# CONQUAS®

## THE BCA CONSTRUCTION QUALITY ASSESSMENT SYSTEM

BCA QUALITY MARK

Building and Construction Authority

We shape a **safe**, **high quality**, **sustainable** and **friendly** built environment.

# CONQUAS®

## THE BCA
## CONSTRUCTION QUALITY ASSESSMENT SYSTEM

First Edition 1989
Second Edition 1990
Third Edition 1992
Fourth Edition 1995
Fifth Edition 1998
Fifth Edition 2000 version
Fifth Edition 2003 version
Sixth Edition 2005
Seventh Edition 2008
Eighth Edition 2012
Eight Edition 2014 version
Ninth Edition 2017
Ninth Edition 2017 (Nov 2017)
Ninth Edition 2019 (May 2019)
Ninth Edition 2019 (Oct 2019)
Ninth Edition 2019 (Apr 2020)

# CONTENTS

# 1.0 INTRODUCTION

## 1.1 Objectives of CONQUAS

The Construction Quality Assessment System or **CONQUAS** was developed by the Building and Construction Authority (BCA) in conjunction with major public sector agencies and various leading industry professional bodies, organizations and firms to measure the quality level achieved in a completed project.

CONQUAS was designed with three objectives:

(a) To have a standard quality assessment system for construction projects.

(b) To make quality assessment objective by:

- measuring constructed works against workmanship standards and specification.

- using a sampling approach to suitably represent the whole project.

(c) To enable quality assessment to be carried out systematically within reasonable cost and time.

CONQUAS is an independent assessment. Unless specified in the building contract, project engineers or architects should not use CONQUAS to decide if the building or parts of the building project are acceptable.

## 1.2 Scope of CONQUAS

CONQUAS sets out the standards for the various aspects of construction work and awards points for works that meet the standards. These points are then summed up to give a total quality score called the **CONQUAS Score** for the building project.

CONQUAS covers most aspects of general building works and assessments shall be completed prior to application for TOP or CSC inspection, whichever comes first.

The assessment consists of **three components:**

**(1) Structural Works,**
**(2) Architectural Works and**
**(3) Mechanical & Electrical (M&E) Works**.

Each component is further divided into different items for assessment. However, the assessment excludes works such as piling, heavy foundation and sub-

structure works which are heavily equipment-based, buried or covered and usually called under separate contracts or sub-contracts.

The building is assessed primarily on **workmanship standards** achieved through site inspection. The assessment is done throughout the construction process for Structural and 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. These tests help to safeguard the interest of building occupants in relation to safety, comfort and aesthetic defects which surface only after sometime.

To further enhance the robustness of the CONQUAS score, scoring under the 9th edition will now take into consideration major defects (e.g. water seepages through wall/window, inter-floor leakages, functionally deficient doors/windows etc.) detected during the internal finish assessments. The scoring will factor in the severity of these major defects. Adverse feedback from end-users on major defects that surface during the defects liability period of a project will also be considered when finalising the CONQUAS score.

The 3-tier CONQUAS Scheme (see Table A) is introduced to help developers/contractors further raise the quality of their new private residential developments. This involves a higher sampling rate assessment where more samples will be covered and more areas for improvement identified. The 3-tier CONQUAS Scheme will apply to all CONQUAS applications for new *private residential developments received

The 3-tier CONQUAS Scheme is applicable where:

(a) developers or main contractors, in the past 3 years,
   i. has no CONQUAS track record for private residential development, or
   ii. has at least one *private residential development with CONQUAS score below the threshold CONQUAS score[1]
   iii. has at least one *private residential development with major defects affecting ≥ 20 units or 5% of all units, whichever is lower

   (Upon the expiry of the 3 year period, BCA retains the discretion to impose Tier 3 CONQUAS assessment if BCA assesses that the major defects have not been reasonably addressed.)

(b) all other developers or main contractors
   i. to be decided after the initial CONQUAS score[2] is generated

**Note: Includes private mixed developments with residential component.*

**Table A**

| S/N | Applicants | Tier 1 | Tier 2a | Tier 2b | Tier 3 |
|---|---|---|---|---|---|
| | | **25% sampling (25% of the units will be checked, and sampling will be conducted within units)** | **50% sampling[1] (50% of the units will be checked, and sampling will be conducted within units)** | **100% sampling (all units will be checked, and sampling will be conducted within units)** | **100% checks[2] (all locations within all units will be checked)** |
| a) | Developers or main contractors<br>i. with no CONQUAS track record for *private residential development in the past 3 years, or | - | During CONQUAS application | When the initial CONQUAS score[3] is below the threshold CONQUAS score[4] set by BCA | - |
| | ii. has at least one *private residential development in the past 3 years with CONQUAS Score below the threshold CONQUAS score[4], or | - | | | - |
| | iii. has at least one *private residential development in the past 3 years with major defects[5] affecting ≥ 20 units or 5% of all units, whichever is lower<br><br>Upon the expiry of the 3- | - | - | - | During CONQUAS application |

[1] Additional samples will be taken on: architectural internal finishes samples, wet areas water tightness tests for toilets/bathrooms, window water tightness tests.

[2] 100% checks refer to the same regime of inspection as QM. Projects will be required to meet a higher score set at the bottom 40th percentile of industry average CONQUAS score of all private residential developments completed in the preceding year.

[3] The initial CONQUAS score will be derived after 20% of the required architectural internal finishes samples are completed.

[4] The threshold CONQUAS score is set at the bottom 10th percentile of industry average CONQUAS score for private residential projects in the preceding year.

