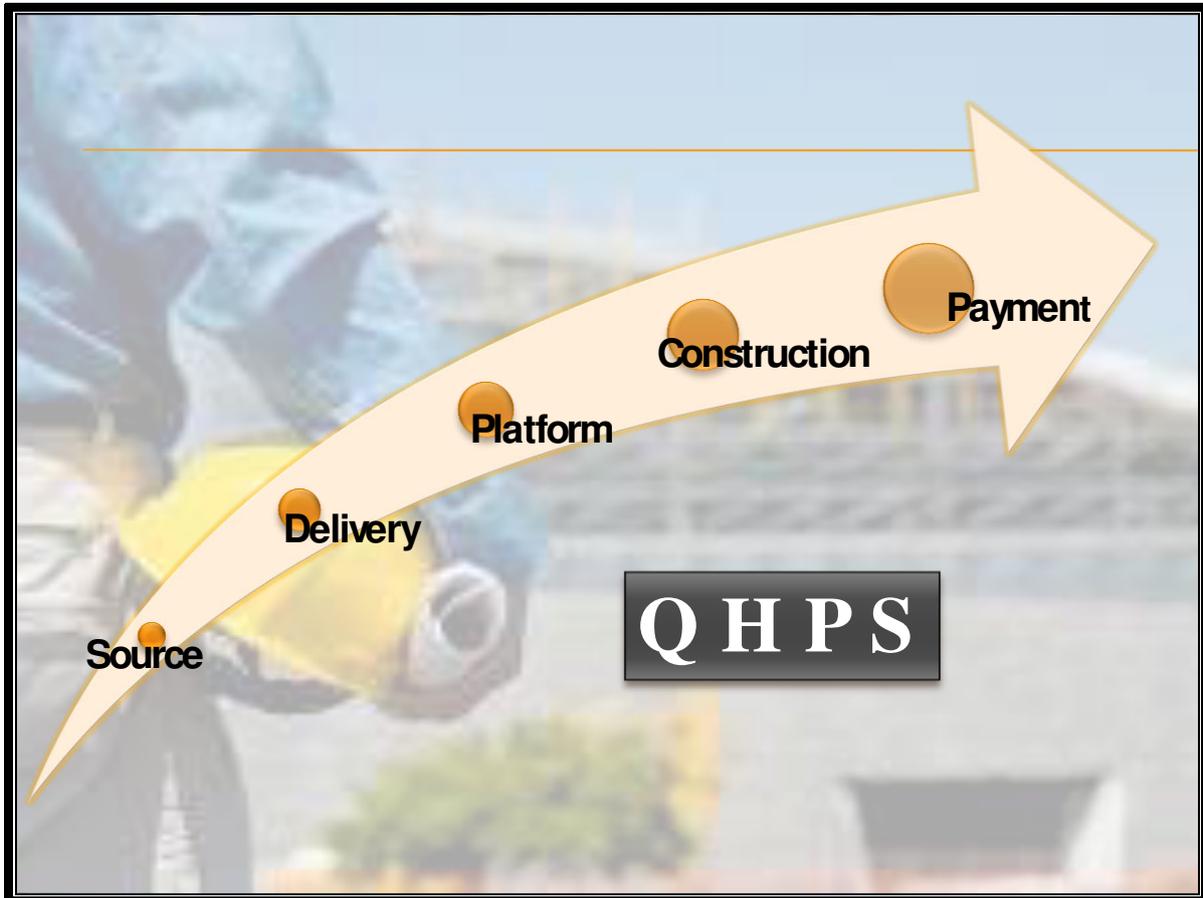


QUALITY HOLD POINTS SYSTEM

HANDBOOK



PRODUCED BY
JABATAN KERJA RAYA SARAWAK

1st. EDITION

FOREWORD

In most engineering development driven environment, the *time* and *cost* elements have always been the primary focus of the stakeholders in the construction industry. The *quality* aspect of the infrastructure and facilities built is presumably upheld in the natural course of construction and supervision. However, persistent voices of dissent by public and users seemingly points towards shortcomings in the quality of products built. In 2012, Jabatan Kerja Raya Sarawak, under the new leadership of Datu Ir Hj. Zuraimi Bin Hj Sabki, refused to ignore and be oblivion to the status quo level of quality of the construction project undertaken by the organisation. Initiatives, under JKR Transformation Agenda 1.0, were rolled out in order to instil awareness and appreciation to quality management, and also to restore order and to realign the quality assurance agenda in construction. JKR Sarawak QAQC Guidelines was drafted and implemented across the Department in the same year. The impact has been tremendous. Notwithstanding that, previously the guidelines, together with contract specifications and standards were purely activity-based in nature. Sensing its limitations, Datu Ir Hj Zuraimi, prompted a process based approach to QAQC. Thus, Quality Hold Point System (QHPS) was mooted and developed in 2016. This Handbook seeks to underline and explain the principle and concept behind QHPS, which is now being implemented in the Department state-wide. It also provides an easy step by step guide to implement the JKR Sarawak's home grown system. It is envisaged by with the QHPS, QAQC in the organisation will become more robust and effective, producing better quality built infrastructure and facilities for the people of Sarawak.

