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Quality Management Control of the Materils and Performance in the Construction Stage of the Building Projects

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Abstract

Quality is defined as: the needs of a client must be understood and satisfied clients expect a product or services to match. This research aims to control the managing quality of construction and use it as a tool to minimize construction faults as possible. This is done by identifying the reasons of construction faults and their effect, the performance activities concerning construction quality management, and measure to improve it. In this study, quality management philosophy deals with, identifying the tools and methods, used by the engineer, contractor and technician to carry out the required management activities, the experience needed, the responsibility toward those activities, and finally scheduling them regarding building stages and work program, use test methods and acceptance, attempt to set up quality test system and publish quality or primary test certificate.

In the field study, two questionnaire sets were applied as a method for collecting data regarding the opinion and attitude of engineers, contractors and technician. The statistical analysis of the study showed that, the main reason of construction quality faults is don't meeting construction materials with specifications, little skills for labors in site work.

الخلاصة

تعرف الجودة على وجوب فهم متطلبات العميل وتلبية حاجاته لتحقيق توقعاتهم والتجهيز في الوقت المناسب. يهدف البحث إلى السيطرة على إدارة الجودة لتقليل العيوب الإنشائية عن طريق تشخيص أسبابها وتأثيراتها وتحديد الفعاليات المطبقة المتعلقة بنوعية الإنشاء والإجراءات التي يجب أن تتخذ لتحسين إدارة الجودة. هذه الدراسة اهتمت بتشخيص الأسباب والأدوات المستخدمة من قبل المنفذ لتنفيذ فعاليات الإدارة، والخبرة المطلوبة، والمسؤولية تجاه تلك الفعاليات وكذلك توقيتها حسب مراحل تقدم برنامج العمل. بالإضافة إلى طرق اختيار المواد الإنشائية وطرق فحصها وقبولها، المحاولة إلى تطبيق نظام فحص أو إصدار شهادة فحص أولي للجودة.

خلال الدراسة العملية، تم استخدام استمارتي استبيان كوسيلة لجمع المعلومات من خلال آراء وأجوبة المنفذين.من خلال التحليل الإحصائي أظهرت نتائج البحث إن السبب الرئيسي لعيوب الجودة الإنشائية هو عدم التوافق أو التطابق في التنفيذ والتي تعزى إلى عدم كفاية خبرة المنفذ بالإضافة إلى عدم جودة المواد الإنشائية المستعملة.

1. Introduction

Total Quality Management (TQM) is the philosophy of management that strives to make the best of all available recourse and opportunities by constant important. Total Quality Management is the key business important strategy and the key management issue of the future because it is essential for efficiency and competitiveness. TQM is a common approach to implementing a quality improvement program within an organization (Bee& Dinnis, 2000).

Quality Control (QC) is all the actives and statistical methods to keep the meeting of specifications. It used the tools and do different actives to improve the quality or service, QC include assurance from the design meets the limit specification, and assurance that production and after production meetings with specifications. QC considers an advance stage for testing concerning with method's composition and improvement the use system. QC is not something built into the end–production prior to its handover to the user. It should be applied continuously during production

similarly, for systems development; QC starts at the beginning of the development cycle and continues right through to on–going maintenance (David & Thomas, 2004)

This research deals with construction management, thus. The progress and efficiency of construction sector performance depend on a number of essential factors, these factors constitute as a whole, and the final result of the degree of progress of these factors can be classified principally into: human resources, work system equipments of building and materials (AlFao Co., 2002).

1.1 Quality Control of Materials

The materials audit unit is responsible for verifying that construction material used in the projects from approved sources and that it has been sampled and tested at the required frequency according to specifications. Once it is determined that the materials were properly sampled and tested and that they met all project specifications, a materials certificate is issued. This is accomplished by reviewing the final construction report, all test and mill certification. Laboratory files are maintained by the materials audit unit. As projects are let a file is prepared for each project. During the project's construction all test reports, mill certifications and correspondence are filed in the appropriate file. This unit also maintains project plants for most current projects (Khudair, 2000).