[5] Major defects refer to defects that would generally not be acceptable to end-users as specified in the guide on "Construction Quality Assessment System (CONQUAS)" available on BCA's website.

| | | | | | |
|---|---|---|---|---|---|
| | year period, BCA retains the discretion to impose Tier 3 CONQUAS assessment if BCA assesses that the major defects[5] have not been reasonably addressed. | | | | |
| b) | <u>All other developers or main contractors</u><br>i. to be decided after the initial CONQUAS score[3] is generated | During CONQUAS application | When the initial CONQUAS score[3] is below the threshold CONQUAS score[4] set by BCA | When the CONQUAS score, after 50% of the required architectural internal finishes samples are completed, fall below the threshold CONQUAS score[4] set by BCA | - |

**Note: Includes private mixed developments with residential component.*

## 1.3 Derivation of CONQUAS

The minimum standards were derived **from discussions with the major public sector agencies, developers, consultants and contractors** based on the general specifications used in their projects.

To match the expectations from the end users, feedback through complaints, homeowners' survey findings and defects listings were also considered in refining the weightages and assessment standards.

In developing CONQUAS, studies and numerous trials were conducted to fine-tune its new test techniques and assessment standards. Moderation of the scoring system was carried out along with trials to ensure accuracy, consistency and alignment with end users expectations.

# 2.0 CONQUAS

## 2.1 Components to be assessed

The CONQUAS assessment is divided into three main components - Structural Works, Architectural Works and M&E Works.

**(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:

(i) Non-destructive testing of the uniformity and the cover of hardened concrete;

(ii) Laboratory testing of compressive strength of concrete and tensile strength of steel reinforcement;

(iii) Steel welding test reports if structural steelwork cost is more than 20% of the total structural cost.

The quality standards for Structural Works are given in Appendix 1.

**(b) Architectural Works**

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

(i) 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 (architectural works that are not classified above).

(ii) Material & functional tests such as window water-tightness, wet area water-tightness and adhesion of internal wall tiles. There is also in-process assessment on installation of waterproofing for internal wet areas.

The quality standards for Architectural Works are given in Appendix 2.

### (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 basic M&E fittings. The stages of the assessment include:

(i) Site inspection of installed works **before** they are concealed. Such items include ACMV ductworks, concealed pipes, etc.

(ii) Site inspection of final installed works such as the Air-Handling Unit (AHU), cooling tower, fire alarm control panel, etc.

(iii) Performance tests on selected works such as Water Pressure Test, Earthing Test, Dry Riser Test, etc.

The quality standards for M&E Works are given in Appendix 3.

## 2.2 The Weightages

In CONQUAS, the weightages for Structural, Architectural and M&E works are allocated according to four categories of buildings as follows:

| Components | CAT A Commercial, Industrial, Institution, Mixed Development & others | CAT B | | CAT C | | CAT D Landed Residential |
|---|---|---|---|---|---|---|
| | | Commercial, Industrial, Institution, Mixed Development & others | Private Residential | Public Residential (Sold Flats) | Public Residential (Rental Flats) | |
| **Structural Works** | 10% | 15% | 10% | 15% | 20% | 10% |
| **Architectural Works** | 75% | 80% | 85% | 80% | 75% | 85% |
| **M&E Works** | 15% | 5% | 5% | 5% | 5% | 5% |
| **CONQUAS Score** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |

*Note : (i) In general, projects with central cooling system having cooling tower, chiller system, etc. are classified under CAT A. Otherwise, it will be classified under CAT B. Appendix 5 provides a guide with listing of buildings under the various categories.*
*(ii) For Public Residential with a combination of Sold and Rental Flats, the project will take the Category of the flat type where the number of units is more than 50% of the total units.*

The weightage system, which is aimed at making the CONQUAS score objective in representing the quality of a building, is a compromise between the cost proportions of the three components in the various buildings and their aesthetic consideration.

The CONQUAS score of a building is the sum of points awarded to the three components in each category of buildings.

## 2.3 CONQUAS Assessor

BCA assessors undergo a rigorous training programme. They are required to attend BCA's in-house CONQUAS training and calibration programme to ensure competency and consistency in the assessment.

## 2.4 Sampling

As it is impractical to assess all elements in a building, CONQUAS uses a sampling system for the assessment. The sampling system, which is based on the gross floor area of the building, will ensure that the assessment adequately represents the entire building.

# 3.0 THE ASSESSMENT

## 3.1 Assessment Approach

In general, the Assessor should select the actual locations to be assessed prior to each assessment. Selection of samples shall be based on drawings and location plans. The samples shall be distributed as uniformly as possible throughout the construction stages.

The scoring will be done on the works that are inspected for the first time. Rectification and correction carried out after the assessment will not be re-scored. The objective of this practice is to encourage contractors ***"doing things right the first time".***

When an assessed item does not comply with the corresponding CONQUAS standards, it is considered failed and a "**X**" will be noted in the assessment form. Likewise a "✓" is given for an item meeting the standards. A "**blank**" will indicate that the item is not applicable. The score is computed based on the number of "✓" over the total number of items assessed.

