreement with each other based on the Pearson correlation. The client moderately agreed with production MSE responses ( $p=0.719$ ), and the client had low agreement with construction MSEs ( $p=0.408$ ) & contractor respondent ( $P=0.479$ ) and had weak agreement/correlation with consultants ( $p=0.096$ ). The contractor moderately agreed with the consultant ( $p=0.597$ ) & with production MSEs ( $p=0.561$ ) and weak negative agreement with the construction MSEs ( $p= -0.136$ ). The consultant had low negative agreement with construction MSE ( $p= -0.249$ ) and low positive agreement with production MSEs ( $p= 0.438$ ) respondents. The two MSEs moderately agreed with each other responses ( $p=0.573$ )

Table 4.20: Correlation among Contracting Parties on the Consulting Firm Related Quality Issues

|                                                             | Correlation | Client  | Contractor | Consultant | Construction MSE | Production MSE |
|-------------------------------------------------------------|-------------|---------|------------|------------|------------------|----------------|
| Client                                                      | Pearson     | 1       | 0.479      | 0.096      | 0.408            | 0.719**        |
| Contractor                                                  | Pearson     | 0.479   | 1          | 0.597*     | -0.136           | 0.561*         |
| Consultant                                                  | Pearson     | 0.096   | 0.597*     | 1          | -0.249           | 0.438          |
| Construction MSE                                            | Pearson     | 0.408   | -0.136     | -0.249     | 1                | 0.573*         |
| Production MSE                                              | Pearson     | 0.719** | 0.561*     | 0.438      | 0.573*           | 1              |
| * Correlation is significant at the 0.05 level (2-tailed).  |             |         |            |            |                  |                |
| ** Correlation is significant at the 0.01 level (2-tailed). |             |         |            |            |                  |                |

#### 4.2.14 The Contractor In AAHDPO

On the contractor perspective using three likert scale measurement 1=disagree, 2=no opinion and 3=agree, relatively high %age 48%, 43%, 42% and 42% of respondents agreed on the presence of key personnel who can communicate, the required skill to read, interpret designs and specifications, motivated personnel to insure quality conformance of works and favorable organizational structure for quality management respectively. But the majority of respondents disagreed on the presence of trained key personnel in quality management, key personnel practiced to reject inferior quality materials delivered by the client, qualified quality control personnel, consistent key personnel from commencement to provisional acceptance of the project, key personnel complying the contract requirement, key personnel committed to remove inferior quality works, experienced key personnel in quality management as rated 62%, 59%, 55%, 54%, 50%, 48% and 43% as shown bellow in Table 4.21.

Table 4.21: %age table on Assessment of the Contractor Firm

| Questions | %age of responses |            |       |
|-----------|-------------------|------------|-------|
|           | Disagree          | No opinion | Agree |
| QC8.5     | 28%               | 24%        | 48%   |
| QC8.9     | 48%               | 7%         | 45%   |
| QC8.11    | 54%               | 2%         | 44%   |
| QC8.4     | 34%               | 23%        | 43%   |
| QC8.1     | 50%               | 8%         | 42%   |
| QC8.7     | 35%               | 23%        | 42%   |
| QC8.8     | 35%               | 23%        | 42%   |
| QC8.6     | 55%               | 4%         | 41%   |
| QC8.3     | 43%               | 18%        | 39%   |
| QC8.2     | 62%               | 3%         | 35%   |
| QC8.10    | 59%               | 14%        | 27%   |

Table 4.22: Mean Score Values and Ranks on the Assessment of the Contractor Firm

| Question                                                                 |        | Client     |      | Contractor |      | Consultant |      | Construction MSE |      | Production MSE |      | Weighted |      |
|--------------------------------------------------------------------------|--------|------------|------|------------|------|------------|------|------------------|------|----------------|------|----------|------|
| The contractor has                                                       | Code   | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank | Mean Score       | Rank | Mean Score     | Rank | Mean     | Rank |
| key personnel to communicate                                             | QC8.5  | 2.19       | 1    | 2.41       | 1    | 2.32       | 1    | 1.96             | 2    | 2.43           | 1    | 2.26     | 1    |
| the required skill to read, interpret designs and specification          | QC8.4  | 2.08       | 2    | 2.33       | 3    | 2.26       | 2    | 1.87             | 5    | 2.27           | 2    | 2.16     | 2    |
| motivated personnel to insure quality conformance of works               | QC8.7  | 2.05       | 3    | 2.29       | 4    | 2.00       | 3    | 1.92             | 3    | 2.22           | 5    | 2.10     | 3    |
| favorable organizational structure for quality management                | QC8.8  | 1.89       | 4    | 2.34       | 2    | 1.90       | 7    | 1.99             | 1    | 2.24           | 3    | 2.07     | 4    |
| experienced key personnel in quality management                          | QC8.3  | 1.84       | 6    | 2.20       | 6    | 1.98       | 4    | 1.89             | 4    | 2.23           | 4    | 2.03     | 5    |
| key personnel from commencement to provisional acceptance of the project | QC8.11 | 1.89       | 4    | 2.16       | 7    | 1.89       | 8    | 1.79             | 6    | 2.15           | 6    | 1.98     | 6    |
| key personnel complying the contract requirement                         | QC8.1  | 1.81       | 7    | 2.05       | 8    | 1.97       | 5    | 1.76             | 8    | 1.95           | 8    | 1.91     | 7    |
| commitment to remove inferior quality works                              | QC8.9  | 1.70       | 8    | 2.00       | 9    | 1.92       | 6    | 1.78             | 7    | 2.12           | 7    | 1.90     | 8    |
| qualified quality control personnel                                      | QC8.6  | 1.38       | 10   | 2.23       | 5    | 1.69       | 9    | 1.74             | 9    | 1.86           | 11   | 1.78     | 9    |
| practice to reject inferior quality materials delivered by the client    | QC8.10 | 1.65       | 9    | 1.90       | 10   | 1.68       | 10   | 1.36             | 11   | 1.95           | 8    | 1.71     | 10   |
| trained key personnel in quality management                              | QC8.2  | 1.38       | 10   | 1.89       | 11   | 1.61       | 11   | 1.63             | 10   | 1.95           | 8    | 1.69     | 11   |

#### 4.2.14.1 Comparison Analysis of Contracting Parties on Contractor Related Quality Issues

There were strong positive correlation/agreement ( $0.75 < p < 1$ ) with all contracting parties respondents responses on the contractor related issues as the Pearson correlation shown bellow on Table 4.23

Table 4.23: Correlation among Contracting Parties on Contractor Related Quality Issue

|                                                             | Correlation | Client  | Contractor | Consultant | Construction MSE | Production MSE |
|-------------------------------------------------------------|-------------|---------|------------|------------|------------------|----------------|
| Client                                                      | Pearson     | 1       | 0.945**    | 0.966**    | 0.917**          | 0.975**        |
| Contractor                                                  | Pearson     | 0.945** | 1          | 0.963**    | 0.895**          | 0.979**        |
| Consultant                                                  | Pearson     | 0.966** | 0.963**    | 1          | 0.911**          | 0.977**        |
| Construction MSE                                            | Pearson     | 0.917** | 0.895**    | 0.911**    | 1                | 0.960**        |
| Production MSE                                              | Pearson     | 0.975** | 0.979**    | 0.977**    | 0.960**          | 1              |
| * Correlation is significant at the 0.05 level (2-tailed).  |             |         |            |            |                  |                |
| ** Correlation is significant at the 0.01 level (2-tailed). |             |         |            |            |                  |                |

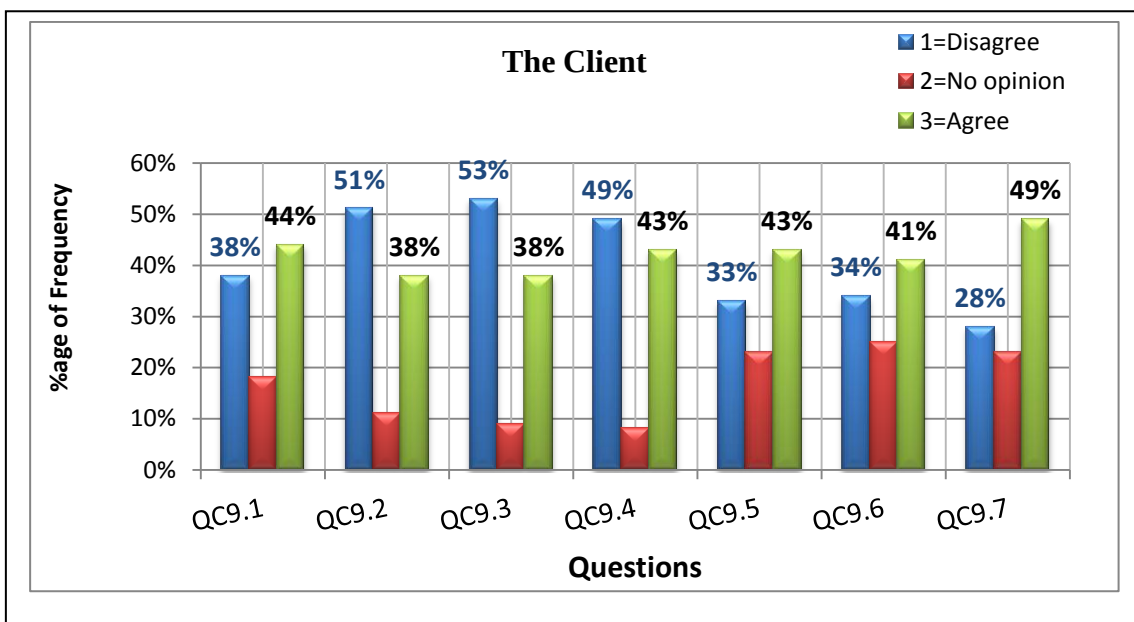
#### 4.2.15 The Client in AAHDPO

On the basis of three likert scale measurement 1=disagree, 2= No opinion and 3=agree, 49% of the total respondents indicated their agreement on the client has quality mission and policies, 44% of the whole respondents agreed on top managers hade awareness and sound control of quality management practice ,43% of the total again accepted the client were empowered employees on quality management perspective and 41% of the respondents also agreed on the presence of free flow of quality management information in the client office, on the other hand 53%,51% and 49% of the total respondents disagreed the client practices proper quality management technique, top managers play leadership role in quality management and the organization has a formal quality management structure respectively as depicted in Figure 4.9.

Table 4.24: Mean Score Values and Ranks on the Assessment of the Contractor Firm

| Question                                                   |       | Client     |      | Contractor |      | Consultant |      | Construction MSE |      | Production MSE |      | Weighted |      |
|------------------------------------------------------------|-------|------------|------|------------|------|------------|------|------------------|------|----------------|------|----------|------|
| Client Related                                             | Code  | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank | Mean Score       | Rank | Mean Score     | Rank | Mean     | Rank |
| the client has quality mission and policies                | QC9.7 | 2.38       | 1    | 2.49       | 1    | 2.24       | 1    | 1.99             | 1    | 2.51           | 1    | 2.32     | 1    |
| empower employees on quality management                    | QC9.5 | 2.24       | 2    | 2.33       | 2    | 1.95       | 4    | 1.93             | 2    | 2.30           | 3    | 2.15     | 2    |
| top managers have awareness and sound control of quality   | QC9.1 | 2.19       | 3    | 2.04       | 6    | 2.15       | 2    | 1.76             | 4    | 2.34           | 2    | 2.09     | 3    |
| there is free flow of quality management information       | QC9.6 | 2.19       | 3    | 2.21       | 4    | 2.00       | 3    | 1.86             | 3    | 2.20           | 4    | 2.09     | 4    |
| the organization has a formal quality management structure | QC9.4 | 2.14       | 5    | 2.25       | 3    | 1.73       | 6    | 1.75             | 5    | 2.08           | 5    | 1.99     | 5    |
| top managers play leadership role in quality management    | QC9.2 | 2.05       | 6    | 2.04       | 6    | 1.89       | 5    | 1.63             | 7    | 2.07           | 6    | 1.93     | 6    |
| practices proper quality management technique              | QC9.3 | 1.92       | 7    | 2.18       | 5    | 1.66       | 7    | 1.74             | 6    | 2.01           | 7    | 1.90     | 7    |

Figure 4.9: %age Histogram on Assessment of the Client



#### 4.2.15.1 Comparison Analysis of Contracting Parties On Client Related Quality Issues

All respondents had strong positive correlation/agreement ( $0.75 < p < 1$ ) with all contracting party respondents responses on the contractor related issues as the Pearson correlation depicted in the Table 4.25 bellow.

Table 4.25: Correlation among Contracting Parties on Client Related Quality Issue

|                                                             | Correlation | Client  | Contractor | Consultant | Construction MSE | Production MSE |
|-------------------------------------------------------------|-------------|---------|------------|------------|------------------|----------------|
| Client                                                      | Pearson     | 1       | 0.959**    | 0.921**    | 0.975**          | 0.919**        |
| Contractor                                                  | Pearson     | 0.959** | 1          | 0.826*     | 0.971**          | 0.946**        |
| Consultant                                                  | Pearson     | 0.921** | 0.826*     | 1          | 0.881**          | 0.864*         |
| Construction MSE                                            | Pearson     | 0.975** | 0.971**    | 0.881**    | 1                | 0.912**        |
| Production MSE                                              | Pearson     | 0.919** | 0.946**    | 0.864*     | 0.912**          | 1              |
| * Correlation is significant at the 0.05 level (2-tailed).  |             |         |            |            |                  |                |
| ** Correlation is significant at the 0.01 level (2-tailed). |             |         |            |            |                  |                |

#### 4.2.16 The Construction Process, Material Storage And Uses Adopted In AAHDPO

From Table 4.26 below, the weighted mean score value of props to beams and slabs were removed only after 21 days(2.68), Soffit form works were striped only after 21days(2.6), Vertical /side form works were striped only after 16 hrs(2.57), Appropriate immersion vibrator were used during concreting(2.54) and Concrete cubes were taken for compressive strength test properly (2.42) were ranked 1<sup>st</sup> to 5<sup>th</sup> respectively, based on three likert scale measurement 1=disagree, 2= no opinion and 3=agree, respondents agreed only on work process listed from 1<sup>st</sup> to 4<sup>th</sup>, but respondents on the rest work process ranked from 5<sup>th</sup> to 18<sup>th</sup> had no opinion.

##### 4.2.16.1 Comparison Analysis of Contracting Parties on Construction Process Related Quality Issues

The client respondents as depicted on Table 4.27 bellow moderately agreed with all contracting parties ( $0.5 < p < 0.75$ ) respondents except there was low agreement with construction MSEs ( $p=0.385$ ) on construction process related quality issues. The contractor had strong Pearson correlation with construction MSE respondents ( $p=0.817$ ) and moderate agreement with consultants (0.565) & production MSE respondents ( $p=0.673$ ). The consultant respondents had low agreement with construction MSE respondents (0.379) and moderate agreement with production MSE respondents (0.646) on construction process related quality issues. The construction MSEs and the Production MSEs moderately agreed ( $p=0.551$ ) on the issues stated.