All materials used in work shall be the best of their kind and shall conform in quality and treatment to the conditions herein specified. The contractor shall submit to the engineer when required and at his own expense, samples of all materials to be used in the works. The quality of the samples so provided being representative of the bulk of such materials.

All materials shall be new and unused, of standard first grade quality, and of the best workmanship and design. Before procurement, the contractor shall furnish to the engineer, for his approval, the names of the manufacturers of all materials and equipment, which he intends to use on the works. Samples of materials shall be submitted to the engineer, for his approval, when so directed. Materials used or installed on the works, without the approval of the engineer shall be liable to subsequent rejection. The research though that must test the construction materials before used it in building, otherwise change the material which is failed in test, also must condition test, origin and ISO certificate for all materials (Mohammed, 2004).

1.2 Skills

All workers shall have sufficient skill and experience to perform properly the work assigned to them. Upon request by the engineer, the contractor shall submit satisfactory qualifications evidence for any person engaged in special work requiring professional training. Any person employed by the contractor or by any subcontractor who does not perform assigned work in a proper and skillful manner, or he is intemperate or disorderly shall be removed from the project forth with by the contractor upon written order of the engineer and shall not be employed again on any portion of the work without the engineer's consent. Should the contractor fail to remove such person or fail to furnish suitable and sufficient personnel for the proper prosecution of the work the engineer may suspend the work until the contractor has compiled with the orders (Barret, 2000)

This requirement means that they should not be merely transferable between reams, but also be able to apply different skills as required throughout the project. Ideally, each person should process the necessary skills required during analysis, definition, design, programming, proving, building, etc. In Iraq skills of labor don't

arrive to advance stage till know, the research though develop their skills by open training course and make workshop (Ternonko H., 2005).

1.3 Specifications

It is defined as (a comprehensive description and explanation of the project, it components and materials and all the required standards of workmanship).
The specifications, as such, can be realized through number of sources. These sources are three types:

1. Individual standards set up by the owner.
2. Standards established by other users, suppliers, or technical societies.
3. Governmental standards.

The specifications shall be clear laid down and documented in order that the project execution team will have a common understanding to the project requirements besides recognizing the limits of human beings and field conditions. All materials that are subject to definite section requirements will be sampled, tested and inspected by the department at any time prior to being incorporated permanently in the work (Steven & Arnold, 1998).

The first publish ISO 9000:1987 on ***Quality Control (QC)*** which means apply all the activities and manners concerning with follow client's requirements continuity, in anther meaning fixing was on the detection found and making it right in the first degree.

The second publish ISO 9000:1994 was published in 1994; it fixed on ***Quality Assurance***, which means applying all necessary activities to provide confidence that the production accept the client's requirements, from here was fixing on prevention of wrong and protection from happened.

The last publish ISO 9000:2000 was published in 2000 fixed on ***Quality Management System***, means applying all activities and manners concerning with Quality Management, thus, it fixed in the different elements direction in the first degree.

From the noticing, we found the interesting directed into the process not on the production itself, thus, requirements subjected according to the processes and not according to production, this requirements refer to organization management and it operating so assurance product the good production, therefore, goal to client's acceptance (Milosevic D. Z., 2003).

2. The Research Significance

The significance of this paper is four fold:

1. Quality control or quality itself is the third prime factor, besides cost and time in any successful construction management.
2. The knowledge, experience and attitudes of engineers, contractors, and all interested in construction quality management is still ambiguous, because that activities for managing construction quality are invisible and have always been uncontrolled.
3. Global development in the field of quality / quality control resulting in an international unified systems (such as ISO 9000) and convening of scientific workshops to have it adopted in Iraq.
4. Making critical and important decisions in the early stages of a project has been always emphasizing the role of construction management in reducing the risk of errors and faults, and potential for subsequent problems in construction phase (Fegin, 1999)

3. Designing The Questionnaire

The questionnaire has been accomplished by choosing a number of persons working in construction quality control, the results compared with a document works of Babylon University Laboratory it's appeared meeting questionnaire results, so the last passed through the following steps

1. Interviews

Interviews were made with 50 engineers and technicians involved in construction materials and construction performance of different specializations, to know the current activities that have been applied for managing quality control and the current problems relating to quality failure rising form materials faults and performance work. The research allowed the concerned people to explore the subject in their own way, and has not had anticipated facet in the prepared questions.