## 3.2 Structural Works Assessment

The assessment for Structural Work will be carried out for every building block as the construction proceeds. A sample in structural work can be a beam, a column, a wall or a slab. The assessment of a reinforced concrete and steel structure consists of the following items:

| Reinforced Concrete Structure | Weightage % |
|---|---|
| NDT - UPV test for concrete uniformity | 35 |
| NDT - Electro-Covermeter test for concrete cove | 35 |
| Concrete Quality | 10 |
| Steel Reinforcement Quality | 10 |
| Steel Welding Test* | 10 |
| **Total** | **100** |

** Steel welding test is applicable if structural steelwork cost is more than 20% of the total structural work cost.*

For a reinforced concrete and steel structure, selection of samples for assessment is based on the following guidelines:

| | Items | GFA per Sample | Min Sample | Max Sample | Remarks |
|---|---|---|---|---|---|
| 1 | NDT- UPV test for concrete uniformity | 5,000 $m^2$ | 2 sets | 20 sets | a) 5 structure members per set<br>b) Self-Testing by contractor using an accredited testing firm<br>c) Declaration by project Structural Qualified Person |
| 2 | NDT - Electro-Covermeter test for concrete cover | 5,000 $m^2$ | 2 sets | 20 sets | a) 5 structure members per set<br>b) Self-Testing by contractor using an accredited testing firm<br>c) Declaration by project Structural Qualified Person |
| 3 | Concrete Compressive Strength | - | 100% | - | Declaration by project Structural Qualified Person |
| 4 | Steel Reinforcement Tensile Strength | - | 100% | - | Declaration by project Structural Qualified Person |
| 5 | *Steel Welding Test Reports | - | 100% | - | Declaration by project Structural Qualified Person |

*Note:*
*a) The computed number of elements to be checked must be evenly distributed throughout all the block(s) in the entire project. They should also as far as possible cover the different types of structural elements.*
*b) *Applicable if structural steelwork cost is more than 20% of the total structural work cost.*

The conduct of the non-destructive tests, i.e. on concrete uniformity and cover for steel reinforcement, is to assess the risk of carbonation and steel corrosion which affect the durability of the concrete structures. These tests are to be carried out by the contractor using an accredited testing firm.

The assessment of the quality of concrete and steel reinforcement and the non-destructive tests is based on compliance to the standards (see Appendix 1a).
If Structural Works consists of structural steelwork which constitutes more than 20% of the structural cost, the result of the steel welding test report for all critical welding joints specified in the contract requirements must comply with the acceptable criteria and submitted with the project Structural QP's endorsement (see Appendix 1b).

## 3.3 Architectural Works Assessment

Assessment of Architectural works is carried out upon completion of the building and before handing over of the project to the owner.

The assessment consists of the following items:

| Architectural Elements | Weightage % | | |
|---|---|---|---|
| | Total | Breakdown | |
| | | Non- Residential | Private & Public Residential |
| **Internal Finishes** | **56** | | |
| Floor | | 16 | 16 |
| Internal Wall | | 16 | 10 |
| Ceiling | | 6 | 10 |
| Door | | 6 | 7 |
| Window | | 6 | 7 |
| Component | | 6 | 6 |
| Roof | **4** | 4 | 4 |
| **External Wall** | **12** | 12 | 12 |
| **External Work** | **6** | 6 | 6 |
| **Design, Material & Functional Tests** | **22** | | |
| Field Window Water-Tightness Test (WTT) (BCA Test) | | 9 | 9 |
| *Field Window Water-Tightness Test (WTT) (Self-Testing) | | *Pre-requisite | *Pre-requisite |
| Wet Area Water-Tightness Test (BCA Test) | | 5 | 5 |
| *Wet Area Water-Tightness Test (Self-Testing) | | *Pre-requisite | *Pre-requisite |
| Internal Wet Area Waterproofing Process | | 2 | 2 |
| Pull-Off-Test for Internal Wall Tiles | | 4 | 4 |
| External Facade (Precast or System Formwork or Cladding Facade) | | 1 | 1 |
| Internal Wall Partition (Drywall or Precast panel partition) | | 1 | 1 |
| **Total** | | **100** | **100** |

*Note:*
*a) Assessment for internal wet area waterproofing process will be waived and points allocated automatically if the appointed contractor for such works is accredited under the SCI (Singapore Concrete Institute) Accreditation Scheme for Waterproofing Specialist Contractors. The accredited water proofing contractor must produce a valid SCI certificate that covers the entire contractual period of water proofing works for the project.*
*b)*Project Qualified Person to declare the results of the self-testing carried out by the project.*

Weightages for internal finishes and M&E fittings assessment of **Non- Residential** projects are allocated at the defect level based on the guidelines set out below:

| Element | Element Weightage | Defect Category | Defect Weightage |
|---|---|---|---|
| **Floor** | **16 points** | Finishing | **4.8** |
| | | Alignment & Evenness | **2.8** |
| | | Crack & Damages | **4.8** |
| | | Hollowness | **2.0** |
| | | Jointing | **1.6** |
| **Internal Wall** | **16 points** | Finishing | **4.0** |
| | | Alignment & Evenness | **1.9** |
| | | Crack & Damages | **7.2** |
| | | Hollowness | **1.6** |
| | | Jointing | **1.3** |
| **Ceiling** | **6 points** | Finishing | **1.2** |
| | | Alignment & Evenness | **1.2** |
| | | Crack & Damages | **1.8** |
| | | Roughness | **1.5** |
| | | Jointing | **0.3** |
| **Door** | **6 points** | Joint & Gap | **0.6** |
| | | Alignment & Evenness | **0.6** |
| | | Material & Damages | **1.5** |
| | | Functionality | **1.8** |
| | | Accessories Defects | **1.5** |
| **Window** | **6 points** | Joint & Gap | **0.6** |
| | | Alignment & Evenness | **0.6** |
| | | Material & Damages | **1.5** |
| | | Functionality | **2.4** |
| | | Accessories Defects | **0.9** |
| **Component** | **6 points** | Joint & Gap | **0.6** |
| | | Alignment & Evenness | **1.2** |
| | | Material & Damages | **2.4** |
| | | Functionality | **0.9** |
| | | Accessories Defects | **0.9** |
| **M&E Fitting** | ***15 points** | Joint & Gap | ***1.5** |
| | | Alignment & Evenness | ***1.5** |
| | | Material & Damages | ***4.5** |
| | | Functionality | ***6.0** |
| | | Accessories Defects | ***1.5** |