Table 4.27: Correlation among Contracting Parties on Construction Process Related Quality Issue

|                                                             | Correlation | Client  | Contractor | Consultant | Construction MSE | Production MSE |
|-------------------------------------------------------------|-------------|---------|------------|------------|------------------|----------------|
| Client                                                      | Pearson     | 1       | 0.612**    | 0.547*     | 0.385            | 0.578*         |
| Contractor                                                  | Pearson     | 0.612** | 1          | 0.565*     | 0.817**          | 0.673**        |
| Consultant                                                  | Pearson     | 0.547*  | 0.565*     | 1          | 0.379            | 0.646**        |
| Construction MSE                                            | Pearson     | 0.385   | 0.817**    | 0.379      | 1                | 0.551*         |
| Production MSE                                              | Pearson     | 0.578*  | 0.673**    | 0.646**    | 0.551*           | 1              |
| * Correlation is significant at the 0.05 level (2-tailed).  |             |         |            |            |                  |                |
| ** Correlation is significant at the 0.01 level (2-tailed). |             |         |            |            |                  |                |

Table 4.26: Mean Score Values and Ranks on the Assessment Of Construction Process, Material Storage &amp; Uses

| Question                                                                                | Code    | Client     |      | Contractor |      | Consultant |      | Construction MSE |      | Production MSE |      | weighted |      |
|-----------------------------------------------------------------------------------------|---------|------------|------|------------|------|------------|------|------------------|------|----------------|------|----------|------|
|                                                                                         |         | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank | Mean Score       | Rank | Mean Score     | Rank | Mean     | Rank |
| <b>The construction process adopted and materials used before expiry date properly?</b> |         |            |      |            |      |            |      |                  |      |                |      |          |      |
| Props of beams and slabs are removed only after 21 days                                 | QC10.13 | 2.59       | 1    | 2.74       | 1    | 2.76       | 1    | 2.74             | 1    | 2.55           | 3    | 2.68     | 1    |
| Soffit form works are striped only after 21days                                         | QC10.14 | 2.43       | 3    | 2.59       | 4    | 2.73       | 2    | 2.63             | 4    | 2.61           | 2    | 2.60     | 2    |
| Vertical /side form works are striped only after 16 hrs                                 | QC10.12 | 2.51       | 2    | 2.59       | 4    | 2.58       | 4    | 2.71             | 2    | 2.46           | 4    | 2.57     | 3    |
| Appropriate immersion vibrator were used during concreting                              | QC10.9  | 2.32       | 5    | 2.49       | 6    | 2.56       | 5    | 2.65             | 3    | 2.65           | 1    | 2.54     | 4    |
| Concrete cubes were taken for compressive strength test properly                        | QC10.10 | 2.41       | 4    | 2.63       | 2    | 2.60       | 3    | 2.10             | 5    | 2.35           | 5    | 2.42     | 5    |
| Concrete structures were cured adequately as per the requirements                       | QC10.15 | 2.22       | 6    | 2.43       | 8    | 2.47       | 6    | 1.99             | 8    | 2.34           | 6    | 2.29     | 6    |
| Form works were good to prevent bulging & bleeding                                      | QC10.11 | 2.03       | 7    | 2.60       | 3    | 2.24       | 9    | 2.07             | 6    | 2.24           | 7    | 2.24     | 7    |
| Appropriate concrete transportation method were used                                    | QC10.7  | 2.03       | 7    | 2.48       | 7    | 2.19       | 10   | 2.05             | 7    | 2.15           | 9    | 2.18     | 8    |
| Concrete ingredients were mixed as per the mix design                                   | QC10.5  | 2.03       | 7    | 2.29       | 9    | 2.35       | 7    | 1.96             | 9    | 2.11           | 11   | 2.15     | 9    |
| The workability of concrete used were as per the slump test result                      | QC10.6  | 2.00       | 12   | 2.25       | 10   | 1.98       | 14   | 1.96             | 10   | 2.16           | 8    | 2.07     | 10   |
| Cement used were fresh (<1 month from date of manufacture)                              | QC10.1  | 1.84       | 15   | 2.16       | 13   | 2.15       | 2    | 1.90             | 11   | 2.14           | 10   | 2.04     | 11   |
| Mixed concrete were placed in formworks from a height of < 2 m                          | QC10.8  | 2.03       | 7    | 2.15       | 14   | 2.31       | 8    | 1.68             | 17   | 1.97           | 13   | 2.03     | 12   |
| Selected material fills were tested in layers to assure the specification               | QC10.18 | 2.03       | 7    | 2.18       | 11   | 2.00       | 13   | 1.86             | 12   | 1.96           | 14   | 2.00     | 13   |
| Cement stored in stacks less than 10 bags height over a raised (>20cm) wooden platform  | QC10.2  | 1.97       | 13   | 2.18       | 11   | 1.89       | 5    | 1.68             | 17   | 2.07           | 12   | 1.96     | 14   |

Table 4.26: Mean Score Values And Ranks On The Assessment Of The Construction Process, Material Storage &amp; Uses ...Continued

|                                                                                 |         |      |    |      |    |      |    |      |    |      |    |      |    |
|---------------------------------------------------------------------------------|---------|------|----|------|----|------|----|------|----|------|----|------|----|
| Selected material fill were done in layers of 15-20cm as per the specifications | QC10.16 | 1.76 | 16 | 2.14 | 15 | 1.98 | 14 | 1.83 | 15 | 1.85 | 16 | 1.91 | 15 |
| Proper fill material compaction method were adopted                             | QC10.17 | 1.86 | 14 | 2.03 | 17 | 1.98 | 14 | 1.79 | 16 | 1.86 | 15 | 1.91 | 16 |
| Steel reinforcement bars were stored in clean condition                         | QC10.4  | 1.68 | 17 | 2.06 | 16 | 1.73 | 6  | 1.85 | 13 | 1.81 | 17 | 1.83 | 17 |
| Reinforcement bars used for the project were free of corrosion                  | QC10.3  | 1.65 | 18 | 1.99 | 18 | 1.66 | 18 | 1.84 | 14 | 1.78 | 18 | 1.78 | 18 |

Table 4.28: Mean Score Values and Ranks on the Assessment of Construction Quality Management Documents

| Question                                                        |        | Client     |      | Contractor |      | Consultant |      | Construction MSE |      | Production MSE |      | Weighted |      |
|-----------------------------------------------------------------|--------|------------|------|------------|------|------------|------|------------------|------|----------------|------|----------|------|
| Are there quality management related documents in AAHDPO?       | Code   | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank | Mean Score       | Rank | Mean Score     | Rank | Mean     | Rank |
| Clearly stated site book                                        | QD1.8  | 3.49       | 2    | 3.71       | 1    | 3.71       | 1    | 4.10             | 1    | 3.66           | 1    | 3.73     | 1    |
| Clearly stated specification of works                           | QD1.5  | 3.30       | 6    | 3.54       | 5    | 3.52       | 5    | 3.84             | 2    | 3.51           | 2    | 3.54     | 2    |
| Supervision check lists for construction works                  | QD1.6  | 3.46       | 4    | 3.66       | 2    | 3.61       | 4    | 3.18             | 3    | 3.39           | 3    | 3.46     | 3    |
| Contract document which clarifies quality management techniques | QD1.9  | 3.46       | 1    | 3.64       | 3    | 3.69       | 2    | 3.06             | 7    | 3.16           | 9    | 3.40     | 4    |
| Clearly stated construction material specifications             | QD1.3  | 3.57       | 1    | 3.65       | 3    | 3.31       | 7    | 2.90             | 6    | 3.24           | 5    | 3.33     | 5    |
| Production check lists for precast beams, HCBs & aggregates     | QD1.7  | 3.49       | 2    | 3.51       | 6    | 3.35       | 6    | 2.99             | 5    | 3.09           | 7    | 3.29     | 6    |
| Properly endorsed quality control test results by the Engineer  | QD1.10 | 3.19       | 7    | 3.50       | 7    | 3.63       | 3    | 2.76             | 7    | 3.27           | 4    | 3.27     | 7    |
| Complete construction designs                                   | QD1.4  | 3.08       | 8    | 3.03       | 9    | 2.60       | 9    | 2.55             | 8    | 2.47           | 9    | 2.75     | 8    |
| Clear quality management manuals                                | QD1.1  | 2.76       | 9    | 3.10       | 8    | 2.63       | 8    | 2.29             | 10   | 2.47           | 9    | 2.65     | 9    |
| Easily available quality management manuals in AAHDPO           | QD1.2  | 2.43       | 10   | 2.73       | 10   | 2.32       | 10   | 2.32             | 9    | 2.85           | 8    | 2.53     | 10   |

#### **4.2.17 Assessment on Construction Quality Management Documents In AAHDPO**

From Table 4.28 above respondents ranked 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> based on the weighted mean values of the presence of clearly stated site book(3.73), Clearly stated specification of works(3.54), supervision check lists for construction works(3.46), Contract document which clarifies quality management techniques(3.4) and Clearly stated construction material specifications(3.33) respectively. Using five likert scale measurement 1=strongly disagree, 2=disagree, 3=No opinion, 4=agree and 5=strongly agree the majority of respondents agreed only on the presence of clearly stated site book(3.73) and Clearly stated specification of works(3.54), respondents had no opinion on the presence and clarity of other quality management documents ranked from 3<sup>rd</sup> to 7<sup>th</sup> with weighted mean values in between 3.5 and 2.75, further more respondents disagreed on the presence of the last three quality management documents ranked 10<sup>th</sup>, 9<sup>th</sup> and 8<sup>th</sup> were the presence of; easily available quality management manuals in AAHDPO, Clear quality management manuals and Complete construction designs.

##### **4.2.17.1 Comparison Analysis of Contracting Parties on Construction Quality Management Document Related Issues**

The client respondents moderately agreed with production MSE respondents on quality management document related issues with a Pearson correlation value of  $p=0.659$ , low agreement with the contractor ( $p=0.415$ ) & with construction MSE ( $p=0.491$ ) and weak agreement with consultant respondents. The contractor respondents moderately agreed with consultants ( $p=0.697$ ) & the construction MSEs ( $p=0.520$ ) and strong agreement with the production MSEs ( $p=0.759$ ) on construction quality management document related issues. The consultant in this case had moderate agreement with the production MSE ( $p=0.716$ ) and low agreement with the construction MSEs ( $p=0.459$ ). The two MSEs strongly agreed each other ( $p=0.772$ ) on quality management document related issues as shown on Table 4.29 below.

**Table 4.29: Correlation among Contracting Parties on Construction Quality Management Document Related Issues**

|                                                             | Correlation | Client | Contractor | Consultant | Construction MSE | Production MSE |
|-------------------------------------------------------------|-------------|--------|------------|------------|------------------|----------------|
| Client                                                      | Pearson     | 1      | 0.415      | 0.011      | 0.491            | 0.659*         |
| Contractor                                                  | Pearson     | 0.415  | 1          | 0.697*     | 0.520            | 0.759*         |
| Consultant                                                  | Pearson     | 0.011  | 0.697*     | 1          | 0.459            | 0.716*         |
| Construction MSE                                            | Pearson     | 0.491  | 0.520      | 0.459      | 1                | 0.772**        |
| Production MSE                                              | Pearson     | 0.659* | 0.759*     | 0.716*     | 0.772**          | 1              |
| * Correlation is significant at the 0.05 level (2-tailed).  |             |        |            |            |                  |                |
| ** Correlation is significant at the 0.01 level (2-tailed). |             |        |            |            |                  |                |

#### 4.2.18 Causes of Poor Construction Quality Management

Table 4.30 below presents causes of poor construction management ranked 1<sup>st</sup> to 17<sup>th</sup> were significant factors as the respondents agreed, but participation of incompetent contractors, Sub-contractors work, Difficulty to manage MSEs with the main contractor, Corruption and Failure in distribution & practicing quality management systems, manuals & programs to all participants were identified as the top five causes of poor construction quality management in AAHDPO ranked as 1<sup>st</sup> to 4<sup>th</sup> with weighted mean average value of 3.84, 3.74, 3.72, 3.7 and 3.7, but the ground conditions, Absence of weekly/monthly supervision & quality control report, the project specifications, lack of qualified & experienced manpower on the consultant side and lack of effective communication between stakeholders were not the causes of poor construction quality management in AAHDPO.

Table 4.30: Mean Score Values and Ranks of Causes of Poor Construction Quality Management in AAHDPO

| Question                                                                                        |        | Client     |      | Contractor |      | Consultant |      | Construction MSE |      | Production MSE |      | Weighted |      |
|-------------------------------------------------------------------------------------------------|--------|------------|------|------------|------|------------|------|------------------|------|----------------|------|----------|------|
|                                                                                                 | Code   | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank | Mean Score       | Rank | Mean Score     | Rank | Mean     | Rank |
| Participation of incompetent contractors                                                        | QE1.16 | 3.27       | 7    | 3.86       | 3    | 3.77       | 2    | 4.25             | 2    | 4.05           | 1    | 3.84     | 1    |
| Subcontractors work                                                                             | QE1.23 | 3.46       | 2    | 3.60       | 14   | 3.65       | 10   | 4.18             | 4    | 3.80           | 9    | 3.74     | 2    |
| Difficulty to manage MSEs with the main contractor                                              | QE1.20 | 3.30       | 5    | 3.80       | 5    | 3.48       | 16   | 4.28             | 1    | 3.74           | 11   | 3.72     | 3    |
| Failure in distribution of quality management systems, manuals and programs to all participants | QE1.9  | 3.27       | 7    | 3.61       | 13   | 3.76       | 4    | 4.09             | 7    | 3.77           | 10   | 3.70     | 4    |
| Corruption                                                                                      | QE1.15 | 3.19       | 13   | 3.93       | 1    | 3.76       | 4    | 3.65             | 17   | 3.99           | 2    | 3.70     | 4    |
| Absence of quality management implementation strategies                                         | QE1.12 | 3.24       | 10   | 3.81       | 4    | 3.56       | 12   | 4.00             | 11   | 3.82           | 5    | 3.69     | 6    |
| Extended project duration                                                                       | QE1.22 | 3.30       | 5    | 3.59       | 15   | 3.68       | 7    | 4.03             | 8    | 3.81           | 7    | 3.68     | 7    |
| Labours employed are contributors to poor quality housing delivery                              | QE1.8  | 3.22       | 11   | 3.68       | 11   | 3.55       | 13   | 4.03             | 8    | 3.86           | 4    | 3.67     | 8    |
| Inappropriate organizational structure                                                          | QE1.14 | 3.05       | 17   | 3.73       | 7    | 3.44       | 18   | 4.14             | 5    | 3.91           | 3    | 3.65     | 9    |
| Lack of qualified & experienced manpower on the <u>contractor</u> side                          | QE1.3  | 3.22       | 11   | 3.55       | 18   | 3.89       | 1    | 3.96             | 12   | 3.55           | 16   | 3.63     | 10   |
| Delivery of poor quality construction materials                                                 | QE1.7  | 3.00       | 21   | 3.79       | 6    | 3.53       | 14   | 4.02             | 10   | 3.82           | 5    | 3.63     | 11   |
| The participation of MSEs                                                                       | QE1.19 | 3.35       | 3    | 3.58       | 16   | 3.45       | 17   | 4.23             | 3    | 3.54           | 19   | 3.63     | 12   |
| Incomplete designs                                                                              | QE1.17 | 2.86       | 24   | 3.69       | 10   | 3.68       | 7    | 4.10             | 6    | 3.81           | 7    | 3.63     | 13   |
| Lack of leadership involvement in monitoring and coordinating                                   | QE1.13 | 3.05       | 17   | 3.88       | 2    | 3.60       | 11   | 3.79             | 14   | 3.74           | 11   | 3.61     | 14   |

Table 4.30: Mean Score Values And Ranks Of Causes Of Poor Construction Quality Management In AAHDPO... Continued

|                                                                        |        |      |    |      |    |      |    |      |    |      |    |      |    |
|------------------------------------------------------------------------|--------|------|----|------|----|------|----|------|----|------|----|------|----|
| Low effort in reinforcing quality culture                              | QE1.11 | 3.11 | 16 | 3.71 | 8  | 3.44 | 18 | 3.77 | 15 | 3.69 | 14 | 3.54 | 15 |
| Poor quality of pre-fabricated materials                               | QE1.25 | 3.14 | 15 | 3.53 | 20 | 3.76 | 4  | 3.51 | 18 | 3.73 | 13 | 3.53 | 16 |
| Low rate of salary for quality management personnel                    | QE1.24 | 3.51 | 1  | 3.71 | 8  | 3.77 | 2  | 3.09 | 22 | 3.55 | 16 | 3.53 | 17 |
| Low unit price/cost of work items                                      | QE1.21 | 3.35 | 3  | 3.56 | 17 | 3.66 | 9  | 3.21 | 21 | 3.55 | 16 | 3.47 | 18 |
| Inappropriate relationship between the consultant and the contractor   | QE1.5  | 3.16 | 14 | 3.55 | 18 | 3.39 | 21 | 3.68 | 16 | 3.38 | 21 | 3.43 | 19 |
| Lack of senior management body commitment to deliver quality houses    | QE1.10 | 3.00 | 21 | 3.65 | 12 | 3.34 | 23 | 3.38 | 20 | 3.61 | 15 | 3.40 | 20 |
| Lack of effective communication between stakeholders                   | QE1.2  | 3.03 | 20 | 3.53 | 20 | 3.42 | 20 | 3.47 | 19 | 3.53 | 20 | 3.39 | 21 |
| Lack of qualified & experienced manpower on the <u>consultant</u> side | QE1.4  | 3.05 | 17 | 3.33 | 22 | 3.27 | 24 | 3.85 | 13 | 3.20 | 24 | 3.34 | 22 |
| The project specifications of AAHDPO                                   | QE1.6  | 3.27 | 7  | 3.30 | 23 | 3.35 | 22 | 2.94 | 23 | 3.28 | 22 | 3.23 | 23 |
| Absence of weekly/monthly supervision & quality control report         | QE1.18 | 2.68 | 25 | 3.13 | 25 | 3.53 | 14 | 2.58 | 25 | 3.23 | 23 | 3.03 | 24 |
| The ground conditions and the land where low cost housing are executed | QE1.1  | 3.00 | 21 | 3.19 | 24 | 2.87 | 25 | 2.59 | 24 | 2.84 | 25 | 2.90 | 25 |

#### 4.2.18.1 Comparison of Contracting Parties Response on Causes of Poor Construction Quality Management in AAHDPO.

There were strong positive Pearson correlation/agreement ( $7.5 < p < 1$ ) among all contracting parties respondents responses on the causes of poor construction quality management in AAHDPO as depicted bellow on Table 4.31

**Table 4.31.: Correlation among Contracting Parties on Causes of Poor Construction Quality Management In AAHDPO.**

|                                                             | Correlation | Client  | Contractor | Consultant | Construction MSE | Production MSE |
|-------------------------------------------------------------|-------------|---------|------------|------------|------------------|----------------|
| Client                                                      | Pearson     | 1       | 0.958**    | 0.924**    | 0.868**          | 0.976**        |
| Contractor                                                  | Pearson     | 0.958** | 1          | 0.895**    | 0.827**          | 0.961**        |
| Consultant                                                  | Pearson     | 0.924** | 0.895**    | 1          | 0.779**          | 0.916**        |
| Construction MSE                                            | Pearson     | 0.868** | 0.827**    | 0.779**    | 1                | 0.916**        |
| Production MSE                                              | Pearson     | 0.976** | 0.961**    | 0.916**    | 0.916**          | 1              |
| * Correlation is significant at the 0.05 level (2-tailed).  |             |         |            |            |                  |                |
| ** Correlation is significant at the 0.01 level (2-tailed). |             |         |            |            |                  |                |

#### 4.2.19 Contracting Parties and Causes of Poor Construction Quality Management

As depicted on Table 4.32 & Figure 4.20 below, the weighted mean score value of all contracting parties were  $> 3.5$  indicate respondents agreement on the five likeret scale measurement as they had their own contribution to poor construction quality management in AAHDPO. Contractors ranked as 1<sup>st</sup> cause of poor construction quality management with weighted mean score value of 4.08. Construction MSEs, Production MSEs, HDPO/Client and Consultants ranked from 2<sup>nd</sup> to 5<sup>th</sup> causes of poor construction quality management in AAHDPO with weighted mean score values of 4.01, 3.72, 3.65 and 3.6 respectively.