ACKNOWLEDGEMENT

The Department would like to accord its utmost gratitude to Ir. Dr. Ting Sim Nee, senior lecturer of University Of Malaysia Sarawak for her valuable input and contribution in the drafting of this Handbook.

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1. INTRODUCTION

1.1 WHAT IS QUALITY

In construction industry, the products are the infrastructures and facilities such as road, building, wharf and jetty such as drainage, sewerage, plants and many others. One of the biggest problems in the construction industry worldwide is the resources and management controls necessary to achieve adequate levels of quality in completed projects. And when picking on what can be given away, quality is usually the give away.

Quality is defined as meeting the requirement, expectation, and needs of the client and is free from the defects, lacks and substantial variants. There are standards needs to follow to satisfy the client requirements. Quality of a product is often based on the **standard (piawaian)** of product/service (**produk/perkhimatan**) **as measured against other product/service of a similar kind**. It represents the characteristics and **properties (ciri ciri)** of products and/or services that are wanted and **valued by the customer, i.e. the needs and requirements of the customer**. At the fundamentals, standards are used determine the quality.

Quality can be measured qualitatively or quantitatively and measurement can be described in eight dimensions and different levels:

Level 1: Basic intended use and features with no defects and no complaints

Level 2: Conformance to standards and specifications dictated by statutory bodies and designers

Level 3: Long Durability

Level 4: Good performance, efficiency and operability

Level 5: High Reliability

Level 6: Serviceability in various environment

Level 7: Aesthetics, i.e. attractive to the eyes

Level 8: Perceived Quality deals with emotional and sensory characteristics

At which ever level, the measure for **‘good quality’ and ‘poor quality’ product, depending on the standard/initial set requirements it is measured against.**Orwig and Brennan (2000) suggest that quality planning is important because it:

- provides direction
- provides a structured framework
- reveals opportunities
- ***facilitates quality control and assurance***

1.2 What is Quality Control

Control is to test or verify actual results by comparing it with the defined standards.

Quality control (QC) is an activity or set of activities in sequence (LANGKAH – LANGKAH) intended to ensure (MEMASTIKAN) that a constructed product adheres (MENEPATI) to a defined set of quality criteria and meets the requirements of the client or customer. Quality criteria are standards stipulated in specification of the works. Quality Control is a reactive process and is detection in nature. It recognizes the defects. Quality Control has to complete after Quality Assurance.

Thus, quality control can range from simple activity such as visual inspection, examination, or a more complicated, lab testing.

1.3 Purpose of Quality Control

Quality control plays an important in construction project delivery as it

- a) Ensure the material used, and works done are according to the required specification
- b) Ensure that the payment for the materials and works are justified, according to Service Order, Quotation and Contract
- c) Ensure that the works/facilities completed will function as it is intended to be,
- d) Ensure that it does not
 - i. deteriorates easily,
 - ii. deteriorates before its intended lifespan
 - iii. causes harm (**mudarat**) to properties and human lifes,

- iv. cause time and inconveniences (**kesusahan**) with downtimes
- e) Ensure the goodwill and reputation of those involved in the construction process. Quality issues often causes reputation damage and client losing confidence in the construction team; and in some circumstances, disqualifying from future projects within the same agencies.

2 LEVEL OF QUALITY CONTROL

As previously defined, QC is an activity or set of activities in ensuring the compliance of product to a standard or specification. Such activity, or series of activities can range from simple act of looking at the product to using set of equipment to determine the properties of product.

Based on the level of complexity, QC for construction project can be classified into four(4) levels

- a) Visual inspection with or without checklist;
 - b) Inspection with measurement;
 - c) Examination of quality document or records;
 - d) Testing; eg. Lab or in-situ
- a) **VISUAL INSPECTION (PEMERIKSAAN SECARA MATA KASAR)**
- This is the most basic and simplest way of QC by just using the visual sense of the inspectors. No tools are required at all. And at most a set of checklist is used to ensure all properties are observed.

During the visual inspection, physical appearance of materials and constructed works are observed; be it the color, features, appearance, among others. Besides, in order to ensure quality in place, checking should be made visually on whether there are cracks, contamination, among others.

In certain cases, a pro forma checklist is required to ensure necessary features are observed and to ensure all key elements are being visually examined.



