APPLICATION COMPARISON BETWEEN CONSTRUCTION QUALITY ASSESSMENT SYSTEM (CONQUAS 21) AND QUALITY ASSESSMENT SYSTEM IN CONSTRUCTION (QLASSIC) FOR CONSTRUCTION PROJECT

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A project report submitted in partial fulfilment of the requirements for the award

of Master of Project Management

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DECLARATION

I hereby declare that this dissertation is based on my original work except for citations and quotations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree or award at UTAR or other institutions.

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APPROVAL FOR SUBMISSION

I certify that this project report entitled "**APPLICATION COMPARISON BETWEEN CONSTRUCTION QUALITY ASSESSMENT SYSTEM (CONQUAS 21) AND QUALITY ASSESSMENT SYSTEM IN CONSTRUCTION (QLASSIC) FOR CONSTRUCTION PROJECT**" was prepared by **LAU YEONG CHERNG** has met the required standard for submission in partial fulfilment of the requirements for the award of Master of Project Management at Universiti Tunku Abdul Rahman.

Approved by,

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Date : _____

DEDICATION

TO MY BELOVED FAMILY, WIFE, DAUGHTER AND FRIENDS

ABSTRACT

APPLICATION COMPARISON BETWEEN CONSTRUCTION QUALITY ASSESSMENT SYSTEM (CONQUAS 21) AND QUALITY ASSESSMENT SYSTEM IN CONSTRUCTION (QLASSIC) FOR CONSTRUCTION PROJECT

Lau Yeong Cherng

The quality of building construction is one of the main issues that concerns developers, contractors, consultants, authorities and property buyers. In Malaysia, there are two common quality assessment systems for construction projects, known as Construction Quality Assessment System (CONQUAS 21) which was developed by Building and Construction Authority (BCA) of Singapore and Quality Assessment System In Construction (QLASSIC) which was developed by Construction Industry Development Board (CIDB) of Malaysia. Therefore, four objectives are formulated for this research and they are: (1) to compare the application of CONQUAS 21 and QLASSIC; (2) to determine the advantages and disadvantages of applying CONQUAS 21 and QLASSIC in construction projects; (3) to examine the hurdles when implementing CONQUAS 21 and QLASSIC in construction projects, and (4) to find out developers and contractors prefer to apply CONQUAS 21 or QLASSIC and the reasons in Malaysia. In order to achieve the objectives of this research, literature review had been conducted to identify the differences in between CONQUAS 21 and QLASSIC. Besides, a survey was conducted by distributing a questionnaire to developers and contractors in Malaysia to identify the advantages, disadvantages, hurdles and the preference, there were total of 23 numbers of developer and 35 numbers of contractors who responded to the survey. The data collected were then analysed by using Relative Importance Index (RII) and Spearman's Rank Correlation Test. The result shows that majority

of the developer and contractor reckoned that the major advantage of applying quality assessment system was this system will improve the product quality, moreover, both developer and contractor also perceived that additional of construction cost was the main disadvantage of applying quality assessment system. On the other hand, developer reckoned that insufficient of skilled worker was the major hurdle for them to apply quality assessment system, however, contractor opined that time constraint was the major hurdle. This research outcomes can provide a clear guideline on the differences in between CONQUAS 21 and QLASSIC to the applicant.

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SUBMISSION OF DISSERTATION

It is hereby certified that **LAU YEONG CHERNG** (ID No: **14UEM05440**) has completed this dissertation entitled **"APPLICATION COMPARISON BETWEEN CONSTRUCTION QUALITY ASSESSMENT SYSTEM (CONQUAS 21) AND QUALITY ASSESSMENT SYSTEM IN CONSTRUCTION (QLASSIC) FOR CONSTRUCTION PROJECT"** under the supervision of **Ir. Dr. LEE WAH PENG** (Supervisor) from the Faculty of Engineering and Science. I understand that the University will upload softcopy of my dissertation in pdf format into UTAR Institutional Repository, which may be made accessible to UTAR community and public.

Yours truly,

_____
(LAU YEONG CHERNG)

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LIST OF ABBREVIATIONS

ACMV	Air Conditioning and Mechanical Ventilation
BCA	Building and Construction Authority
CIDB	Construction Industry Development Board
CONQUAS 21	Construction Quality Assessment System
M&E	Mechanical and Electrical
QLASSIC	Quality Assessment System in Construction
RC	Reinforced Concrete
RII	Relative Importance Index

CHAPTER 1

INTRODUCTION

1.1 Introduction

In this century, customers are more concerned on the building quality and this has become one of the important factors which will affect customers' decision to purchase. Thus, developers nowadays become more pressure to provide the product with excellent quality, in order to attract more customers to purchase from them.

In order to solve the inconsistency in construction quality, Building and Construction Authority (BCA) of Singapore, together with other leading industry professional bodies and organizations had designed the Construction Quality Assessment System (CONQUAS) in year 1988. At later stage, CONQUAS had been evolved and be renamed as CONQUAS 21 in fifth edition.

On the other hand, Quality Assessment System In Construction (QLASSIC), which was developed by Construction Industry Development Board (CIDB) of Malaysia, various professional bodies and associations. Generally, QLASSIC have the same objectives as CONQUAS 21. The purposes of having QLASSIC in Malaysia are to standardize the quality standards in construction industry of Malaysia, to evaluate the performance of the construction, to have a proper standard of assessment system and continue to improve quality of construction. QLASSIC also can be served as quality benchmark for the construction industry in Malaysia. Besides, it also allows the players in this industry to compare relatively and quantitatively the quality of workmanship between their construction projects.

An independent inspector from BCA Singapore or CIDB Malaysia will conduct the assessment for both CONQUAS 21 and QLASSIC respectively. Inspector will only select and inspect several sample of the building rather than evaluate and measure every single unit in the project (BCA, 2005) (CIDB, 2006).

1.2 Problem Statement

Nowadays, majority of the people are more concerned about the building's quality. They will hesitate if the building or product is worth to purchase and is up to the standard. People are always emphasize quality in a construction project, hence CONQUAS 21 and QLASSIC are designed and introduced to the developers and contractors which can act as a reliable guideline for them to produce a quality product.

In Malaysia, CONQUAS 21 and QLASSIC are commonly heard in the construction industry. However, most of the people may not know the differences of standards and specifications in between these two quality assessment system.

Besides, CONQUAS 21 and QLASSIC are still not commonly implemented in Malaysia. Thus, this study will discover the developers' and contractors' perception on the advantages, disadvantages and hurdles of applying these two quality assessment system.

1.3 Objectives

The aim of this research is to study and compare the quality assessment system between CONQUAS 21 and QLASSIC in construction industry in Malaysia.

In order to achieve the aim mentioned above, several objectives are created as below:

1. To compare the standards and specifications of CONQUAS 21 and QLASSIC;

2. To determine the advantages and disadvantages of applying CONQUAS 21 and QLASSIC in construction projects;

3. To examine the hurdles when implementing CONQUAS 21 and QLASSIC in construction projects;

4. To find out developers and contractors prefer to apply CONQUAS 21 or QLASSIC and the reasons for using the quality assessment system in Malaysia.

1.4 Scope of Study

The scope of this research will focus on the developer and main contractor who involved on the building construction for residential development, such as terrace houses, semi-detached houses, high-rise apartments etc. and commercial development, for instance shop office, office tower etc. This is due to quality assessment system is mainly designed to assess building construction works.

1.5 Limitation of Study

The limitation of this study are as follows:

1. Low respondent rate. People might not be willing to spend time to answer the questionnaire which does not bring benefit to them.
2. Reliability of collected data. Some of the respondents might not give the answer accurately, unwilling to disclose the information of their company or might not answer the survey seriously.

3. Insufficient respondents. There were only 23 and 35 numbers of respondents from developer and contractor respectively, who took part in this survey. Thus, the results from this survey may not good enough to shows the perception of majority developer and contractor in Malaysia.

1.6 Layout of Dissertation

This research is organized into five chapters as followings:

Chapter 1 (Introduction) is inclusive of introduction, problem statement, objectives, scope of study and limitation of study.

Chapter 2 (Literature Review) presents of the definition of quality, the introduction of CONQUAS 21 and QLASSIC and the comparison in between these two quality assessment system. The differences of these two quality assessment system will be tabulated in this chapter as well.

Chapter 3 (Research Methodology) describes the methods will be used to carry out this research in order to achieve the objectives.

Chapter 4 (Results and Discussions) shows the results which obtained from the survey and analyzation.

Chapter 5 (Conclusion and Recommendation) concludes the summary of findings obtained from this study and provide some recommendation to government, developer and contractor.

CHAPTER 2

LITERATURE REVIEW

2.1 Definition of Quality

According to Joel E.Ross, the word “quality” has a wide definition and it is an elusive concept due to different people view it differently (Joel E.Ross, 2009). This can be proven by Kerzner, who indicated that quality cannot be defined accurately, as the major reason for quality depends on the view of the customer (Kerzner’s, 2009). Quality experts define quality in other way, they based on the customer’s perspective, specification-based perspective.

With refer to Prof.R.K.Gupta, he define that quality is “fitness for intended use” (Gupta, 2008). Quality can be explained as “meeting or exceeding customer expectations” and “degree of fulfillment of customer needs and expectations” by a vendor. There is no argument that end users rather than vendors are the one who evaluate the quality of the products.

“Functions”, “Safety”, “Aesthetics”, “Reliability”, “Longevity”, “Service-delivery” and “Customer Communication” are the seven essentials of measuring quality and elements to cover customers’ satisfaction and developers’ perception about the quality of product (Gupta, 2008).

According to Joel E.Ross, quality can be summarized into five principal approaches (Joel E.Ross, 2009) as below:

- Transcendental view of quality - cannot be defined, but it can be differentiated by looking product. For instance, advertisement.

- Product-based view - quality is deemed as quantifiable and measurable characteristics. For instance, measure product's durability or reliability (e.g. mean time of failure or finish) and design the product to the benchmark. Although this approach has a lot of benefit, but it has restriction as well. In fact, quality is mostly based on individual taste or preference, therefore the benchmark for measuring may be misleading.
- User-based view - products that meet customers' preferences are esteemed as highest quality. This may lead to two problems, one is the differences of customers' preferences and the other is the difficulty of unifying the different preferences of customers. This approach can identify the products that meet the needs of major customers.
- Manufacturing-based view - products are complied with the requirements, or specification. This concept applies to both services and products. Good quality product is not necessary in the eye of end-user but in the standards or specification set by the organization.
- Value-based view - quality is defined in terms of costs, prices and other attributes. Therefore, the materialization of customers' decision mostly depends on the quality at an acceptable price.

2.2 CONQUAS 21

CONQUAS 21 is a quality assessment system used to assess three components in the building, which inclusive of structural works, architectural works and mechanical & electrical works. The assessment for structural works will be carried out during

construction stage, however, the assessment for architectural works and M&E works will be carried out after the completion of the building. CONQUAS 21 is widely applied in housing project, factory, institution, high rise and special building such as airport, hospital and etc. Although this not compulsory to developer to apply this quality assessment system, but developer can take the initiative to specify in the contract in order to get a quality product.

The first edition of CONQUAS 21 was introduced in year 1989, to evaluate the quality performance of building contractors in the public sector (Tang, 2005). In 1991, CONQUAS 21 was applied to the superstructure works of private projects and public housing project sold by Housing and Development Board of Singapore in 1993. In 1998, the assessment of mechanical & electrical (M&E) works was included in the fifth edition, to replace the external works component, in order to make CONQUAS 21 scoring more accurate and customer-oriented (Chiang, 2005). In order to focus on the latent defects, the sixth edition was launched in 2005, incorporated with the wet area water-tightness testing and in progress inspection for internal wet area waterproofing works to ensure better quality assurance and higher CONQUAS score.

2.3 QLASSIC

Construction Industry Development Board (CIDB) introduced a quality assessment system, known as Quality Assessment System In Construction (QLASSIC) in 2006. QLASSIC has adopted the main assessment elements from CONQUAS. Therefore, both of the quality assessment systems are similar. The QLASSIC Score is evaluated by an

independent assessor, which indicate the level of quality for a given project, the higher the score, the better the product quality.

2.4 Comparison Between CONQUAS 21 and QLASSIC

2.4.1 Objectives

CONQUAS 21 was designed with three objectives (BCA, 2005):

1) To have a standard quality assessment system for construction projects

2) To make quality assessment objective by:

- measuring constructed works against workmanship standards and specification
- using a sampling approach to suitably represent the whole project

3) To enable quality assessment to be carried out systematically within reasonable cost and time

QLASSIC was designed and developed to enable the user to achieve any of the following objectives (CIDB, 2006):

1) To benchmark the level of quality of the construction industry in Malaysia

2) To have standard quality assessment system for quality of workmanship of building projects

3) To assess quality of workmanship of a building project based on the approved standards

4) To evaluate the performance of contractors based on quality of workmanship

5) To compile data for statistical analysis

Comparison:

In general, the objectives for both CONQUAS 21 and QLASSIC are similar. The differences in objectives between CONQUAS 21 and QLASSIC are, i) CONQUAS 21 is to enable quality assessment system to be carried out systemically within reasonable cost and time; ii) QLASSIC is to evaluate the performance of contractors based on quality of workmanship and; iii) QLASSIC is to compile data for statistical analysis.

2.4.2 Scope

CONQUAS provides the standards and specifications for the various aspects of construction work and give points for the works that meet the standards. All these points will be summed up and called CONQUAS Score to indicate the quality achievement for the building.

CONQUAS 21 consists of three components:

1) Structural Works
2) Architectural Works
3) Mechanical & Electrical (M&E) Works

Each component is further divided into different items for assessment. However, piling, heavy foundation and sub-structure works are excluded from the assessment. The building is assessed primarily on workmanship standards achieved through site inspection and field testing. The inspection is done throughout the construction process for Structural works, M&E works and on the completed building for Architectural works.

Apart from site inspection, the assessment also includes tests on the materials and the functional performance of selected services and installations. (BCA, 2005)

QLASSIC sets out the quality of workmanship for the various aspects of the construction elements for the general building works.

QLASSIC cover four main components:

1) Structural Works
2) Architectural Works
3) Mechanical and Electrical (M&E) Works
4) External Works

Assessments on the workmanship are carried out based on this standard and marks are awarded if the workmanship complies with the standards. These marks are then summed up to give a total quality score (%) for the building project.

QLASSIC excludes works such as piling, foundation and sub-structure works which are heavily equipment-based and called under separate contracts or sub-contracts.

The building is assessed primarily on workmanship standards achieved through site inspection and field testing. The assessment is done throughout the construction process for Structural and M&E works. For completed building projects the assessment is done for Architectural, M&E fittings and External Works. (CIDB, 2006)

Comparison:

	CONQUAS 21	**QLASSIC**
Assessed by using point system	√	√
Structural Works	√	√

Architectural Works	√	√
Mechanical & Electrical Works	√	√
External Works	X	√
Site Inspection	√	√

Table 1: Scope comparison

2.4.3 Components To Be Assessed

The CONQUAS assessment is divided into three main components:

a) Structural Works

The structural integrity of the building is of paramount importance as the costs of failure and repairs are very significant. The assessment of Structural Works comprises:

- Site inspection of formwork, steel reinforcement, prefabricated components etc during construction. The assessment shall include structural steel and pre-stressed concrete if each constitutes more than 20% of the total structural cost. Precast elements will also be assessed if the precast concrete volume exceeds 20% of total structural concrete volume.
- Laboratory testing of compressive strength of concrete and tensile strength of steel reinforcement.
- Non-destructive testing of the uniformity and the cover of hardened concrete.

b) Architectural Works

Architectural works deals mainly with the finishes and components. This is the part where the quality and standard of workmanship are most visible. The assessment covers:

- Site inspection of internal finishes, roofs, external walls and external works at the completion stage of the building. Internal finishes include floors, internal walls, ceiling, doors, windows and components which are not classified above.
- Material and functional tests such as on window water-tightness, wet area water tightness test and adhesion of internal wall tiles. There is also in-process assessment on installation of waterproofing for internal wet areas.

c) Mechanical & Electrical (M&E) Works

The quality of M&E works is important in view of its increasingly high cost proportion and its impact on the performance of a building. The assessment covers Electrical Works, Air-Conditioning & Mechanical Ventilation Works (ACMV), Fire Protection Works, Sanitary & Plumbing Works and the basic M&E fittings. The stages of assessment include:

- Site inspection of installed works before embedded or concealed. Such items include ACMV ductworks, electrical conduits, concealed pipes etc.
- Site inspection of final installed works such as the Air-Handling Unit (AHU), cooling tower, fire alarm control panel etc.
- Performance tests on selected works such as the Water Pressure Test, Earthing Test, Dry Riser Test etc.

QLASSIC divides the quality standards for building construction work into four main components:

a) Structural Works

The structural integrity of the building is of paramount importance as the cost of failure and repairs are very significant. The assessment of structural works comprises:

- Site inspection of formwork, steel reinforcement, prefabricated or precast elements etc during construction
- Laboratory testing of compression strength of concrete and tensile strength of steel reinforcement
- Non-destructive testing of the uniformity and the cover of hardened concrete

b) Architectural Works

Architectural works deal mainly with the finishes. This is the part where the quality and standards of workmanship are most visible.