**Illustration refers to CONQUAS Category B projects only. For projects in other categories, weightages at defect level will be distributed in similar proportions*

Weightages for internal finishes and M&E fittings assessment of **Private and Public Residential** projects are allocated at the defect level based on the guidelines set out below:

| Element | Element Weightage | Defect Category | Defect Weightage |
|---|---|---|---|
| **Floor** | **16 points** | Finishing | **4.8** |
| | | Alignment & Evenness | **2.8** |
| | | Crack & Damages | **4.8** |
| | | Hollowness | **2.0** |
| | | Jointing | **1.6** |
| **Internal Wall** | **10 points** | Finishing | **2.5** |
| | | Alignment & Evenness | **1.2** |
| | | Crack & Damages | **4.5** |
| | | Hollowness | **1.0** |
| | | Jointing | **0.8** |
| **Ceiling** | **10 points** | Finishing | **2.0** |
| | | Alignment & Evenness | **2.0** |
| | | Crack & Damages | **3.0** |
| | | Roughness | **2.5** |
| | | Jointing | **0.5** |
| **Door** | **7 points** | Joint & Gap | **0.7** |
| | | Alignment & Evenness | **0.7** |
| | | Material & Damages | **1.75** |
| | | Functionality | **2.1** |
| | | Accessories Defects | **1.75** |
| **Window** | **7 points** | Joint & Gap | **0.7** |
| | | Alignment & Evenness | **0.7** |
| | | Material & Damages | **1.75** |
| | | Functionality | **2.8** |
| | | Accessories Defects | **1.05** |
| **Component** | **6 points** | Joint & Gap | **0.6** |
| | | Alignment & Evenness | **1.2** |
| | | Material & Damages | **2.4** |
| | | Functionality | **0.9** |
| | | Accessories Defects | **0.9** |
| **M&E Fitting** | ***15 points** | Joint & Gap | ***1.5** |
| | | Alignment & Evenness | ***1.5** |
| | | Material & Damages | ***4.5** |
| | | Functionality | ***6.0** |
| | | Accessories Defects | ***1.5** |

** Illustration refers to CONQUAS Category B projects only. For projects in other categories, weightages at defect level will be distributed in similar proportions*

The assessment is based on the sampling guidelines table as set out below:

| Sampling Guidelines Table | | | | | |
|---|---|---|---|---|---|
| | **Items** | **GFA per Sample** | **Min Sample** | **Max Sample** | **Remarks** |
| 1 | Internal Finishes | 500 $m^2$ | 50 | 150 | For Non- Residential Project & Public Mixed Development Project with Non-Residential GFA exceeding 50% |
| 1a | Internal Finishes | 70 $m^2$ | 90 | 800 | For all Private Residential Project & Mixed Development Project with Residential component. For Public Mixed Development with Residential GFA exceeding 50% |
| 1a(i) | Internal Finishes (Tier 2a) | - | 90 | 1,440 | 50% Sampling (50% coverage for all units):<br>Max Principal samples: 640<br>Max Service samples: 640<br>Max Circulation samples: 160 |
| 1a(ii) | Internal Finishes (Tier 2b) | - | 90 | 2,160 | 100% Sampling (100% coverage for all units):<br>Max Principal samples: 1000<br>Max Service samples: 1000<br>Max Circulation samples: 160 |
| 1b | Internal Finishes | 70 $m^2$ | 90 | 600 | For Public Residential Project |
| 2 | External Wall | - | 100% | - | 100% of the blocks / units |
| 3 | External Work | - | 1 | - | 1 for each type of external work |
| 4 | External Facade | - | - | - | Precast or System Formwork or Cladding Facade. Declaration by project Qualified Person |
| 5 | Internal Wall Partition | - | - | - | Drywall or Precast panel partition. Declaration by project Qualified Person |
| 6a | Field Window Water-tightness Test (WTT) | 1,000 $m^2$ | 20 | 100 | Conducted by BCA. A sample is defined as 2m length of joint. |
| 6a(i) | Field Window Water-tightness Test (WTT) (Tier 2a) | 1,000$m^2$ | 40 | 200 | 50% Sampling<br><br>For all Private Residential Project & Mixed Development Project with Residential component |
| 6a(ii) | Field Window Water-tightness Test (WTT) (Tier 2b & Tier 3) | 500$m^2$ | 40 | 200 | 100% Sampling<br><br>For all Private Residential Project & Mixed Development Project with Residential component |
| 6b | Field Window Water-tightness Test (WTT) | - | 25% | - | Self-Testing with declaration by project Qualified Person |