Figure 1: Example of Visual Inspection

b) INSPECTION WITH MEASUREMENT (PENGUKURAN)

This next level requires more than just visual observation. Some physical examinations are conducted by measuring the constructed product with measuring tools. The measurement is made on the physical properties such as dimension, temperature and weight. Measuring tools and equipment are used at this level, for instance, measuring tape, thermometer, survey equipment and thickness gauge.

Physical properties of materials are checked, eg. Diameter of bars, weight of hammer, platform survey, roofing sheet thickness. Figure 1 shows the typical measuring tools.

Figure 2: Example of Tools Used for Measurement

c) EXAMINATION OF RECORDS (REKOD DAN SIJIL)

Many construction materials come with factory certificates, testing report by third party or the authorities. For example,

- a) Sectional steels, eg. (JIS, MS, etc)

- b) Building products/fittings
- c) RC piles
- d) Electrical products

The certificates or test reports normally show the compliant of the materials to the relevant standards. Testing report by accredited testing laboratories are preferred.

Besides testing certificates or reports, product warranty or installation guarantee are also documents and records, which could prove the level of compliant to standard and design requirement. Figure 3 shows a typical compliant certificate issued by an accredited lab.

It has been enforced since 2015, that under CIDB Act 520 (amendment 2011), Schedule III, all construction materials used on sites must be certified by CIDB with a Certificate Of Standard Compliant. Figure 4 shows a typical certificate from CIDB.

Thus, at this level of quality control, the document and certificates of the construction material to be used, or delivered to sites should be examined by the supervision team as a mean to ascertain to quality of the material is conforming to the specification and standards. The contractors should be required to solicit these documents from the manufacturer or supplier, for submission to the supervision team.



Figure 3: Typical Compliant Certificate



Figure 4: Typical CIDB Certificate

d) LAB & FIELD TESTING (UJIAN BAHAN)

The most complicated QC method is to conduct testing on the construction materials, or completed elements of the construction. The testing method normally is derived from an internationally recognized testing standard, where standard equipment and tools, and procedures are defined clearly. The testing is done either in controlled laboratory condition, or at the site, under field condition.

Most construction materials can be tested. It is a matter of whether the test requires sophisticated tools and equipment or otherwise. Because of the testing requirement, this QC method would normally cost more than other level of QC, and more time spent as well.

In short, the level of Quality Control could be depicted in the Figure 5 below:

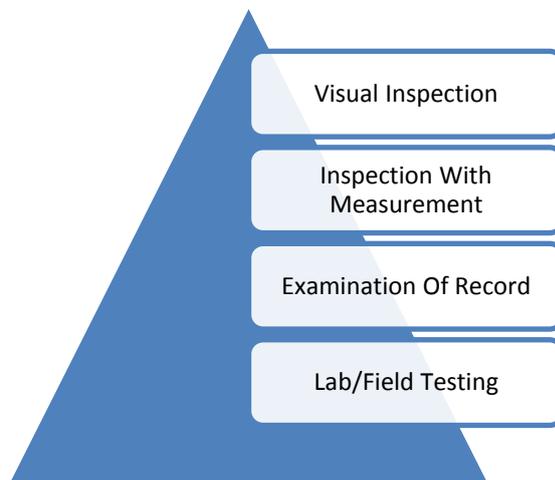


Figure 5: Quality Control Methods at Different Level

The level and method of QC are dependent on the nature of materials as well as the works done. Cost, time and practicality should be weighted to decide on the level and method of QC. Some materials could only be tested practically at source. Hence, the certificates of testing from the accredited lab during delivery of materials suffice. Some works require full scale loading testing, such as roof trusses. Thus, massive setup is necessary and will incur high cost. Practically, correctness in installation may be examined instead, to ensure quality.

3. **KEY PROCESSES FOR CONSTRUCTION ACTIVITIES (PROSES UTAMA UNTUK AKTIVITI PEMBINAAN)**

3.1 BASIC COMPONENTS IN CONSTRUCTION

The key components in ensuring quality in construction works can be identified as

- a) Manpower skill (in executing construction process)
- b) Materials to form the permanent fixtures
- c) Machines, which consists the many kind of tools, machineries and equipment to be used by the skill manpower to construct