**Table 4.32: Mean Score Values and Ranks of Contracting Parties as Causes of Poor Construction Quality Management**

| Question                                                                            |      | Client     |      | Contractor |      | Consultant |      | Construction MSE |      | Production MSE |      | Weighted    |          |
|-------------------------------------------------------------------------------------|------|------------|------|------------|------|------------|------|------------------|------|----------------|------|-------------|----------|
| who is the cause of most quality problems in low cost housing project participants? | Code | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank | Mean Score       | Rank | Mean Score     | Rank | Mean        | Rank     |
| Contractor                                                                          | QE22 | 3.95       | 1    | 3.94       | 2    | 4.05       | 1    | 4.38             | 2    | 4.11           | 1    | <b>4.08</b> | <b>1</b> |
| Construction MSEs                                                                   | QE24 | 3.81       | 2    | 4.04       | 1    | 3.68       | 2    | 4.41             | 1    | 4.09           | 2    | <b>4.01</b> | <b>2</b> |
| Production MSEs                                                                     | QE25 | 3.51       | 4    | 3.78       | 3    | 3.60       | 3    | 3.88             | 3    | 3.85           | 4    | <b>3.72</b> | <b>3</b> |
| HDPO/Client                                                                         | QE21 | 3.38       | 5    | 3.48       | 4    | 3.60       | 3    | 3.82             | 4    | 3.96           | 3    | <b>3.65</b> | <b>4</b> |
| Consultant                                                                          | QE23 | 3.62       | 3    | 3.44       | 5    | 3.50       | 5    | 3.74             | 5    | 3.68           | 5    | <b>3.60</b> | <b>5</b> |

#### 4.2.19.1 Comparison of Contracting Parties Response on Them Selves as Causes of Poor Construction Quality Management in AAHDPO

There were strong positive Pearson correlation/agreement ( $7.5 < p < 1$ ) between the client and all contracting parties respondents responses except moderate agreement ( $p = 0.724$ ) with consultants on contracting parties as the causes of poor construction quality management in AAHDPO as depicted bellow on Table 4.33. The contractor respondents had strong correlation/agreement with the consultant respondents with a Pearson correlation of ( $p = 0.788$ ) and a moderate correlation/agreement with the two MSEs. The consultant also had a moderate agreement with the two MSE respondents and at last the two MSE respondents strongly agreed with each other on contracting parties as a cause of poor quality in AAHDPO.

**Table 4.33: %age of response among Contracting Parties on Causes of Poor Construction Quality Management in AAHDPO.**

|                                                             | Correlation | Client | Contractor | Consultant | Construction MSE | Production MSE |
|-------------------------------------------------------------|-------------|--------|------------|------------|------------------|----------------|
| Client                                                      | Pearson     | 1      | 0.831      | 0.724      | 0.938*           | 0.941*         |
| Contractor                                                  | Pearson     | 0.831  | 1          | 0.788      | 0.609            | 0.651          |
| Consultant                                                  | Pearson     | 0.724  | 0.788      | 1          | 0.621            | 0.631          |
| Construction MSE                                            | Pearson     | 0.938* | 0.609      | 0.621      | 1                | 0.992**        |
| Production MSE                                              | Pearson     | 0.941* | 0.651      | 0.631      | 0.992**          | 1              |
| * Correlation is significant at the 0.05 level (2-tailed).  |             |        |            |            |                  |                |
| ** Correlation is significant at the 0.01 level (2-tailed). |             |        |            |            |                  |                |

#### 4.2.20 Quality Improvement Techniques Adopted In AAHDPO

As depicted on Table 4.34 & Figure 4.10 bellow based on the weighted mean score values AAHDPO promotes quality improvement through continuous supervision(3.95), using corrective action(3.92), By termination /punishment(3.79), and by implementing quality assurance system(3.72) as ranked by respondents 1<sup>st</sup> to 4<sup>th</sup> indicates respondents agreement specially respondents strongly agreed on quality improvement by termination /punishment on five likert scale measurement of 1=Strongly disagree, 2=Disagree, 3=No opinion, 4=Agree and 5=Strongly Agree, but 40% of the total respondents disagreed on the presence of quality improvement technique through training as ranked last.

Figure 4.10 %age On Construction Parties as Causes of Poor Construction Quality Management in AAHDPO

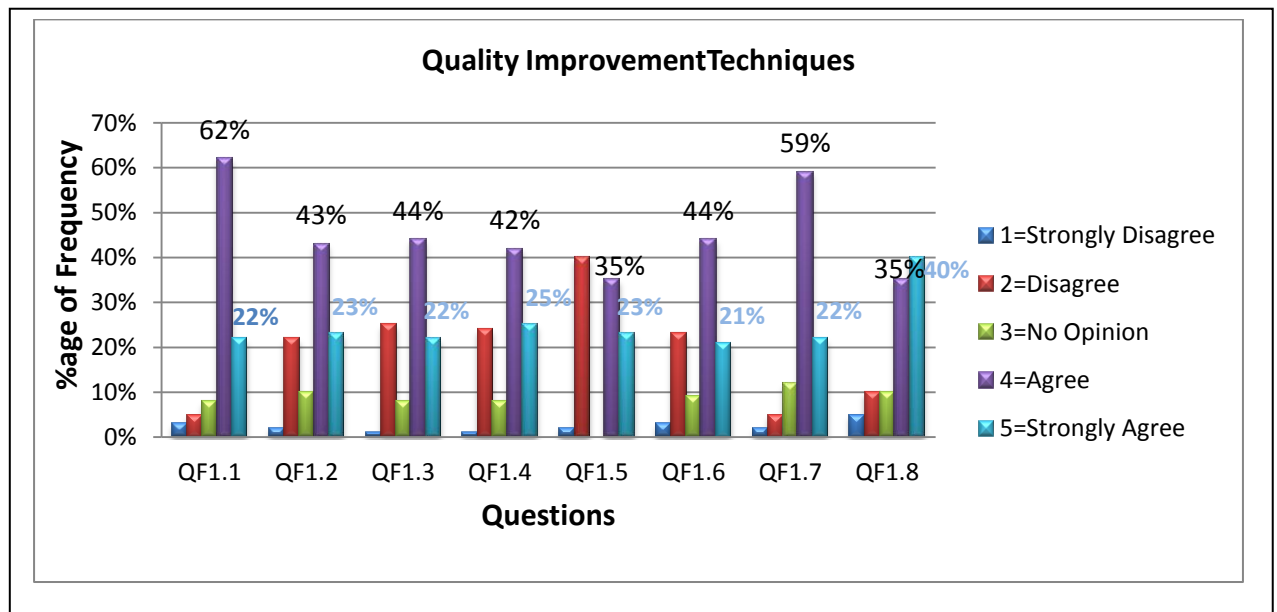


Table 4.34: Mean Score Values and Ranks of Quality Improvement Techniques Followed In AAHDPO

| Question                                              |       | Client     |      | Contractor |      | Consultant |      | Construction<br>MSE |      | Production<br>MSE |      | Weighted |      |
|-------------------------------------------------------|-------|------------|------|------------|------|------------|------|---------------------|------|-------------------|------|----------|------|
| This project promote quality Management by            | Code  | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank | Mean Score          | Rank | Mean Score        | Rank | Mean     | Rank |
| Through continuous supervision                        | QF1.1 | 3.57       | 2    | 3.94       | 2    | 4.27       | 1    | 3.88                | 2    | 4.08              | 2    | 3.95     | 1    |
| Using corrective action                               | QF1.7 | 3.57       | 2    | 4.01       | 1    | 4.13       | 4    | 3.82                | 3    | 4.08              | 2    | 3.92     | 2    |
| By termination /punishment                            | QF1.8 | 3.43       | 6    | 3.70       | 7    | 3.35       | 8    | 4.39                | 1    | 4.09              | 1    | 3.79     | 3    |
| By implementing quality assurance system              | QF1.4 | 3.46       | 5    | 3.89       | 3    | 4.13       | 4    | 3.23                | 4    | 3.89              | 5    | 3.72     | 4    |
| Using feedback if performance measurements undertaken | QF1.3 | 3.59       | 1    | 3.79       | 5    | 4.16       | 3    | 3.08                | 6    | 3.86              | 6    | 3.70     | 5    |
| Through quality performance measurement               | QF1.2 | 3.54       | 4    | 3.76       | 6    | 4.18       | 2    | 3.18                | 5    | 3.82              | 7    | 3.70     | 6    |
| Using preventive action                               | QF1.6 | 3.35       | 7    | 3.84       | 4    | 4.08       | 6    | 3.06                | 8    | 3.91              | 4    | 3.65     | 7    |
| Through training                                      | QF1.5 | 3.30       | 8    | 3.30       | 8    | 4.06       | 7    | 3.07                | 7    | 3.30              | 8    | 3.41     | 8    |

#### 4.2.20.1 Comparison of Contracting Parties Response on Quality Improvement Techniques in AAHDPO

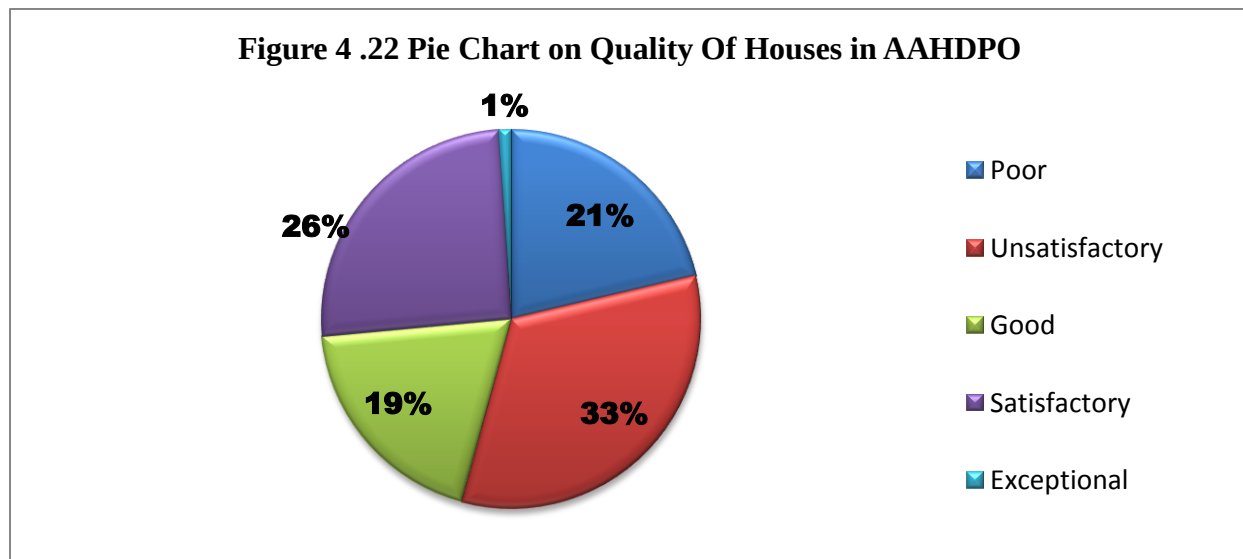
Pearson correlation shown on Table 4.35 below indicates, the client respondents moderately agreed with contractor ( $p=0.67$ ), consultant (0.648) and low agreement with construction MSE respondents (0.48), but had weak agreement with production MSEs (0.239) on the quality improvement techniques adopted in AAHDPO. The contractor respondents strongly agreed with consultants ( $p=0.88$ ) & construction MSEs ( $p=0.961$ ), moderately agreed with production MSEs ( $p=0.499$ ). Consultants had strong agreement with construction MSEs ( $p=0.78$ ) and production MSEs ( $p=0.794$ ), lastly the two MSEs had low correlation/agreement with each other ( $p=0.459$ ).

Table 4.35: Correlation among Contracting Parties on Quality Improvement Techniques

|                                                             | Correlation | Client | Contractor | Consultant | Construction MSE | Production MSE |
|-------------------------------------------------------------|-------------|--------|------------|------------|------------------|----------------|
| Client                                                      | Pearson     | 1      | 0.670      | 0.648      | 0.480            | 0.239          |
| Contractor                                                  | Pearson     | 0.670  | 1          | 0.880**    | 0.961**          | 0.499          |
| Consultant                                                  | Pearson     | 0.648  | 0.880**    | 1          | 0.780*           | 0.794*         |
| Construction MSE                                            | Pearson     | 0.480  | 0.961**    | 0.780*     | 1                | 0.459          |
| Production MSE                                              | Pearson     | 0.239  | 0.499      | 0.794*     | 0.459            | 1              |
| * Correlation is significant at the 0.05 level (2-tailed).  |             |        |            |            |                  |                |
| ** Correlation is significant at the 0.01 level (2-tailed). |             |        |            |            |                  |                |

#### 4.2.21 Quality of the Completed Low Cost Houses in AAHDPO

From Table 4.36 above and Figure 4.11 depicted below, relatively higher percentage (33%) of the total respondents put their perception in AAHDPO houses as unsatisfactory quality.



#### 4.2.22 Impact of Poor Quality Management

From Table 4.44 and Figure 4.23 bellow, respondents identified the impacts of poor quality management in AAHDPO based on the weighted mean values as extended construction period(3.88), reduction of productivity(3.77), customer dissatisfaction(3.66), occurrence of claims(3.65) and high cost of reworks(3.49) ranked from 1<sup>st</sup> to 5<sup>th</sup> respectively which means respondents agreed on the five scale measurement as 4.

##### 4.2.22.1 Comparison of Contracting Parties Response on The Impacts Of Poor Quality Management In AAHDPO

From Table 4.37 shown bellow client respondents had low agreement with consultants ( $p=0.281$ ) & production MSEs ( $p=0.251$ ), weak agreement with the contractor ( $p=0.046$ ) and negatively low agreement with construction MSEs ( $p= -0.258$ ). The contractor had negative moderate agreement with the consultant ( $p= -0.579$ ) that is opposite perception, negative weak agreement with production MSEs ( $p= -0.112$ ) and low negative agreement with construction MSEs ( $p= -0.288$ ).

The consultant also had negative week agreement with construction MSEs ( $p= -0.189$ ) and production MSEs ( $p= -0.164$ ). The two MSEs had moderate agreement with each other ( $p=0.556$ ) on the impacts of poor quality management techniques in AAHDPO.

Table 4.37: Correlation among Contracting Parties on Impacts of Poor Quality Management in AAHDPO

|                                                             | Correlation | Client | Contractor | Consultant | Construction MSE | Production MSE |
|-------------------------------------------------------------|-------------|--------|------------|------------|------------------|----------------|
| Client                                                      | Pearson     | 1      | 0.046      | 0.281      | -0.258           | 0.251          |
| Contractor                                                  | Pearson     | 0.046  | 1          | -0.579     | -0.112           | -0.288         |
| Consultant                                                  | Pearson     | 0.281  | -0.579     | 1          | -0.189           | -0.164         |
| Construction MSE                                            | Pearson     | -0.258 | -0.112     | -0.189     | 1                | 0.556          |
| Production MSE                                              | Pearson     | 0.251  | -0.288     | -0.164     | 0.556            | 1              |
| * Correlation is significant at the 0.05 level (2-tailed).  |             |        |            |            |                  |                |
| ** Correlation is significant at the 0.01 level (2-tailed). |             |        |            |            |                  |                |

Table 4.38: Mean Score Values and Ranks on the Impacts of Poor Quality Management in AAHDPO

| Question                                                            |       | Client     |      | Contractor |      | Consultant |      | Construction<br>MSE |      | Production<br>MSE |      | Weighted |      |
|---------------------------------------------------------------------|-------|------------|------|------------|------|------------|------|---------------------|------|-------------------|------|----------|------|
| How do you rate the impact of quality management problem in AAHDPO? | Code  | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank | Mean Score          | Rank | Mean Score        | Rank | Mean     | Rank |
| Extended construction period                                        | QG1.6 | 3.78       | 1    | 3.69       | 2    | 3.97       | 1    | 4.04                | 1    | 3.91              | 2    | 3.88     | 1    |
| Reduction of productivity                                           | QG1.9 | 3.38       | 5    | 3.76       | 1    | 3.79       | 3    | 3.88                | 2    | 4.05              | 1    | 3.77     | 2    |
| Customer dissatisfaction                                            | QG1.3 | 3.59       | 2    | 3.53       | 5    | 3.65       | 4    | 3.71                | 5    | 3.80              | 4    | 3.66     | 3    |
| Occurrence of claims                                                | QG1.7 | 3.41       | 4    | 3.65       | 3    | 3.81       | 2    | 3.58                | 6    | 3.82              | 3    | 3.65     | 4    |
| High cost of reworks                                                | QG1.1 | 3.14       | 7    | 3.63       | 4    | 3.37       | 6    | 3.76                | 4    | 3.54              | 6    | 3.49     | 5    |
| Contract termination                                                | QG1.4 | 3.24       | 6    | 3.44       | 6    | 3.32       | 7    | 3.78                | 3    | 3.58              | 5    | 3.47     | 6    |
| Presence of change order                                            | QG1.8 | 3.49       | 3    | 3.28       | 7    | 3.48       | 5    | 3.17                | 7    | 3.47              | 8    | 3.38     | 7    |
| Idle buildings without occupants due to the risk of failure         | QG1.2 | 3.11       | 8    | 3.09       | 8    | 2.94       | 9    | 3.04                | 8    | 3.53              | 7    | 3.14     | 8    |
| Loss of life                                                        | QG1.5 | 2.57       | 9    | 3.05       | 9    | 3.19       | 8    | 2.85                | 9    | 3.39              | 9    | 3.01     | 9    |

### 4.3 Interviews

Interviews were made for two contract administration division heads on client side, two coordinators on consultant, four contractor technical managers, five interviews from electrical installation MSEs, metal work MSEs, sanitary MSEs, HCB production MSEs and Pre-cast MSE one from each on January 1 to 3/2009 E.C for three consecutive days at Project 13 and Addis Ketema Sub-city branch housing construction projects.