Architectural works are works such as floors, internal walls, ceiling, door and window, fixtures and fittings, external wall, roofs, driveway, porch and apron.

c) Mechanical and Electrical (M&E) Works

The quality of M&E works is important in view of its increasingly high cost proportion and its impact on the performance of a building. The assessment covers electrical works,

air-conditioning and mechanical ventilation works (ACMV), fire protection works, sanitary and plumbing works, lifts, escalator and other basic M&E fittings.

d) External Works

External works cover the general external work elements in building construction such as the link-ways, shelters, drains, road works, car parks, footpaths, turfings, playgrounds, gates and fences, swimming pools, hardscapes and electrical substation.

Comparison:

The components of CONQUAS 21 and QLASSIC are quite similar. However, there is only one difference, it is CONQUAS 21 does not have external works. In fact, the external works was grouped together with architectural works.

The following tables are the comparison of sub-components to be assessed between CONQUAS 21 and QLASSIC:

Quality Standards for Structural Works

Part 1: Reinforced Concrete Structures

No.	Item	Standards	
		CONQUAS 21	QLASSIC
1	Formwork		
1a	Formwork dimensions and openings for services	1) Tolerance for cross-sectional dimensions of cast in-situ & precast elements: +10mm/-5mm	1) Same
		2) Tolerance for penetration/opening for services: +10mm for size and ±25mm for location	2) Same

		3) Tolerance for length of precast members (major dimension of unit): • Up to 3m: ±6mm • 3m to 4.5m: ±9mm • 4.5m to 6m: ±12mm • Additional deviation for every subsequent 6m: ±6mm	3) Same
1b	Alignment, plumb and level	1) Tolerance for departure of any mark from its position: 10mm	1) Same
		2) Tolerance for plumb: 3mm/m, maximum 20mm	2) Same
		3) Maximum deviation of mean level of staircase tread to temporary bench mark: ±5mm	3) Same
		4) For cast in-situ elements, the deviation of level of any mark from the intended level: ±10mm	4) Same
1c	Condition of formwork, props and bracing	1) Formwork must be free from defects	1) Same
		2) Before concreting, the interior must be free from debris	2) Same

		3) All formwork joints must not have gaps to prevent leakage	3) Same
		4) There must be adequate support, bracing and tieback for the formwork to prevent bulging or displacement of structural elements	4) Same
2	Reinforcement (Cast In-Situ & Precast)		
2a	Main and secondary rebars	1) According to structural drawings (numbers/sizes)	1) Same
		2) Spacing of bars not more than that specified	2) ±10mm
2b	Anchorages and lap lengths	1) Required lap length not less than that specified	1) Same
2c	Cover provision	1) According to specifications with tolerance of +5mm	1) Same
2d	Links, stirrups and trimming bars	1) According to structural drawings (numbers/sizes)	1) Same
2e	Rebar condition	1) Rebars must be securely and properly tied in place	1) Same
		2) Rebars must be free from concrete dropping, corrosion etc.	2) Same

3	Finished Concrete (Cast In-Situ & Precast)		
3a	Dimension for elements/opening for services	1) Tolerance for cross-sectional dimension of cast in-situ and precast elements: +10mm/-5mm	1) Same
		2) Tolerance for opening: +10mm for size and ±25mm for location	2) Same
		3) Tolerance for length of precast members (major dimension of unit): • Up to 3m: ±6mm • 3m to 4.5m: ±9mm • 4.5m to 6m: ±12mm • Additional deviation for every subsequent 6m: ±6mm	3) Same
		4) Straightness or bow (deviation from intended line) of precast member: • Up to 3m: 6mm • 3m to 4.5m: 9mm • 4.5m to 6m: 12mm • Additional deviation for every subsequent 6m: 6mm	4) Straightness or bow (deviation from intended line) of precast member: • Up to 3m: ±6mm • 3m to 4.5m: ±9mm • 4.5m to 6m: ±12mm • Additional deviation for

			every subsequent 6m: ±6mm
		5) Squareness of precast member-Difference between the greatest and shortest dimensions should not exceed the following: Length of shorter sides • Up to and including 1.2m: 6mm • Over 1.2m but less than 1.8m: 9mm • 1.8m and over: 12mm	5) Squareness of precast member-Difference between the greatest and shortest dimensions should not exceed the following: Length of shorter sides • Up to and including 1.2m: ±6mm • Over 1.2m but less than 1.8m: ±9mm • 1.8m and over: ±12mm

		6) Twist of precast member - Any corner should be not more than the deviation stated from the plane containing the other 3 corners: • Up to 600mm wide and 6m in length: 6mm • Over 600 mm wide and for any length: 12mm	6) Twist of precast member - Any corner should be not more than the deviation stated from the plane containing the other 3 corners: • Up to 600mm wide and 6m in length: ±6mm • Over 600 mm wide and for any length: ±12mm
		7) Flatness: 6mm per 1.5m	7) Flatness: 6mm per 1.2m
3b	Alignment, plumb and level	1) Tolerance for departure of any point from its position: ±10mm	1) Same
		2) Tolerance for plumb: 3mm/1m, maximum 20 mm for floor to floor height and 40 mm for the entire building height	2) Same
		3) Maximum deviation of mean level: ±10mm	3) Same
		4) For cast in-situ elements, the maximum deviation of levels within the elements: 10mm	4) For cast in-situ elements, the maximum deviation of levels within the elements: ±10mm

		5) Chamber at mid-span: according to specifications	5) Same
3c	Exposed surface	1) Should not have visual exposure of groups of coarse aggregates resulting from grout leakage	1) Same
		2) Cold joint & formwork joint must be smooth	2) Same
		3) No bulging of structural element	3) Same
		4) All formwork, nails, zinc strips, etc must be removed	4) Same
		5) No cracks or damages	5) Same
		6) Not specified	6) No exposed rebar
4	Precast Specific Requirements		
4a	Lifting points/inserts	1) Tolerance for position: ±20mm from centre line location in drawing	1) Same
		2) Lifting devices and inserts free from damages	2) Same
4b	Sleeve system/connection	1) Tolerance for position: ±6mm from centre line location in drawings	1) Same
		2) Bar protrusion length according to requirements. No bending, cranking or	2) Same

		damages to bars	
		3) Bars free from concrete droppings or corrosion	3) Same
		4) Sleeves, grout holes, grout tubes not congested with debris	4) Same
4c	Interface/joint requirement	1) Joint taper: • Over 3m length: 6mm • Maximum for entire length: 9mm	1) Joint taper: • Over 3m length: ±6mm • Maximum for entire length: ±9mm
		2) Alignment of horizontal and vertical joint: ±6mm	2) Same
		3) Jog in alignment of matching edges: 6mm	3) Jog in alignment of matching edges: ±6mm
		4) Sitting of element: according to specifications	4) Same
		5) Installation of sealant and waterproofing: according to specifications	5) Same
4d	Cast-in steel items/welded & bolted connection	1) Tolerance for position of cast-in steel items: ±6mm from centre line location in drawings	1) Same

		2) Tolerance for position of openings for bolt connections: ±3mm from centre line location in drawings	2) Same
		3) Relevant requirements in CONQUAS steelwork standards to be used where applicable	3) Not specified
5	Structure Quality		
5a	Concrete Cube test	1) According to specifications; for every pour of concrete, test cubes results at 28 days must satisfy the passing criteria as in SS289	According to specifications; for every pour of concrete, test cubes results at 28 days must satisfy the passing criteria in relevant approved standard
5b	Reinforcement (Rebar)	1) To pass the tensile strength test for all the reinforcement bars used as according to: • SS2:1999 for Grade 500 ribbed bars or • SS2:1987 for Grade 460 ribbed bars	1) To pass the tensile strength test for all the reinforcement bars used as according to: • Approved Standard for Grade 500 ribbed bars • Approved Standard for Grade 460 ribbed bars

		2) All the welded steel fabric used to comply with SS32 in their respective specified characteristic strength of not less than 250 N per mm2, 460 N per mm2 and 485 N per mm2	2) All the welded steel fabric used to comply with approved standard in their respective specified characteristic strength of not less than 250 N per mm2, 460 N per mm2 and 485 N per mm
		3) No non-conforming reinforcement detected through test records has been installed in the structure	3) Same
6	Non-destructive testing		
6a	Ultra Pulse Velocity (UPV) test for Concrete Uniformity	1) To conduct NDT using ultrasonic pulse velocity (UPV) to check the degree of uniformity of hardened concrete	1) Same
		2) 5 columns/walls per set and 2 readings per column/wall	2) Same
		3) Assessment is based on the difference between 2 UPV readings within a column/wall not exceeding 0.05 km/s	3) Same
		4) Method as per SS78:Part B3:1992	4) Method as per approved standard

6b	Electro-Covermeter test for concrete cover	1) To check hardened concrete cover for reinforcement bars after casting	1) Same
		2) 5 structural members per set including: • 3 for slab soffit @ 4 readings each • 1 for column @ 2 readings each on both axis of the column • 1 for beam @ 2 readings each on the soffit and one side of the beam	2) Same
		3) For each reading, full point for ±5 mm and half point for > ±5 mm to ±8 mm. For each location, no point will be awarded if any of the 4 readings exceeds ±12 mm	3) Same
		4) Method as per SS78:Part B4:1992	4) Method as per approved standard

Table 2: Reinforced concrete structure

Part 2: Structural Steel Works

No.	Item	Standards	
		CONQUAS 21	QLASSIC
1	Main member/partial assembled component		
1a	Physical dimensions	1) Cross sectional tolerance should meet approved structural steel specification or approved plan	1) Same
		2) Tolerance for length of structural steel member: ±3mm	2) Same
		3) Tolerance for bolt hole size: • ≤2mm for bolt diameter <24mm • ≤3mm for bolt diameter ≥24mm Tolerance for bolt hole position: ±2mm	3) Tolerance for bolt hole size: • 2mm for bolt diameter <24mm • 3mm for bolt diameter =24mm Tolerance for bolt hole position: ±2mm
1b	Type and condition	1) According to the structural steel specifications	1) Same
		2) Surface preparation shall meet the surface roughness specifications	2) Same
		3) Material used must be traceable to its original mill certificates	3) Same

1c	Welding	1) Welding size, length and profile shall meet the structural steel specifications and drawings	1) Same
		2) Visual inspection shall meet the structural steel specifications	2) Same
		3) All weld shall follow approved welding procedures	3) Not specified
		4) All welding must be done by qualified welders	4) Same
1d	Bolting	1) Bolts and washers, type, size and number shall be according to the structural steel specifications	1) Same
		2) Drilled holes shall be free from burrs	2) Same
		3) The condition of bolted parts adjacent to the bolt heads, nuts, flat washers, connection gussets and splice plates shall be free from oil, paint, and loose mill scales or otherwise specified by the structural steel specifications	3) Same
		4) Gap between adjacent parts shall not exceed 2mm	4) Same
		5) Bolts shall be tightened to specified torque or as specified by the structural steel specification	5) Not specified

		6) Threaded bolts protruding at least one thread length with washers	6) Same
2	Metal decking		
2a	Type and condition	1) Correct type and thickness of metal decking used	1) Same
		2) All decking joints must not have gaps	2) Same
		3) All metal decking must be properly secured in place	3) Same
		4) Metal decking must be free from defects and visible damages	4) Same
		5) Before concreting, the decking must be free from grease, oil, paint and all other foreign materials	5) Same
		6) All accessories such as pour stop, and end closures and cover plates must be in place before concreting	6) Same
2b	Shear studs	1) Correct numbers and type of shear studs used	1) Same
		2) Spacing and position according to approved plan	2) Same
		3) Strength of shear stud welds not less than specified	3) Same
		4) All welds should show a full 360degree weld fillet. All welds free from visible	4) Same

		damages	
2c	Lapping and deck openings	1) According to structural steel specifications or approved plan	1) Same
3	Erection tolerances		
3a	Column verticality	1) Tolerance for verticality: ±H/600 mm or 5 mm, maximum ±25 mm; where H is the floor to floor height in mm	1) Same
3b	Column position	1) The position in plan of a steel column at the base shall not deviate from the specified position by more than 10mm along either of the principal setting out axes	1) Same
3c	Beam level	1) Maximum deviation of level at each end of the same beam: ±5mm	1) Same
		2) The level of the top of the steelwork at any storey shall be within ±10 mm of the specified level	2) Same
3d	Beam position	1) Beams shall not deviate from their specified positions relative to the column to which they are connected by more than 5 mm	1) Same
4	Corrosion and fire protection		
4a	Thickness of coating	1) Average thickness of the	1) Same

		coating or the protective layer must not be less than specified	
4b	Condition	1) No visible damages	1) Same
		2) No spalling of coating or protective layer from structural steel members	1) Same
5	Welding test reports	1) Reports for all critical welding joints from the specified contract requirements must be submitted	1) Same
		2) Test reports must comply with the acceptable criteria and to be endorsed by client's representative	2) Same

Table 3: Structural steel works

Part 3: Pre-stressed Concrete

No.	Item	Standards	
		CONQUAS 21	QLASSIC
1	Condition of tendons & anchorages	1) All pre-stressing strands and wires should comply with the specified standards and requirements and be free from loose rust, oil, tar, paint and any foreign objects	1) Same
		2) All tendon anchorage are to comply with the specified standards and protected from corrosion Thread parts to be greased wrapped and tapped holes protected until use	2) Same
2	Installation of sheathing	1) Sheathing properly secured and protected and free from damage or puncture	1) Same
		2) Sheathing profile according to drawings throughout the length with position tolerance: ±5mm	2) Same
		3) Splice to sheathing shall be mortar tight	3) Same
		4) Air vents grout tubes provided according to the drawing	4) Same
3	Stressing & Grouting process	1) Tendon ducts clean and free from foreign objects and tendon free moving in the	1) Same

		duct	
		2) Strands stressed to the final pressure/elongation within the specific % accuracy of the stipulated value	2) Not specified
		3) All grouting operations of the tendons must be smooth and achieved without need to flush out in the first grouting	3) Same
4	Debonding	1) Open ends of debond tubes over the debond length of strands sealed	1) Same
		2) Debond lengths according to the drawings	2) Same
		3) Debonding materials not punctured or damaged	3) Same

Table 4: Pre-stressed concrete

Quality Standards For Architectural Works

Part 1: Internal Finishes

No.	Item	Standards	
		CONQUAS 21	QLASSIC
1	Floors		
1a	General requirements	1) Finishing • No stain marks • Consistent colour tone	1) Same
		2) Alignment & Evenness • Evenness of surface: <3mm per 1.2m • Falls in wet areas should be in right direction • No ponding in falls for wet area • For staircases, the variance in lengths of threads and risers must not exceed 5mm; nosing must be straight	2) Alignment & Evenness • Same • Same • Not specified • For staircases, the variance in lengths of treads and risers must not exceed 5mm from dimensions specified in the approved drawings
		3) Crack and damage	3) Same

		• No visible damage/defects	
		4) Hollowness/Delamination • No hollow sound when tapped with a hard object • No sign of delamination	4) Same
		5) Jointing • Consistent skirting thickness and no visible gap between wall & skirting	5) Jointing • Consistent skirting thickness and no visible gap between wall & skirting • Edge to be straight and aligned: 3mm per 1.2m
1b	Screed finish	1) Surface should not be unduly rough or patchy	1) Same
		2) Expansion joints should be provided at interval as stated by architect	2) No permanent foreign material visually detected
1c	Tiled finish	1) Consistent and neat pointing	1) Not specified
		2) No hollow sound when tapped with a hard object	2) Not specified
		3) Joints are aligned and consistent with skirting and wall tiles	3) Same
		4) Consistent joint size	4) Consistent and neat marking
		5) Lippage between 2 tiles should not be more than 1mm	5) Same
		6) Expansion joints should be provided at interval as stated by architect	6) Not specified

1d	Timber floor	1) No warpage	1) Same
		2) Timber strips to rest firmly on joists or screeds	2) Same
		3) No visible gaps between timber strips	3) Same
		4) Edges of the floor to be properly sealed	4) Same
1e	Carpet	1) Stretched and even surface	1) Surface should be stretched and even: 3mm per 1.2m
		2) Joints should not be visible	2) Same
		3) All edges should be properly anchored	3) Same
1f/1g	Raised floor	1) No loose floor panels or rocking	1) Same
		2) No protrusion/ potential of tripping over floor panels	2) Same
1f	Special floor finish	1) Not specified	1) Finished texture and colour to be uniform
		2) Not specified	2) Follow general requirement where applicable
2	Internal walls		
2a	General requirements	1) Finishing • No stain mark • Consistent colour tone • No rough/patchy surface	1) Finishing • Same • Consistent colour tone and good paintwork • Same
		2) Alignment & Evenness • Evenness of surface: <3mm per 1.2m • Verticality of wall: <3mm per 1.2m • Walls meet at right angle: <4mm over 300mm • Edges to appear	2) Alignment & Evenness • Same • Same • Same • Edge to be straight and aligned: 3mm per

		straight and aligned	1.2m
		3) Crack & Damages • No visible damage/defect	3) Same
		4) Hollowness/Delamination • No hollow sound when tapped with a hard object • No sign of delamination	4) Same
		5) Jointing • Straightness of corners and joints	5) Not specified
2b	Plaster finish	1) Surface evenness: <3mm over 1.2m	1) Not specified
		2) No hollow sound when tapped with a hard object	2) Not specified
		3) Surfaces should not be unduly rough or patchy esp no brush/trowel marks	3) Not specified
		4) Not specified	4) No visual crack
2c	Tiled finish	1) Tile joints aligned and with consistent joint size	1) Same
		2) No hollow sound when tapped with a hard object	2) Not specified
		3) Consistent and neat pointing	3) Consistent and neat marking
		4) Lippage between 2 tiles: <1mm	4) Same
2d/2g	Cladding	1) Proper anchorage for panels	1) Same
		2) Joints aligned and with consistent joint size	2) Same
		3) Sealant material compatible with cladding	3) Same
		4) Consistent spacing and within allowable tolerance	4) Consistent spacing and within allowable tolerance: <3mm per 1.2m
		5) Not specified	5) No sign of corrosion
2e/2j	Architectural Coating	1) Substrade – see plaster finish	1) Not specified