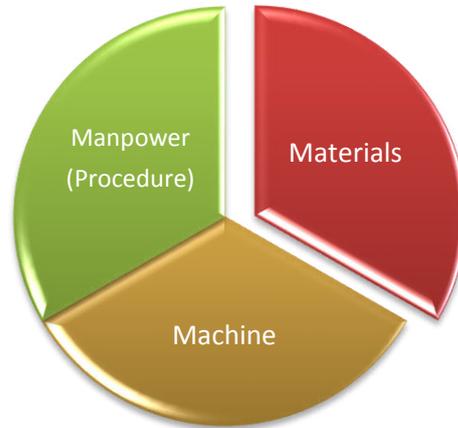


Figure 6: Key Components of Construction Processes

3.2 CONSTRUCTION MATERIALS (BAHAN BINAAN)

While the skill of manpower can be quite difficult and subjective to gauge and the machineries are subject to the competency of the operators, the quality of construction materials is more easily ascertained and significantly affects to quality of end product. Thus, this QA system proposed here focuses on controlling the quality of materials used. However, the construction materials which do not form part of the end product, or otherwise, recognised as for temporary works only are not inclusive. In another word, temporary works are excluded in this approach.

All Construction projects use all kinds of materials to be put together in order to produce (**MENGHASILKAN**) another entity, or composite

materials, or at the end of the project, the facilities and infrastructures. The materials used can be raw (**ASLI**) natural materials such as soil, sand, aggregates and timber. The materials can also be processed (**KILANG**) materials either from factory or other means, for example, roofing sheet, paint, tiles and doors.

Every kind of construction projects uses different types of construction materials. Typically, building construction projects will need materials such as, Concrete, Steel bars, Roofing sheet, Paint, Tiles, Door, Windows, etc. For road projects, the common materials used are soil, sand, aggregates, concrete, steel bars, asphalt concrete and thermoplastic paint. Likewise, for other infrastructure such as, reinforced concrete bridge, RC wharf and jetty, and the likes, where concrete and steel bars. If steel structures is constructed, steel sections will be the main material.

3.3 THE PROCESS FLOW OF CONSTRUCTION MATERIALS

3.3.1 From the supply source to site

- i. Before the contractor begins construction, he will source for the construction materials needed in this projects – **SOURCE/SUPPLY(SUMBER)**
- ii. After he has confirmed his source/supply of materials, whether from hardware retailer, or wholesaler, he will order the materials in the right quantum, to be delivered to site – **DELIVERY(HANTARAN)**

- iii. The contract specification specifies the type, properties, STANDARD of materials to be used, which he is obligated to comply with.
- iv. These information of the materials determine the standard and quality of the end product

3.3.2 From the site storage to the platform

- i. While the materials are being sourced, ordered and delivered to site, the workers will start constructing a platform
- ii. A platform can be defined as any works which needs to be done before subsequent works could be constructed or installed or built on. It could be temporary work or permanent work.
- iii. In order to proceed to construct/install, the platform must be ready to be constructed on – **PLATFORM READY (TAPAK)**
- iv. During the construction/installation process, certain **procedures** are being followed, using correct **tools**/machines by the workers or labourers – **CONSTRUCTION/INSTALLATION (AKTIVITI PEMBINAAN)**
- v. The requirement of the platform and the workmanship also are spelt out in project specification.

3.3.3 Completion/payment

- i. After the Contractor has completed the work, he will claim payment for the works done – **PAYMENT (BAYARAN)**

- ii. The project specification will usually specify the performance standard requires for the finished product

Thus, in short, the process path of the raw construction materials until the end constructed product can be represented by the simple flow chart below:



Figure 7: Construction Material Process Flow Chart

4. **FUNCTION OF HOLD POINTS IN CONSTRUCTION**

4.1 MEANING OF HOLD POINT

At a certain point or stage in the construction, Contractor is 'held' (tahan), or NOT allowed to proceed with the next sequence of process BEFORE and UNTIL Quality Control is conducted to check and determine whether the specification of the materials and works concerned are complied with (KUALITI DIPERIKSA).

Contractor must fulfill the QC requirement and specification for the particular material or/and work before he is allowed to proceed (PEMATUHAN DIKEHENDAKI). The methods to conduct QC vary in levels, and are in accordance with the nature of material and work, as explained in Section 2 Figure 5 :

4.2 APPLICATION OF HOLD POINT

The point or stage where the Hold Point is applied, is at the key process of the construction materials path which have been pre-identified, as in Section 3.3.3 and Figure 7.

4.2.1 SUPPLY/SOURCE OF MATERIAL/BEKALAN BAHAN



Figure 7 (a): Hold Point at Supply

Before the contractor order the material from the wholesale or retailer...the supervisor should apply QC method on the materials to be ordered and delivered by the contractor. The contractor is HOLD...



And the question to be asked is

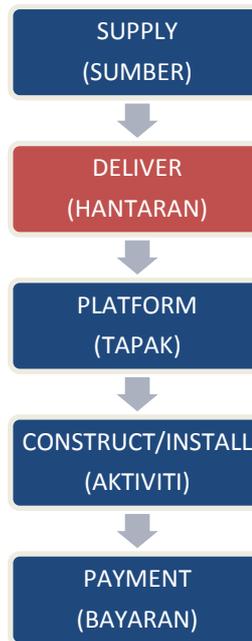
IS THE SOURCE OF SUPPLY OF THE MATERIALS COMPLIED WITH SPECIFICATION ???