This investigation was aimed to get the interviews perception and practice on construction quality management systems adopted and the causes of construction quality management problems. The interview was mad using six semi structured open ended questions and the respondents perception summarized as follows:

#### **Q1. How do you grade the quality of houses in AAHDPO?**

Respondents of the interview stressed their perception on the grades of the quality of houses in AAHDPO as except the presence of un maintainable electrical installation lines and finishing work defects the condominium houses structural work were satisfactory in quality.

#### **Q2. How do you control the quality of each activity during construction/Process control? Do you have activity based quality control requirements?**

Respondents of the interview put their perception as the quality of the house were the result of all contracting parties participated in the construction process. Most construction materials were delivered by the client in AAHDPO trained, so material related quality issues were controlled/assured by the client and the consultants. Sand and temporary work materials were delivered by main contractor, therefore the quality of those materials were controlled & approved by contractors and consultants. The works and workmanship quality were controlled and approved by the client and the consultant. There are work inspection certificates prepared by the executor then after approved and signed by the consultant.



Figure 4.12 Cube  
Samples for test

**Q3. Do you have any quality management documents used to refer to keep quality of the houses?**

Respondents of the interview state, that there is no readymade quality control and quality assurance manual to use as a reference for quality management except the general condition of contract, design and work specification attached with bill of quantities in the contract document.

From consultant interviews stated, they do have different quality requirement references used to check/approve activities and materials.

**Q4. What is your perception in relation to low cost concept to the delivery of quality houses?**

Client and consultant respondents participated in the interview agree low cost house delivery not with compromising in quality standard/requirements and they stated that low cost is due to government support to the project by giving free land, using new technology during construction and by covering administrative cost. But other respondents participated in this interview believe that low cost couldn't achieved without using sub-standard quality material, sub-standard workmanship and equipments with low cost.

**Q5. What are the main Causes for poor construction quality in AAHDPO?**

The interviewed respondents put first their perception as the main cause of poor quality in AAHDPO were due to the political structure imposed, this had influenced the quality of houses that the leaders/top managers were not professionals rather they are politicians "commitment given out of their profession resulted poor quality, since their main concern were other issues out of quality house delivery agenda", the other issue raised related to this were inappropriate contractor selection methods and the participation of specialty sub-contractors/MSEs, electrical installation, sanitary installation, metal work, agrostone board and PVC window fixing MSEs were assumed sub-contractors under the supervision of main contractors, but the reality were not true due to this building structures specially block walls were demolished and reworked again and again.

The second issue raised by interviews as a cause of poor quality works were professionals less commitment and corrupted behavior "tests taken in AAHDPO didn't represent the real works, since samples were not taken from the real work" concrete cubes were not casted from the concrete mix under construction rather specially made from special mix design and special materials with high care by site inspectors in conjunction with the contractor.

The third issue raised as a cause of poor construction quality in AAHDPO by the interview was main players/organizations key personnel participated in the construction of houses poor skill in quality management.

Absence of harmonized quality control/assurance manuals among the branch project offices and participants in each organization were other factor contributing to poor quality management in AAHDPO rose during the interview.

**Q6. What are your recommendations to improve poor quality management problems?**

Respondents recommended that quality management problems will be improved by:

- ❖ Assigning competitive professionals as project executers in all contracting parties including project managers on the client side.
- ❖ If contractors are selected on previous project performance base.
- ❖ If sub-contractors/specialty sub-contractors are selected by main contractors, they believe that this has highest value in managing and controlling sub contractors work like plastering and other work sub-contractors.
- ❖ If project participants/key personnel are updated with continues on job training
- ❖ If harmonized quality control/assurance manuals are prepared and disseminated or easily accessible to contracting parties in all project branch office.
- ❖ If there are ethically disciplined contracting party key personnel

#### 4.4 Focus Group Discussion/FGD

Focus group discussions were done among the sampled sites out of those where interviewed respondents didn't exist. Gulelle sub-city and Project 11 housing construction project coordinators and resident engineers of consultants, construction and contract administration division heads of the client, contractor technical managers, three construction MSE representatives and two production MSE representatives participated in the FGD organized at their respective construction and contract division head offices.

The discussion were very hot specially participants of the Gulelle branch office construction project focus group discussion. The Interview questions were paused to the groups and the two focus group discussions support the interview results with



Figure 4.13 Footing columns were not aligned problem to elevation columns

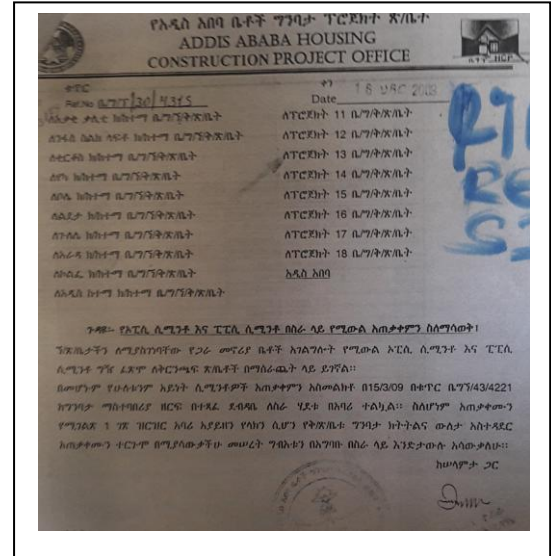
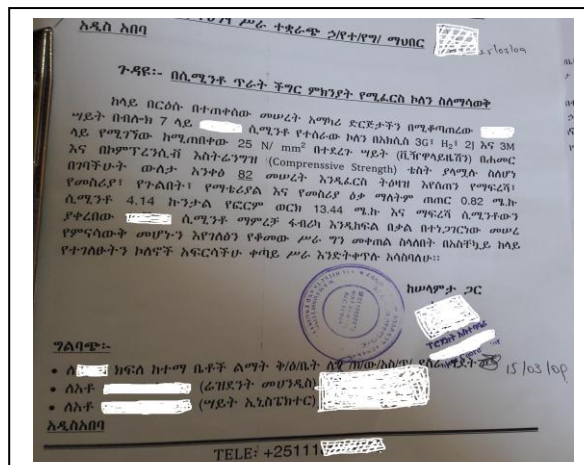


Figure 4.14 Cement quality

Figure 4.15 Impacts of poor Constriction material



## **CHAPTER FIVE**

### **5 CONCLUSIONS AND RECOMMENDATIONS**

#### **5.1 Conclusions**

The aim of this research, as stated in section 1.5 and 1.6 of this thesis, were to investigate the quality management practices of AAHDPO, to identify sources of quality problems in condominium housing construction projects and to recommend alternative quality control techniques for low cost contracting parties.

The quality management practices of AAHDPO were investigated by assessing:

- ❖ the quality management techniques adopted in the project,
- ❖ the presence of tests at commencement for basic construction materials
- ❖ the presence of tests at material source change for basic construction materials
- ❖ the presence of submitting samples for approval to consultants before bulk delivery
- ❖ the presence of clearly stated obligations in the contract document to perform quality tests
- ❖ the presence of materials complying the specification requirements
- ❖ the presence of workmanship complying the contract requirements in each contracting parties
- ❖ the construction process and material usage adopted in AAHDPO
- ❖ the presence of construction quality management documents
- ❖ the method practiced to improve quality problems

The investigation addressed the quality management practices of AAHDPO as stated below:

Respondents ranked first their awareness and practice on quality control as quality management technique with 3.79 weighted mean score value and the last quality management technique adopted were updating regularly quality management plans, test at commencement were done for reinforcement bars, aggregates, hollow concrete blocks and selected fill materials with weighted mean values of 2.54, 2.54, 2.52 and 2.51 respectively but no test for cement at commencement were done.

The weighted mean score value of the eight short listed materials were in between 1.5 and 2.5 which in turn dictates no material were tested when change of quarry or source were observed in AAHDP, majority of respondents 56%, 52% and 51% of the total respondents disagree on submission of Cement, Reinforcement bars and Aggregate samples respectively to the consulting engineer for approval before bulk delivery to the projects, the weighted mean values for Concrete (2.69), Selected fill materials (2.68) and Sand (2.54) ranked 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> respectively are > 2.5 indicates the presence of contractual obligation to perform quality control tests, but there is no testing obligation in the contract document for reinforcement bars, cement and aggregate with %age of frequency 54%, 52% and 52% respectively.

Door locks were not complying the quality requirement/specifications, the majority of respondents (61%) disagreed on the presence of contractor key personnel complying the specification requirement, the consulting firm has key personnel having the required skill to read, interpret designs and specifications, but there is no qualified and trained key personnel in quality management, the majority of respondents disagreed the presence of trained key personnel in quality management on the contractor side, relatively more number 49% of the total respondents indicated their agreement on the client has quality mission and policies, but 53% of the total respondents disagreed the client practices proper quality management technique.

Formworks and props were striped properly in AAHDPO, but reinforcement bars were not stored properly and they were affected by corrosion. Site books and work specifications were the basic quality documents found in AAHDPO, but there are no quality management manuals and completed designs.

Respondents identified most quality problems occur in the construction phase of selected material fill Compaction under hard core, grade beams, masonry & around footings

### **Causes of poor construction quality management in AAHDPO**

The top five causes of construction quality problems identified by respondents are:-

- participation of incompetent contractors,
- Sub-contractors/MSEs work,
- Difficulty to manage MSEs with the main contractor, and

- Failure in distribution & practicing quality management systems, manuals & programs to all participants were identified as the top five causes of poor construction quality management in AAHDPO ranked as 1<sup>st</sup> to 4<sup>th</sup> with weighted mean average value of 3.84, 3.74, 3.72, 3.7 and 3.7

All contracting parties had their own contribution to poor construction quality management in AAHDPO, but contractors were the most contributors of poor quality management in AAHDPO.

AAHDPO promotes quality improvement through continuous supervision and by termination /punishment, but 40% of the total respondents disagreed on the presence of quality improvement technique through training as ranked last.

Relatively higher percentage (33%) of the total respondents put their perception in AAHDPO houses as unsatisfactory quality.

Respondents identified the impacts of poor quality management in AAHDPO based on the weighted mean values as follows:-

- ❖ Extended construction period(3.88),
- ❖ Reduction of productivity(3.77),
- ❖ Customer dissatisfaction(3.66),
- ❖ Occurrence of claims(3.65)

## 5.2 Recommendations

### **To Head Office**

- ❖ Harmonize quality control and quality assurance manuals prepared by contractors and consultants respectively and approved by branch offices.
- ❖ Top managers are leaders of the system, so it is recommended that they should be construction professionals.
- ❖ It is recommended that contractors selection needs great care to be performed as per their technical performance.

### **To Clients Branch Offices**

- ❖ Better to check and control quality management plans are updated regularly
- ❖ Implement/practices proper quality management technique in conjunction with consultants
- ❖ Control/approve the consultants key personnel are as per the minimum requirement of their contract agreement page 18-22 of Appendix "B"
- ❖ Store properly reinforcement bars to be free from corrosion
- ❖ Approve quality assurance manuals and quality control manuals prepared by the consultant and the contractor respectively.

### **To contractors**

- ❖ Employee Key personnel as per the contract agreement minimum requirement listed in the special condition of your contract document, since the first beneficiary from this is your company
- ❖ Store properly reinforcement bars to be free from corrosion
- ❖ Prepare quality control manuals and construction method to be followed
- ❖ Perform all material tests as per the work standards
- ❖ Tests samples must represent the total work, therefore take responsibility during sampling

### **To consultants**

- ❖ Check and approve contractors quality management plans are updated regularly
- ❖ Check all construction materials are tested and comply the required quality standard at commencement before using for the project.
- ❖ Control the quality of materials when there is original source change using the original sample collected and laboratory tests based on your contract agreement page 10 section "D" number xvi
- ❖ Collect original construction material samples for approval and to use as a reference during source change/quality changes
- ❖ List out materials/works/ and the construction phases to be tested based on the contract document for quality control and check material tests not included in the contract document but required to be tested based on local and international quality control documents to keep the quality of houses in AAHDPO
- ❖ List the minimum requirements at which construction resources should fulfill/comply quality standards/ Example: Check Appendix 'C' of the current AAHDPO contract agreement
- ❖ Control/check contractors key personnel Curriculum vita and their performance based on the contract requirement.
- ❖ Provide /Organize on job training to all key personnel on quality management techniques regularly based on your contract agreement page 13 of section "D" number xxxiii
- ❖ Check and consult material stores in the project are as per standards specially reinforcement bars to be free from corrosion
- ❖ Prepare quality assurance manual as per your contract agreement page 16 of section 6
- ❖ Properly manage the relation between the structural contractor and specialized sub-contractors based on your contract agreement page 12 of section 'D' number xxiv.

### **Recommendation For Researchers**

Further research works will improve the quality of works and brings stakeholders/occupants satisfaction.

- Assess in detail the impacts of poor quality management practice in relation to:
  - ❖ Occupants satisfaction
  - ❖ The future construction industry
  - ❖ Delay
  - ❖ cost overrun
  - ❖ Risks
- Investigate the causes of poor quality management in relation to:
  - ❖ Political leaders as project executor
  - ❖ Unethical professionals
  - ❖ Contractors selection criteria
  - ❖ The participation of specialty sub- contractors/MSEs as nominated sub-contractors

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**APPENDIX-A -----Questioner**  
**Adama Science and Technology University**  
**school of Civil Engineering and Architecture**



**Department of Civil Engineering (MSc in Construction Management)**

**Dear participants:**

The questionnaire is prepared by Civil Engineering (MSc in Construction Management) post graduate student for conducting thesis on “**Assessment of Quality Management Practices of Addis Ababa Housing Development Construction Projects**” under the supervision of Girmay Kahssay(PhD).

Your honest response is very much important input to my thesis. The confidentiality of responding to this questionnaire is completely assured.

I know that your time is valuable, and I hope that you will take the time (estimated 7-10 minutes) to complete the questionnaire. Please attempt to answer all the questions and tick (✓) in one appropriate box that best suits your perspective for each statement. If you have any questions/queries please do not hesitate to contact me on 0912 77 92 20 or email: getchcotm@gmail.com.

Thank you very much for your time and assistance

Getnet Genanew/post graduate student

**Part I: Demographic or General information**

Choose the suitable answer and tick (✓) in the box given for each question.