2. Questionnaire Compilation

The following steps have been followed through forming the questionnaire list:

1. Articles of the questionnaire have been prepared, by keeping in mind the literature review aspect.
2. Questions have been prepared, developed and set forth with answers for some of them using (yes / no) style for the rest.
3. Questions have been covered, the whole research's matter.

4. The Administration of The Questionnaire

Two questionnaire set were found for the study, the first list questionnaire constitute three main categories:

1. Category One

Covered the personal information about the respondent, such as; the specialization, qualification, years of experience, and number of project and courses that he/she had participated in, it has been from question (1 to 5) of the list.

2. Category Two

The inter relationship between the construction management and the quality control, regarding:

a. Execution approach and its relation with quality control.
b. Quality control requirements through out the construction stages.
c. Quality cycles responsibility to achieve the construction management. The questions have been from question (6 to 20) of the list.

3. Category Three

An adoption of the origin certificated and the international standards ISO:

a. Understanding of the system.
b. The necessary of origin certificate of the construction materials.
c. Possibility of the system's adoption as a replacement of inspection.
d. Period of validity of system's compliance certificate.

The questions have been from question (21 to 25) of the list.The second list questionnaires constitute three main categories:

1. Category One

Aimed at the investigation into the reasons causing adopting quality for the construction materials, contain; bricks, sand, gravel, gypsum, marble, ceramic and cement.

2. Category Two

Aimed at an investigation into the reasons causing the performance faults in construction quality, contain; concrete works, finishing works, Sanitarian works, roofing works,…et

3. Category Three

Aimed at the correction performance of quality concerning with meeting state, Contractor's Punishing Performances in don't meeting case,...etc.

5. The Research Sample

The two questionnaire set were administered in Arabic to different people with different fields of specialization, the sample of the research was classified according to the person specialization in the following organizations, each one get an equal number of list questionnaire:

1. Constructional Babylon Laboratory.
2. Babylon Building Directorate.
3. General Directorate of Teaching / Building Department.
4. General Directorate of municipality and works.
5. General Directorate of Water.
6. Square Contracting Company.
7. AlSharqiya Contracting Company.
8. AlFehan Contracting Company.
9. AlMasar AlThabit Contracting Company.
10. AlNeel AlHandasiya Contracting Company.

6. Designers Samples

The constructions questionnaire was distributed to 50 participates working in the construction building field, 50% of the sample work in public sector organization, the remaining 50% work in private sector and involved in large building projects, the following section present this percentage.

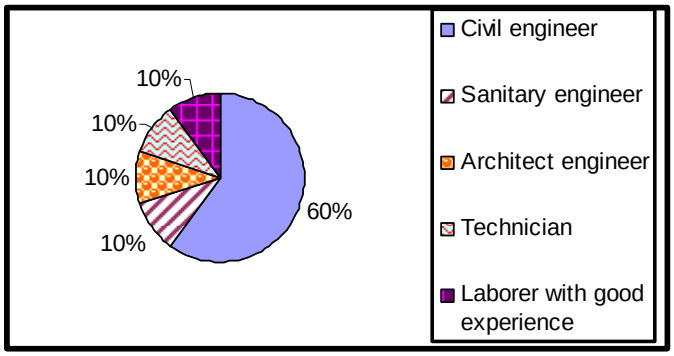

Fig. (6:1) Pie – Chart represent the specialization

7. Results Analysis and Discussion

7-1 The Faults In Concreting Works (The Materials Used, Performance and Inspection)

For materials used, cement's faults compressive strength take the first place in faults, then sulphates, time of setting, and other. In sand and gravel faults appear in sulphates then grading, while the yield strength take the large percent of faults in reinforcement material then diameter. It means the sulphates causing the main faults

and must be treated by using good specifications materials, and use high strength reinforcement.