The supervisor will request the contractor to seek approval from him on type, model, made, manufacturer and supplier, whichever applicable, to ensure that the contractor is ordering the correct materials, which

complies with the specification, BEFORE the contractor place his order. If it complies, contractor will be allowed to proceed, or otherwise, to source and seek approval till it is ascertained as in compliant.

This step is critical as it prevents non conforming materials from being ordered and delivered to site. The QC methods at different level as discussed in Section 2 Figure 5 can be used.

4.4.2 DELIVERY OF MATERIAL

**Figure 7(b): Hold Points at Delivery**

After the source of supply has been accepted/approved, the contractor is allowed to deliver the materials to site for use. Once the construction materials have been delivered, the supervisor will apply QC method on the materials on site. Before the contractor is allowed to use the materials on site, the contractor is then HELD again...



And the question to be asked is

IS THE MATERIALS DELIVERED CORRECTLY CONFORM TO THE SPECIFICATION ???

The supervisor will request the contractor to show evidence that the materials at site is complying to the specification. Or in another word, they are exactly what have been approved at the first Hold Point. In case, non conformity is noted, these materials must be rejected and removed from site.

At this juncture, sample of materials may be extracted to be tested as well as a mean of QC. Certificate of compliant for the batch delivered, delivery docket, etc are evidences of QC method applied. This step aims at ensuring the materials on site that will be used are in accordance with what have been approved, or in compliant with specification. Otherwise, if non compliance is detected only after construction has begun, where the materials are used or installed, it is more difficult to undo or removed. Time, and effort are wasted. The QC method at different level or method discussed in Section 2 Figure 5 will be used.

4.2.3 PLATFORM READINESS

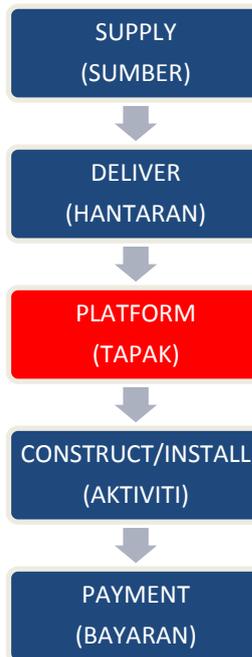


Figure 7(c): Hold Points at Platform (Site)

Once the materials on site are checked and approved, the contractor can proceed with constructing or installing the materials onto a platform, or any position meant for the materials. However, the platform has to be ready and in accordance with specification also. Thus, the contractor is HELD again, to allow the supervisor to apply QC method on the platform as well,



and ask this question...

IS THE PLATFORM READY, FOLLOWING THE SPECIFICATION ???

It is usually at this juncture, that the supervisor will resort to visual inspection, or measurement to ascertain the conformity. For instance, the formwork and reinforcement steel bars should be checked for compliance to design drawings. In road works, the survey level or the degree of compaction should be checked or tested.

This Hold Point is to ensure that those elements which will be concealed are in order and in place, or otherwise, could not be inspected again later. Apart from that, any non conformity and defective work could still be reworked or corrected. The QC method at different methods to be used may be as discussed in Section 2 Figure 5.

4.2.4 CONSTRUCTION/INSTALLATION



Figure 7(d): Hold Point at Construction/Installation

After the platform has been ready, the contractor can then proceed with the construction or installation works.



•PROCEED

be used are accepted and

been ascertained to contractor can then construction or Now, the materials to ready, and likewise,

the platform for works. The contractor shall not be HELD back at this point. Instead, the contractor can commence his works, as long as his workers and equipment and tools are ready. However, the supervisor shall also exercise QC during the process of constructing and installing. Usually, the supervisor shall do standing supervision, by visually witnessing the process of construction.

The contractor is not being held at this point. Meaning, this is not a Hold Point. Instead, it is called Witness Point. The observation to be made...

IS THE WORKERS USING THE RIGHT MACHINE/TOOLS AND STEPS IN ACCORDANCE WITH THE SPECIFICATION ???

During the witnessing, he shall observe whether the workers are using the right tools, and and right skills, in the right work procedure to construct or install.