1. Education qualification: ☐ Level -III ☐ Level- IV ☐ Diploma  
☐ Degree ☐ Postgraduate ☐ Others-----
2. Company: ☐ HDPO Head Office ☐ HDPO Branch Office ☐ Contractor  
office ☐ Consultant ☐ Construction MSE ☐ Production  
MSE
3. Please mention your position in your company: \_\_\_\_\_
4. How many years of work experience do you have on building construction?  
☐ Below one year ☐ 1 -2 year ☐ 2- 3years ☐ 3-4 year  
☐ 4 -5 year ☐ 5 -6 year ☐ 6 -7 year ☐ more than 7  
year
5. For how many years you have services in AAHDPO?  
☐ Below one year ☐ 1 -2 year ☐ 2- 3years ☐ 3-4 year  
☐ 4 -5 year ☐ 5 -6 year ☐ 6 -7 year ☐ more than 7  
year

**Part II**

Please, indicate your opinion by marking (✓) the appropriate box on the five point scale where: 1=Strongly Disagree 2= Disagree 3=No Opinion 4=Agree 5=Strongly Agree

| <b>A-About quality management practices of AAHDPO</b> |                                                                                                                              |          |          |          |          |          |
|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|
| <b>No.</b>                                            | <b>Is your company aware of the following quality management techniques?</b>                                                 | <b>1</b> | <b>2</b> | <b>3</b> | <b>4</b> | <b>5</b> |
| 1                                                     | Quality planning                                                                                                             |          |          |          |          |          |
| 2                                                     | Quality assurance                                                                                                            |          |          |          |          |          |
| 3                                                     | Quality control                                                                                                              |          |          |          |          |          |
| 4                                                     | Quality improvement                                                                                                          |          |          |          |          |          |
| 5                                                     | Quality management systems                                                                                                   |          |          |          |          |          |
| 6                                                     | Your organization use any of the above techniques                                                                            |          |          |          |          |          |
| 7                                                     | Your company has an organizational quality mission and Policies                                                              |          |          |          |          |          |
| 8                                                     | Quality management plan in low cost housing project is updated regularly during the life of the contract                     |          |          |          |          |          |
| 9                                                     | Your organization outlines the inspection and test activities specific to the houses and the criteria for housing acceptance |          |          |          |          |          |
| 10                                                    | Works in AAHDPO commenced when satisfactory test results required by the Specification have been submitted                   |          |          |          |          |          |
| 11                                                    | Construction material test results and samples were presented to the consulting engineer for approval before bulk purchase   |          |          |          |          |          |
| 12                                                    | Tests in AAHDPO are carried out under the supervision and with the approval of the Resident Engineer                         |          |          |          |          |          |

| (✓) mark On a scale of 1= Strongly disagree, 2=Disagree, 3=No opinion,4=Agree, 5=Strongly agree |                                                    |          |          |          |          |          |
|-------------------------------------------------------------------------------------------------|----------------------------------------------------|----------|----------|----------|----------|----------|
| <b>No</b>                                                                                       | <b>When do most quality problems occur? during</b> | <b>1</b> | <b>2</b> | <b>3</b> | <b>4</b> | <b>5</b> |
| 1                                                                                               | Setting out of the building                        |          |          |          |          |          |
| 2                                                                                               | Excavation                                         |          |          |          |          |          |
| 3                                                                                               | Super Structure Concreting                         |          |          |          |          |          |
| 4                                                                                               | Sub Structure Concreting                           |          |          |          |          |          |
| 5                                                                                               | Selected material fill                             |          |          |          |          |          |
| 6                                                                                               | Compaction                                         |          |          |          |          |          |
| 7                                                                                               | Foundation depth determination                     |          |          |          |          |          |
| 8                                                                                               | Masonry work                                       |          |          |          |          |          |
| 9                                                                                               | Plastering work                                    |          |          |          |          |          |
| 10                                                                                              | Electrical installation work                       |          |          |          |          |          |
| 11                                                                                              | Sanitary installation work                         |          |          |          |          |          |
| 12                                                                                              | Terrazzo and Screed work                           |          |          |          |          |          |
| 13                                                                                              | Fixing metal doors and windows                     |          |          |          |          |          |
| 14                                                                                              | Fixing PVC windows                                 |          |          |          |          |          |
| 15                                                                                              | Fixing glass                                       |          |          |          |          |          |
| 16                                                                                              | Roof construction                                  |          |          |          |          |          |

| Please (✓) mark your opinion on the appropriate box 1=Disagree, 2=No opinion, 3=Agree |                                                                                                                     |          |          |          |
|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|----------|----------|----------|
| <b>1</b>                                                                              | <b>Test at commencement of materials are done in AAHDPO for</b>                                                     | <b>1</b> | <b>2</b> | <b>3</b> |
| 1.1                                                                                   | Cement                                                                                                              |          |          |          |
| 1.2                                                                                   | Aggregate                                                                                                           |          |          |          |
| 1.3                                                                                   | Sand                                                                                                                |          |          |          |
| 1.4                                                                                   | Reinforcement bars                                                                                                  |          |          |          |
| 1.5                                                                                   | Selected fill materials                                                                                             |          |          |          |
| 1.6                                                                                   | Hollow Concrete Blocks                                                                                              |          |          |          |
| 1.7                                                                                   | Ribbed Slab Blocks                                                                                                  |          |          |          |
| 1.8                                                                                   | Pre-cast beams                                                                                                      |          |          |          |
| <b>2</b>                                                                              | <b>Test of materials are done when change of source is observed for</b>                                             | <b>1</b> | <b>2</b> | <b>3</b> |
| 2.1                                                                                   | Cement                                                                                                              |          |          |          |
| 2.2                                                                                   | Aggregate                                                                                                           |          |          |          |
| 2.3                                                                                   | Sand                                                                                                                |          |          |          |
| 2.4                                                                                   | Reinforcement bars                                                                                                  |          |          |          |
| 2.5                                                                                   | Selected fill materials                                                                                             |          |          |          |
| 2.6                                                                                   | Hollow Concrete Blocks                                                                                              |          |          |          |
| 2.7                                                                                   | Ribbed Slab Blocks                                                                                                  |          |          |          |
| 2.8                                                                                   | Pre-cast beams                                                                                                      |          |          |          |
| <b>3</b>                                                                              | <b>Material sample is supplied to the consulting Engineer for approval before bulk delivery to the project site</b> | <b>1</b> | <b>2</b> | <b>3</b> |
| 3.1                                                                                   | Cement                                                                                                              |          |          |          |
| 3.2                                                                                   | Aggregate                                                                                                           |          |          |          |
| 3.3                                                                                   | Sand                                                                                                                |          |          |          |
| 3.4                                                                                   | Reinforcement bars                                                                                                  |          |          |          |
| 3.5                                                                                   | Selected fill materials                                                                                             |          |          |          |
| 3.6                                                                                   | Hollow Concrete Blocks                                                                                              |          |          |          |
| 3.7                                                                                   | Ribbed Slab Blocks                                                                                                  |          |          |          |
| 3.8                                                                                   | Pre-cast beams                                                                                                      |          |          |          |
| 3.9                                                                                   | Rectangular Hollow Section Metals                                                                                   |          |          |          |
| 3.10                                                                                  | L-T-Z Hollow Section Metals                                                                                         |          |          |          |
| 3.11                                                                                  | Door locks                                                                                                          |          |          |          |
| 3.12                                                                                  | PPR                                                                                                                 |          |          |          |
| 3.13                                                                                  | PVC                                                                                                                 |          |          |          |
| 3.14                                                                                  | Electrical Wires and Cables                                                                                         |          |          |          |
| 3.15                                                                                  | Conduits                                                                                                            |          |          |          |
| 3.16                                                                                  | Electrical fittings                                                                                                 |          |          |          |

❖ Testing instruments and measuring tools are calibrated regularly, and records maintained.

☐ Strongly disagree ☐ Disagree ☐ No opinion ☐ Agree ☐ Strongly agree

|          | <b>agreement to</b>                                                                                            |          |          |          |
|----------|----------------------------------------------------------------------------------------------------------------|----------|----------|----------|
| 4.1      | Cement                                                                                                         |          |          |          |
| 4.2      | Aggregate                                                                                                      |          |          |          |
| 4.3      | Sand                                                                                                           |          |          |          |
| 4.4      | Concrete                                                                                                       |          |          |          |
| 4.5      | Reinforcement bars                                                                                             |          |          |          |
| 4.6      | Selected fill materials                                                                                        |          |          |          |
| 4.7      | Hollow Concrete Blocks                                                                                         |          |          |          |
| 4.8      | Ribbed Slab Blocks                                                                                             |          |          |          |
| 4.9      | Pre-cast beams                                                                                                 |          |          |          |
| <b>5</b> | <b>Materials delivered to construction projects comply the contract specification and quality requirements</b> | <b>1</b> | <b>2</b> | <b>3</b> |
| 5.1      | Cement                                                                                                         |          |          |          |
| 5.2      | Aggregate                                                                                                      |          |          |          |
| 5.3      | Sand                                                                                                           |          |          |          |
| 5.4      | Reinforcement bars                                                                                             |          |          |          |
| 5.5      | Selected fill materials                                                                                        |          |          |          |
| 5.6      | Hollow Concrete Blocks                                                                                         |          |          |          |
| 5.7      | Ribbed Slab Blocks                                                                                             |          |          |          |
| 5.8      | Pre-cast beams                                                                                                 |          |          |          |
| 5.9      | Rectangular Hollow Section Metals                                                                              |          |          |          |
| 5.10     | L-T-Z Hollow Section Metals                                                                                    |          |          |          |
| 5.11     | Door locks                                                                                                     |          |          |          |
| 5.12     | PPR and Fittings                                                                                               |          |          |          |
| 5.13     | PVC and Fittings                                                                                               |          |          |          |
| 5.14     | Wires                                                                                                          |          |          |          |
| 5.15     | Terrazzo tiles                                                                                                 |          |          |          |
| 5.16     | Water Closets                                                                                                  |          |          |          |
| 5.17     | Kitchen Sinks                                                                                                  |          |          |          |

- ❖ Are you interested to get feedback about the quality of your work?  
☐ Yes    ☐ No
- ❖ Have anyone ever gave you a feedback concerning the quality of your work?  
☐ Yes    ☐ No
- ❖ Who did gave you a feedback concerning the quality of your work?  
☐ Client   ☐ Contractor   ☐ Consultant   ☐ Occupants   ☐ Small & Micro enterprises
- ❖ How did you consider the feedback given to you concerning the quality of work?  
☐ Constructive   ☐ Destructive   ☐ Neither Constructive nor Destructive
- ❖ Your work in AAHDPO mostly based on  
☐ the contract agreement   ☐ personal opinion /trained   ☐ No opinion

| Please (✓) mark your opinion on the appropriate box 1=Disagree, 2=No opinion, 3=Agree |                                                                                      |          |          |          |
|---------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|----------|----------|----------|
| <b>6</b>                                                                              | <b>Workmanship employed in AAHDPO comply the contract agreement</b>                  | <b>1</b> | <b>2</b> | <b>3</b> |
| 6.1                                                                                   | Contractor key personnel                                                             |          |          |          |
| 6.2                                                                                   | Consultant key personnel                                                             |          |          |          |
| 6.3                                                                                   | Client key personnel                                                                 |          |          |          |
| 6.4                                                                                   | Construction Small & Micro Enterprises                                               |          |          |          |
| 6.5                                                                                   | Production Small & Micro Enterprises                                                 |          |          |          |
| <b>7</b>                                                                              | <b>The consulting firm has</b>                                                       | <b>1</b> | <b>2</b> | <b>3</b> |
| 7.1                                                                                   | the required acceptance criteria for construction materials                          |          |          |          |
| 7.2                                                                                   | the required acceptance criteria for works under construction                        |          |          |          |
| 7.3                                                                                   | trained key personnel in quality management                                          |          |          |          |
| 7.4                                                                                   | experienced key personnel in quality management                                      |          |          |          |
| 7.5                                                                                   | the required skill to read, interpret designs and specification                      |          |          |          |
| 7.6                                                                                   | key personnel to communicate verbal or in writing                                    |          |          |          |
| 7.7                                                                                   | qualified quality control personnel to perform their assigned duties                 |          |          |          |
| 7.8                                                                                   | motivated personnel to insure conformance/compliance of works                        |          |          |          |
| 7.9                                                                                   | favorable organizational structure for quality management                            |          |          |          |
| 7.10                                                                                  | production quality control Engineers which fulfill minimum requirements              |          |          |          |
| 7.11                                                                                  | committed supervisors to reject inferior quality materials/works ethically           |          |          |          |
| 7.12                                                                                  | a power/practice to reject inferior quality materials delivered by the client        |          |          |          |
| 7.13                                                                                  | free flow of quality management information                                          |          |          |          |
| 7.14                                                                                  | Supervisors follow clearly stated acceptance criteria for casted concrete structures |          |          |          |
| <b>8</b>                                                                              | <b>The contractor has</b>                                                            | <b>1</b> | <b>2</b> | <b>3</b> |
| 8.1                                                                                   | key personnel complying the contract agreement requirement                           |          |          |          |
| 8.2                                                                                   | trained key personnel in quality management                                          |          |          |          |
| 8.3                                                                                   | experienced key personnel in quality management                                      |          |          |          |
| 8.4                                                                                   | the required skill to read, interpret designs and specification                      |          |          |          |
| 8.5                                                                                   | key personnel to communicate verbal or in writing                                    |          |          |          |
| 8.6                                                                                   | qualified quality control personnel to perform their assigned duties                 |          |          |          |
| 8.7                                                                                   | motivated personnel to insure conformance/compliance of works                        |          |          |          |
| 8.8                                                                                   | favorable organizational structure for quality management                            |          |          |          |
| 8.9                                                                                   | commitment to remove inferior quality materials/works rejected by the supervisor     |          |          |          |
| 8.10                                                                                  | a power/practice to reject inferior quality materials delivered by the client        |          |          |          |
| 8.11                                                                                  | key personnel from commencement to provisional acceptance of the project             |          |          |          |
| <b>9</b>                                                                              | <b>Client Related</b>                                                                | <b>1</b> | <b>2</b> | <b>3</b> |
| 9.1                                                                                   | Top managers have awareness and sound control of quality                             |          |          |          |
| 9.2                                                                                   | Top managers in AAHDPO Play a leadership role in quality management initiatives      |          |          |          |
| 9.3                                                                                   | The organization practices a proper quality management technique                     |          |          |          |
| 9.4                                                                                   | The organization has a formal quality management structure                           |          |          |          |
| 9.5                                                                                   | Employees in this company are empowered on quality management perspectives           |          |          |          |
| 9.6                                                                                   | there is free flow of quality management information                                 |          |          |          |
| 9.7                                                                                   | The organization has quality mission and policies                                    |          |          |          |

| Please (✓) mark your opinion on the appropriate box 1=Disagree, 2=No opinion, 3=Agree |                                                                                                                                                                  |   |   |   |
|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|
| 10                                                                                    | In AAHDPO: the construction process, materials stored and used                                                                                                   | 1 | 2 | 3 |
| 10.1                                                                                  | Cement is fresh (<1 month from date of manufacture)                                                                                                              |   |   |   |
| 10.2                                                                                  | Cement stored in stacks less than 10 bags height over a raised (>20cm)                                                                                           |   |   |   |
| 10.3                                                                                  | Reinforcement bars used for the project are free of corrosion                                                                                                    |   |   |   |
| 10.4                                                                                  | Steel reinforcement bars are stored in clean condition                                                                                                           |   |   |   |
| 10.5                                                                                  | Concrete ingredients were mixed as per the mix design with batching method                                                                                       |   |   |   |
| 10.6                                                                                  | The workability of concrete is as per slump test result                                                                                                          |   |   |   |
| 10.7                                                                                  | Appropriate concrete transportation method is used to minimize segregation                                                                                       |   |   |   |
| 10.8                                                                                  | Mixed concrete is placed in formworks /position from a height of less than 2 m                                                                                   |   |   |   |
| 10.9                                                                                  | Appropriate immersion vibrator was used during concreting                                                                                                        |   |   |   |
| 10.10                                                                                 | Concrete cube samples are taken for compressive strength test appropriately                                                                                      |   |   |   |
| 10.11                                                                                 | The form work was strong enough to prevent bulging when vibrated, free from                                                                                      |   |   |   |
| 10.12                                                                                 | Vertical /side form works are striped only after 16 hrs                                                                                                          |   |   |   |
| 10.13                                                                                 | Props of beams and slabs are removed only after 21 days                                                                                                          |   |   |   |
| 10.14                                                                                 | Soffit form work for slabs and beams are striped only after 21days                                                                                               |   |   |   |
| 10.15                                                                                 | Concrete structures were cured adequately as per technical requirements                                                                                          |   |   |   |
| 10.16                                                                                 | Selected material fill has been done in layers of 15-20cm as per specifications                                                                                  |   |   |   |
| 10.17                                                                                 | Proper compaction method has been adopted                                                                                                                        |   |   |   |
| 10.18                                                                                 | Selected material fill under , above & around footing pads and under hard core are tested in layers to assure the specification /95% modified AASHTO dry density |   |   |   |

| D-Quality Management Documents Related Questions                                                |                                                                               |   |   |   |   |   |
|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|---|---|---|---|---|
| (✓) mark On a scale of 1= Strongly disagree, 2=Disagree, 3=No opinion,4=Agree, 5=Strongly agree |                                                                               |   |   |   |   |   |
| No.                                                                                             | Are there quality management related documents in AAHDPO?                     | 1 | 2 | 3 | 4 | 5 |
| 1                                                                                               | Clear quality management /quality control manuals                             |   |   |   |   |   |
| 2                                                                                               | Easily available quality management manuals in AAHDPO                         |   |   |   |   |   |
| 3                                                                                               | Clearly stated construction material specifications                           |   |   |   |   |   |
| 4                                                                                               | Complete and clear construction designs                                       |   |   |   |   |   |
| 5                                                                                               | Clearly stated specification of works                                         |   |   |   |   |   |
| 6                                                                                               | Supervision check lists for construction works                                |   |   |   |   |   |
| 7                                                                                               | Production check lists for Precast beams, hollow concrete blocks & aggregates |   |   |   |   |   |
| 8                                                                                               | Clearly stated site book or resident Engineer observation records             |   |   |   |   |   |
| 9                                                                                               | Contract document which clarifies quality management techniques               |   |   |   |   |   |
| 10                                                                                              | Properly endorsed quality control test results by the Engineer                |   |   |   |   |   |