For performance, all participates expressed with approximant equal percentage, except summer and winter curing because of the difference of temperature in Iraq between summer and winter. However summer curing takes a large percent of the faults due to the high temperature during summer in Iraq. Form work has a less percent, which may be attributed to the good skill of labor of this item in Iraq.

The research found that the large percent of faults was in method of sampling then in summer curing, time of sampling and other. It means that the large faults were due to the method of choosing and taking samples, which should be taken into accordance to make limit order to do it. All participants conform that most of core samples had failed during the test, according to bad skill of the test, on the other hand most of loading tests successes, which gives more confidence for both engineer and owner.

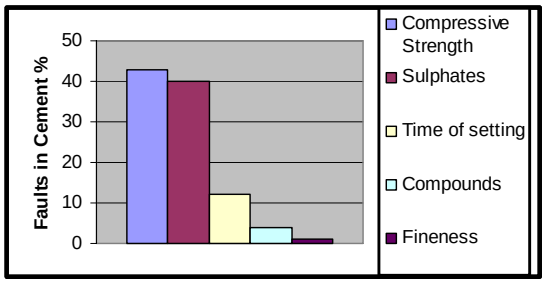

Fig. (7.1): Column – Chart of Cement's Faults

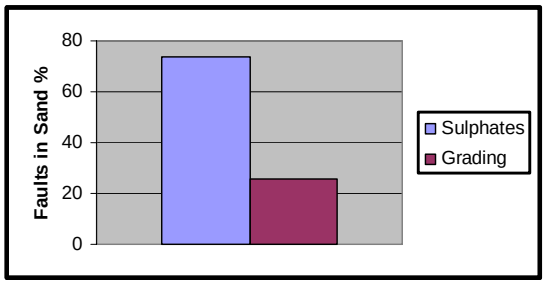

Fig. (7.2): Column – Chart of Sand's Faults

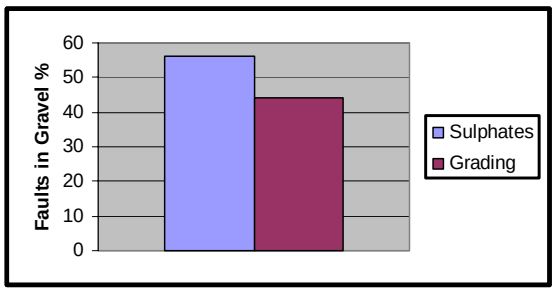

Fig. (7.3): Column – Chart of Gravel's Faults

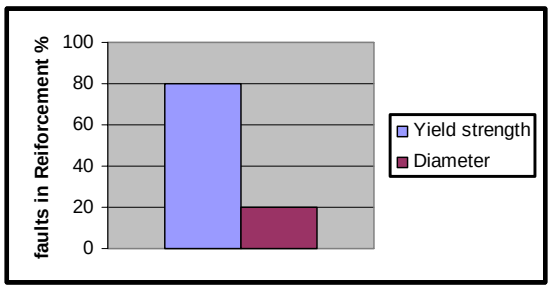

Fig. (7.4): Column – Chart of Reinforcement's Faults

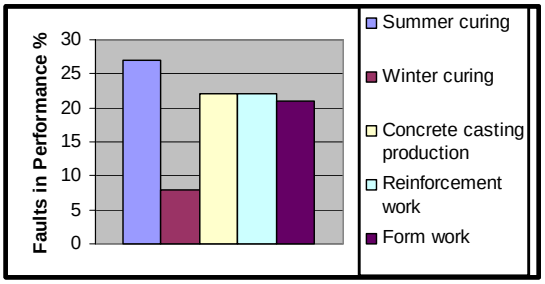

Fig. (7.5): Column – Chart of Performance faults

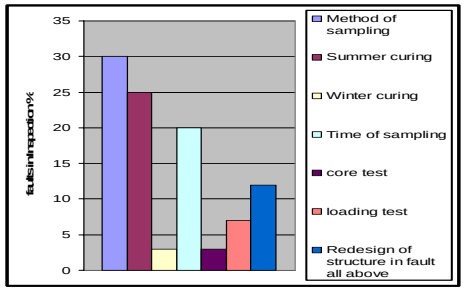

Fig. (7.6): Column – Chart of fielding and laboratory inspection faults