| | | | | | |
|---|---|---|---|---|---|
| 7a | Wet Area Water-tightness Test:<br>• Non-Housing Projects<br>• Housing Projects | - | 20<br>60 | 100<br>300 | Conducted by BCA:<br>Non-Housing Projects:<br>• 20% of all bathrooms and/or toilets (by location)<br>Residential projects<br>• 30% of all bathrooms and/or toilets (by location)<br>• all will be tested if less than the minimum sample (for all projects) |
| 7a(i) | Wet Area Water-tightness Test<br>(Tier 2a) | - | 100 | 600 | 50% Sampling (50% of all bathrooms and/or toilets):<br>Based on number of bathrooms and/or toilets<br>For all Private Residential Project & Mixed Development Project with Residential component<br>All will be tested if less than the minimum sample |
| 7a(ii) | Wet Area Water-tightness Test<br>(Tier 2b) | - | 120 | 1000 | 100% Sampling (100% coverage for all units):<br>Based on number of bathrooms and/or toilets<br>For all Private Residential Project & Mixed Development Project with Residential component<br>All will be tested if less than the minimum sample |
| 7b | Wet Area Water-tightness Test | | 100% | | • Self-Testing with declaration by project Qualified Person<br>• Including flat roof |
| 8 | Internal Wet Area Waterproofing Process | - | - | - | In-process assessment based on approved Method Statement |
| 9 | Pull-Off-Test for Internal Wall tiles | 10,000 $m^2$ | 1 set | 5 sets | 5 tiles per set (by location) |

A location for **internal finishes** assessment is a functional space of a building such as a room, hall, toilet, kitchen, yard, corridor or lobby. Locations are further categorised into three types:

**Principal locations** are major functional places such as halls and rooms.

**Circulation locations** include lift lobbies, corridors and staircases.

**Service locations** are utility areas such as toilets, kitchens, balconies and yards.

The computed number of locations will be distributed according to "Principal", "Circulation" and "Service" based on the percentages set out in the four categories of buildings as below:

| Locations | CAT A Commercial Industrial Institution Others | CAT B | | CAT C Public Residential | CAT D* Landed Properties |
|---|---|---|---|---|---|
| | | Residential * | Non-Residential | | |
| Principal | 60% | 40% | 60% | 40% | 40% |
| Service | 15% | 40% | 15% | 40% | 40% |
| Circulation | 25% | 20% | 25% | 20% | 20% |

**Note: For 3 Tier CONQUAS scheme, please refer to the above sampling guidelines table.*

Scoring of internal finishes is based on the defects groups as shown in Appendix 4 *'Defects Grouping Guide for Assessment of Internal Finishes'*.

In general, any item which is not available in a project will not be considered for scoring. For such case, the architectural score will be pro-rated accordingly. However, any available item that is not offered for assessment will be considered as failed and no points awarded.

An item under assessment will be considered failed if it does not meet the standards. In addition, any item found to be defective functionally such as evidence of water seepage in the window, wall, slab, ceiling or roof, is considered to have failed the assessment. Likewise for a particular defect that is found excessive in an item (say excessive cracks on a wall).

For the assessment of **roof**, a minimum 50% of the total number of buildings will be assessed. For the assessment of **external walls,** 100% of the total number of buildings will be assessed. For a building, the external wall will be divided into 4 walls for assessment.

The External Works assessment consists of the following locations:

(a) Link-way / Shelter - 10m length section per sample and minimum 2 samples
(b) Apron & Drain - 10m length section per sample and minimum 2 samples
(c) Roadwork & Carpark - 10m length section per sample and minimum 1 sample
(d) Footpaths & Turfing - 10m length section per sample and minimum 2 samples
(e) Playground - 1 location
(f) Court - 1 location
(g) Fencing & Gate - 10m length section per sample and minimum 1 sample
(h) Swimming Pool - 10m length section per sample and minimum 1 sample
(i) Club House - 1 location
(j) Guard House - 1 location
(k) Electrical Substation - 1 location

Each item in the **External Works** will be assessed separately and all the locations listed above must be assessed where applicable.

Under the material & functional tests, self-testing items like field window water-tightness test for 25% of windows and 100% wet area water-tightness test (including flat roof) are set as pre-requisites and based on declaration by the project Qualified Person (QP).

Points for design/material choices such as external facade and internal wall partition are awarded based on declaration by the project QP. The computation are as follows:

| **Design/ Material Choice** | **Formula** |
|---|---|
| External Facade (Precast or System Formwork or Cladding Facade) | $\frac{\text{Precast/System Formwork/Cladding area x 1 point}}{\text{Total area of facade}}$ |
| Internal Wall Partition (Drywall or Precast Panel Partition) | $\frac{\text{Drywall/Precast Panel Partition area x Allocated point*}}{\text{Total area of internal partition (Excluding wet areas)}}$ |

*Allocated points are as follows:
Drywall: 1 point
Other lightweight partitions (with skim coat): 0.9 point
Other lightweight partitions (with plastering): 0.6 point

## 3.4 M&E Works Assessment

The M&E Works assessment will be carried out upon completion of the building.

The assessment covers the following areas, with their weightages allocated in accordance with the four categories of projects:

| M&E Elements | CAT A | CAT B | CAT C | CAT D |
|---|---|---|---|---|
| M&E Works Assessment | | | | |
| Electrical | 15 | 15 | 10 | 10 |
| ACMV | 20 | 20 | - | 10 |
| Fire Protection | 10 | 10 | 10 | - |
| Plumbing & Sanitary | 15 | 15 | 20 | - |
| Basic Fittings | 15 | 15 | 60 | 80 |
| Sub-total | 75 | 75 | 100 | 100 |
| **Weightage** | **100%** | **100%** | **100%** | **100%** |
| M&E Performance Test Assessment | | | | |
| *Performance Testing | *Pre-requisite | *Pre-requisite | - | - |

*Note:*
*a)"-" means that no assessment on that M&E elements is required.*
*b)* project QP to declare the results of the performance testing carried out by the project.*