| (✓) mark On a scale of 1= Strongly disagree, 2=Disagree, 3=No opnion,4=Agree, 5=Strongly agree |                                                                                                                 |   |   |   |   |   |
|------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|---|---|---|---|---|
| No.                                                                                            | E- Causes of Poor Quality Management                                                                            | 1 | 2 | 3 | 4 | 5 |
| 1                                                                                              | The ground conditions and the land where low cost housing projects are executed                                 |   |   |   |   |   |
| 2                                                                                              | Lack of effective communication between low cost housing stakeholders                                           |   |   |   |   |   |
| 3                                                                                              | Lack of qualified, trained/experienced manpower on the <u>contractor</u> side                                   |   |   |   |   |   |
| 4                                                                                              | Lack of qualified, trained/experienced manpower on the <u>consultant</u> side                                   |   |   |   |   |   |
| 5                                                                                              | Inappropriate relationship between the consultant and the contractor                                            |   |   |   |   |   |
| 6                                                                                              | The project specifications of Addis Ababa housing construction                                                  |   |   |   |   |   |
| 7                                                                                              | Delivery of poor quality construction materials to the project                                                  |   |   |   |   |   |
| 8                                                                                              | Labours employed are contributors to poor quality housing delivery                                              |   |   |   |   |   |
| 9                                                                                              | Failure in distribution of quality management systems, manuals and programs to all participants of AAHDPO       |   |   |   |   |   |
| 10                                                                                             | Lack of senior management body commitment to deliver quality houses                                             |   |   |   |   |   |
| 11                                                                                             | Lack of capacity in reinforcing quality culture                                                                 |   |   |   |   |   |
| 12                                                                                             | Absence of formal quality management implementation strategies                                                  |   |   |   |   |   |
| 13                                                                                             | Lack of leadership involvement in monitoring and coordinating                                                   |   |   |   |   |   |
| 14                                                                                             | Inappropriate organizational structure                                                                          |   |   |   |   |   |
| 15                                                                                             | Corruption                                                                                                      |   |   |   |   |   |
| 16                                                                                             | Participation of incompetent contractors                                                                        |   |   |   |   |   |
| 17                                                                                             | Incomplete designs                                                                                              |   |   |   |   |   |
| 18                                                                                             | Absence of weekly/monthly supervision & quality control report                                                  |   |   |   |   |   |
| 19                                                                                             | The participation of different small and micro enterprises in the project                                       |   |   |   |   |   |
| 20                                                                                             | Difficulty to manage small & micro enterprises with the main contractor                                         |   |   |   |   |   |
| 21                                                                                             | Low unit price/cost of work items                                                                               |   |   |   |   |   |
| 22                                                                                             | Extended construction period of the project                                                                     |   |   |   |   |   |
| 23                                                                                             | Problems with subcontractors' work                                                                              |   |   |   |   |   |
| 24                                                                                             | Low rate of salary for quality management personnel                                                             |   |   |   |   |   |
| 25                                                                                             | Poor quality of pre-fabricated materials                                                                        |   |   |   |   |   |
|                                                                                                | In your opinion or practice, who is the cause of most quality problems in low cost housing project participants | 1 | 2 | 3 | 4 | 5 |
| 1                                                                                              | HDPO/Client                                                                                                     |   |   |   |   |   |
| 2                                                                                              | Contractor                                                                                                      |   |   |   |   |   |
| 3                                                                                              | Consultant                                                                                                      |   |   |   |   |   |
| 4                                                                                              | Electrical, Sanitary, metal work small and micro enterprise                                                     |   |   |   |   |   |
| 5                                                                                              | Production small and micro enterprise                                                                           |   |   |   |   |   |

### Part III OPEN ENDED QUESTIONNAIRE SURVEY

- Are there any other problematic issues relating to poor quality management in AAHDPO?  
☐ Yes    ☐ No
- If yes, Please state, the factors which contribute to poor construction quality houses in AAHDPO -----  
 -----

| (√) mark On a scale of 1= Strongly disagree, 2=Disagree, 3=No opinion, 4=Agree, 5=Strongly agree |                                                       |   |   |   |   |   |
|--------------------------------------------------------------------------------------------------|-------------------------------------------------------|---|---|---|---|---|
| No.                                                                                              | F-How does this project promote quality Management    | 1 | 2 | 3 | 4 | 5 |
| 1                                                                                                | Through continuous supervision                        |   |   |   |   |   |
| 2                                                                                                | Through quality performance measurement               |   |   |   |   |   |
| 3                                                                                                | Using feedback if performance measurements undertaken |   |   |   |   |   |
| 4                                                                                                | By implementing quality assurance system              |   |   |   |   |   |
| 5                                                                                                | Through training                                      |   |   |   |   |   |
| 6                                                                                                | Using preventive action                               |   |   |   |   |   |
| 7                                                                                                | Using corrective action                               |   |   |   |   |   |
| 8                                                                                                | By termination /punishment                            |   |   |   |   |   |
| If any please state-----<br>-----                                                                |                                                       |   |   |   |   |   |

|   |                                                                                                                  |  |
|---|------------------------------------------------------------------------------------------------------------------|--|
|   | What is your view on the quality of completed low cost houses in AAHDPO?<br>(√) mark only the appropriate answer |  |
| 1 | Poor quality                                                                                                     |  |
| 2 | Unsatisfactory Quality                                                                                           |  |
| 3 | Satisfactory quality                                                                                             |  |
| 4 | Good quality                                                                                                     |  |
| 5 | Exceptional quality                                                                                              |  |

| (√) mark On a scale of 1= Strongly disagree, 2=Disagree, 3=No opinion, 4=Agree, 5=Strongly agree |                                                                       |   |   |   |   |   |
|--------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|---|---|---|---|---|
| No.                                                                                              | G-How do you rate the impact of quality management problem in AAHDPO? | 1 | 2 | 3 | 4 | 5 |
| 1                                                                                                | High cost of reworks                                                  |   |   |   |   |   |
| 2                                                                                                | Idle buildings without occupants due to the risk of failure           |   |   |   |   |   |
| 3                                                                                                | Customer dissatisfaction                                              |   |   |   |   |   |
| 4                                                                                                | Contract termination                                                  |   |   |   |   |   |
| 5                                                                                                | Loss of life                                                          |   |   |   |   |   |
| 6                                                                                                | Extended construction period                                          |   |   |   |   |   |
| 7                                                                                                | Occurrence of claims                                                  |   |   |   |   |   |
| 8                                                                                                | Presence of change order                                              |   |   |   |   |   |
| 9                                                                                                | Reduction of productivity                                             |   |   |   |   |   |
| If any please state-----<br>-----                                                                |                                                                       |   |   |   |   |   |

❖ What do you recommend to improve the quality of the houses under construction in Addis Ababa housing development project?  
please state your opinion -----  
-----  
-----

**THANK YOU FOR YOUR COOPERATION!**

## APPENDIX-B----Raw Data

| Question | Client Respondents Mean | Contractor Respondents Mean | Consultant Respondents Mean | Con.MSE Respondents Mean | PRO.MSE Respondents Mean | Weighted Mean Score |
|----------|-------------------------|-----------------------------|-----------------------------|--------------------------|--------------------------|---------------------|
| QA1#1    | 3.16                    | 3.69                        | 3.98                        | 2.96                     | 3.55                     | 3.47                |
| QA1#2    | 3.14                    | 3.74                        | 3.85                        | 3.06                     | 3.42                     | 3.44                |
| QA1#3    | 3.41                    | 3.81                        | 4.10                        | 3.84                     | 3.81                     | 3.79                |
| QA1#4    | 3.19                    | 3.83                        | 3.79                        | 2.98                     | 3.46                     | 3.45                |
| QA1#5    | 3.08                    | 3.61                        | 3.74                        | 2.90                     | 3.36                     | 3.34                |
| QA1#6    | 3.41                    | 3.73                        | 3.89                        | 3.99                     | 3.82                     | 3.77                |
| QA1#7    | 3.46                    | 3.85                        | 3.92                        | 3.10                     | 3.82                     | 3.63                |
| QA1#8    | 3.32                    | 3.49                        | 3.15                        | 2.38                     | 3.19                     | 3.10                |
| QA1#9    | 3.35                    | 3.84                        | 4.16                        | 2.93                     | 3.72                     | 3.60                |
| QA1#10   | 3.08                    | 3.64                        | 4.10                        | 2.68                     | 3.50                     | 3.40                |
| QA1#11   | 3.32                    | 3.76                        | 3.66                        | 2.88                     | 3.43                     | 3.41                |
| QA1#12   | 3.41                    | 3.49                        | 3.97                        | 3.57                     | 3.69                     | 3.62                |
| QA2#1    | 3.19                    | 3.33                        | 3.34                        | 3.62                     | 3.32                     | 3.36                |
| QA2#2    | 3.14                    | 3.04                        | 3.23                        | 3.76                     | 3.36                     | 3.31                |
| QA2#3    | 3.49                    | 3.69                        | 3.40                        | 4.01                     | 3.58                     | 3.63                |
| QA2#4    | 3.46                    | 3.69                        | 3.63                        | 4.27                     | 3.92                     | 3.79                |
| QA2#5    | 3.65                    | 3.64                        | 3.60                        | 3.82                     | 3.92                     | 3.73                |
| QA2#6    | 3.76                    | 3.68                        | 3.76                        | 3.83                     | 3.91                     | 3.79                |
| QA2#7    | 3.38                    | 3.59                        | 3.18                        | 4.19                     | 3.80                     | 3.63                |
| QA2#8    | 3.32                    | 3.19                        | 3.10                        | 3.12                     | 3.26                     | 3.20                |
| QA2#9    | 3.19                    | 3.35                        | 3.13                        | 3.84                     | 3.46                     | 3.39                |
| QA2#10   | 3.46                    | 3.60                        | 3.31                        | 4.21                     | 3.80                     | 3.68                |
| QA2#11   | 3.62                    | 3.83                        | 3.35                        | 4.10                     | 3.88                     | 3.76                |
| QA2#12   | 3.19                    | 3.54                        | 3.19                        | 3.20                     | 3.39                     | 3.30                |
| QA2#13   | 3.14                    | 3.60                        | 3.18                        | 3.60                     | 3.55                     | 3.41                |
| QA2#14   | 3.08                    | 3.41                        | 2.84                        | 3.08                     | 3.24                     | 3.13                |
| QA2#15   | 2.92                    | 3.14                        | 2.79                        | 3.04                     | 3.08                     | 2.99                |
| QA2#16   | 3.41                    | 3.59                        | 3.19                        | 3.83                     | 3.66                     | 3.54                |
| QB1#1    | 1.97                    | 2.18                        | 2.06                        | 1.82                     | 1.97                     | 2.00                |
| QB1#2    | 2.54                    | 2.55                        | 2.32                        | 2.72                     | 2.55                     | 2.54                |
| QB1#3    | 2.24                    | 2.38                        | 2.44                        | 2.65                     | 2.41                     | 2.42                |
| QB1#4    | 2.35                    | 2.59                        | 2.40                        | 2.73                     | 2.65                     | 2.54                |
| QB1#5    | 2.32                    | 2.55                        | 2.44                        | 2.76                     | 2.46                     | 2.51                |
| QB1#6    | 2.35                    | 2.46                        | 2.53                        | 2.70                     | 2.55                     | 2.52                |
| QB1#7    | 2.35                    | 2.43                        | 2.44                        | 2.70                     | 2.30                     | 2.44                |
| QB1#8    | 2.03                    | 2.03                        | 2.19                        | 1.82                     | 2.05                     | 2.02                |

|        |      |      |      |      |      |      |
|--------|------|------|------|------|------|------|
| QB2#1  | 1.92 | 2.00 | 1.74 | 1.75 | 1.89 | 1.86 |
| QB2#2  | 2.46 | 2.33 | 2.39 | 1.93 | 2.31 | 2.28 |
| QB2#3  | 1.97 | 2.20 | 2.23 | 1.72 | 1.84 | 1.99 |
| QB2#4  | 2.24 | 2.26 | 2.24 | 1.87 | 2.22 | 2.17 |
| QB2#5  | 2.05 | 2.04 | 2.31 | 1.75 | 1.99 | 2.03 |
| QB2#6  | 2.30 | 2.29 | 2.50 | 1.91 | 2.30 | 2.26 |
| QB2#7  | 2.32 | 2.30 | 2.42 | 1.93 | 2.20 | 2.24 |
| QB2#8  | 2.03 | 2.00 | 2.10 | 1.65 | 2.20 | 2.00 |
| QB3#1  | 2.00 | 2.03 | 2.02 | 1.69 | 1.89 | 1.92 |
| QB3#2  | 2.35 | 2.13 | 2.10 | 1.74 | 1.86 | 2.04 |
| QB3#3  | 2.22 | 2.16 | 2.27 | 1.76 | 2.05 | 2.09 |
| QB3#4  | 2.19 | 2.08 | 2.10 | 1.71 | 1.95 | 2.00 |
| QB3#5  | 2.03 | 2.18 | 2.10 | 1.87 | 1.95 | 2.02 |
| QB3#6  | 2.41 | 2.29 | 2.32 | 1.99 | 2.18 | 2.24 |
| QB3#7  | 2.38 | 2.40 | 2.26 | 2.02 | 2.18 | 2.25 |
| QB3#8  | 2.19 | 2.38 | 2.26 | 1.98 | 2.26 | 2.21 |
| QB3#9  | 2.27 | 2.43 | 2.27 | 2.67 | 2.26 | 2.38 |
| QB3#10 | 2.27 | 2.50 | 2.26 | 2.60 | 2.26 | 2.38 |
| QB3#11 | 2.24 | 2.31 | 2.42 | 2.32 | 2.16 | 2.29 |
| QB3#12 | 2.32 | 2.23 | 2.40 | 2.40 | 2.30 | 2.33 |
| QB3#13 | 2.41 | 2.38 | 2.42 | 1.94 | 2.18 | 2.26 |
| QB3#14 | 2.43 | 2.30 | 2.32 | 2.67 | 2.46 | 2.44 |
| QB3#15 | 2.51 | 2.45 | 2.35 | 1.91 | 2.26 | 2.30 |
| QB3#16 | 2.62 | 2.46 | 2.34 | 2.01 | 2.23 | 2.33 |
| QB3#17 | 2.86 | 3.39 | 3.27 | 3.58 | 3.32 | 3.29 |
| QB4#1  | 1.97 | 2.18 | 1.94 | 1.78 | 2.03 | 1.98 |
| QB4#2  | 2.03 | 2.20 | 1.94 | 1.78 | 2.03 | 1.99 |
| QB4#3  | 2.24 | 2.64 | 2.56 | 2.82 | 2.43 | 2.54 |
| QB4#4  | 2.57 | 2.75 | 2.66 | 2.79 | 2.66 | 2.69 |
| QB4#5  | 1.86 | 2.23 | 2.16 | 1.69 | 1.84 | 1.96 |
| QB4#6  | 2.57 | 2.69 | 2.71 | 2.79 | 2.65 | 2.68 |
| QB4#7  | 2.49 | 2.39 | 2.60 | 1.99 | 2.41 | 2.37 |
| QB4#8  | 2.46 | 2.33 | 2.53 | 1.96 | 2.31 | 2.32 |
| QB4#9  | 2.51 | 2.46 | 2.48 | 2.04 | 2.53 | 2.41 |
| QB5#1  | 2.35 | 2.45 | 2.61 | 2.06 | 2.49 | 2.39 |
| QB5#2  | 2.51 | 2.43 | 2.37 | 2.01 | 2.35 | 2.34 |
| QB5#3  | 1.81 | 2.15 | 2.06 | 1.88 | 2.03 | 1.99 |
| QB5#4  | 2.43 | 2.65 | 2.60 | 2.13 | 2.36 | 2.44 |
| QB5#5  | 1.92 | 2.28 | 2.00 | 1.85 | 1.99 | 2.01 |
| QB5#6  | 2.32 | 2.49 | 2.31 | 2.14 | 2.14 | 2.28 |
| QB5#7  | 2.24 | 2.46 | 2.21 | 2.71 | 2.42 | 2.41 |