7-2 The Faults In Building (The Materials Used, Performance and Inspection)

For the cement the compressive strength take the first place in faults, then sulphates, and other. For sand sulphates and grading, while the bricks distributed between Compressive and Absorption. It means that the sulphates are causing the main faults and must be treated by using good materials specifications, specially the sand.

For performance large number of participants expressed it quality work and type of bricks, then others. It must improve worker's experience and depend on good type of bricks according to origin and test certificate.

For inspection, large faults in compressive strength then absorption, dimensions, efflorescence.

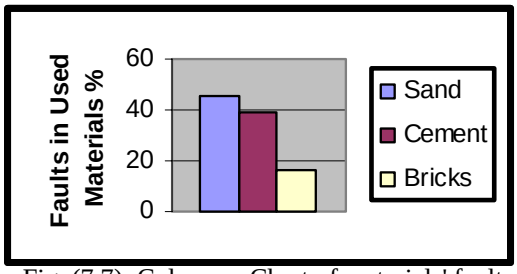

Fig. (7.7): Column – Chart of materials' faults

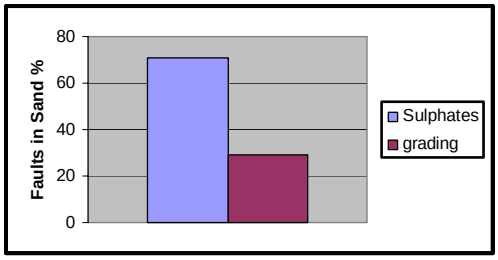

Fig. (7.8): Column – Chart of sand's faults

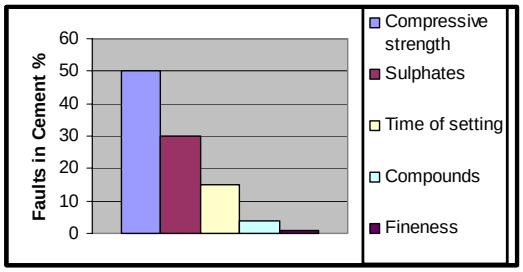

Fig. (7.9): Column – Chart of cement's faults

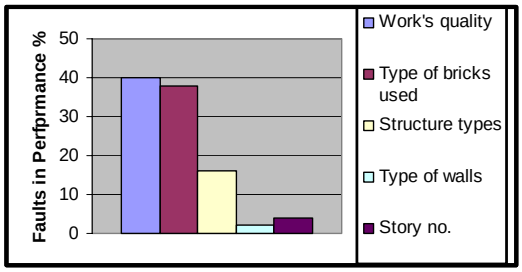

Fig. (7.10): Column – Chart of performance's faults

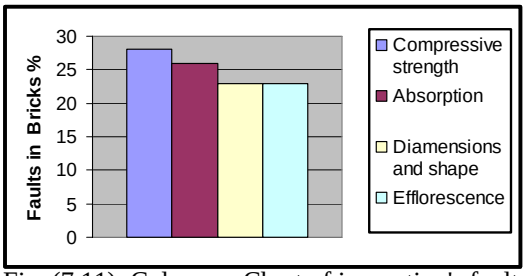

Fig. (7.11): Column – Chart of inspection's faults

7-3 The Faults In Finishing Works (The Materials Used, Performance and Inspection)

For materials, Sulphates take the first place in faults, compressive strength, time of setting and other for cement, sulphates and grading for sand, while juss and gypsum takes the remain. This means that the sulphates causing faults and must be treated.