		2) Finished texture and colour to be uniform	2) Same
2f/2d	Painting	1) Substrate – see plaster finish	1) Not specified
		2) Surfaces are evenly painted with no visible brush marks	2) Surfaces are evenly painted
		3) Good opacity, no patchiness resulted from touch up work	3) Same
		4) Surface should be free from peeling, blister, chalkiness (No discolouration and fading)	4) Same
2g	Pre-cast concrete planks	1) Alignment with adjacent planks: <3mm	1) Not specified
2h/2e	Wall Paper	1) Stretched and even surface	1) Wall paper should be stretched and even surface: <3mm per 1.2m
		2) Joints should not be visible	2) Same
		3) Edges should be neatly laid and finished	3) Same
		4) Proper anchoring at all edges	4) Same
2i/2h	Glass blocks	1) Pointing should be satisfactory	1) Consistent and neat marking
		2) Joint should be even	2) Same
		3) Glass blocks should be properly aligned	3) Same
2j/2f	Wood/Timber panels	1) Timber panels should rest firmly on joists or render	1) Same
		2) No visible gaps between panels	2) Same
		3) Edges should be properly aligned and sealed	3) Same
		4) No warpage	4) Cracks and warpage should not be detected

		5) Not specified	5) Surface should be smoothly Finished
3	Ceilings		
3a	General requirements	1) Finishing • No stain marks • Consistent colour tone • No patchy surface	1) Same
		2) Alignment & Evenness • Overall surface should be smooth, even, not wavy • Straightness of corners	2) Same
		3) Crack & Damages • No visible damage e.g. spalling, leaks, cracks, etc	3) Same
		4) Roughness • No rough surface	4) Same
		5) Jointing • Consistent, aligned and neat	5) Same
3b	Skim coats/boarded ceiling	1) Not patchy, with no pin holes and with no trowel marks	1) No pin holes and with no trowel marks
		2) Formwork joints are grounded smooth	2) Same
		3) Paintwork with good opacity and with no brush marks	3) Same
		4) Access door joints should be sharp and in consistent width	4) Access door joints should be neat and have consistent Width
		5) Not specified	5) No gap between wall and Ceiling
		6) Not specified	6) No sign of corrosion
3c	False ceiling/grid	1) Alignment of rails should be	1) Same

	system	visually straight	
		2) Surface should be overall level and even	2) Not specified
		3) Chipped surfaces or corners should not be seen	3) Chipped/cracked surfaces or corners should not be Detected
		4) Not specified	4) Gap between ceiling and wall should not be detected
		5) Not specified	5) Panels should not warp and laid neatly into grids
		6) Not specified	6) No sign of corrosion
4	Doors	1) Joints & Gap • No visible gaps between door frame and wall • Consistent & neat joints • Consistent gap between door leaf and frame: <5mm	1) Joints & Gap • Same • Same • Same • Consistent gap between bottom of door leaf and finished floor: <5mm
		2) Alignment & Evenness • Alignment/level with walls • Door frame and leaf to flush • Door leaf and frame corners maintained at right angles	2) Alignment & Evenness • Parallel to with the walls • Same • Same • Door frame to be plumb and square • Double leaf doors to flush with each other
		3) Material & Damages • No stain marks and any visible damage • No sags, warps on door leaf	3) Material & Damages • Same • Same • Not

		• Fire stop provided where necessary • Door joints and nail holes filled up, properly sanded down and with good paint finish (including on top and bottom of door leaf and consistent in colour) • Glazing clean and evenly sealed with gasket • No sign of corrosion for metal frame • Consistent colour tone	specified • Same • Not specified • Same • Not specified
		4) Functionality • Ease in opening and closing • No squeaky sound during swinging the leaf	4) Functionality • Same • No squeaky sound during opening and closing of the door: tested 5 times continuously • Lockset should be functional: tested 20 times continuously
		5) Accessories defects • Lock sets with good fit and no stains • No sign of corrosion in ironmongery • No missing or defective accessories	5) Accessories defects • Same • Same • Same
		6) Not specified	6) For timber frame, no additional timber strip added

			for site adjustment should be detected
5	Windows	1) Joints & Gaps • Consistent gap between window leaf and frame: <5mm • No visible gap between window frame and wall • Neat joint between window frame and wall internally and externally	1) Joints & Gaps • Same • Same • Same
		2) Alignment & Evenness • Alignment/level with wall openings • Window leaf and frame corners maintained at right angles	2) Alignment & Evenness • Parallel with wall opening • Window leaf and frame corner maintained at right angle: <4mm per 300mm • Window frame to be plumb and square
		3) Material & Damages • No stain mark & visible damage / defect • Louvered window with glass panels of correct length • Glazing clean and evenly sealed with putty or gasket for aluminium windows	3) Material & Damages • Same • Same • Same • No sign of corrosion • Good paintwork
		4) Functionality • Ease of opening and closing • No sign of rainwater leakage	4) Functionality • Same • No squeaky sound during

		• No squeaky sound during swinging the leaf	opening and closing of the window: tested 5 times continuously
		5) Accessories defects • Lock sets with good fit and aligned • No sign of corrosion • No missing or defective accessories • Rivet at hinges in stainless steel	5) Accessories defects • Same • Same • Same
6	Components	Internal fixtures such as wardrobe, kitchen cabinet, vanity top, bathtub, water closet, shower screen, railings, basin, etc	Internal fixtures such as wardrobe, kitchen cabinet, vanity top, bathtub, water closet, shower screen, railings, basin, etc
6a	General requirements	1) Joints & Gap • Consistent joint width & neat joint • No visible gap	1) Joints & Gap • Same • Same
		2) Alignment & Evenness • Level and in alignment	2) Alignment & Evenness • Same
		3) Material & Damages • No stain mark • No visible damage/defect • Consistent in colour tone	3) Material & Damages • Same • Same • Same
		4) Functionality • Function, secured and safe	4) Functionality • Same
		5) Accessories defects • No missing accessory • No sign of corrosion • No visible damages/defect	5) Accessories defects • Same • Same • Same

6b	Railings	1) Verticality of balusters: <3mm per metre	1) Same
		2) Welding at joint must be grounded or flush	2) Same

Table 5: Internal finishes

Part 2: Roof

No.	Item	Standards	
		CONQUAS 21	QLASSIC
1	Roof		
1a	General requirements	1) Stain/Painting • No stain marks • Good paint works	1) Same
		2) Rough/ Uneven/ Falls • Look smooth and with no tool marks • Even and level especially no potential in stripping • Good falls in right direction	2) Rough/ Uneven/ Falls • Same • Same • Same
		3) Crack/Chip/Damage • No visible damage/ defects	3) Crack and damages • No visible damage/ defects e.g. cracks, chip and etc.
		4) Joint/ Sealant/ Alignment • Consistent joint width, neat and aligned	4) Joint/ Sealant/ Alignment • Same
		5) Chockage/ Ponding	5) Chockage/

		• No sign of chockage / ponding	Ponding • Same
		6) Construction • No sign of leaking • Proper dressing for any protrusion • Neat and secured installation of fixtures	6) Construction • Same • Same • Same
1b	Flat roof	1) Ponding: <3mm	1) Same
		2) Surface to level to avoid tripping	2) Same
		3) Proper dressing for any protrusion	3) Same
		4) Openings to be sealed to prevent pest invasion	4) Same
		5) Clean and no stain marks	5) Same
1c	Pitched roof	1) No leaking	1) Same
		2) No rust or stains	2) Same
		3) Good painting to roof structural members	3) Same
		4) Roof tiles in alignment	4) Same
		5) Openings to be sealed to prevent pest invasion	5) Same
		6) Consistent colour tone	6) Same
		7) Proper dressing for any protrusion	7) Same
1d	Waterproofing (exposed)	1) Should be evenly installed, no sharp protrusion	1) Same
		2) Complete adhesion to base	2) Same
		3) Good laps at joints and proper vertical abutment details	3) Same
		4) No leaking and sign of damage to membrane / coating	4) Same

		5) Clean and no mortar stains	5) Same
		6) No paint defects	6) Same
1e	Gutters and rainwater down pipes (RWDP)	1) No ponding and chockage	1) Same
		2) No cracks, chips and any other visible damages/ defects	2) Same
		3) RWDP inlet should be lower than the surrounding gutter invert level	3) Same
		4) Gutter and RWDP inlet to be covered to prevent chockage where practical	4) Same
		5) Clean and no cement stains	5) Same

Table 6: Roof

Part 3: External Wall

No.	Item	Standards	
		CONQUAS 21	QLASSIC
1	General requirements	1) Evenness/Roughness • Overall surface should be even, not wavey & not patchy	1) Roughness • Not wavy and not patchy
		2) Staining/Painting • No visible stain marks • Good paint works	2) Finishing • No stain mark • Consistent colour tone and good paintwork

		3) Cracking/Damages • No visible damage/defects	3) Crack and damage • Same
		4) Jointing/Alignment • External features visually in alignment • Corners of wall maintained at right angles and straight • Consistent joint width, neat & aligned	4) Not Specified
2	Plaster finish	1) As above	1) As per *General Requirement* above
3	Tiled finish	1) Tile joints aligned and between 2-4mm wide unless specified	1) Joint are aligned between tiles and consistent size
		2) Plumb tolerance and evenness of surface: 3mm over 1.2m	2) Not specified
		3) Not specified	3) Consistent and neat marking
		4) Not specified	4) Lippage between 2 tiles should not be more than 1mm
4	Claddings/Curtain Walls	1) Gaps around openings to be properly sealed	1) Same
		2) Joint of regular widths as Specified	2) Same
		3) Plumb tolerance as specified	3) Not specified
		4) Evenness of surface, no dent or scratches	4) Same
		5) Sealant material compatible	5) Same

		with cladding	
		6) Not specified	6) No sign of corrosion
5	Facing brickwork	1) 10mm joints with pointing	1) 10mm joint with marking
		2) Weep holes are provided as Specified	2) Same
		3) No mortar droppings and other stains	3) Not specified
		4) No efflorescence	4) Same
6	Architectural coating	1) Substrate – see plaster finish	1) Not specified
		2) Finished texture and colour to be uniform	2) Same
		3) No paint drips and other stains	3) Same
7	Painting	1) Substrate – see plaster finish	1) Not specified
		2) Surfaces are evenly painted; no patchiness due to touch up work	2) Same
		3) Good opacity, no Discolouring and free from peeling	3) Good opacity, no discolouration and fading
		4) Not specified	4) Surface should be free from peeling, blister and chalkiness

Table 7: External Wall

Part 4: External Works

No.	Item	Standards	
		CONQUAS 21	QLASSIC
1	General requirements (basis for assessment)	1) No stain marks and visible damages/ defects	1) Same
		2) Finishes must be even, level, align and consistent	2) Same

		3) Consistent joints width and Neat	3) Same
		4) Paintworks with good opacity, no patchiness and brush marks	4) Same
		5) Constructed according to Contract Specification	5) Not specified
		6) Fixtures installed must be safe, secured and functional	6) Same
		7) Standards defined under Part 1: internal finishes, Part 2: roof and Part 3: External wall shall apply for similar items	7) Same
1a	Link-Way/Shelter	1) Floor as per Internal Finishes – Floor	1) Same
		2) Column as per Internal Finishes – Wall	2) Column as per *External Wall* where applicable
		3) Ceiling as per Internal Finishes – Ceiling	3) Same
		4) Other finishes as per Internal Finishes – Components	4) Other finishes as per *Fixtures - External*
		5) M&E Fitting as per M&E Works – Part 5 Basic M&E Fittings	5) Same
		6) Not specified	6) Same
1b	Apron & drain	1) Drain • Free flowing and no ponding of water	1) Drain • Same
		2) Drain cover • Level and do not warp or rock • Gap between drain covers and side of drain: 5-10mm wide • Drain grating properly painted	2) Drain cover • Same • Same • Same
		3) Apron • Bitumen joints with neat edges and sufficient length	3) Apron • Same • Same

		• No ponding • Not specified	• No visible cracks
		4) Inspection chamber • Inspection chambers are level with surrounding without depression and with tolerance of 20mm for protrusion • Covers to be level with frames	4) Inspection chamber • Same • Same
1c	Roadwork & carpark	1) Side Drain as per 1b Apron & Drain	1) Not specified
		2) Road surface • No ponding • Road painting according to drawings; dimensional tolerance of 5mm • Gaps between aeration slabs properly filled up with sand • Aeration slabs stable and not broken	2) Road surface • Same • Same • Same • Same
		3) Kerbs – as per General Requirements	3) Kerbs • Consistent joint width & neat • No stain marks and visible damages/defects • Finishes must be even, level, align & consistent

			• Good paint works
		4) Road sign • Provided according to specification • Firm and secured at base – with footing if required • Metal parts below ground are corrosion treated	4) Road sign • Same • Same • Same
		5) Lightings – as per 1c Road Sign	5) Same
1d	Footpaths & turfing	1) Footpath as per Internal Finishes – Floor	1) Same
		2) Turfing • No depression of bald patches • Turfing done evenly, no dead grass or weeds • Not specified	2) Turfing • Same • Same • Turfing should be according to drawing & specification - spot/close turfing
		3) Lightings as per 1c Road sign	3) Lighting • Firm and secured at base - with footing if required
		4) Fencing & Railing • As per 1c Road Sign • Wire fencing is PVC covered • Footings provided for supports • Vertical tolerance: 4mm over 1.2m	4) Not specified
		5) Other fixtures • As per Internal Finishes –	5) Other fixtures • As per

		Components	*Fixtures-External*
1e	Playground	1) Floor as per Internal Finishes – Floor	1) Same
		2) Permanent fixture as per Internal Finishes – Components	2) Permanent fixture as per External Fixtures
		3) Lightings as per 1c Road Sign	3) Lightings • Firm and secured at base - with footing if required • Metals parts below ground are corrosion treated
		4) Signage as per Internal Finishes – Components	4) Signage • Firm and secured at base - with footing if required • Metals parts below ground are corrosion treated
1f	Court	1) Floor as per Internal Finishes – Floor	1) Same
		2) Signage as per Internal Finishes – Components	2) Signage • Firm and secured at base - with footing if required • Metals parts below ground are corrosion

			treated
		3) M&E Fitting as per M&E Works – Part 5 Basic M&E Fittings	3) M & E Fittings - as per *Basic M & E Fittings*
		4) Permanent Fixture as per Internal Finishes – Components	4) Permanent Fixture - as per *Fixtures – External*
1g	Fence & Gate	1) Fence as per 1d item 4)	1) Not specified
		2) Gate as per Internal Finishes – Components	2) Not specified
		3) M&E Fitting as per M&E works – Part 5 Basic M&E Fittings	3) Not specified
		4) Signage as per Internal Finishes – Components	4) Not specified
		5) Not specified	5) vertical tolerance for piers to be perpendicular & straight: 5mm per 1.2m
		6) Not specified	6) Fencing to be plumb and Straight: 5mm per 1.2m
		7) Not specified	7) Good paintworks
1h	Swimming pool	1) Side Drain as per Internal Finishes – Floor	1) Overflow drain - as per *Internal Finishes – floor and drain*
		2) Foot Path as per Internal Finishes – Floor	2) Not specified
		3) M&E Fitting as per M&E Works – Part 5 Basic M&E Fittings	3) Not specified
		4) Other Fixture as per Internal Finishes – Components	4) Other fixtures - as per *Fixtures – External*
		5) Not specified	5) Pool deck tile - as per *Internal Finishes- Floor*
		6) Not specified	6) Ladder and railing properly

			secured - as per *External Fixtures*
		7) Not specified	7) Signage - as per *External Fixtures*
1i	Club house	1) External Wall as Part 3 External Wall	1) Not specified
		2) Apron & drain as per 1b	2) Not specified
1j	Guard house	1) External Wall as Part 3 External Wall	1) Not specified
		2) Apron & Drain as per 1b	2) Not specified
		3) Gantry as per Internal Finishes – Components	3) Not specified
		4) Other Fixture as per Internal Finishes – Components	4) Not specified
1k	Electrical substation	1) External Wall as Part 3 External Wall	1) External wall - as per architectural - external wall
		2) Apron & Drain as per 1b	2) Not specified
		3) Not specified	3) Doors and windows - as per architectural
		4) Not specified	4) Fencing and gate - as per external - fencing and gate

Table 8: External works

Quality Standards For M&E Works

Part 1: Electrical Works

No.	Item	Standards	
		CONQUAS 21	QLASSIC
1	Embedded conduits		
	Installation	1) Conduit ends properly protected	1) Not specified
		2) Correct type of conduit installed as per approved sample	2) Not specified
		3) Conduit boxes clean and open end plugged/temporarily protected	3) Not specified
		4) Coupling joints fastened	4) Not specified
		5) Bonding to earth provided for all metallic conduits	5) Not specified
	Secured properly	6) Conduits properly secured	6) Not specified
	Bent properly	7) Conduits properly bent without distortion and damage	7) Not specified
	No visible damage		Not specified
2	Main cables		
	Properly supported	1) Cables adequately supported	1) Same
	Fire stop	1) Fire stops properly installed	1) Same