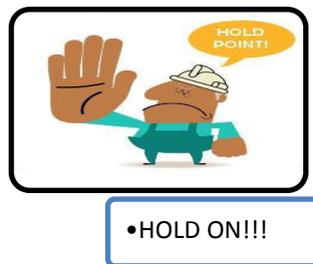
4.2.5 COMPLETION/PAYMENT



Figure 7(e): Hold Point at

Payment

After all that has been done and completed, as far as that stage of work is concerned, the contractor shall be entitled to claim for payment for the works completed. This is where it all matters as the final point where the supervisor shall apply QC method on the works done. The payment due to the contractor is HELD again, until the requirement of the project is fulfilled.



The supervisor will seek to determine

*IS THE END PRODUCT CORRECT OR PERFORM ACCORDING TO
SPECIFICATION ???*

The supervisor can either visually check on site, pull the tape to measure and waiting for the testing report to be produced before he is satisfied that the requirement has been met. Subsequently, he will proceed to process payment.

5. EXAMPLE OF QHPS APPLICATION

5.1 CONSTRUCTION OF ROAD BASE

At every Hold Point (HP/WP), the supervisor conduct QC by various QC level on the aggregates and the platform for roadbase, before the contractor is allowed to proceed. At the end, the degree of compaction of road base level shall be tested as well.

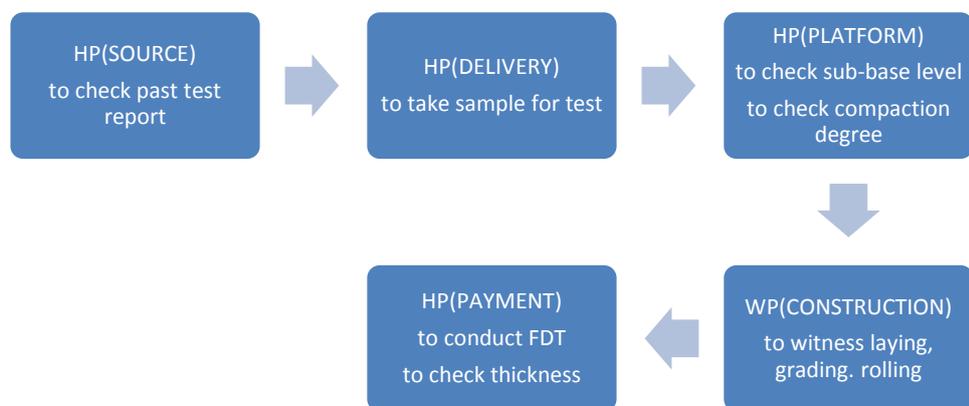


Figure 8: Hold Points for Road Construction

5.2 REINFORCED CONCRETE WORKS

At every Hold Point (HP/WP), the supervisor conduct QC by various QC level on the concrete mix design, on the delivered concrete or site mix and the formwork with rebar, before the contractor is allowed to proceed. At the end, the concrete cubes shall be tested as well.

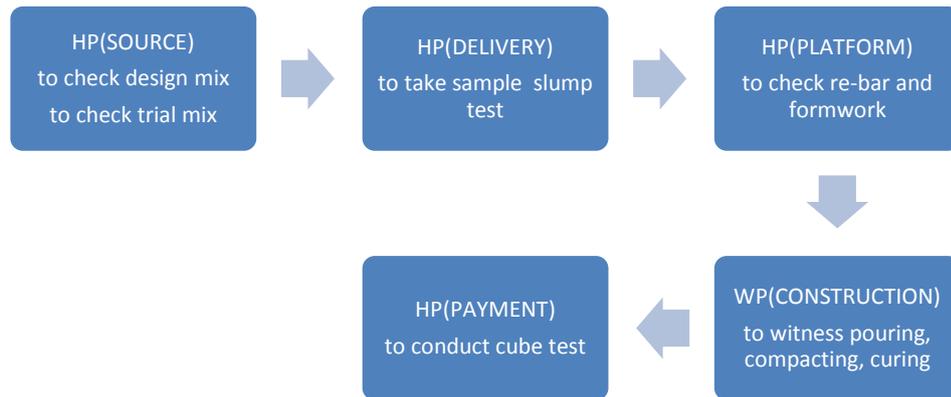


Figure 9: Hold Points for Reinforced Concrete Works

5.3 PAINTING FOR BUILDING

At every Hold Point (HP/WP), the supervisor conduct QC by various QC level on the source of paint, on the delivered paint to site and the wall or surface to be painted (usually a checklist or Request For Inspection), before the contractor is allowed to proceed. At the end, the painted surface is checked as well.