For performance, large number of participants expressed it a quality work, then type of materials. Therefore; worker's skills and use of materials of a good quality according to origin and test certificate must be improved.

For inspection, the research saw that the large percent in surface leveling, then in Edge's straightness, and other. Worker's skills should be improved.

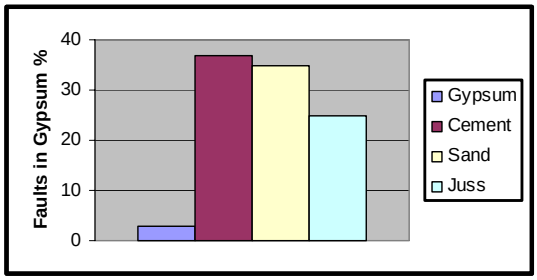

Fig. (7.12): Column – Chart of materials' faults

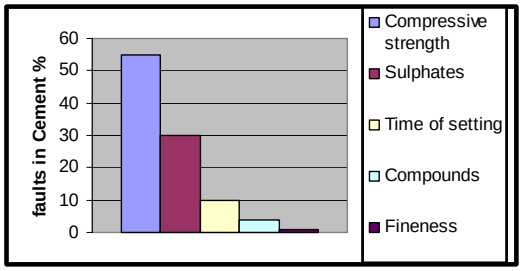

Fig. (7.13): Column – Chart of cement's faults

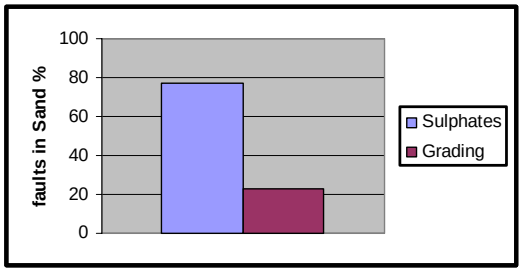

Fig. (7.14): Column – Chart of sand's faults

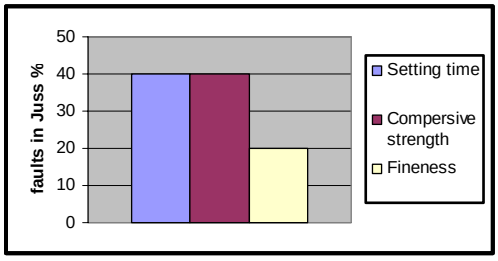

Fig. (7.15): Column – Chart of jusse's faults

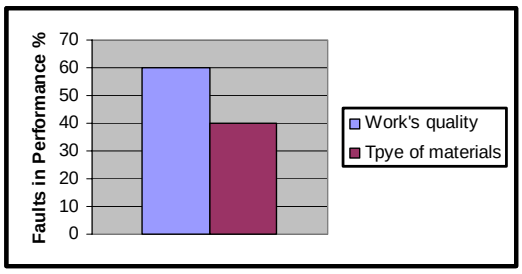

Fig. (7.16): Column – Chart of performance faults

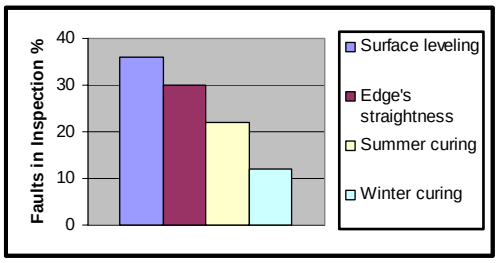

Fig. (7.17): Column – Chart of inspection faults

8. Conclusions

1. Through the research, in large quantities of construction materials appeared faults in meeting putting specifications, like cement, sand and gravel, this must be attended to increase the carry out of quality researches or use adding materials to which be able to improve construction materials especially sulphates faults in aggregate which threaten durability of concrete and all items which use in aggregate, so the faults appear in summer curing because high temperature in Iraqi summer, we must make a suitable situation to curing and method of sampling in inspection.
2. There were large faults in bricks uses in building caused by type of bricks, which are faults in compressive strength and absorption, this lead to break down the structure, work's quality and type of bricks in performance.
3. For the finishing works, the research found faults in surface leveling and edge's straightness that, because a little technical skill for labor, this case meeting for tiling works.
4. For applying work, the faults appear in shtaiker, tile then marble, work's quality, surfaces leveling in performance and compressive strength in inspection. Good materials and high technical skills must be employed for this item.
5. Wooding and steeling works, main faults appear in wood material, work's quality and surface leveling.
6. The faults appear in roof slope causing by a little work quality leading to crowd water in some places.
7. Sanitarian works, main faults appear in water and follow founded work's quality. This must be improved.
8. Poor coordination of disciplines, the faults appear when accept the work which it don't meeting the specifications effecting on durability and using the structure, in addition to insufficient experience of the engineers, are the main reasons causing construction quality faults.
9. Through the interviews with contractors, the researcher concluded that there is not enough understanding of the subject of quality management in construction.

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Appendix (A1)
Samples of Designers Questionnaire