	Spacing of cable	1) Adequate spacing of cables	1) Adequate spacing between cables and avoid overlapping of cables
	No visible damage		Same
3	Surface conduits		
	Installation	1) Conduit end properly connected	1) Same
		2) Metallic conduits properly earthed	2) Same
		3) Correct type of conduit as per approved sample	3) Not specified
		4) Conduits properly bent without distortion and damage	4) Same
	Support	5) Support / brackets rigidly fitted	5) Same
		6) Screw used properly fastened	6) Same
	Fire stop	7) Fire stops properly installed	7) Same
	No visible damage	8) Conduits and accessories properly painted	8) Same
4	Cable tray, ladder and trunking		
	Installation	1) Joints protected against corrosion	1) Same
		2) Correct type of material used as per approved sample	2) Not specified
		3) Metallic trunking properly earthed	3) Same
	Support	4) Support / brackets rigidly fitted	4) Same
		5) Screw used properly fastened	5) Same
	Fire stop	6) Fire stops properly done	6) Same
	No visible damage		
5	Distribution board		

	Circuit diagram	1) Circuit diagram provided	1) Same
		2) Proper labelling for panel	2) Same
	Cable termination/earthing	3) Suitable cable termination provided	3) Not specified
		4) All live parts to be non-accessible	4) Same
		5) All exposed metal parts effectively earthed	5) Same
	No visible damage		Same

Table 9: Electrical works

Part 2: ACMV Works

No.	Item	Standards	
		CONQUAS 21	QLASSIC
1	Ductwork		
	Location & installation	1) Location and ductwork installed according to approved shop drawings	1) Not specified
	Paints	2) Exposed ductwork and hanger properly painted to approve colour code	1) Same
	Support	3) Ductwork properly supported	3) Same
	No visible damage		Same
2	Fire-rated ducts		
	Location & installation	1) Location and ductwork installed according to approved shop drawings	1) Not specified
		2) No hanging of other services	2) Same
	Access panel	3) Fire-resistant sealed access panel provided with fire rated enclosure of equipment for maintenance	3) Same

3	Flexible ducts		
	Location & installation	1) Installed as per approved shop drawings	1) Not specified
	Support	2) Duct properly supported	2) Not specified
	Sufficient radius	3) Bending radius sufficiently wide to prevent tensioning and restriction of the throat	3) Not specified
	No visible damage		Not specified
4	Flexible connectors		
	Location & installation	1) Installed as per approved shop drawings	1) Not specified
		2) Provided at ductwork, between AHU/FCU/Fans and related ductwork	2) Not specified
	Length limit	3) Within 50-250mm length	3) Not specified
	No visible damage		Not specified
5	Dampers		
	Location & installation	1) Location of dampers as per approved shop drawings	1) Not specified
		2) Dampers/splitter dampers can be adjusted freely between the open and close position	2) Same
	Access door	3) Access door provided to all dampers	3) Same
	No visible damage		Same
6	Fire dampers		
	Location & installation	1) Location of dampers as per approved shop drawings	1) Not specified
		2) Installed as per CP13 and no gap around fire dampers	2) Not specified
		3) Dampers in open position	3) Same

		and held in position by fusible link	
	Access door	4) Access doors provided to all dampers according to CP13	4) Access doors provided to all dampers according to relevant code of practice
	No visible damage		Same
7	Split unit/Window air conditioner		
	Installation	1) Units are levelled when placed on plinth	1) Same
		2) Drainage provided/units slightly tilted for condensation	2) Same
		3) Drain hose connected to the drain pipe	3) Same
		4) Cool air is not blocked by wall, beam, shelving or other built-in furniture in the room	4) Same
	Seal penetration	5) Proper sealant of wall or roof opening after pipe are fixed	5) Same
	No leakage	6) No sign of leakage from pipe	6) Same
	No visible damage		Same
8	Air-con comfort		
	Temperature	1) Room temperature between 23 ℃ - 25 ℃ or according to specification	1) Same
	Air flow	2) Room airflow rate not exceeding 0.25 m/s or according to specification	2) Same
	Relative humidity	3) Room relative humidity not more than 60 % or according to specification	3) Same
9	Air handling unit		

	Location & installation	1) Location & pipe layout installed as per approved shop drawings	1) Not specified
		2) Inspection access door for fan, coil, motor and filter	2) Not specified
		3) All metal parts properly earthed	3) Not specified
		4) Smoke detector installed at the return air stream	4) Not specified
		5) Name plate installed with manufacturer's name, serial number and model number	5) Not specified
	Support	6) Pipe/duct from Ahu must be supported	6) Not specified
10	Pump		
	Location & installation	1) Location & pipe layout installed as per approved shop drawings	1) Not specified
		2) Pump & motor assembly installed on inertia block & spring isolator	2) Not specified
		3) Guard provided to exposed shafts, coupling & moving parts	3) Not specified
		4) Name plate installed with manufacturer's name, serial number and model number	4) Not specified
	Electrical termination	5) No bad electrical termination	5) Not specified
	No visible damage		Not specified
11	Cooling tower		
	Self-earthing system	1) Cooling tower completed with self-earthing system for connection to building lightning protection system	1) Not specified
	Location & installation	2) Name plate installed with manufacturer's name, serial number and model number	2) Not specified
		3) Location & pipe layout installed as per approved shop drawing	3) Not specified
	No visible damage	4) Cooling tower clear of all debris	4) Not specified

12	Pipework – including chilled water, hot water, steam, condenser water, condenser drain, cold water make-up, water treatment and refrigerant	1) Pipe installed as per approved shop drawing	1) Not specified
	Paints & support	2) Pipework provided with drains at each low point and automatic air vents with manual isolating valve at each high point	2) Not specified
		3) Properly painted and supported	3) Not specified
	Fire stop	4) Fire stop for passage of pipes at opening for fire resistance walls and floor	4) Not specified
	No visible damage		Not specified
13	Chiller		
	Location & installation	1) Location & pipe layout installed as per approved shop drawing	1) Not specified
		2) Chiller to be levelled when placed on plinth or vibration isolators	2) Not specified
		3) Chiller fixed securely in position	3) Not specified
		4) Correct model, make & capacity	4) Not specified
	Pipe support & label	5) Pipes supported properly by hangers or bracket	5) Not specified
		6) Pipe connections follow specified flow direction	6) Not specified
	No leakage	7) No sign of leakage	7) Not specified
	No visible damage		Not specified

Table 10: ACMV works

Part 3: Fire Protection Works

No.	Item	Standards	
		CONQUAS 21	QLASSIC
1	Wet/Dry riser		
	Landing valve	1) Landing valve must be accessible	1) Same
		2) Landing valve strapped & padlocked	2) Same
		3) Labeling for riser door	3) Same
		4) Landing valve painted red for wet riser/yellow for dry rise	4) Same
		5) Automatic air release valve provided at highest mark of rising main	5) Same
	Pipe & pipe support	6) Riser pipes properly supported	6) Same
		7) Labeling & painting for riser pipe	7) Same
		8) Bonding to earth provided for rising main	8) Same
	Wall/Floor penetration	9) Proper wall/floor penetration	9) Same
	No visible damage		Same
2	Sprinkle		
	Location & installation	1) Location, sprinkle and pipe layouts and sizes as per approved shop drawing	1) Not specified

		2) Double layer sprinkle for false ceiling>800mm in depth	2) Same
		3) No obstruction and painting to sprinkle heads	3) Same
		4) Correct sprinkler heads used in correct locations	4) Same
	Pipe support	5) Pipework properly supported	5) Same
	Wall/Floor penetration	6) Proper wall/floor penetration	6) Same
	No visible damage		Same
3	Fire alarm		
	Location & installation	1) Location of the fire alarm panel, breakglass & bell is correct	1) Not specified
		2) Location & spacing of detectors are correct	2) Not specified
		3) Fire alarm wiring n conduit (G1 type)	3) Same
	Paints	4) Panel and conduit properly painted	4) Same
	Fire alarm zoning diagram	5) Fire Alarm zoning diagram provided near panel/subpanel	5) Same
	No visible damage		Same
4	Hosereel		
	Location & installation	1) Location of hosereel as per approved shop drawing	1) Not specified

		2) Hosereel cabinet properly labeled	2) Same
		3) Hosereel pipe properly fixed with hanger & bracket	3) Same
		4) Hosereel operation instruction fixed on hosereel drum or door	4) Same
	Paints	4) Correct paint and good finish for hosereel	4) Same
	No visible damage		Same

Table 11: Fire protection works

Part 4: Plumbing & Sanitary Works

No.	Item	Standards	
		CONQUAS 21	QLASSIC
1	Concealed pipes		
	Location & installation	1) Pipes properly support, bent without distortion, kink and damage	1) Not specified
		2) Pipe & fittings ends properly capped	2) Not specified
		3) Proper joints	3) Not specified
		4) Materials used are of approved types	4) Not specified
	No visible damage		Not specified
2	Exposed pipes		
	Location & installation	1) Location of pipes installed and labeled as per approved	1) Not specified

		shop drawing	
		2) Pipes properly support, bent without distortion, kink and damage	2) Same
		3) Joint are watertight	3) Same
		4) Pipe & fitting ends properly capped	4) Same
		5) No potable water pipes below non-potable water pipes	5) No cold water pipes below sewerage pipes
		6) Materials used are of approved types	6) Not specified
	Alignment	7) Horizontally, vertically and parallel aligned to building surface	7) Same
		8) Inclined pipes laid to proper gradients	8) Same
		9) Plumb: <3mm per 1m height	9) Same
	Clearance	10) Do not cause obstruction / pose safety hazard at public area	10) Same
		11) Sufficient clearance between installed pipes / ceiling and pipes / wall for accessibility	11) Same
		12) Service pipe duct accessible	12) Same
	No visible damage	13) Painting with good opacity and no drippings	13) Same

		14) No visible damage	14) Same
3	Water tank		
	Location & installation	1) Location, type & capacity as per approved shop drawing	1) Not specified
		2) All openings properly covered	2) Same
		3) Joints and pipe connections are watertight	3) Same
		4) Not located below non-potable water pipes	4) Not located below sewerage pipes
		5) Corrosion-resistant external cat ladders provided for large water tank	5) Same
		6) Not specified	6) Overflow pipe to be discharged at proper location
		7) Not specified	7) Well supported on plinth or bearers
	Netting	8) Netting properly fitted for overflow/ warning/ vent pipes	8) Same
	Clearance	9) Accessible for maintenance. Minimum clearance of 600mm all rounded the water tank	9) Same
	No visible damage	10) No visible damage	10) Same
		11) Clean & free from debris	11) Same

4	Pump & motor		
	Location & installation	1) Location & type as per approved shop drawing	1) Not specified
		2) No noticeable vibration & noise from pump/ motor	2) Same
		3) Test certificate for alignment of pump & motor from manufacturer	3) Same
	Electrical termination	4) No bad/ loose electrical terminations	4) Same
	No visible damage		Same

Table 12: Plumbing and sanitary works

Part 5: Basic M&E Fittings

No.	Item	Standards	
		CONQUAS 21	QLASSIC
1	General requirements	1) Joints & gap • No visible gap • Consistent joint width & neat	1) Same
		2) Alignment & Evenness • Aligned, leveled and straight	2) Same
		3) Material & Damages • No visible damage/ defects • No stain marks • Securely fixed	3) Same

		• Consistent colour tone	
		4) Functionality • Functional and safe	4) Same
		5) Accessories defects • No missing accessories • No visible damage/defects	5) Same
2	Plumbing & sanitary fittings		
2a	Gully & floor trap	1) No damage or chokage	1) Same
		2) Must be securely fixed	2) Same
		3) Trap's top lower than the surrounding floor level	3) Same
2b	Pipes	1) Visually aligned horizontally, vertically and parallel to building surface	1) Same
		2) Inclined pipes laid to proper gradients	2) Same
		3) No leakage at joints	3) Same
		4) Plumb: <10mm/storey height	4) Same
		5) Brackets firmly secured & adequately spaced	5) Brackets firmly secured & joints properly sealed & marked
		6) If painted, no drippings & with good opacity	6) Same

		7) Not specified	7) Pipes properly support, bent without distortion, kink and damage
		8) Not specified	8) Sufficient clearance between installed pipes and building surface for accessibility
2c	Fittings	1) Firmly secured & joints properly sealed & pointed	1) Same
		2) No leakage at joints	2) Same
		3) No chipping or cracks	3) Same
		4) No paint drops or mortar droppings	4) Same
		5) Fittings in working condition	5) Same
		6) Accessible for maintenance	6) Same
		7) Do not cause obstruction/pose as safety hazard (e.g. sprinkler head to point inward)	7) Not specified
		8) No sediments / particles found in water collected at terminal water fittings (remove aerator & showerhead)	8) Same
		9) All sensors covers properly sealed against water seepage	9) Same

		10) Materials used are of approved types	10) Not specified
3	M&E fittings e.g. power mark, telephone mark, air-con diffuser, fan coil unit, lighting, smoke alarm, sprinkler heads, CATV/CCTV camera, etc		
3a	Installation	1) Fittings must be aligned and location as per approved drawings	1) Fittings must be aligned
		2) No stains	2) Same
		3) Neat patch-up for pointing/ penetration	3) Same
		4) Not specified	4) Heights of switch and marks should be consistent
		5) Not specified	5) Switch can properly function: On and off for 20 times nonstop
3b	Safety	1) No exposed wiring within reach	1) Same
3c	Damages	1) No visible damage	1) Same

Table 13: Basic M&E fittings

2.4.4 Assessment

2.4.4.1 Building Grouping Guide

Category	CONQUAS 21	QLASSIC
Category A	Commercial, industrial, institution & others e.g bank, hotel, hospital etc.	Landed housing e.g detached, semi-detached, terrace etc.
Category B	Private housing, commercial, institution, industrial & others e.g condominium, apartments, school, factory etc.	Stratified housing e.g flat, apartment, condominium, town house etc.
Category C	Public housing e.g HDB public housing	Public building e.g. office building, schools etc.
Category D	Landed housing e.g. bungalow, semi-detached, terrace house etc.	Special public building e.g. hospitals and airports only

Table 14: Building grouping guide

2.4.4.2 Weightage

Components	Commercial, Industrial, Institution & others		Private housing, commercial, institution, industrial & others		Special public building e.g airports & hospitals		Landed housing	
	CONQUAS 21	QLASSIC	CONQUAS 21	QLASSIC	CONQUAS 21	QLASSIC	CONQUAS 21	QLASSIC
Structural Works	25%	30%	30%	30%	25%	30%	30%	25%

Architectural Works	55%	45%	60%	50%	55%	35%	65%	60%
M&E Works	20%	15%	10%	10%	20%	25%	5%	5%
External Works	-	10%	-	10%	-	10%	-	10%
Score	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Table 15: Weightage

2.4.4.3 Weightage for Reinforced Concrete Structure Element

Reinforced Concrete Structure	**CONQUAS 21**	**QLASSIC**
Formwork	15%	20%
Rebar	20%	15%
Finished concrete	25%	25%
Concrete quality	5%	5%
Steel reinforcement quality	5%	5%
NDT-UPV test for concrete uniformity	15%	15%
NDT-Electro-Covermeter test for concrete cover	15%	15%
TOTAL	**100%**	**100%**

Table 16: Weightage for reinforced concrete structure element

2.4.4.4 Sampling Guidelines for Reinforced Concrete Structure Work

	Items	GFA per sample		Min sample		Max sample		Remarks
		CONQUAS 21	QLASSIC	CONQUAS 21	QLASSIC	CONQUAS 21	QLASSIC	
1	Structural elements	500 m2	500m2	30	30	150	150	For non-housing project
1a	Structural elements	1500 m2	1500 m2	30	30	50	50	For housing project
2	Concrete compressive strength	-	-	100%	100%	-	-	Declaration by qualified person
3	Steel reinforcement tensile strength	-	-	100%	100%	-	-	Declaration by qualified person
4	NDT-UPV test for concrete uniformity	5,000 m2	5,000 m2	2 sets	2 sets	20 sets	20 sets	5 structure members per set
5	NDT-UPV test for concrete uniformity	5,000 m2	5,000 m2	2 sets	2 sets	20 sets	20 sets	5 structure members per set

Table 17: Sampling guidelines for reinforced concrete structure work

2.4.4.5 Weightage for Structural Steel Element and Pre-Stressed Concrete Element

Structural Steelwork	**Weightage**	
	CONQUAS 21	**QLASSIC**
Main member/partially assembled component	40%	40%
Metal decking	20%	20%
Erection tolerance	10%	10%
Corrosion & fire protection	10%	10%
Welding test reports	20%	20%
TOTAL	**100%**	**100%**

Table 18: Weightage for structural steel element

Pre-stressed Concrete	**Weightage**	
	CONQUAS 21	**QLASSIC**
Tendon & Anchorage	25%	25%
Sheathing	25%	25%
Stressing & Grouting	25%	25%
Debonding	25%	25%
TOTAL	100%	100%

Table 19: Weightage for pre-stressed concrete element

2.4.4.6 Sampling Guidelines for Structural Steelwork

Items	Steel Tonnage per Sample		Min Sample	
	CONQUAS 21	**QLASSIC**	**CONQUAS 21**	**QLASSIC**
Structural elements				
• Main member/partial assembled component	250	250	5	5
• Metal decking	250	250	5	5
• Erection tolerances	500	500	5	5
• Corrosion & fire protection	500	500	5	5
Material & functional test				
• Welding test report (NDT)	All critical welding joints	All critical welding joints	All critical welding joints	All critical welding joints

Table 20: Sampling guidelines for structural steelwork

2.4.4.7 Weightage for Architectural Element

Architectural Elements	Weightage			
	Total		Breakdown	
	CONQUAS 21	QLASSIC	CONQUAS 21	QLASSIC
Internal finishes	56	56	-	-
• Floor	-	-	16	16
• Internal wall	-	-	16	16