Points allocated under each element of the M & E works assessed, regardless of building category, will follow these guidelines:

| Element | Points Allocated |
|---|---|
| **Electrical** | |
| 1. Main cables | 1 |
| 2. Surface conduits | 2 |
| 3. Cable tray, ladder & trunking | 2 |
| 4. Distribution board | 4 |
| **ACMV** | |
| 1. Air handling unit | 2 |
| 2. Pump | 1 |
| 3. Cooling tower | 1 |
| 4. Chiller | 1 |
| 5. Pipework | 1 |
| 6. Split unit / Window air conditioner | 3 |
| 7. Air-con comfort | 2 |
| 8. Ductwork | 4 |
| 9. Fire-rated duct | 1 |
| 10. Dampers | 2 |
| 11. Fire Dampers | 1 |
| 12. Flexible ducts | 3 |
| 13. Flexible connectors | 1 |
| **Fire Protection** | |
| 1. Wet / Dry riser | 2 |
| 2. Sprinkler | 2 |
| 3. Fire Alarm | 1 |
| 4. Hosereel | 2 |
| **Plumbing & Sanitary** | |
| 1. Concealed pipes | 2 |
| 2. Exposed pipes | 5 |
| 3. Water tank | 1 |
| 4. Pump | 1 |

Performance Testing, covering Electrical, ACMV, Fire Protection and Sanitary & Plumbing, are set as pre-requisites and based on by the project QP. The declaration will be on the ***percentage of tests passing the inspection*** for each type of test.

The assessment of Basic M&E Fittings will be carried out during the Internal Finishes assessment.

Like the Architectural Works, sampling of M&E works will be determined based on the four categories of buildings as per the guidelines below:

| | CAT A<br>1,000 $m^2$ per sample | CAT B<br>1,500 $m^2$ per sample | CAT C<br>3,500 $m^2$ per sample | CAT D<br>3,500 $m^2$ per sample |
|---|---|---|---|---|
| **Electrical** | | | | |
| 1. Main cables | 1 | 1 | | |
| 2. Surface conduits | 2+ | 2+ | 1+ | 2+ |
| 3. Cable tray, ladder & trunking | 2+ | 2+ | 1+ | 2+ |
| 4. Distribution board | 2+ | 2+ | | 1 |
| **ACMV** | | | | |
| 1. Air handling unit | 1+ | | | |
| 2. Pump | 1 | | | |
| 3. Cooling tower | 1 | | | |
| 4. Chiller | 1 | | | |
| 5. Pipework | 1 | | | |
| 6. Split unit / Window air conditioner | 2+ | 2+ | | 3+ |
| 7. Air-con comfort | 1+ | 1+ | | 2+ |
| 8. Ductwork | 3+ | 1 | | |
| 9. Fire-rated duct | 1 | 1 | | |
| 10. Dampers | 1+ | 1 | | |
| 11. Fire Dampers | 1 | 1 | | |
| 12. Flexible ducts | 2 | | | |
| 13. Flexible connectors | 1 | | | |
| **Fire Protection** | | | | |
| 1. Wet / Dry riser | 1+ | 1+ | 1+ | |
| 2. Sprinkler | 1+ | 1 | | |
| 3. Fire Alarm | 1 | 1 | | |
| 4. Hosereel | 1+ | 1+ | 1+ | |
| **Plumbing & Sanitary** | | | | |
| 1. Concealed pipes | 1+ | 1+ | | |
| 2. Exposed pipes | 4+ | 4+ | 4+ | |
| 3. Water tank | 1 | 1 | 1 | |
| 4. Pump | 1 | 1 | 1 | |
| **Minimum Samples** | **35** | **25** | **10** | **10** |
| **Maximum Samples** | **70** | **50** | **20** | **20** |

*Remarks : + means to be repeated for additional samples required*

**Note : Basic M&E Fittings - 500 $m^2$ per sample with min 30 and max 150 samples**

## 3.5 Bonus Points

### (a) Certified QM/CONQUAS Personnel

CONQUAS bonus point is awarded for projects that employ certified personnel. This is to facilitate quality achievement and encourage deployment of competent certified personnel on site.

| Requirement | Bonus Point |
|---|---|
| Certified CONQUAS Supervisor | 0.15 |
| Certified QM/CONQUAS Supervisor | 0.3 |
| • *A supervisor can only be deployed on one project at any time*<br>• *Supervisor must be deployed for minimum 75% of project duration* | |
| Certified CONQUAS Manager | 0.4 |
| Certified QM/CONQUAS Manager | 0.6 |
| • *A manager can be deployed for maximum of 2 projects at any time*<br>• *Manager must be deployed for minimum 75% of project duration* | |
| **Maximum** | **1.0** |

Note:

1. QM/CONQUAS Personnel must be certified at the start of the project and be deployed for the minimum duration as specified.

2. Both employer and employee must declare the personnel was deployed for the minimum duration as specified.

3. The QM/CONQUAS manager/supervisor shall demonstrate commitment and satisfactory performance during the project duration pertaining to quality and CONQUAS assessment issues. It is the responsibility of the certified personnel to ensure the project personnel attend all allocated CONQUAS training, assessments are completed, and submission of documents done timely. They should conduct themselves in a professional manner when dealing with feedback on defects related to workmanship quality, failing which, CONQUAS bonus points will not be awarded.