1. **Specialization:** Architect Engineer Civil Engineer Sanitary Engineer Technical Specialist
2. **Qualification:** Master Bachelor Diploma Specialist
3. **Quality Experience:** Less than 6 years (6 – 10) years (11 – 15) years (16 – 20) years (21 – 25) years
4. **Number of projects involved in:** Control Quality Check Quality Construction Quality
5. **Number of courses involved in :** Control Quality Check Quality Construction Quality No Courses
6. **What does the quality mean to you:** owner's requirements meeting standard specification A measure for product performance
7. **Range of Quality Management Important?** High Impotent Middle Important Little Important
8. **Range of Quality effect on the structure performance?** Large Middle Little
9. **can Construction quality control be verified through controlling the following factors:**
   Specifications Initial materials labor contractors
10. **Can an overall quality control be accomplished? Through the cooperation of:**

leaderships of constructions managements cooperation of the site engineer cooperation of the site technical staff cooperation of the contractor's technical staff cooperation of all the above

11. **Are you of the opinion of setting quality circles specification to each construction process, take the responsibility accomplish quality control?** Yes No
12. **If is yes, do you use quality circles in?** production construction factors major projects minor projects medium sized projects
13. **We make Quality to meet a client's requirements, in construction quality who is client?** Owner Site engineer Users All over above
14. **Would you regard the following as constituting the construction management team?**

owner construction manager designer contractor supplier

15. **Would you consider the owner, when using the general contractor execution approach, having distinct influence?** Yes No

16. **Is it possible to say that the owner, when using construction management execution approach, has flexibility in his favour?** Yes No

17. **Is it possible to consider the construction management execution approach as securing competition amongst contractor to realize the owner's quality goals minimum cost?** Yes No

18. **A person who charges with inspection is he?** Specialized Don't specialized

19. Places which the construction materials taken achieve quality with?
100% 50% Dot achieve quality

20. Experience of construction's working-hands in Iraq?
Good Middle Poor

21. What is an inspection office? Constructional Babylon Laboratory
Babylon University Laboratory Technical Institute laboratory

22. Do you think that the certificate of origin for supplier construction materials is necessary? Yes No

23. Do you know about the international Organization for Standardization, which is called ISO? Yes No

24. How long is the certificate, issued to the materials production companies, by the ISO in Iraq? one year two years Three years don't know

25. Can the aforementioned system be considered as a substitute actual testing on materials having organization? Yes No