• Ceiling	-	-	6	6
• Door	-	-	6	6
• Window	-	-	6	6
• Component	-	-	6	-
• Fixtures (Internal)	-	-	-	6
Roof	4	10	4	10
External wall	12	10	12	10
External work	6	-	6	-
Apron & perimeter drain	-	4	-	4
Material & functional tests	22	20	-	-
• Skim coat/pre-packed plaster	-	-	1	3
• Field Window Water-Tightness Test (WTT)	-	-	10	6
• Wet Area Water-Tightness Test	-	-	5	6
• Internal wet area waterproofing process	-	-	2	-
• Pull-off-test for internal wall tiles	-	-	4	5
TOTAL	100	100	100	100

Table 21: Weightage for architectural element

2.4.4.8 Sampling Guidelines for Architectural Work

No	Items	GFA per Sample		Min Sample		Max Sample		Remarks
		CONQUAS 21	QLASSIC	CONQUAS 21	QLASSIC	CONQUAS 21	QLASSIC	
1	Internal finishes	500 m2	500 m2	30	30	150	150	For non-housing project
1a	Internal finishes	70 m2	-	30	-	800	-	For all private housing project
1b	Internal finishes	70 m2	-	30	-	600	-	For public housing
1c	Internal finishes	-	70 m2	-	30	-	700	For landed housing
1d	Internal finishes	-	70 m2	-	30	-	600	For stratified housing
1e	Internal finishes	-	500 m2	-	30	-	100	For special public building
2	External wall	-	-	50%	50%	-	-	50% of the blocks/union
3	External work	-	-	1	-	-	-	1 for each type of external work
4	Skim coat and pre-packed plaster	-	-	-	-	-	-	Declaration by qualified person
5	Roof	-	-	-	50%	-	-	50% of the blocks/units
6	Apron and	-	-	-	2	-	-	10m length section per

	perimeter drain							sample
7a	Field Window Water-tightness Test (WTT)	1,000 m2	1,000 m2	20	20	100	100	Independent testing
7b	Field Window Water-tightness Test (WTT)	-	-	25%	25%	-	-	Self-testing with declaration by qualified person
8a	Wet Area Water-tightness Test	-	-	20	20	100	100	• 10% of all bathrooms and/or toilets (by location) • All will be tested if < 20 nos • Not require for non-housing project if < 20 nos

8b	Wet Area Water-tightness Test	-	-	100%	100%	-	-	• Self-testing with declaration by qualified person • Including flat roof
9	Pull-off test for internal wall tiles	10,000 m2	10,000 m2	1 set	1 set	5 sets	5 sets	5 tiles per set (by location)

Table 22: Sampling guidelines for architectural work

2.4.4.9 Weightage for Location of Architectural Work According to Building Category

Locations	Commercial, Industrial, Institution & others		Private housing, commercial, institution, industrial & others		Special public building e.g airports & hospitals		Landed housing	
	CONQUAS 21	QLASSIC	CONQUAS 21	QLASSIC	CONQUAS 21	QLASSIC	CONQUAS 21	QLASSIC
Principal	60%	60%	40%	40%	60%	60%	40%	40%
Service	15%	15%	40%	40%	15%	15%	40%	40%
Circulation	25%	25%	20%	20%	25%	25%	20%	20%
TOTAL	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Table 23: Weightage for location of architectural work according to building category

2.4.4.10 Weightage for M&E Element According to Building Category

M&E Elements	Commercial, Industrial, Institution & others		Private housing, commercial, institution, industrial & others		Special public building e.g airports & hospitals		Landed housing	
	M&E Works Assessment (%)							
	CONQUAS 21	QLASSIC	CONQUAS 21	QLASSIC	CONQUAS 21	QLASSIC	CONQUAS 21	QLASSIC
Electrical works	15	20	15	15	15	20	10	10
ACMV works	20	25	20	10	20	20	10	10
Fire protection works	10	10	10	10	10	10	-	-
Plumbing & sanitary works	15	20	15	20	15	25	-	20
Basic Fittings	15	25	15	45	15	25	80	60
Sub-total	75	100	75	100	75	100	100	100
Weightage	50%	30%	50%	50%	50%	30%	100%	50%
	M&E Performance Test Assessment (%)							
Performance testing	100	100	100	100	100	100	-	100
Weightage	50	70	50	50	50	70	-	50
TOTAL	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Table 24: Weightage for M&E element according to building category

2.4.4.11 Sampling Guidelines for M&E Work

	Commercial, Industrial, Institution & others (1000 m2 per sample)		Private housing, commercial, institution, industrial & others (1500 m2 per sample)		Special public building e.g airports & hospitals (1000 m2 per sample)		Landed housing (3500 m2 per sample)	
	CONQUAS 21	QLASSIC	CONQUAS 21	QLASSIC	CONQUAS 21	QLASSIC	CONQUAS 21	QLASSIC
Electrical								
1. Embedded conduit	2+	-	2+	-	2+	-	2+	-
2. Main cables	1	1	1	1	1	1	-	-
3. Surface conduits	1+	1+	1+	1+	1+	1+	1+	1+
4. Cable tray, ladder and trunking	1+	1+	1+	1+	1+	1+	1	1
5. Distribution board	2+	2+	2+	2+	2+	2+	1	1
ACMV								
1. Air handling unit	1+	-	-	-	1+	-	-	-
2.Pump	1	-	-	-	1	-	-	-
3. Cooling tower	1	-	-	-	1	-	-	-

4. Chiller	1	-	-	-	1	-	-	-
5. Pipework	1	-	-	-	1	-	-	-
6. Split unit / Window air conditioner	2+	2+	2+	2+	2+	2+	3+	3+
7. Air-con comfort	1+	1+	1+	1+	1+	1+	2+	2+
8. Ductwork	3+	3+	1	3+	3+	3+	-	-
9. Fire-rated duct	1	1	1	1	1	1	-	-
10. Dampers	1+	1+	1	1+	1+	1+	-	-
11. Fire dampers	1	1	1	1	1	1	-	-
12. Flexible ducts	2	-	-	-	-	-	-	-
13. Flexible connectors	1	-	-	-	-	-	-	-
Fire protection								
1. Wet / Dry riser	1+	1+	1+	1+	1+	1+	-	-
2. Sprinkler	1+	1+	1+	1+	1+	1+	-	-
3. Fire alarm	1	1	1	1	1	1	-	-
4. Hosereel	1+	1+	1+	1+	1+	1+	-	-
Plumbing and sanitary								
1. Concealed pipes	1+	1+	1+	1+	1+	1+	-	-

2. Exposed pipes	4+	4+	4+	4+	4+	4+	-	-
3. Water tank	1	1	1	1	1	1	-	1
4. Pump	1	1	1	1	1	1	-	-
Minimum samples	35	25	25	25	35	25	10	9
Maximum samples	70	43	50	43	70	44	15	20

Table 25: Sampling guidelines for M&E work

2.5 Advantages, Disadvantages and Hurdles of Applying Quality Assessment System

Quality assessment system will definitely bring some advantages to both developers and contractors. The implementation of quality assessment system can improve the quality of the construction of contractor and developer can obtain public recognition (Sr.Dr Hajah Norizan Ahmad, Muhammad Nazreen Sabli & Ir.Dr Ahmad Annuar Othman, 2014). By applying quality assessment system in construction will shorten the lead time, lower cost by reducing re-work and improve workmanship and quality (S.L. Tang, Syed M.Ahmed, Raymond T. Aoieong & S.W.Poon, 2005)

At the same time, applying of quality assessment system is also causing delay in construction activities and have effect on cost of production (Ayob Norizam & Marlinda Abdul Malek, 2013).

On the other hand, the construction cost of any project undergoing the quality assessment system will be slightly higher due to there are additional costs of 10% to 15%

in total, in terms of materials, plant and labor (Sr.Dr Hajah Norizan Ahmad, Muhammad Nazreen Sabli & Ir.Dr Ahmad Annuar Othman, 2014). Hence, these may stop developer and contractor to implement quality assessment system.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

In order to achieve the objectives of this study, there are two methods to be used to collect data, they are respectively the primary data sources and secondary sources.

- Primary Data Sources

  The second, third and fourth objectives, which are determining the advantages and disadvantages of applying CONQUAS 21 or QLASSIC, hurdles when implementing CONQUAS 21 or QLASSIC and preference of the developer and contractor in application of CONQUAS 21 and QLASSIC, can be obtained by conducting survey. Questionnaire will be emailed to developers and contractors in Malaysia.

- Secondary Data Sources

  Literature review is an essential material for researchers to enhance basic knowledge regarding to the research topic. Journal articles, government articles, newspapers, journals, books, magazines and internal research are used in secondary data sources. The review from those sources would complement the information for the first objective which is comparing the standards and specifications between CONQUAS 21 and QLASSIC.

3.2 Questionnaire

McQueen and Knussen (2002) and Andi and Minato (2003) reckoned that the questionnaire survey is one of the most effective method to involve a large number of people in order to achieve a better result. Jackson (2011) explained that questionnaire survey is known as a method which questioning individuals on a topic or topics and then describing their responses. Questionnaire can be delivered to the participants via personal, ie intercept, phone etc. or no personal, for instance computer or mail (Cooper and Schindler, 2008).

The questionnaire comprised of total twelve questions, the respondents are asked on the followings:

1. The designation in the company
2. The nature of business of the company
3. Did the company apply any quality assessment system in the project before?
4. Which of the quality assessment system (CONQUAS 21 or QLASSIC) that did the company practice?
5. Does your company familiar with the differences in between CONQUAS 21 and QLASSIC?
6. Which of the quality assessment system that your company preferred most?
7. What is the following make your company prefer to apply the quality assessment system that chosen in Question 4?
8. Does your company agree that applying the quality assessment system will bring the following advantages to the project?

9. Does your company agree that applying the quality assessment system will bring the following disadvantages to the project?
10. Does your company agree that the followings are the hurdles to apply the quality assessment system in the project?
11. Does your company agree that applying quality assessment system in construction project will benefit the company overall?
12. Will your company continue to apply quality assessment system in construction project in future?

The respondents were asked to indicate their response on Question 8, 9 and 10 by using Five Point Likert Scale. This method was adopted to capture the Relative Importance Index (RII) of advantages, disadvantages and hurdles of applying quality assessment system.

3.3 Survey Target

The questionnaire was distributed to the developers and contractors who involved in building construction works in Malaysia. The developers' list was obtained from Real Estate and Housing Developers Association (REHDA) website, meanwhile, the contractors' list was obtained from Construction Industry Development Board (CIDB) website.

3.4 Calculation of Relative Importance Index (RII)

The Five-Point Likert Scale ranged from 1 (Strongly Disagree) to 5 (Strongly Agree) were adopted in this survey within developer's and contractor's response. Hence, Relative Importance Index (RII) was used to reflect the feedback from the respondnents. The Relative Importance Index (RII) was derived for each factor with the following formula (Lim and Alum, 1995; Abdul Kadir et.al, 2005).

$$RII = \frac{5N_1 + 4N_2 + 3N_3 + 2N_4 + N_5}{5(N_1 + N_2 + N_3 + N_4 + N_5)}$$

Where, N_1 = number of respondents who chose "Strongly Agree"

N_2 = number of respondents who chose "Agree"

N_3 = number of respondents who chose "Neutral"

N_4 = number of respondents who chose "Disagree"

N_5 = number of respondents who chose "Strongly Disgree"

3.5 Spearman's Rank Correlation Test

Wikipedia explained that Spearman's Rank Correlation is a nonparametric measure of rank correlation (statistical dependence between the ranking of two variables). Spearman's correlation coefficient, (ρ, also signified by r_s) measures the strength and direction of association between two ranked variables. Correlation coefficients are presented in the range of -1.00 to +1.00.

Spearman's Rank Correlation Test was used to determine the correlation in between the disadvantages, ie. Time Addition and the hurdles, ie. Time Constraint. This is to test

whether the respondents will reckon that the disadvantages of applying quality assessment system will become the hurdles for applying quality assessment system.

3.6 Conclusion

In short, this chapter described the research methodology inclusive of literature review, questionnaire and analysis methods that had been used in this study to achieve the objectives. The technique adopted for this study was based on the literature review and questionnaire survey of developer and contractor. The researcher used the questionnaire to collect data from the participants and analyzed the data by suing Relative Importance Index (RII) and Spearman's Rank Correlation Test.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

The questionnaires were distributed to 50 numbers each of developer and contractor in Malaysia. The questionnaires were then completed by 23 respondents from developer and 35 respondents from contractor. Details of questionnaire results are analyzed and elaborated in this chapter.

4.2 Result from Questionnaire (Question 1)

Question: Please indicate your designation.

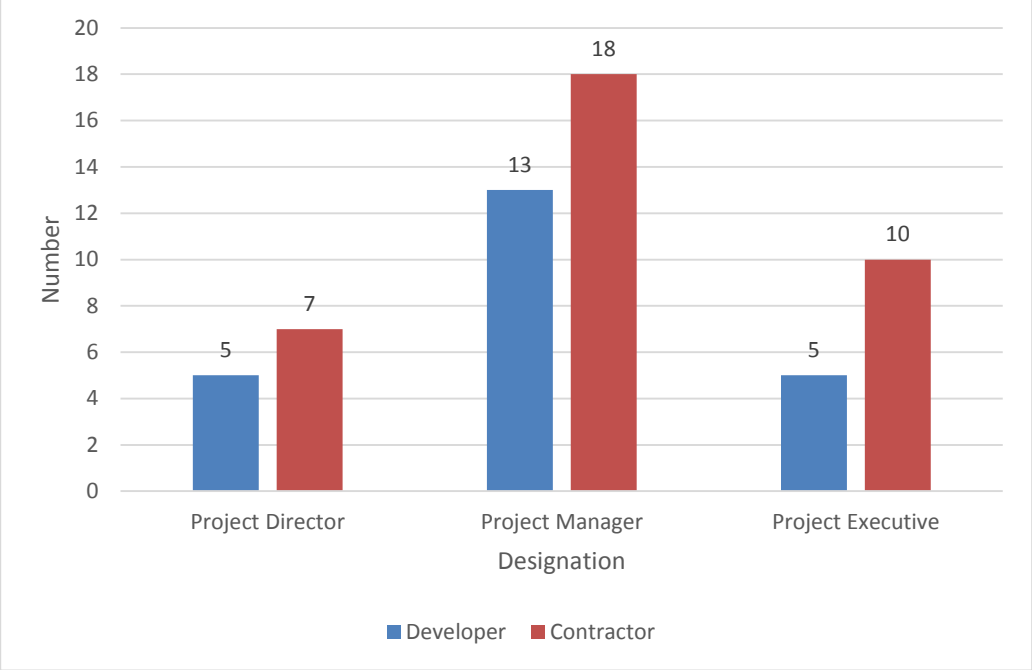

Chart 1: Designation of respondents

Discussion:

The result showed that there were total 23 respondents from developer, which consisted of 5 (21.5%) project director, 13 (57%) project manager and 5 (21.5%) project executive. On the other hand, there were total 35 respondents from contractor, which consisted of 7 (20%) project director, 18 (51%) project manager and 10 (29%) project executive.

4.3 Result from Questionnaire (Question 2)

Question: What is the nature of business of your company?

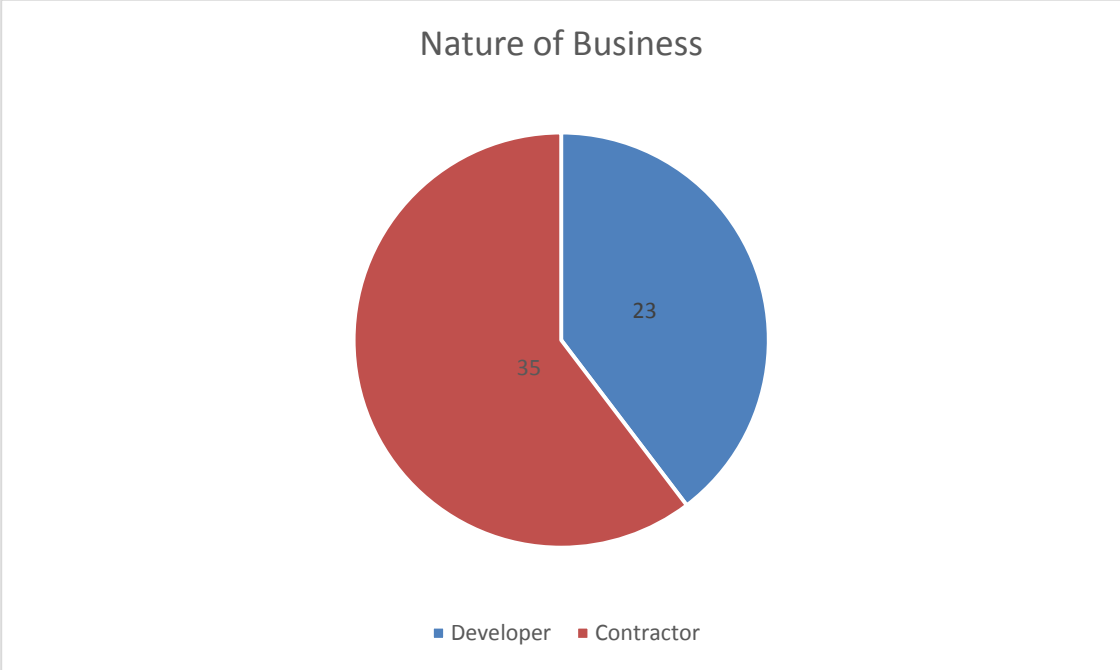

Chart 2: Nature of business

Discussion:

There were total 23 numbers of developer and 35 numbers of contractor participated in this survey.