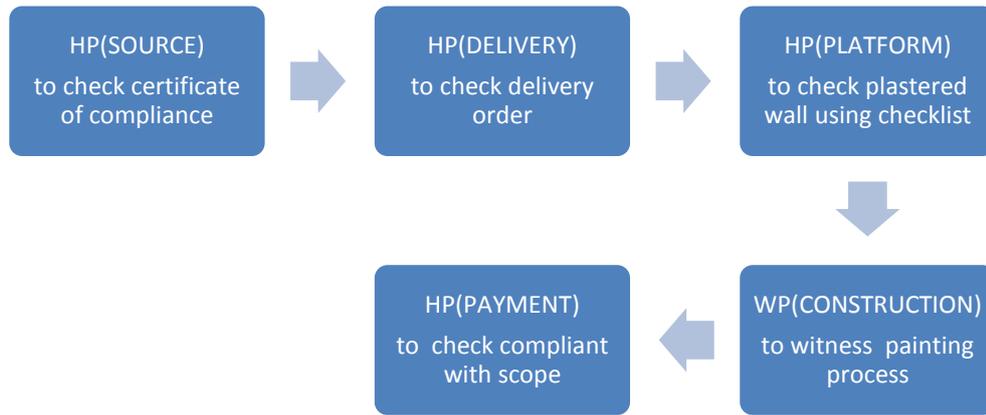


Figure 10: Hold Points for Building works

6. THE USE OF QHPS CHECKLIST ON CONSTRUCTION PROJECTS

A simple checklist is used for QHPS. The blank form is prepared by the supervision team at the beginning of the project. The type of scope to be listed in the form shall fulfill the criteria below:

- a) Refer to Bill Of Quantities
- b) Tangible output of works are specified. NOT activities.
- c) Temporary works are NOT listed. ONLY permanent works.
- d) It should be filled in sequence of output
- e) Sectional scope shall be used if works are repetitive, or over a long long distance.

6.1 TYPICAL QHPS CHECK-LIST FOR BUILDING WORKS

No	Scope	Source	Delivery	Platform	Construction	Payment
1	Piling					
2	Footing					
3	Ground Beam					
4	Slab					
5	Column					
6	Roof Beam					
7	Roof truss					
8	Brick wall					
9	Painting					
10	Windows					
11	Doors					
12	Sanitary wares					
13	Roofing Sheet					

Figure 11: Checklist for Building Works

6.2 TYPICAL QHPS CHECK-LIST FOR ROAD WORKS

No	Scope	Source	Delivery	Platform	Construction	Payment
1	Embankment					
2	Subgrade					
3	Subbase					
4	Road Base					
5	Premix					
6	Culvert					
7	Drain					

Figure 12: Checklist for Road Works

6.3 HOW THE CHECKLIST IS USED

At the beginning of the project, the supervision team prepare the checklist and fill up the scope accordingly. He then solicit from the contractor to submit to him all his proposed sources of materials.

As the work progresses, the supervisor uses the checklist to keep track of all the Hold Points where he needs to do QC. As each QC is done satisfactory, the relevant box is 'v' for the HP for the output.

EXAMPLE 1: USE OF QHPS CHECKLIST - ROOFING FOR BUILDING

At every Hold Point (HP/WP), the supervisor conduct QC by various QC level on the source of roofing materials. Subsequently, the roofing sheet should be inspected on site, either by measuring the thickness or delivery documents. At this juncture, the checklist shall be filled up till Delivery. Apply a 'v' at the cell under the Source and Delivery column respectively.

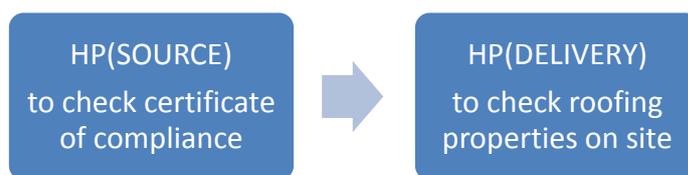


Figure 13: Hold Points for Roofing Works

No	Scope	Source	Delivery	Platform	Construction	Payment
1	Roofing	v	v			

Figure 13(a): Partial completed QHPS Check-list

Before the contractor is allowed to proceed further, the supervisor should check on the platform for installation the roofing sheet, such as the pitch of roof and the trusses, are correct. Apply a 'v' under Construction column. This

is then followed by witnessing the installation process where the steps and tools used should be observed. Likewise, the column is also checked. At the end, the contractor may produce warranty certificate from the manufacturer, or specialised installer as proof as QC. The last column of the Checklist are filled up accordingly. The completed QHPS checklist is shown in Figure 14 (a).