4. Where required, additional documents and records shall be furnished for verification.

### (b) Design/Material Choices

Bonus points are given to projects using better buildable designs which facilitate higher quality achievement.

| Requirement | Bonus Point |
|---|---|
| Use of precast concrete elements supplied by SCI Accredited Precasters (100% of precast concrete elements) | 2.0* |
| Use of Prefabricated Bathroom Unit (at least 65% of toilets) | 1.5** |
| Use of Mass Engineered Timber (e.g. Cross Laminated Timber, Glued Laminated Timber, etc.) (at least 65% of coverage) {A building is deemed to be constructed using engineered timber if both the floor (including roof) and wall are constructed using engineered timber.} | 2.0** |
| Use of Prefabricated Prefinished Volumetric Construction (PPVC) (at least 65% of coverage) {The PPVC system has to be accepted by the Building Innovation Panel (BIP) and accredited under the PPVC Manufacturer Accreditation Scheme (MAS)} | 3.0** |
| Use of productive materials, which facilitate higher quality achievement (at least 65% of coverage) e.g.<br>i. Engineered wood/ Stone flooring – 1 point**<br>ii. Vinyl flooring – 1 point**<br>iii. Other productive material – 1 point** | Max. 3.0** |

** Bonus point is subject to weightage for Structural Works and only applicable if total precast concrete volume exceeds 20% of total structural concrete volume. The accredited precaster must produce a valid SCI certificate that covers the entire contractual period of precast supply for the project.*

*** Bonus point is subject to weightage for Architectural Works.*

**(c) Quality Mark (QM) Projects**

Bonus points are given to the project according to the quality rating achieved under the QM tiered rating scheme.

| Requirement | Bonus Point* |
|---|---|
| QM STAR | 1.5 |
| QM EXCELLENT | 1.0 |
| QM MERIT | 0.5 |

** Bonus point is subject to weightage for Architectural Works.*

## 3.6 Major Defects

Major defects are largely classified as defects that would generally not be acceptable to end-users. Examples are as follows:

a) Any missing/ broken accessories for the architectural items assessed
b) Any cracked/ chipped/ broken window panes, shower screens, mirrors and any glass items;
c) Any visually visible cracked tiles/ stones, timber doors & flooring, ceiling boards and cracks on painted walls, etc.;
d) Functionally deficient doors, windows, wardrobes and cabinets, tap, water closet, switches, etc.;
e) Fan coil unit leaking, water seepage through walls or windows, etc.;
f) Misaligned door frame – only for cases where verticality tolerance > 3mm per door frame height.

When a major defect is identified during the assessment by BCA, it is considered failed and two "**×**" instead of one will be noted in the assessment form.

Declaration by the project QP shall be required on the satisfactory rectification of these major defects before the issue of the CONQUAS score.

## 3.7 Score Moderation Framework

**(a) Adverse Feedback**

This is to allow for fine-tuning of score for any valid negative feedback, received during a project's defect liability period e.g. major workmanship issues that are surfaced or reported questionable/ unacceptable practices, etc.

A Review Committee will evaluate and approve points to be deducted for such cases:

| Major Defects/ Issues Reported | CONQUAS Point Deduction |
|---|---|
| 1. Major Defects<br>a) Water seepage through walls and/ windows;<br>b) Water seepage in the bathrooms/ toilets. | Up to 4 points |
| 2. Questionable/ Unacceptable practices, e.g. cardboards found under timber flooring | Up to 5 points |
| 3. Major defects/ Questionable/ Unacceptable practices with significant social impact, e.g. cement bags/ newspaper found in door frames, national iconic projects with leakages in roof/ façade, etc. | Up to 10 points |

**(b) Restricted Samples Given for Assessment**

To ensure that the sampling system adequately represent the quality of the whole project, CONQUAS score will be adjusted based on the areas provided for assessment, as follows:

| Average *Areas Offered for Assessment | Architectural Point Deduction |
|---|---|
| 90~ 95% | 2 points |
| 75~ 90% | 4 points |
| 50 ~ 75% | 6 points |
| Less than 50% | 10 points |

Note: *Based on number of units for residential projects and blocks/floors for other projects

A project may not be issued the CONQUAS score if less than 90% of the required internal finish samples were assessed.

## 3.8 Computation of CONQUAS Score

Below is two examples of how a project's CONQUAS score will be computed:

**Scenario 1:**

| | | |
|---|---|---|
| Project Type | - | Commercial (CAT A) |
| Structural System | - | Reinforced Concrete system with 31% precast concrete volume and steelworks at 75% to 25% cost ratio |
| Roofing System | - | Flat Roof |
| Nos of Toilet | | - 10 nos (100% Prefabricated Bathrooms supplied by an Accredited Precaster) |
| External Wall | - | Cladding system |
| Internal Wall | - | Brick wall |

**Step 1: Computation of Structural Score**

| **Structural Works (Reinforced Concrete Structure)** | **Weightage %** | **Score** |
|---|---|---|
| NDT - UPV for concrete uniformity | 35 | 30.0 |
| NDT - Electro-Covermeter test for concrete cover | 35 | 31.5 |
| Concrete Quality | 10 | 10.0 |
| Steel Reinforcement Quality | 10 | 10.0 |
| Steel Welding Test | 10 | 10.0 |
| **Total** | **100** | **91.5** |
| Accredited Precaster | | 2.0 |
| **Structural Score** | | **93.5** |