4.4 Result from Questionnaire (Question 3)

Question: Did your company apply any quality assessment system in the project before?

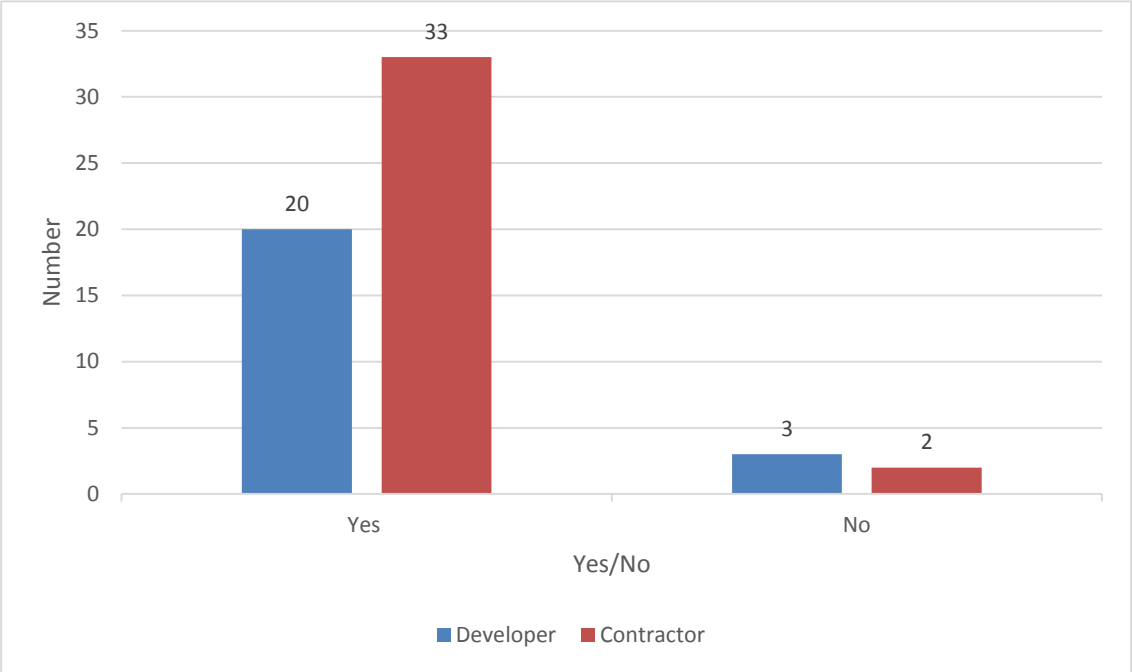

Chart 3: Number of company that apply quality assessment system before

Discussion:

According to the survey, there were 20 (87%) and 33 (94%) numbers of developer and contractor respectively who applied the quality assessment system in their project before. However, there were 3 (13%) and 2 (6%) numbers of developer and contractor respectively did not apply any of the quality assessment system in their project before.

4.5 Result from Questionnaire (Question 4)

Question: Which of the following quality system that did your company practice before?

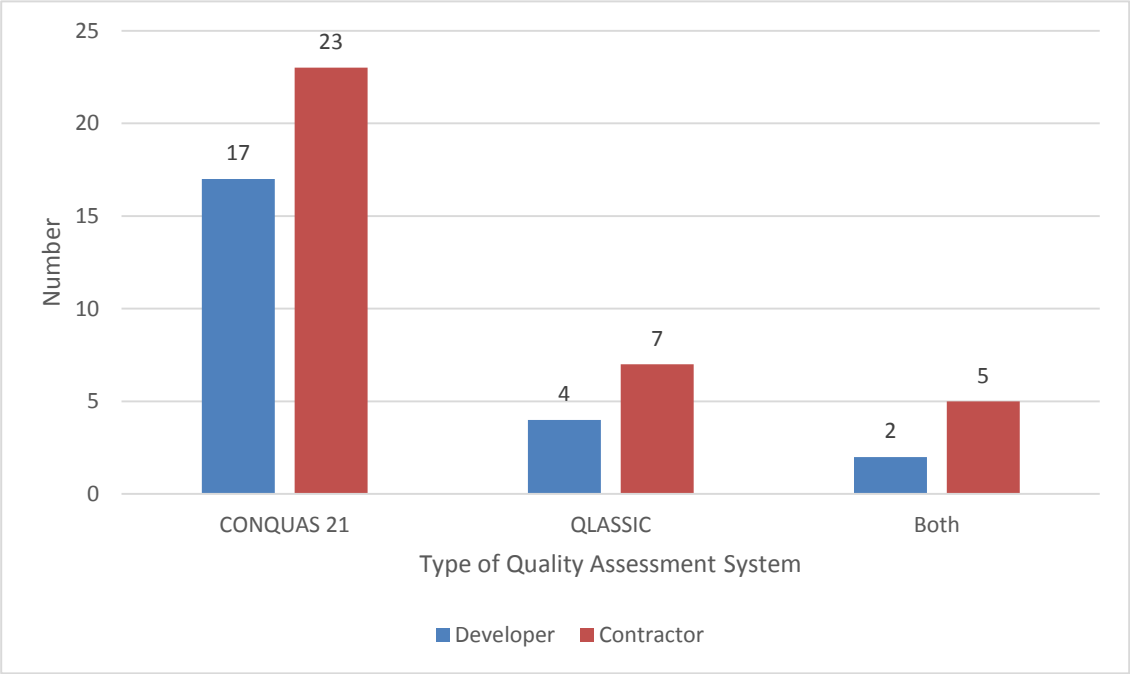

Chart 4: Respondent's practice

Discussion:

The survey showed that there were 17 (74%) numbers of developer practiced CONQUAS 21, 4 (17%) numbers practiced QLASSIC and 2 (9%) numbers practiced both quality assessment system before. The survey also showed that there were 23 (66%) numbers of contractor practiced CONQUAS 21, 7 (20%) numbers practiced QLASSIC and 5 (14%) numbers practiced both quality assessment system before. The researcher noticed that majority of the developer (74%) and contractor (66%) in Malaysia have practiced CONQUAS 21 in their project.

4.6 Result from Questionnaire (Question 5)

Question: Does your company familiar with the differences in between CONQUAS 21 and QLASSIC?

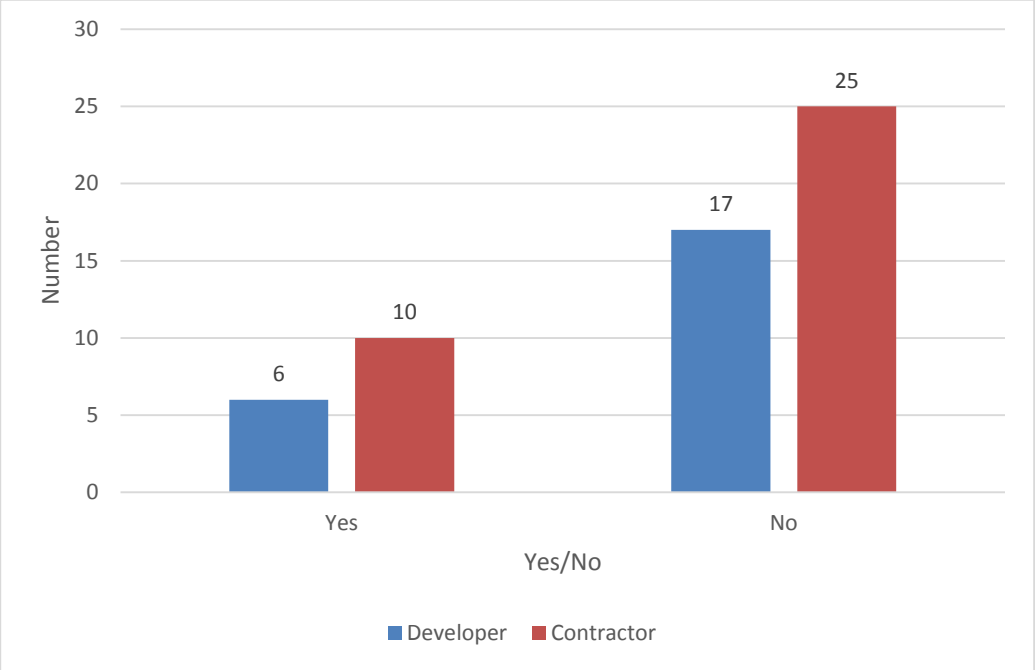

Chart 5: Respondent's familiarity with the differences in between CONQUAS 21 and QLASSIC

Discussion:

The result showed that there were 6 (26%) numbers of developer and 10 (29%) numbers of contractor were familiar with the differences in between CONQUAS 21 and QLASSIC. In contrast, there were 17 (74%) numbers of developer and 25 (71%) numbers of contractor were not familiar with the differences in between CONQUAS 21 and QLASSIC.

4.7 Result from Questionnaire (Question 6)

Question: Which of the quality assessment system that your company preferred most?

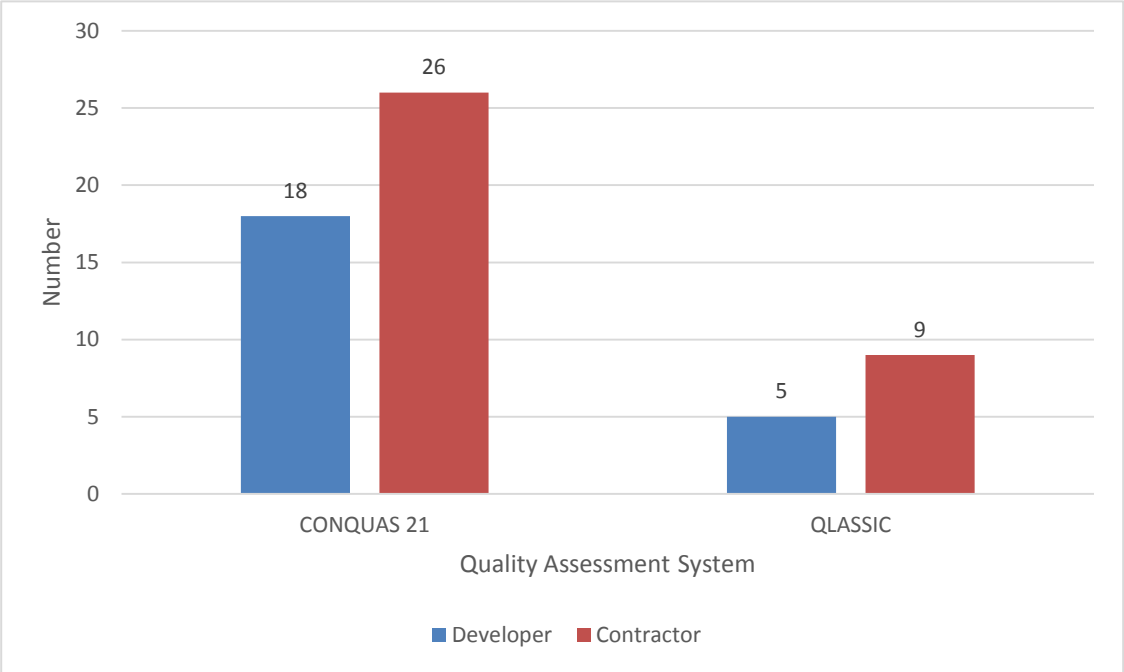

Chart 6: Respondent's preference

Discussion:

The result showed that 18 (78%) numbers of developer and 26 (74%) numbers of contractor were prefer to apply CONQUAS 21 compared to only 5 (22%) numbers of developer and 9 (26%) numbers of contractor who prefer QLASSIC.

4.8 Result from Questionnaire (Question 7)

Question: What is the following make your company prefer to apply the quality assessment system that chosen in Question 6?

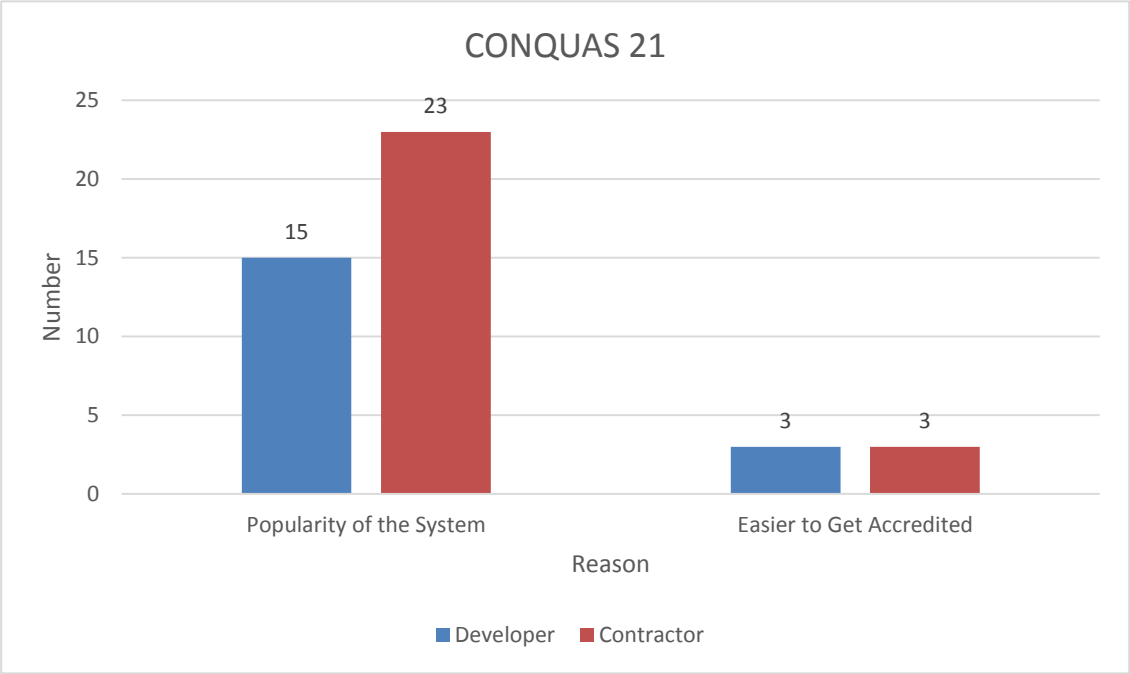

Chart 7: Respondent's reason on choosing CONQUAS 21

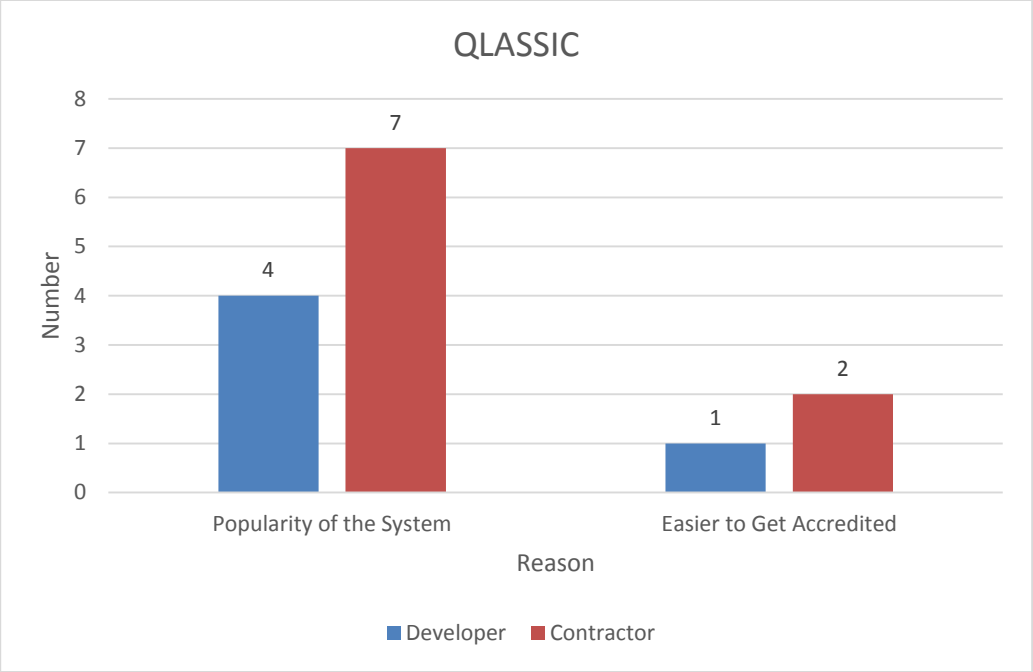

Chart 8: Respondent's reason on choosing QLASSIC

Discussion:

Refer to the results showed in Chart 7, 15 (83%) numbers of developer and 23 (88%) numbers of contractor who preferred to apply CONQUAS 21 was due to the popularity of the system, whereas only 3 (17%) numbers of developer and 3 (12%) numbers of contractor preferred to apply CONQUAS 21 due to they felt the system was easier to get accredited.

On the other hand, with reference to Chart 8, there were 4 (80%) numbers of developer and 7 (78%) numbers of contractor who preferred to apply QLASSIC was due to the popularity of the system, there were only 1 (20%) numbers of developer and 2 (22%) numbers of contractor preferred to apply QLASSIC due to they felt the system was easier to get accredited.

From the both chart, the researched noticed that majority of the developer and contractor in Malaysia are preferred to apply CONQUAS 21 due to the popularity of this system.