|        |      |      |      |      |      |      |
|--------|------|------|------|------|------|------|
| QB5#8  | 1.86 | 2.10 | 2.03 | 1.96 | 1.86 | 1.96 |
| QB5#9  | 2.30 | 2.58 | 2.45 | 2.77 | 2.38 | 2.49 |
| QB5#10 | 2.35 | 2.53 | 2.50 | 2.71 | 2.35 | 2.49 |
| QB5#11 | 2.16 | 2.24 | 2.31 | 1.56 | 1.86 | 2.03 |
| QB5#12 | 2.35 | 2.40 | 2.47 | 2.60 | 2.47 | 2.46 |
| QB5#13 | 2.35 | 2.41 | 2.50 | 2.03 | 2.28 | 2.32 |
| QB5#14 | 2.32 | 2.33 | 2.52 | 2.59 | 2.39 | 2.43 |
| QB5#15 | 2.14 | 2.15 | 2.05 | 1.78 | 1.97 | 2.02 |
| QB5#16 | 2.22 | 2.30 | 2.52 | 1.96 | 2.20 | 2.24 |
| QB5#17 | 2.27 | 2.38 | 2.47 | 1.98 | 2.23 | 2.26 |
| QB5#18 | 1.95 | 1.93 | 1.95 | 1.96 | 1.88 | 1.93 |
| QB5#19 | 1.78 | 1.88 | 1.87 | 1.96 | 1.88 | 1.87 |
| QB5#20 | 2.54 | 2.81 | 2.15 | 2.67 | 2.74 | 2.58 |
| QB5#21 | 1.19 | 1.21 | 1.29 | 1.27 | 1.20 | 1.23 |
| QB5#22 | 1.22 | 1.28 | 1.21 | 1.24 | 1.35 | 1.26 |
| QC6#1  | 1.95 | 2.29 | 2.00 | 1.80 | 1.84 | 1.97 |
| QC6#2  | 2.32 | 2.44 | 2.79 | 2.02 | 2.32 | 2.38 |
| QC6#3  | 2.57 | 2.40 | 2.35 | 2.06 | 2.27 | 2.33 |
| QC6#4  | 2.19 | 2.40 | 2.23 | 2.04 | 2.15 | 2.20 |
| QC6#5  | 2.19 | 2.35 | 2.26 | 2.02 | 2.18 | 2.20 |
| QC7#1  | 2.03 | 2.05 | 2.55 | 1.60 | 1.95 | 2.03 |
| QC7#2  | 1.89 | 2.19 | 2.45 | 1.69 | 1.81 | 2.01 |
| QC7#3  | 1.84 | 1.90 | 1.97 | 1.56 | 1.89 | 1.83 |
| QC7#4  | 2.43 | 2.45 | 2.60 | 1.93 | 2.39 | 2.36 |
| QC7#5  | 2.49 | 2.48 | 2.81 | 1.71 | 2.54 | 2.40 |
| QC7#6  | 2.54 | 2.39 | 2.84 | 1.68 | 2.51 | 2.39 |
| QC7#7  | 1.70 | 2.13 | 1.90 | 1.71 | 1.86 | 1.86 |
| QC7#8  | 2.03 | 2.16 | 1.97 | 1.76 | 1.61 | 1.90 |
| QC7#9  | 1.81 | 2.13 | 2.08 | 1.78 | 2.16 | 1.99 |
| QC7#10 | 2.30 | 2.44 | 2.56 | 1.98 | 2.47 | 2.35 |
| QC7#11 | 1.95 | 2.06 | 2.27 | 1.68 | 2.19 | 2.03 |
| QC7#12 | 2.08 | 2.08 | 2.08 | 1.74 | 2.22 | 2.04 |
| QC7#13 | 2.27 | 2.35 | 2.42 | 1.99 | 2.41 | 2.29 |
| QC7#14 | 2.30 | 2.40 | 2.65 | 1.99 | 2.49 | 2.36 |
| QC8#1  | 1.81 | 2.05 | 1.97 | 1.76 | 1.95 | 1.91 |
| QC8#2  | 1.38 | 1.89 | 1.61 | 1.63 | 1.95 | 1.69 |
| QC8#3  | 1.84 | 2.20 | 1.98 | 1.89 | 2.23 | 2.03 |
| QC8#4  | 2.08 | 2.33 | 2.26 | 1.87 | 2.27 | 2.16 |
| QC8#5  | 2.19 | 2.41 | 2.32 | 1.96 | 2.43 | 2.26 |
| QC8#6  | 1.38 | 2.23 | 1.69 | 1.74 | 1.86 | 1.78 |
| QC8#7  | 2.05 | 2.29 | 2.00 | 1.92 | 2.22 | 2.10 |

|         |      |      |      |      |      |      |
|---------|------|------|------|------|------|------|
| QC8#8   | 1.89 | 2.34 | 1.90 | 1.99 | 2.24 | 2.07 |
| QC8#9   | 1.70 | 2.00 | 1.92 | 1.78 | 2.12 | 1.90 |
| QC8#10  | 1.65 | 1.90 | 1.68 | 1.36 | 1.95 | 1.71 |
| QC8#11  | 1.89 | 2.16 | 1.89 | 1.79 | 2.15 | 1.98 |
| QC9#1   | 2.19 | 2.04 | 2.15 | 1.76 | 2.34 | 2.09 |
| QC9#2   | 2.05 | 2.04 | 1.89 | 1.63 | 2.07 | 1.93 |
| QC9#3   | 1.92 | 2.18 | 1.66 | 1.74 | 2.01 | 1.90 |
| QC9#4   | 2.14 | 2.25 | 1.73 | 1.75 | 2.08 | 1.99 |
| QC9#5   | 2.24 | 2.33 | 1.95 | 1.93 | 2.30 | 2.15 |
| QC9#6   | 2.19 | 2.21 | 2.00 | 1.86 | 2.20 | 2.09 |
| QC9#7   | 2.38 | 2.49 | 2.24 | 1.99 | 2.51 | 2.32 |
| QC10#1  | 1.84 | 2.16 | 2.03 | 1.90 | 2.14 | 2.01 |
| QC10#2  | 1.97 | 2.18 | 2.13 | 1.68 | 2.07 | 2.00 |
| QC10#3  | 1.65 | 1.99 | 1.66 | 1.84 | 1.78 | 1.78 |
| QC10#4  | 1.68 | 2.06 | 1.76 | 1.85 | 1.81 | 1.83 |
| QC10#5  | 2.03 | 2.29 | 2.35 | 1.96 | 2.11 | 2.15 |
| QC10#6  | 2.00 | 2.25 | 1.98 | 1.96 | 2.16 | 2.07 |
| QC10#7  | 2.03 | 2.48 | 2.19 | 2.05 | 2.15 | 2.18 |
| QC10#8  | 2.03 | 2.15 | 2.31 | 1.68 | 1.97 | 2.03 |
| QC10#9  | 2.32 | 2.49 | 2.56 | 2.65 | 2.65 | 2.54 |
| QC10#10 | 2.41 | 2.63 | 2.60 | 2.10 | 2.35 | 2.42 |
| QC10#11 | 2.03 | 2.60 | 2.24 | 2.07 | 2.24 | 2.24 |
| QC10#12 | 2.51 | 2.59 | 2.58 | 2.71 | 2.46 | 2.57 |
| QC10#13 | 2.59 | 2.74 | 2.76 | 2.74 | 2.55 | 2.68 |
| QC10#14 | 2.43 | 2.59 | 2.73 | 2.63 | 2.61 | 2.60 |
| QC10#15 | 2.22 | 2.43 | 2.47 | 1.99 | 2.34 | 2.29 |
| QC10#16 | 1.76 | 2.14 | 1.98 | 1.83 | 1.85 | 1.91 |
| QC10#17 | 1.86 | 2.03 | 1.98 | 1.79 | 1.86 | 1.91 |
| QC10#18 | 2.03 | 2.18 | 2.00 | 1.86 | 1.96 | 2.00 |
| QD1#1   | 2.76 | 3.10 | 2.63 | 2.29 | 2.47 | 2.65 |
| QD1#2   | 2.43 | 2.73 | 2.32 | 2.32 | 2.85 | 2.53 |
| QD1#3   | 3.57 | 3.65 | 3.31 | 2.90 | 3.24 | 3.33 |
| QD1#4   | 3.08 | 3.03 | 2.60 | 2.55 | 2.47 | 2.75 |
| QD1#5   | 3.30 | 3.54 | 3.52 | 3.84 | 3.51 | 3.54 |
| QD1#6   | 3.46 | 3.66 | 3.61 | 3.18 | 3.39 | 3.46 |
| QD1#7   | 3.49 | 3.51 | 3.35 | 2.99 | 3.09 | 3.29 |
| QD1#8   | 3.49 | 3.71 | 3.71 | 4.10 | 3.66 | 3.73 |
| QD1#9   | 3.46 | 3.64 | 3.69 | 3.06 | 3.16 | 3.40 |
| QD1#10  | 3.19 | 3.50 | 3.63 | 2.76 | 3.27 | 3.27 |
| QE1#1   | 3.00 | 3.19 | 2.87 | 2.59 | 2.84 | 2.90 |
| QE1#2   | 3.03 | 3.53 | 3.42 | 3.47 | 3.53 | 3.39 |

|        |      |      |      |      |      |      |
|--------|------|------|------|------|------|------|
| QE1#3  | 3.22 | 3.55 | 3.89 | 3.96 | 3.55 | 3.63 |
| QE1#4  | 3.05 | 3.33 | 3.27 | 3.85 | 3.20 | 3.34 |
| QE1#5  | 3.16 | 3.55 | 3.39 | 3.68 | 3.38 | 3.43 |
| QE1#6  | 3.27 | 3.30 | 3.35 | 2.94 | 3.28 | 3.23 |
| QE1#7  | 3.00 | 3.79 | 3.53 | 4.02 | 3.82 | 3.63 |
| QE1#8  | 3.22 | 3.68 | 3.55 | 4.03 | 3.86 | 3.67 |
| QE1#9  | 3.27 | 3.61 | 3.76 | 4.09 | 3.77 | 3.70 |
| QE1#10 | 3.00 | 3.65 | 3.34 | 3.38 | 3.61 | 3.40 |
| QE1#11 | 3.11 | 3.71 | 3.44 | 3.77 | 3.69 | 3.54 |
| QE1#12 | 3.24 | 3.81 | 3.56 | 4.00 | 3.82 | 3.69 |
| QE1#13 | 3.05 | 3.88 | 3.60 | 3.79 | 3.74 | 3.61 |
| QE1#14 | 3.05 | 3.73 | 3.44 | 4.14 | 3.91 | 3.65 |
| QE1#15 | 3.19 | 3.93 | 3.76 | 3.65 | 3.99 | 3.70 |
| QE1#16 | 3.27 | 3.86 | 3.77 | 4.25 | 4.05 | 3.84 |
| QE1#17 | 2.86 | 3.69 | 3.68 | 4.10 | 3.81 | 3.63 |
| QE1#18 | 2.68 | 3.13 | 3.53 | 2.58 | 3.23 | 3.03 |
| QE1#19 | 3.35 | 3.58 | 3.45 | 4.23 | 3.54 | 3.63 |
| QE1#20 | 3.30 | 3.80 | 3.48 | 4.28 | 3.74 | 3.72 |
| QE1#21 | 3.35 | 3.56 | 3.66 | 3.21 | 3.55 | 3.47 |
| QE1#22 | 3.30 | 3.59 | 3.68 | 4.03 | 3.81 | 3.68 |
| QE1#23 | 3.46 | 3.60 | 3.65 | 4.18 | 3.80 | 3.74 |
| QE1#24 | 3.51 | 3.71 | 3.77 | 3.09 | 3.55 | 3.53 |
| QE1#25 | 3.14 | 3.53 | 3.76 | 3.51 | 3.73 | 3.53 |
| QE21   | 3.38 | 3.48 | 3.60 | 3.82 | 3.96 | 3.65 |
| QE22   | 3.95 | 3.94 | 4.05 | 4.38 | 4.11 | 4.08 |
| QE23   | 3.62 | 3.44 | 3.50 | 3.74 | 3.68 | 3.60 |
| QE24   | 3.81 | 4.04 | 3.68 | 4.41 | 4.09 | 4.01 |
| QE25   | 3.51 | 3.78 | 3.60 | 3.88 | 3.85 | 3.72 |
| QE26   | 1.46 | 1.36 | 1.60 | 1.45 | 1.49 | 1.47 |
| QF1#1  | 3.57 | 3.94 | 4.27 | 3.88 | 4.08 | 3.95 |
| QF1#2  | 3.54 | 3.76 | 4.18 | 3.18 | 3.82 | 3.70 |
| QF1#3  | 3.59 | 3.79 | 4.16 | 3.08 | 3.86 | 3.70 |
| QF1#4  | 3.46 | 3.89 | 4.13 | 3.23 | 3.89 | 3.72 |
| QF1#5  | 3.30 | 3.30 | 4.06 | 3.07 | 3.30 | 3.41 |
| QF1#6  | 3.35 | 3.84 | 4.08 | 3.06 | 3.91 | 3.65 |
| QF1#7  | 3.57 | 4.01 | 4.13 | 3.82 | 4.08 | 3.92 |
| QF1#8  | 3.43 | 3.70 | 3.35 | 4.39 | 4.09 | 3.79 |
| QF2#1  | 2.59 | 2.48 | 2.69 | 2.38 | 2.64 | 2.56 |
| QG1#1  | 3.14 | 3.63 | 3.37 | 3.76 | 3.54 | 3.49 |
| QG1#2  | 3.11 | 3.09 | 2.94 | 3.04 | 3.53 | 3.14 |
| QG1#3  | 3.59 | 3.53 | 3.65 | 3.71 | 3.80 | 3.66 |

|       |      |      |      |      |      |      |
|-------|------|------|------|------|------|------|
| QG1#4 | 3.24 | 3.44 | 3.32 | 3.78 | 3.58 | 3.47 |
| QG1#5 | 2.57 | 3.05 | 3.19 | 2.85 | 3.39 | 3.01 |
| QG1#6 | 3.78 | 3.69 | 3.97 | 4.04 | 3.91 | 3.88 |
| QG1#7 | 3.41 | 3.65 | 3.81 | 3.58 | 3.82 | 3.65 |
| QG1#8 | 3.49 | 3.28 | 3.48 | 3.17 | 3.47 | 3.38 |
| QG1#9 | 3.38 | 3.76 | 3.79 | 3.88 | 4.05 | 3.77 |

## APPENDIX-C--- AAHDPO SUPERVISION FORMATS

Date \_\_\_\_\_

Sign. \_\_\_\_\_  
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### CONSUTING ARCHITECTS AND ENGINEERS

#### Weekly supervision & quality control report

Reporting period from \_\_\_\_\_ to \_\_\_\_\_

**Table: 2.0 Major quality defects, causes and solution/actions**

Production site \_\_\_\_\_ Production type \_\_\_\_\_

| S. No. | Date of occurrence | Quality defect/Problem description | Cause of quality defect/problem | Action/instruction/Solution given | Remark |
|--------|--------------------|------------------------------------|---------------------------------|-----------------------------------|--------|
|        |                    |                                    |                                 |                                   |        |
|        |                    |                                    |                                 |                                   |        |
|        |                    |                                    |                                 |                                   |        |

**Note:-** this table is believed to show the type and frequency of occurrences of problems that could possibly be occurred in HDPO production sites, their causes, and enabling to device means of preventing occurrences of such problems in future planning

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## CONSULTING ARCHITECTS AND ENGINEERS

### Weekly supervision & quality control report

Reporting period from \_\_\_\_\_ to \_\_\_\_\_

**Table: 3.0 Weekly/Monthly material test result & action report**

**Project office** \_\_\_\_\_

| Site name | Type of Materials tested | Unit           | Bach quantity | Material Source/made in/Quarry name/Producer | Type of tested      | Result of Tested (Failed/Passed) | Action taken/instruction given      | Remark (date of action) |
|-----------|--------------------------|----------------|---------------|----------------------------------------------|---------------------|----------------------------------|-------------------------------------|-------------------------|
|           | Sand                     | m <sup>3</sup> | 14            | Debrezeit                                    | Gradation           | Passed                           | Approved for use                    |                         |
|           | Sand                     | m <sup>3</sup> | 30            | Mojo                                         | Silt & clay content | Failed                           | Approval refused, removed from site |                         |
|           | Class B HCB              | No             | 4000          | Batu construction                            | Compression         | Failed                           | Rejected                            |                         |
|           | Reinforcement            | Qt             | 1000          | Turkey                                       | Tensile strength    | Passed                           | Approved for use                    |                         |
|           | Reinforcement            | Qt             | 1000          | Turkey                                       | Yield stress        | Passed                           | Approved for use                    |                         |
|           | Reinforcement            | Qt             | 1000          | Turkey                                       | Elongation          | Passed                           | Approved for use                    |                         |
|           |                          |                |               |                                              |                     |                                  |                                     |                         |

**Additional comment**

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**CONSULTING ARCHITECTS AND ENGINEERS**

**Weekly supervision & quality control report**

Reporting period from \_\_\_\_\_ to \_\_\_\_\_

**Table : 4.0 Amount of defective work/product rejected**

**Project office**

| S. No. | Site name | Defective work/product description | Unit of measure | Quantity/amount | Remark |
|--------|-----------|------------------------------------|-----------------|-----------------|--------|
| 1      |           |                                    |                 |                 |        |
| 2      |           |                                    |                 |                 |        |
| 3      |           |                                    |                 |                 |        |
| 4      |           |                                    |                 |                 |        |
| 10     |           |                                    |                 |                 |        |

**Additional comment**

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**CONSULTING ARCHITECTS AND ENGINEERS**

**Weekly supervision & quality control report**  
**Reporting period from \_\_\_\_\_ to \_\_\_\_\_**

**Table : 5.0 Material quality delivered to the site in this week**

**Project office**

| No. | Site name | Type of materials delivered to the sites | Unit           | Quantity | Material source/made in/quarry name/producer | Material quality description | Action /Instruction given   | Remark |
|-----|-----------|------------------------------------------|----------------|----------|----------------------------------------------|------------------------------|-----------------------------|--------|
|     |           | Sand                                     | m <sup>3</sup> | 14       |                                              | Looks clayey                 | Lab test ordered before use |        |
|     |           | C. aggregate                             | m <sup>3</sup> | 28       |                                              | Tested at source             | approved for use            |        |
|     |           | C. aggregate                             | m <sup>3</sup> | 8        |                                              | doubtful on gradation        | Lab test ordered before use |        |
|     |           |                                          |                |          |                                              |                              |                             |        |
|     |           |                                          |                |          |                                              |                              |                             |        |
|     |           |                                          |                |          |                                              |                              |                             |        |
|     |           |                                          |                |          |                                              |                              |                             |        |

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## CONSULTING ARCHITECTS AND ENGINEERS

**Weekly supervision & quality control report**  
**Reporting period from \_\_\_\_\_ to \_\_\_\_\_**

**Table: 6. Weekly/Monthly material tests ordered**

**Project office**

| No. | Site name | Type of Materials | Unit           | Batch Quantity | Material Source/made in/Quarry name/Producer | Test type           | Date         |                 | Testing organization | Remark    |
|-----|-----------|-------------------|----------------|----------------|----------------------------------------------|---------------------|--------------|-----------------|----------------------|-----------|
|     |           |                   |                |                |                                              |                     | Test ordered | result expected |                      |           |
|     |           | Sand              | m <sup>3</sup> | 30             | (specify the quarry name)                    | Silt & clay content | 12-Jan       | 18-Jan          | CDSC                 | Block 1-3 |
|     |           | Sand              | m <sup>3</sup> | 100            |                                              | -do-                | 01-Jan       | 08-Jan          | CDSC                 | Block 4-6 |
|     |           | Class B HCB       | No             | 1000           |                                              | Compression         | 02-Jan       | 18-Jan          | TCDCS                |           |
|     |           | Concrete C-25     | m <sup>3</sup> | 60             |                                              | Compression         | 03-Jan       | 04-Jan          | CDSC                 |           |
|     |           |                   |                |                |                                              |                     |              |                 |                      |           |
|     |           |                   |                |                |                                              |                     |              |                 |                      |           |