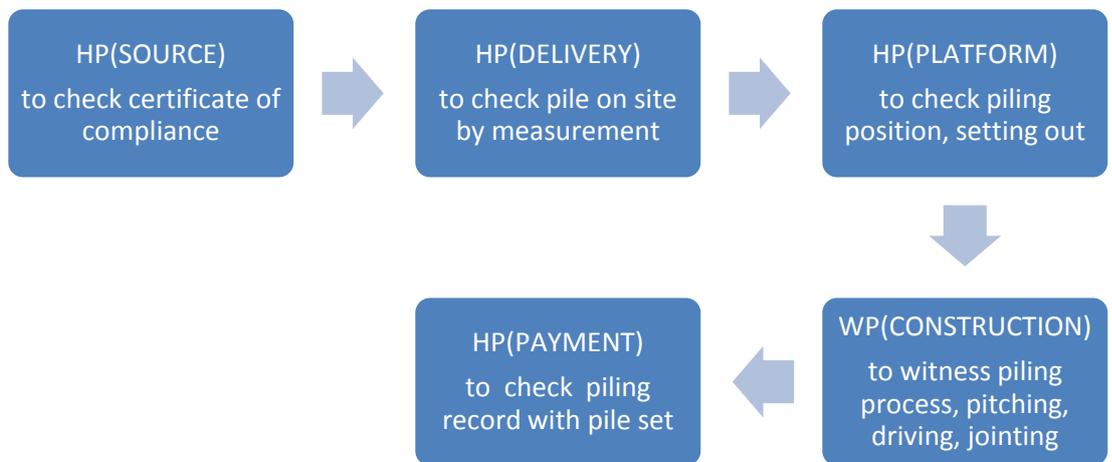


Figure 14: Complete Hold Points for Roofing Works

No	Scope	Source	Delivery	Platform	Construction	Payment
1	Roofing	√	√	√	√	√

Figure 14 (a) Completed QHPS Check-list

EXAMPLE 2: USE OF QHPS CHECKLIST - PILING WORKS

At every Hold Point (HP/WP), the supervisor conduct QC by various QC level on the source of pile, subsequently, on the delivered pile at site. The partial Completed checklist shall appear like Figure 15(a).

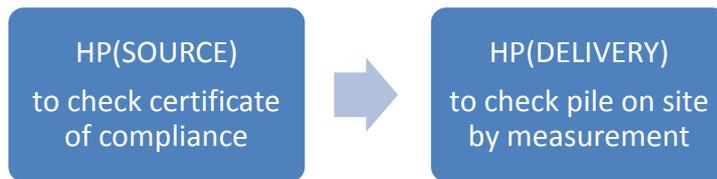


Figure 15: Hold Points for Piling Works

No	Scope	Source	Delivery	Platform	Construction	Payment
1	Piling	√	√			

Figure 15 (a): Partial completed QHPS Check-list

Before contractor can proceed with driving the piles, the supervisor shall note that the platform for piling works are not checked with QC method yet. Thus, he shall conduct inspection to ascertain the correctness of piling positions (by proper setting out), before the contractor is allowed to proceed. The box under the Platform column is checked ' √ '. During the driving of pile, the supervisor must ensure that the pile are driven vertically, joined correctly and

driven to set, where applicable. The box under the Installation column is checked '✓', if everything is in order. At the end, the contractor shall show proof of piling works with set graph and piling records, before payment can be processed. Once all these HP are applied with QC, the checklist would look like the form in Figure 16 (a).

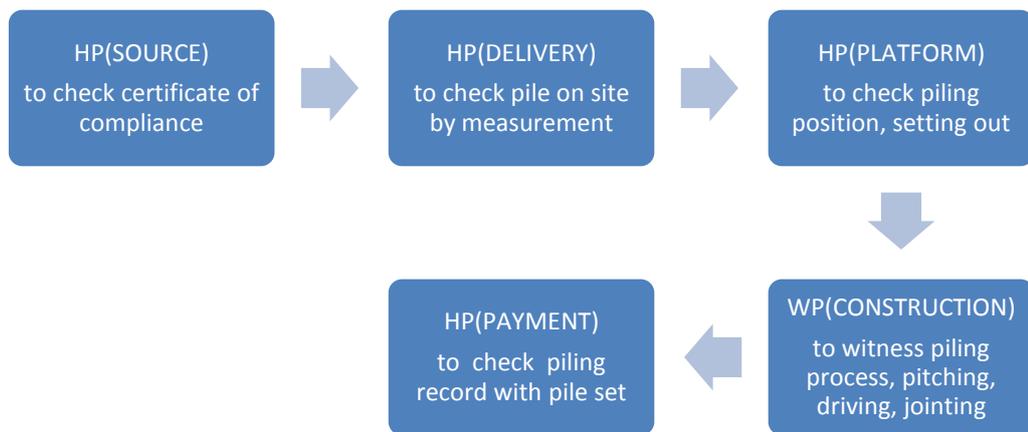


Figure 16: Complete Hold Points for Piling Works

No	Scope	Source	Delivery	Platform	Construction	Payment
1	Piling	✓	✓	✓	✓	✓

Figure 16(a): Completed QHPS Check-list