4.9 Result from Questionnaire (Question 8)

Question: Does your company agree that applying the quality assessment system will bring the following advantages to the project?

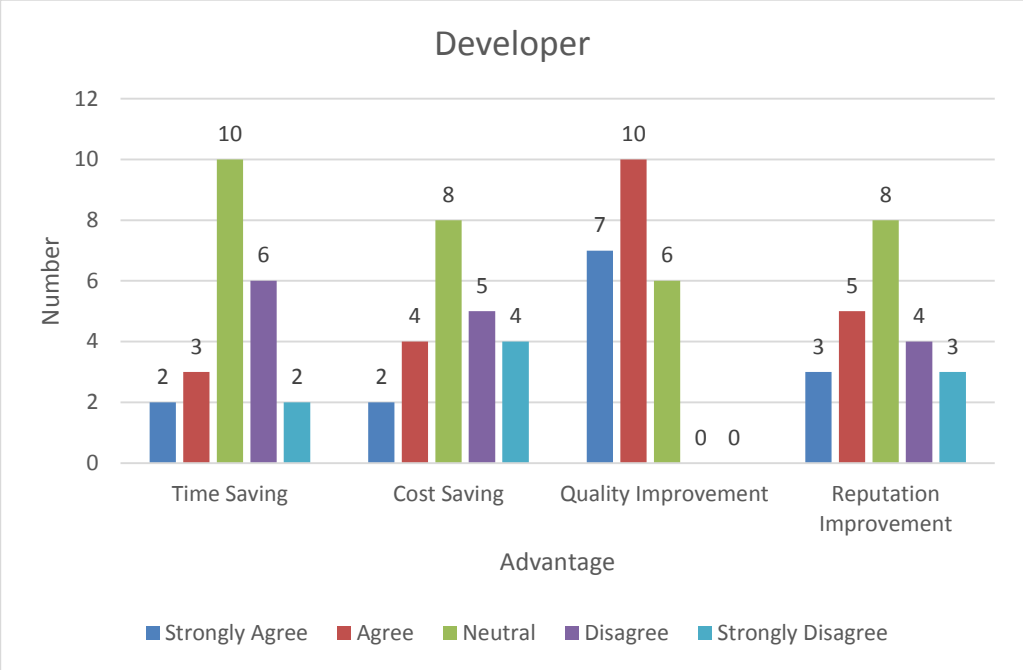

Chart 9: Developer's rating on the advantages of applying quality assessment system

Advantage	Developer	
	RII	Rank
Time Saving	0.574	3
Cost Saving	0.557	4
Quality Improvement	0.809	1
Reputation Improvement	0.609	2

Table 26: Relative Importance Index (RII) and ranking of the advantages of applying quality assessment system (developer)

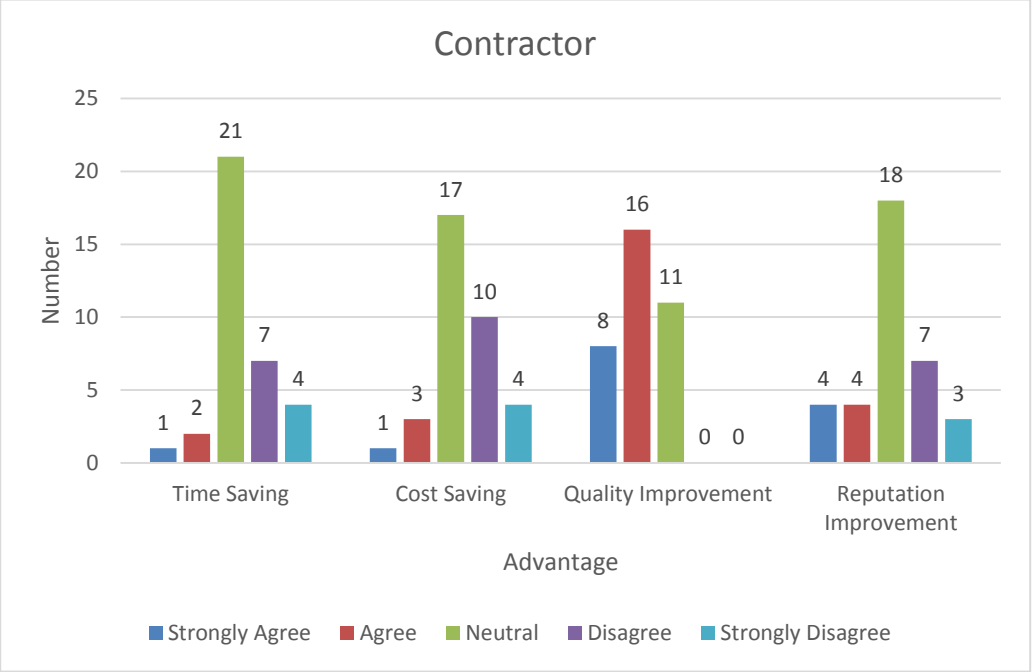

Chart 10: Contractor's rating on the advantages of applying quality assessment system

Advantage	Contractor	
	RII	Rank
Time Saving	0.537	3
Cost Saving	0.526	4
Quality Improvement	0.783	1
Reputation Improvement	0.594	2

Table 27: Relative Importance Index (RII) and ranking of the advantages of applying quality assessment system (contractor)

Discussion:

Refer to the Relative Importance Index (RII) analysis shown in both tables, both developer and contractor perceived that Quality Improvement (1^{st}) was the main advantage by applying quality assessment system in the project and following with Reputation Improvement (2^{nd}), Time Saving (3^{rd}) and Cost Saving (4^{th}).

Developer and contractor reckoned that applying quality assessment system will improve the product quality, this is due to quality assessment system can provide them a guideline to produce a quality product. Besides, developer and contractor also agreed that their company reputation will be improved by applying quality assessment system, this has been reckoned as second advantage. The third advantage was time saving, both of the developer and contractor agreed that they will be able to save some time by applying quality assessment system, as this will help to mitigate the rework and rectification. The last advantage which perceived by developer and contractor was cost saving, there were only few developers and contractors agreed that they will be able to save some cost by applying quality assessment system.

4.10 Result from Questionnaire (Question 9)

Question: Does your company agree that applying the quality assessment system will bring the following disadvantages to the project?

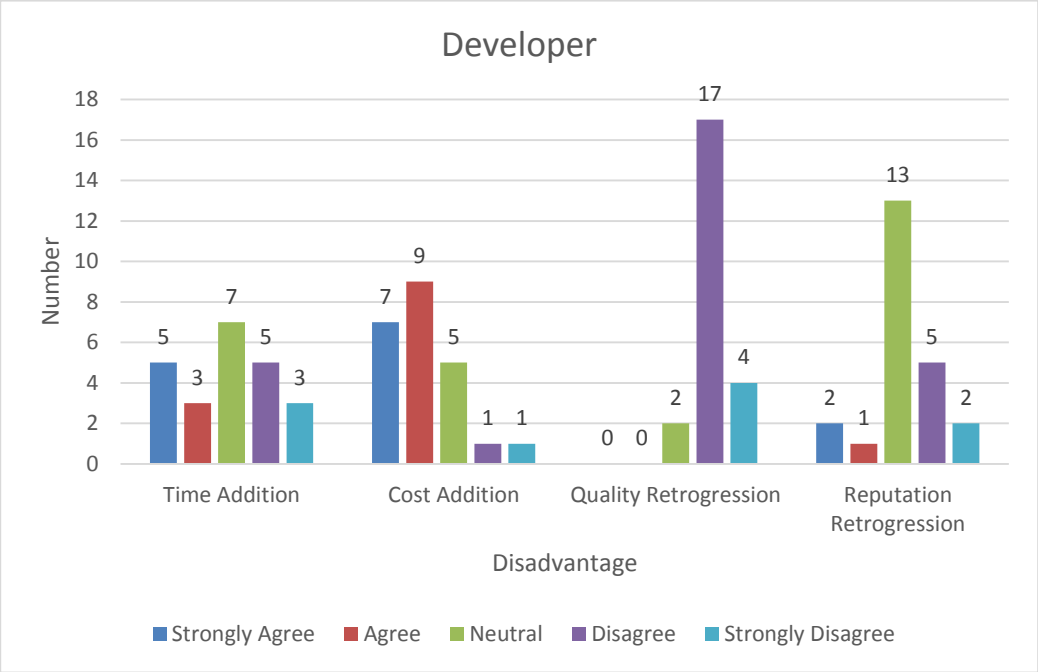

Chart 11: Developer's rating on the disadvantages of applying quality assessment system

Disadvantage	Developer	
	RII	Rank
Time Addition	0.617	2
Cost Addition	0.774	1
Quality Retrogression	0.383	4
Reputation Retrogression	0.565	3

Table 28: Relative Importance Index (RII) and ranking of the disadvantages of applying quality assessment system (developer)

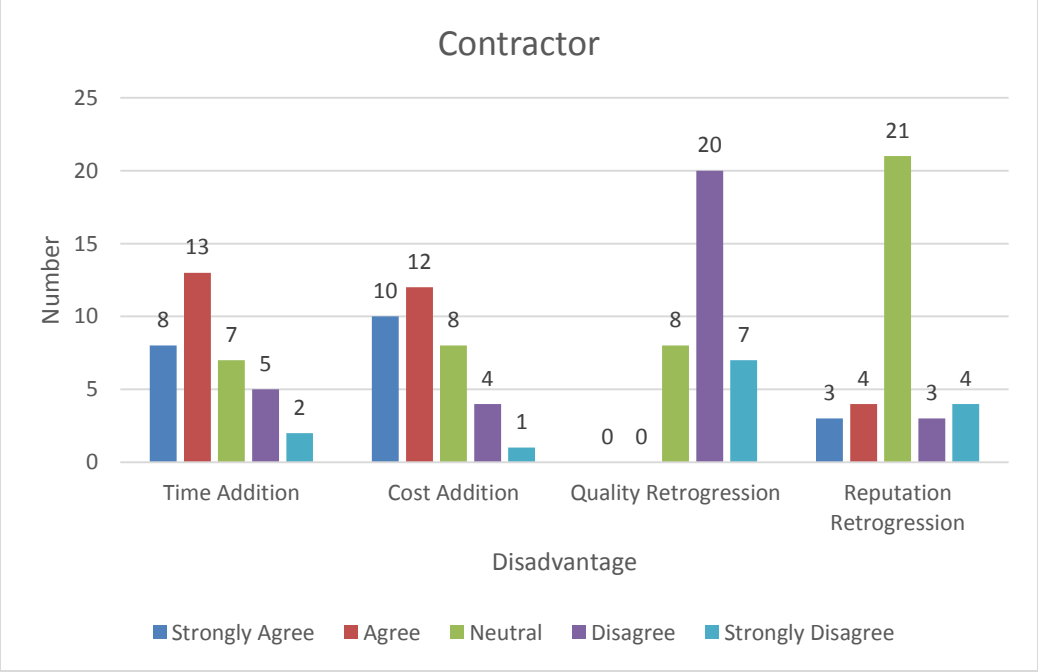

Chart 12: Contractor's rating on the disadvantages of applying quality assessment system

Disadvantage	Contractor	
	RII	Rank
Time Addition	0.714	2
Cost Addition	0.749	1
Quality Retrogression	0.406	4
Reputation Retrogression	0.594	3

Table 29: Relative Importance Index (RII) and ranking of the disadvantages of applying quality assessment system (contractor)

Discussion:

Refer to the Relative Importance Index (RII) analysis shown in both tables, both developer and contractor perceived that Cost Addition (1^{st}) was the main disadvantage by applying quality assessment system in the project and following with Time Addition (2^{nd}), Reputation Retrogression (3^{rd}) and Quality Retrogression (4^{th}).

The developer and contractor reckoned that the cost of construction will be increased by applying the quality assessment system, this may due to contractor need to get a skilled worker and quality material to carry out the job and these cost will be transferred to developer. The second disadvantage was time addition, developer and contractor need more time to complete the work in order to fulfill the requirements and specifications as specified in the quality assessment system. Besides, there were only few respondents from developer and contractor

perceived that the quality assessment system will have an bad impact on the company's reputation and the product's quality.

4.11 Result from Questionnaire (Question 10)

Question: Does your company agree that the followings are the hurdles to apply the quality assessment system in the project?

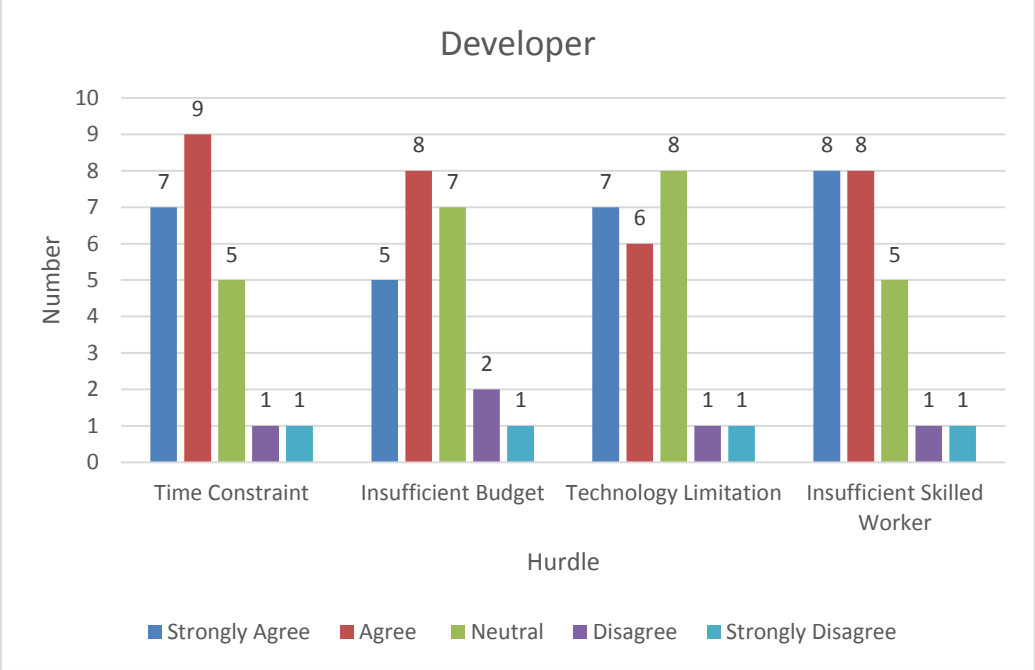

Chart 13: Developer's hurdles to apply the quality assessment system

Hurdle	Developer	
	RII	Rank
Time Constraint	0.774	2
Insufficient Budget	0.722	4
Technology Limitation	0.748	3
Insufficient Skilled Worker	0.783	1

Table 30: Relative Importance Index (RII) and ranking of the hurdles of applying quality assessment system (developer)

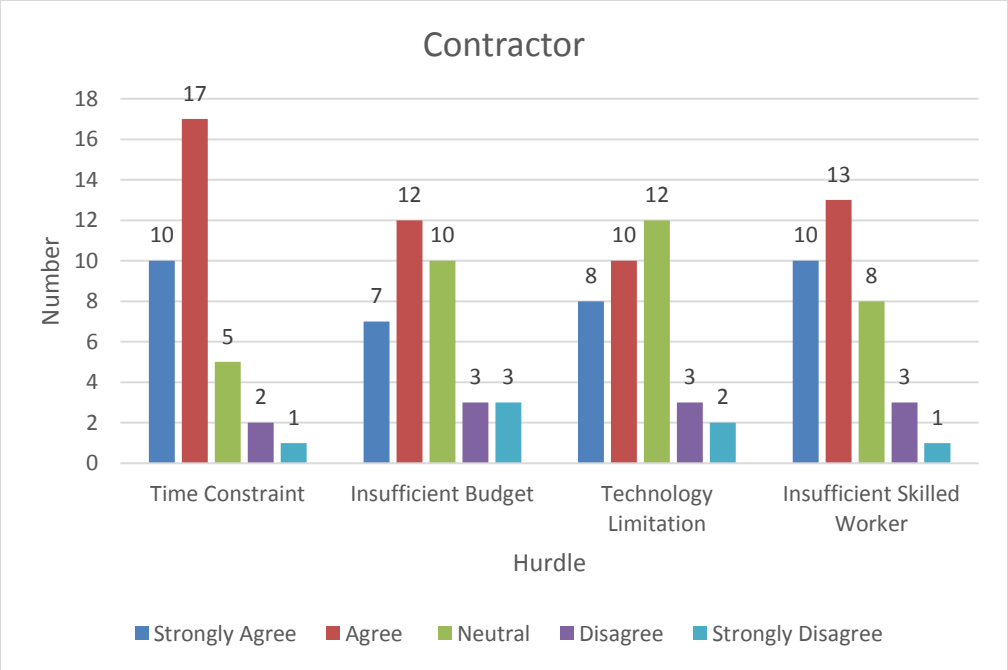

Chart 14: Contractor's hurdles to apply the quality assessment system

Hurdle	Contractor	
	RII	Rank
Time Constraint	0.789	1
Insufficient Budget	0.697	4
Technology Limitation	0.709	3
Insufficient Skilled Worker	0.760	2

Table 31: Relative Importance Index (RII) and ranking of the hurdles of applying quality assessment system (contractor)

Discussion:

With reference to the Chart 13 and Table, developers perceived that Insufficient Skilled Worker (1^{st}) was the main hurdle to apply quality assessment system. This was followed by Time Constraint (2^{nd}), Technology Limitation (3^{rd}) and Insufficient Budget (4^{th}).