**Note:-** Specify the block, contractor or contract number for which the test order is given to differentiate it from the various blocks/contractors within a site

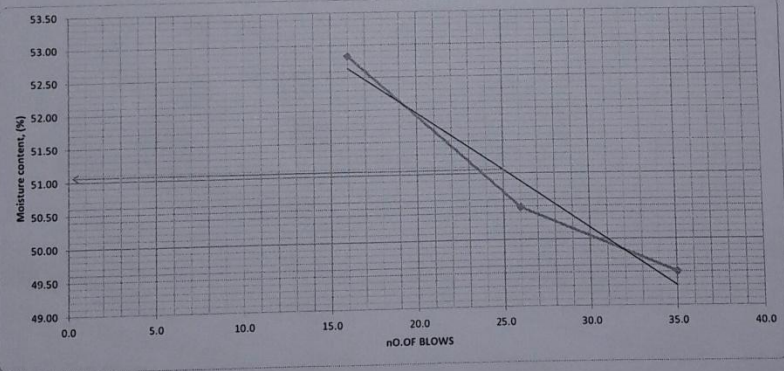

**RKG ENGINEERING PLC**  
 SPECIALIZED CONSULTANT IN GEOTECHNICS AND LABORATORY TESTING

Project:- G+4 Condominium Building  
 Client:- Gulele Housing Development Office  
 Location:- Jemmo Gara site  
 Sampled By:- Maleda Construction plc.  
 Material:- Light grey (from quarry)  
 Date Started: 23/05/2016  
 Lab. No.: RKG/0136/08

| Sample from Quarry             |       |       |
|--------------------------------|-------|-------|
| TP                             |       |       |
| Depth                          |       |       |
| Bottle no.                     | A1    | C2    |
| Weight Of Bottle               | 48.6  | 46.7  |
| Weight Of Bottle + Dry Soil    | 63.6  | 61.7  |
| Weight of Bottle + Soil+ Water | 156.2 | 154.4 |
| Weight of Bottle + Water       | 147   | 145.1 |
| Weight of Dry Soil             | 15    | 15    |
| Weight Of water                | 5.8   | 5.7   |
| Specific Gravity               | 2.59  | 2.63  |
| Average S.G                    | 2.61  |       |

| Sample From Quarry                                                    |       |       |       |
|-----------------------------------------------------------------------|-------|-------|-------|
| BH/TP                                                                 |       |       |       |
| Depth                                                                 |       |       |       |
| Moisture Can no.                                                      | 1     | 4     | 5     |
| Mc=Mass Of CAN (gram)                                                 | 27.3  | 27.9  | 27.8  |
| No. of blows                                                          | 35    | 26    | 16    |
| M <sub>CDS</sub> =Mass of CAN + wet Soil,(gm)                         | 42.4  | 43.4  | 44    |
| M <sub>CDS</sub> =Mass of CAN + dry Soil,(gm)                         | 37.4  | 38.20 | 38.40 |
| M <sub>DS</sub> =Mass of dry Soil,(gm)                                | 10.10 | 10.30 | 10.60 |
| M <sub>w</sub> =Mass of pore water=M <sub>CDS</sub> -M <sub>CDS</sub> | 5.00  | 5.20  | 5.60  |
| W=Water Content, w (%)=(M <sub>w</sub> /M <sub>s</sub> )*100          | 49.50 | 50.49 | 52.83 |
| average=                                                              | 50.94 |       |       |

| Sample From Quarry                                                    |       |       |
|-----------------------------------------------------------------------|-------|-------|
| BH/TP                                                                 |       |       |
| Depth                                                                 |       |       |
| Moisture Can no.                                                      | 1     | 9     |
| Mc=Mass Of CAN (gram)                                                 | 19.9  | 19.8  |
| M <sub>CDS</sub> =Mass of CAN + wet Soil,(gm)                         | 27.3  | 26.5  |
| M <sub>CDS</sub> =Mass of CAN + dry Soil,(gm)                         | 25.7  | 25    |
| M <sub>DS</sub> =Mass of dry Soil,(gm)                                | 5.80  | 5.20  |
| M <sub>w</sub> =Mass of pore water=M <sub>CDS</sub> -M <sub>CDS</sub> | 1.60  | 1.50  |
| W=Water Content, w (%)=(M <sub>w</sub> /M <sub>s</sub> )*100          | 27.59 | 28.85 |
| average=                                                              | 28.2  |       |



| Liquid Limit, LL, (%) | Limit, PL (%) | Plasticity Index, PI, (%) |
|-----------------------|---------------|---------------------------|
| 51.1                  | 28.20         | 22.9                      |

Remarks

Tested By: Alemnesh Kidane

Date:- 23/05/2016

Approved by:- Rahel Kore

Date:- 25/05/2016


**RKG Engineering PLC**  
 Soil and Material Testing Laboratories

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|                                                                                                                                     |  |                          |                        |
|-------------------------------------------------------------------------------------------------------------------------------------|--|--------------------------|------------------------|
| Company Name<br>ETHIOPIAN CONSTRUCTION DESIGN & SUPERVISION WORKS CORPORATION<br>BUILDING & URBAN DESIGN & SUPERVISION WORKS SECTOR |  | Form No<br>OF/BUOSWS/143 |                        |
| Laboratory Concrete Cube Samples Compressive Strength Test Result                                                                   |  | Issue No<br>1            | Page No<br>Page 1 of 1 |
| W.O/Proj. No 633676                                                                                                                 |  | Date 26/08/2016          |                        |
| Sample ID: 2016/6286                                                                                                                |  |                          |                        |

Project :- Gulelle Subcity Condominium Houses 20/80 Project  
 Client :- Temesgen & Arega Construction  
 Site :- Addis Ababa / Karakore Bereket Sefer Site /  
 Object :- 3 Concrete Cube Samples  
 Location :-

**Ingredients Information**

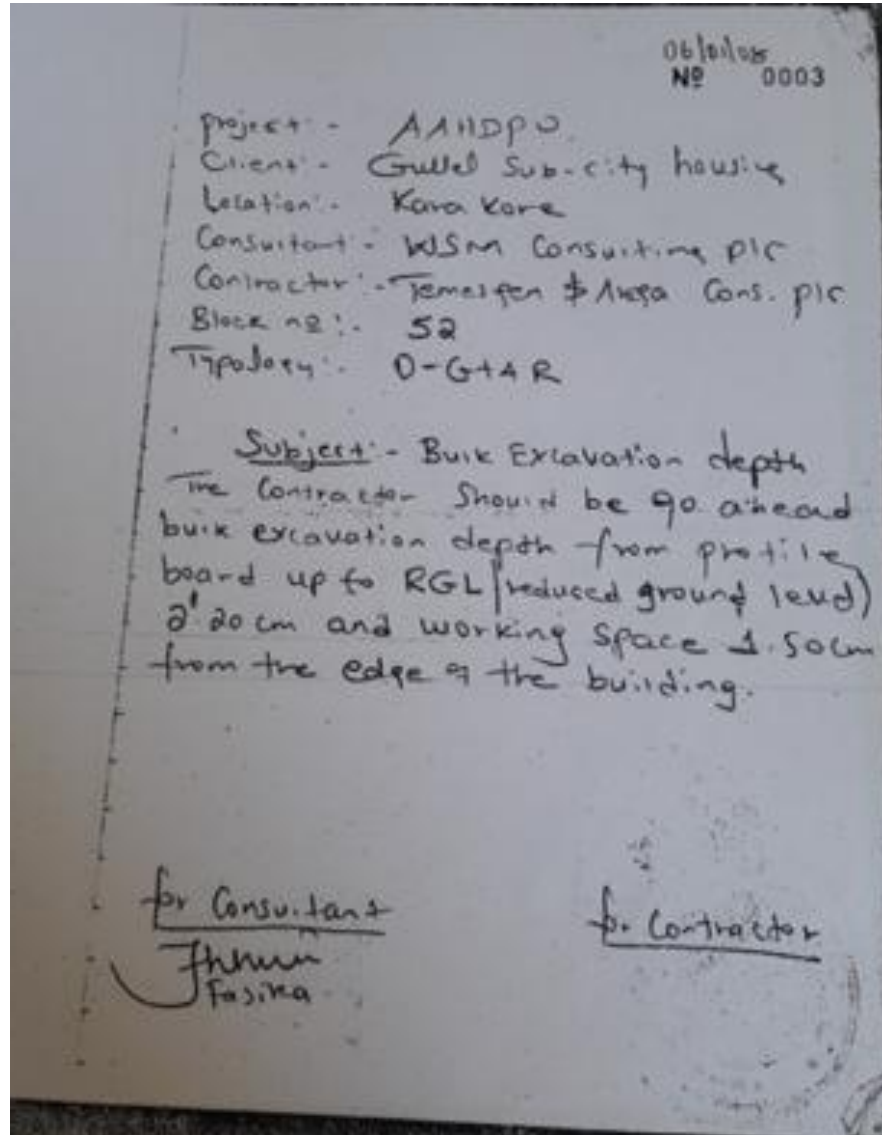
|           |             |   |                  |                |
|-----------|-------------|---|------------------|----------------|
| Cement    | Volume      | - | Consistency (mm) | -              |
|           | Weight      | - |                  | Box Size (Cm3) |
| Sand      | Natural     | - |                  |                |
|           | C.Fine      | - |                  |                |
| Aggregate | Coarse (02) | - |                  |                |
|           | Coarse (01) | - |                  |                |
| W/C       | Ratio       | - |                  |                |

Remark :- Concrete Cube Samples Were prepared by the Client

| Marking | Date       |            | Age in days | Dimensions - m |      |      | Unit Weight<br>(Kg/m <sup>3</sup> ) | Compressive strength  |       |
|---------|------------|------------|-------------|----------------|------|------|-------------------------------------|-----------------------|-------|
|         | Poured     | Tested     |             | L              | W    | H    |                                     | (Kg/Cm <sup>2</sup> ) | (Mpa) |
| 1       | 29/07/2016 | 26/08/2016 | 28          | 0.15           | 0.15 | 0.15 | 2548                                | 421                   | 42.1  |
| 2       | 29/07/2016 | 26/08/2016 | 28          | 0.15           | 0.15 | 0.15 | 2370                                | 397                   | 39.7  |
| 3       | 29/07/2016 | 26/08/2016 | 28          | 0.15           | 0.15 | 0.15 | 2578                                | 363                   | 36.3  |

|                    |                             |                     |                          |
|--------------------|-----------------------------|---------------------|--------------------------|
| Tested by<br>Date  | Derje Tekle<br>26/08/2016   | Approved by<br>Date | Biruk Abdi<br>26/08/2016 |
| Checked by<br>Date | Abate Legesse<br>26/08/2016 |                     |                          |

PLEASE MAKE SURE THAT THIS IS THE CORRECT ISSUE TO FOR USE



**ሴስ ደብዳቤ ቲ የህንጻ ተቋራጭ ኃ/የተ/የግ/ማ**

ቀን: 14/06/2018  
ቀን: 06/06/2018

ላይኛው ሴስ ለምሳሌ መሆንዳለች ለርኩቲክቶር ኃ/የተ/የግ/ማ

ጉዳዩ:- ሀመር ቲስት አሰርተን ስለሚታረፍ ይመለከታል

እንደሚታወቀው ሴስ ደብዳቤ ቲ የህንጻ ተቋራጭ ኃ/የተ/የግ/ማ ማራቀሪያ ዘርፍ ላይት ላሳት የሚገኝ ህንጻውን ስራውን ከገንጠል ወስደን በመሰራት ላይ ገንጠል የተሰጠው ፎት ኮላን ከገንጠል ቲስት አሰርተን (ለ ቤት 5 እና 7) በመውደቁ ሀመር ቲስት እንደሚሰራ ሲታዘዝ መሰረት አሰርተን ውጤቱን ከሴስ ላይ ጽሑፍ ጋር ታረፈው መሆንን በትህትና እንገልጻለን።

ገልጻች- ለገልጻች

11/06/2018  
9/06/2018  
10/06/2018  
11/06/2018

ከሰላም ጋር  
ከሰላም ላይኛው

|     |     | Mean Error<br>±(%) |
|-----|-----|--------------------|
| 270 |     | 21.2               |
| 280 |     | 20.6               |
| 280 |     | 20.6               |
| 25  | 100 | 26.6               |
| 27  | 190 | 24.8               |
| 27  | 190 | 24.8               |

Checked by  
Geremew Mengesha

Approved by  
Kassahun Admassu (Dr.-Ing.)

P.O. Box 518, Addis Ababa Email: [enr@addis.edu.et](mailto:enr@addis.edu.et) Website: [www.addis.edu.et/enr.html](http://www.addis.edu.et/enr.html)



CONSULT PLC  
BOLE ARABSA 6 SITE  
PROJECT 13 HCPO  
Slab Blocks Test Result  
Date 17/02/09 E.C

| Item No | MSE's Name         | Slab block Type | Testing Date | Test Accepted / Not Accepted | Remark                                     |
|---------|--------------------|-----------------|--------------|------------------------------|--------------------------------------------|
| 1       | Aliod and Birtukan | 16              | 8/2/2009     | Accepted                     |                                            |
| 2       | Deraje Melaku      | 22              | 8/2/2009     | Accepted                     |                                            |
| 3       | Workneh Juhar      | 22              | 8/2/2009     | Accepted                     |                                            |
| 4       | Tamrat Assefaw     | 22              | 8/2/2009     | Accepted                     |                                            |
| 5       | Iden Alemayehu     | 22              | 8/2/2009     | Accepted                     |                                            |
| 6       | Almenah Dawit      | 22              | 8/2/2009     | Accepted                     |                                            |
| 7       | Sied Jelebchan     | 22              | 8/2/2009     | Not Accepted                 | one individual 1.42Mpa<br>Average 1.03 Mpa |
| 8       | Tarekagn Tewabe    | 22              | 8/2/2009     | Accepted                     |                                            |
| 9       | Lamrot Tesfaye     | 22              | 8/2/2009     | Accepted                     |                                            |
| 10      | Degife Tsadkan     | 22              | 11/2/2009    | Accepted                     |                                            |
| 11      | Yosef Akzash       | 22              | 11/2/2009    | Accepted                     |                                            |
| 12      | Almenah Dawit      | 22              | 11/2/2009    | Accepted                     |                                            |
| 13      | Murad Shin         | 16              | 11/2/2009    | Accepted                     |                                            |
| 14      | Tarekagn Tewabe    | 22              | 11/2/2009    | Accepted                     |                                            |
| 15      | Tamrat Zewdu       | 22              | 11/2/2009    | Accepted                     |                                            |
| 16      | Lamrot Tesfaye     | 22              | 11/2/2009    | Accepted                     |                                            |
| 17      | Workneh Juhar      | 22              | 11/2/2009    | Accepted                     |                                            |
| 18      | Aliod and Birtukan | 22              | 11/2/2009    | Accepted                     |                                            |

2009. 02. 17  
[Signature]  
[Signature]  
[Signature]

**CHECK LIST FOR WORK**

Employer: \_\_\_\_\_

Contractor: \_\_\_\_\_

Consultant: \_\_\_\_\_

Location: \_\_\_\_\_

Document Referred: \_\_\_\_\_

Block/Bill: \_\_\_\_\_

Axes: \_\_\_\_\_

Floor: \_\_\_\_\_

**Tick (✓, x, ) N.A\*\*/Comment****Element of Structure; Footing****Placing of Concrete (SSTW 5)**

- Preceding work status (Acceptance, Remarks)..... ☐ \_\_\_\_\_
- Submittal of mix proportion for the mix design..... ☐ \_\_\_\_\_
- Rechecking the rigidity of formwork..... ☐ \_\_\_\_\_
- Spacer position..... ☐ \_\_\_\_\_
- Leakage tightness of joints between form work element..... ☐ \_\_\_\_\_
- Cleanliness of form work..... ☐ \_\_\_\_\_
- Cleanliness of Lean concreted area..... ☐ \_\_\_\_\_
- Surface condition of reinforcement..... ☐ \_\_\_\_\_
- Diameter, spacing, length, number, shape and tying of reinforcement bar..... ☐ \_\_\_\_\_
- Positioning of foundation column reinforcement with the footing..... ☐ \_\_\_\_\_
- Alignment and centering of foundation column reinforcements..... ☐ \_\_\_\_\_
- Method used for pouring concrete to avoid segregation/Chute, down pipe, trucking, or any other..... ☐ \_\_\_\_\_

**Concrete production***Check the following before concrete production***Aggregate Fine/course**

- Availability of the required sizes of aggregate and piled separately..... ☐ \_\_\_\_\_
- Test results for quality assurance..... ☐ \_\_\_\_\_
- Conformity of piled aggregate with approved sample..... ☐ \_\_\_\_\_
- Prevention of the piled aggregate from contamination..... ☐ \_\_\_\_\_
- Prevention of intermingling aggregates with adjacent material..... ☐ \_\_\_\_\_