Developer agreed that we are lacking of skilled worker in construction industry of Malaysia who can produce the product quality that can meet the quality as specified in quality assessment system, and this become the main hurdle to developer for applying the quality assessment system. Majority of developer perceived that insufficient construction time was the second hurdle that faced by developer to apply quality assessment system. Moreover, there were only few developers reckoned that there were lack of technology and budget were the

hurdles that will stop developer to consider to apply quality assessment system in their project.

However, refer to the Chart 14 and Table, contractors have different opinion compared with developer. Contractors perceived that Time Constraint (1^{st}) was the main hurdle to apply quality assessment system then only Insufficient Skilled Worker (2^{nd}). These were followed by Technology Limitation (3^{rd}) and Insufficient Budget (4^{th}).

Contractor perceived that they were not given enough time to construct and complete the works according to the standard and specification as stated in the quality assessment system, and this become the main hurdle to contractor. Secondly, contractor reckoned that our country are still lacking of skilled worker to carry out the quality works, and this become their second hurdle to stop the contractor to apply quality assessment system. Thirdly, few contractors reckoned that they were lack of technology to produce a quality product. Lastly, minority of the respondents opined that they were lack of funds to apply quality assessment system.

4.12 Result from Questionnaire (Question 11)

Question: Does your company agree that applying quality assessment system in construction project will benefit the company overall?

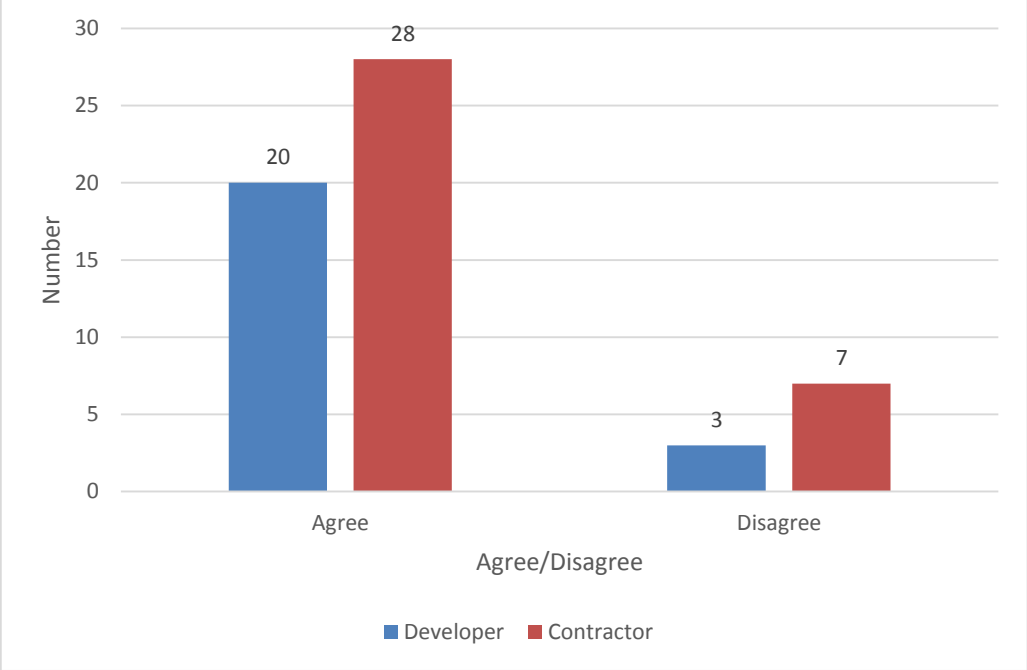

Chart 15: Respondent's opinion on the applying quality assessment system will benefit the company

Discussion:

The result showed that there were 20 (87%) numbers of developer agreed that applying quality assessment system in the project will benefit the company and 3 (13%) numbers of developer did not agree on this.

Moreover, the result also showed that there were 28 (80%) numbers of contractor agreed that applying quality assessment system in the project will benefit the company and 7 (20%) numbers of contractor disagree on this.

4.13 Result from Questionnaire (Question 12)

Question: Will your company continue to apply quality assessment system in construction project in future?

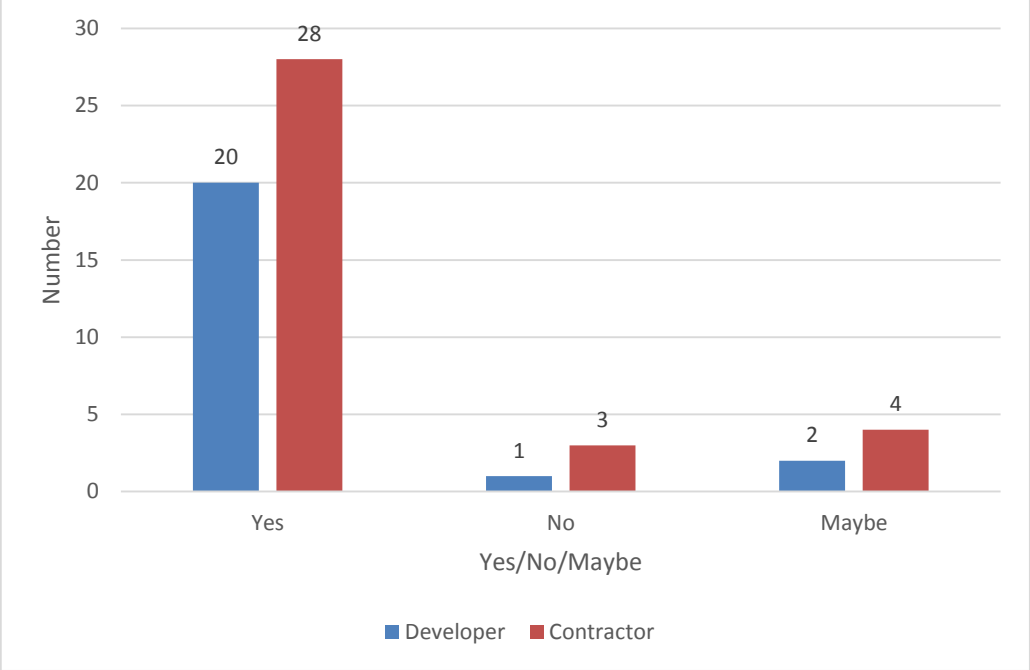

Chart 16: Respondent's option to continue to apply quality assessment system in future

Discussion:

Refer to the Chart 16, the survey showed that there were 20 (87%) numbers of developer will continue to apply quality assessment system in their future project. However, there were only 1 (4%) number and 2 (9%) numbers of developer will not and maybe continue to apply quality assessment system in future project respectively.

There were 28 (80%) numbers of contractor opt for continue to apply quality assessment system in their future project. In contrast, there were 1 (9%) number and 4 (11%) numbers of contractor respectively will not and maybe to continue to apply quality assessment system in future project respectively.

4.14 Correlation Test In Between Time Addition (Disadvantage) and Time Constraint (Hurdle)

Spearman's Rank Correlation Test was used to determine the correlation in between Time Addition of disadvantage and Time Constraint of hurdle. This is to examine whether the respondents who reckon the time addition is the disadvantage will also perceive time constraint is the hurdle.

Correlations

			Time Addition	Time Constraint
Spearman's rho	Time Addition	Correlation Coefficient	1.000	.928**
		Sig. (2-tailed)	.	.000
		N	58	58
	Time Constraint	Correlation Coefficient	.928**	1.000
		Sig. (2-tailed)	.000	.
		N	58	58

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

Table 32: Correlation in between Time Addition (Disadvantage) and Time Constraint (Hurdle)

Discussion:

Time addition (disadvantage) is significantly correlated to the time constraint (hurdle) as the p-value was lesser than 0.05. The correlation between the disadvantage and hurdle was determined based on the r-value table by Cohen and Holliday (1996). Based on Cohen and Holliday (1996), there is a very high positive correlation between time addition and time constraint (r = 0.93).

4.15 Correlation Test In Between Cost Addition (Disadvantage) and Insufficient Budget (Hurdle)

Spearman's Rank Correlation Test was used to determine the correlation in between Cost Addition of disadvantage and Insufficient Budget of hurdle. This is to examine whether the respondents who perceive the cost addition is the disadvantage will also opine insufficient budget is the hurdle.

Correlations

			Cost Addition	Insufficient Budget
Spearman's rho	Cost Addition	Correlation Coefficient	1.000	.912**
		Sig. (2-tailed)	.	.000
		N	58	58
	Insufficient Budget	Correlation Coefficient	.912**	1.000
		Sig. (2-tailed)	.000	.
		N	58	58

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

Table 33: Correlation in between Cost Addition (Disadvantage) and Insufficient Budget (Hurdle)

Discussion:

Cost addition (disadvantage) is significantly correlated to the hurdle, insufficient budget (p=0.0005). The correlation between the disadvantage and hurdle was determined based on the r-value table by Cohen and Holliday (1996). Based on Cohen and Holliday (1996), a very high positive correlation (r = 0.91) was observed between cost addition and insufficient budget.

4.16 Conclusion

Based on the results obtained from the survey, the researcher can conclude that there were total 58 respondents which comprised of 23 numbers of developers and 35 numbers of contractors, who had taken part on this survey. There was 57% of the respondents are project manager in the company. Besides, 91% of the respondents have applied CONQUAS 21, QLASSIC or both quality assessment systems in their project before. However, 81% of the respondents had practiced CONQUAS 21 in their project before. There were 72% of the respondents were not familiar with the differences of the standards and specifications in between CONQUAS 21 and QLASSIC. Moreover, there were total 76% of the respondents preferred to apply CONQUAS 21 and 66% of these respondents opted to apply CONQUAS 21 due to the popularity of the system.

The majority of both developers and contractors reckoned that the major advantage and disadvantage of applying quality assessment system was the system will help to improve the product quality and will incur additional construction cost respectively. Besides, the majority of the developers opined that insufficient skilled worker in the industry was the main hurdle for them to apply the quality assessment system. However, the majority of the contractors reckoned that time constraint was the major hurdle to them. There were 83% of the respondents agreed that their company will be benefited by applying quality assessment system and will definitely continue to apply quality assessment system in the future project.

On the other hand, the results also showed that Time Addition and Cost Addition of disadvantage were strongly correlated with Time Constraint and Insufficient Budget of hurdle respectively.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Research Conclusion

In Chapter 1, the four objectives are stated below:

1. To compare the standards and specifications of CONQUAS 21 and QLASSIC;

2. To determine the advantages and disadvantages of applying CONQUAS 21 and QLASSIC in construction projects;

3. To examine the hurdles when implementing CONQUAS 21 and QLASSIC in construction projects;

4. To find out developers and contractors prefer to apply CONQUAS 21 or QLASSIC and the reasons of using quality assessment system in Malaysia.

All the four objectives as stated above has been achieved through this study and a summary are as follow for ease reference.

For Objective 1, the comparison in between CONQUAS 21 and QLASSIC has been carried out in Chapter 2.4 and the components were as follow:

1. Objectives

2. Scope

3. Components to be assessed

    - reinforced concrete structures works

    - structural steel works

- pre-stressed concrete
- internal finishes
- roof
- external wall
- external works
- electrical works
- ACMV works
- fire protection works
- plumbing and sanitary works
- basic M&E fittings

4. Assessment

- building grouping guide
- weightage
- weightage for reinforced concrete structure element
- sampling guidelines for reinforced concrete structure work
- weightage for structural steel element and pre-stressed concrete element
- sampling guidelines for structural steelwork
- weightage for architectural element
- sampling guidelines for architectural work
- weightage for location of architectural work according to building category
- weightage for M&E element according to building category
- sampling guidelines for M&E works

The comparison of the components in between CONQUAS 21 and QLASSIC were clearly tabulated in Chapter 2.4. In general, the components are similar in between this two quality assessment system.

For Objective 2, the advantages and disadvantages by applying CONQUAS 21 and QLASSIC have been identified by conducting a survey via questionnaire sent to developers and contractors. The results were shown in Chart 9, Chart 10, Chart 11 and Chart 12. With refer to the result, the researcher can conclude that majority of the both developers and contractors perceived that the quality assessment system will improve the quality of works and they agree this is the main advantage. This is mainly due to both CONQUAS 21 and QLASSIC will provide a clear quality guideline and requirement to contractor to follow during construction. Besides, developers and contractors perceived that reputation improvement, time saving and cost saving as the second, third and fourth advantage. On the other hand, in terms of disadvantages, both developer and contractor perceived that cost addition was the main disadvantage by applying quality assessment system in the project and following with time addition, reputation retrogression and quality retrogression. The reason why both developer and contractor agreed that cost addition is the main disadvantage by applying quality assessment system is because contractor has to pay more to hire a competent worker and to purchase a better quality product in order to improve the construction quality to meet the CONQUAS 21 or QLASSIC requirements. Eventually, all this will additional cost will be borne by developer.

For Objective 3, according to Chart 13, the researcher can conclude that the main hurdle by applying quality assessment system for developer is insufficient skilled worker, follow with time constraint, technology limitation and insufficient budget. Majority of the developer perceived that we are lacking of skilled worker, in Malaysia, who can execute their works according to the specification as stated in CONQUAS 21 and QLASSIC. However, according to Chart 14, contractor perceived that time constraint is the main hurdle for them to apply quality assessment system, and this follow with insufficient skilled worker, technology limitation and insufficient budget. Contractor opine that developer is not giving enough time to them to deliver the product with the quality which is able to fulfill the specifications or standards as stated in CONQUAS 21 and QLASSIC.

For Objective 4, according to Chart 7 and Chart 8, researcher can conclude that both developer and contractor in Malaysia prefer to apply CONQUAS 21 rather than QLASSIC. This is due to CONQUAS 21 is more popular or well-known in Malaysia.

On the other hand, according to Table 32, researcher can conclude that there are strongly related in between time addition of disadvantage and time constraint of hurdle, which means if the developer or contractor perceived that time addition is the disadvantage, they will also perceive time constraint is the hurdle when applying quality assessment system in their project.

Moreover, with reference to the Table 33, researcher can conclude that cost addition of disadvantage and insufficient budget of hurdle are strongly related. Developer or contractor, who perceived that cost addition as the disadvantage, will perceive that insufficient budget is the main hurdle as well.

5.2 Research Recommendation and Limitation

The researcher recommends that government shall give incentive to those developer or contractor who is applying quality assessment system in their project. This will definitely improve the construction quality in Malaysia.

Besides, developer shall reward the contractor who can construct the works which can meet the specifications and quality standards that stated in the quality assessment system. This will not only improve the developer's reputation, it will also boost the sales of the developer in future.

On the other hand, CIDB may need to consider to promote QLASSIC in construction industry in Malaysia. There are still plenty of developers and contractors who are not familiar with QLASSIC. CIDB may consider to organize the road show, exhibition, forum and etc. to introduce QLASSIC to developer and contractor.

There were some limitations of this research. The results which obtained from the survey may not be sufficient to show the perception of all the developers and

contractors in Malaysia. These were mainly due to the low respondent rate and the reliability of collected data. People may not be willing to spend their precious time to participate in the survey which does not bring any benefit to them and some of the respondents may not answer the questionnaire seriously or unwilling to disclose the company's information to outsider.

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APPENDIX A

Survey On The Quality Assessment System For Construction Project In Malaysia

Dear Sir/Madam,

I am a final year student from Universiti of Tunku Abdul Rahman and currently working on my final year project. The objective of this survey is to examine the Quality Assessment System for constrcution project in Malaysia. Hence, your valued response is sincerely appreciated. Please be assured that all data will be used for purely academic purpose and will remain strictly anonymous.

Thank you for your participation.

Regards
YC Lau

* Required

1. **Please indicate your designation**
Mark only one oval.

- ◯ Project Director
- ◯ Project Manager
- ◯ Project Executive

2. **What is the nature of business of your company?**
Mark only one oval.

- ◯ Developer
- ◯ Contractor

3. **Did your company apply any quality assessment system in the project before?**
Mark only one oval.

- ◯ Yes
- ◯ No

4. **Which of the following quality system that did your company practice?**
Mark only one oval.

- ◯ CONQUAS 21
- ◯ QLASSIC
- ◯ Both

5. **Does your company familiar with the differences in between CONQUAS 21 and QLASSIC?**
Mark only one oval.

- Yes
- No

6. **Which of the quality assessment system that your company preferred most?**
Mark only one oval.

- CONQUAS 21
- QLASSIC

7. **What is the following make your company prefer to apply the quality assessment system that chosen in Question 4?**
Mark only one oval.

- Popularity of The System
- Easier to Get Accredited

8. **Does your company agree that applying the quality assessment system will bring the following advantages to the project? ***
Mark only one oval per row.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Time Saving					
Cost Saving					
Quality Improvement					
Reputation Improvement					

9. **Does your company agree that applying the quality assessment system will bring the following disadvantages to the project?**
Mark only one oval per row.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Time Addition					
Cost Addition					
Quality Retrogression					
Reputation Retrogression					

10. **Does your company agree that the followings are the hurdles to apply the quality assessment system in the project?**
Mark only one oval per row.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Time Constraint					
Insufficient Budget					
Technology Limitation					
Insufficient Skilled Worker					

11. **Does your company agree that applying quality system in construction project will benefit the company overall?**
Mark only one oval.

- Agree
- Disagree

12. **Will your company continue to apply quality assessment system in construction project in future?**
Mark only one oval.

- Yes
- No
- Maybe

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APPENDIX B

The r-value table

r	Meaning
0.00 – 0.19	A very low correlation
0.20 – 0.39	A low correlation
0.40 – 0.69	A modest correlation
0.70 – 0.89	A high correlation
0.90 – 1.00	A very high correlation

(Adapted from Cohen & Holliday, 1996)