## Step 2: Computation of Architectural Score

| Architectural Works | Weightage % | Score |
|---|---|---|
| Floors | 16 | 9.3 |
| Internal Walls | 16 | 9.0 |
| Ceilings | 6 | 5.8 |
| Doors | 6 | 3.6 |
| Windows | 6 | 4.1 |
| Components | 6 | 4.6 |
| Roof | 4 | 2.5 |
| External Walls | 12 | 9.3 |
| External Works | 6 | 4.5 |
| Field Window Water-tightness Test (WTT) | | |
| - BCA Testing | 9 | 8.4 |
| - Self-Testing | Pre-requisite | submitted |
| Wet Area Water-Tightness Test | | |
| - BCA Testing | 5 | 5.0 |
| - Self-Testing | Pre-requisite | submitted |
| Internal Wet Area Waterproofing Process | 2 | 2.0 |
| Pull-Out-Test for Internal Wall Tiles | 4 | 3.2 |
| Cladding Facade | **1** | 1.0 |
| Internal Wall Partition (Drywall or Precast Panel Partition) | **1** | 0.0 |
| **Sub-total** | **100** | **72.3** |
| 100% Prefabricated Bathroom | | 1.5 |
| **Architectural Score** | **100** | **73.8** |

## Step 3: Computation of M&E Score

| M&E Elements | Cat A | Score |
|---|---|---|
| **M&E Works Assessment** | | |
| Electrical | 15% | 12.2 |
| ACMV | 20% | 18.4 |
| Fire Protection | 10% | 8.8 |
| Plumbing & Sanitary | 15% | 11.2 |
| Basic Fittings | 15% | 12.8 |
| **Sub-total** | 75% | 63.4 |
| Pro-rated Total | 100% | 84.53 |
| M&E Performance Test | Pre-requisite | Submitted |
| **M&E Score:** | **100%** | **84.5** |

### Step 4: Computation of Bonus Points for Certified CONQUAS/QM Personnel

| Certified Personnel Deployed | Bonus Point |
|---|---|
| Certified CONQUAS Supervisor x1 | 0.15 |
| Certified QM/CONQUAS Supervisor x1 | 0.30 |
| Certified QM/CONQUAS Manager x1 | 0.60 |
| **Total** | **1.05 (max awarded 1.0)** |

### Step 5: Computation of Final CONQUAS Score

| Area of Works/Component | (A) Actual Score | (B) CAT A | (A) X (B) |
|---|---|---|---|
| Structural Works | 93.5 | 10% | 9.35 |
| Architectural Works | 73.8 | 75% | 55.35 |
| M&E Works | 84.5 | 15% | 12.68 |
| Certified QM/CONQUAS Personnel | - | - | 1.0 |
| **Total Score** | | 100% | **78.38** |
| **CONQUAS Score** | | | **78.4** |

**Scenario 2:**

Project Type - Private Residential (CAT B)
Structural System - Reinforced Concrete system with 25% precast concrete volume and steelwork cost ratio less than 20%
Roofing System - Flat Roof
Precast System - PPVC system (70% coverage) accepted by BIP & accredited under the PPVC MAS and supplied by a SCI Accredited Precaster
Toilets - 70% Prefabricated Bathrooms supplied by an Accredited Precaster (including bathrooms within PPVC modules)
External Wall - Precast system
Internal Wall - Drywall

## Step 1: Computation of Structural Score

| Structural Works (Reinforced Concrete Structure) | Weightage % | Score |
|---|---|---|
| NDT - UPV for concrete uniformity | 35 | 30.0 |
| NDT - Electro-Covermeter test for concrete cover | 35 | 31.5 |
| Concrete Quality | 10 | 10.0 |
| Steel Reinforcement Quality | 10 | 10.0 |
| Steel Welding Test | 10 | NA |
| Sub-total =(100-10) | 90 | 81.5 |
| **Pro-rated Total** | **100** | **90.6** |
| Accredited Precaster | | 2.0 |
| **Structural Score** | | **92.6** |

## Step 2: Computation of Architectural Score

| Architectural Works | Weightage % | Score |
|---|---|---|
| Floors | 16 | 9.3 |
| Internal Walls | 16 | 9.0 |
| Ceilings | 6 | 5.8 |
| Doors | 6 | 3.6 |
| Windows | 6 | 4.1 |
| Components | 6 | 4.6 |
| Roof | 4 | 2.5 |
| External Walls | 12 | 9.3 |
| External Works | 6 | 4.5 |
| Field Window Water-tightness Test (WTT) | | |
| - BCA Testing | 9 | 8.4 |
| - Self-Testing | Pre-requisite | submitted |
| Wet Area Water-Tightness Test | | |
| - BCA Testing | 5 | 5.0 |
| - Self-Testing | Pre-requisite | submitted |
| Internal Wet Area Waterproofing Process | 2 | 2.0 |
| Pull-Out-Test for Internal Wall Tiles | 4 | 3.2 |
| Precast Facade | **1** | 1.0 |
| Internal Wall Partition (Drywall or Precast Panel Partition) | **1** | 1.0 |
| **Total** | **100** | **73.3** |
| 70% Prefabricated Bathroom Unit | | 1.5 |
| 70% Coverage PPVC | | 3.0 |
| **Architectural Score** | **100** | **77.8** |

### Step 3: Computation of M&E Score

| M&E Elements | Cat B | Score |
|---|---|---|
| **M&E Works Assessment** | | |
| Electrical | 15% | 12.2 |
| ACMV | 20% | 18.4 |
| Fire Protection | 10% | 8.8 |
| Plumbing & Sanitary | 15% | 11.2 |
| Basic Fittings | 15% | 12.8 |
| Sub-total | 75% | 63.4 |
| Pro-rated Total | 100% | 84.53 |
| M&E Performance Test | Pre-requisite | submitted |
| **M&E Score** | **100%** | **84.5** |

### Step 4: Computation of Bonus Points for Certified CONQUAS/QM Personnel

| Certified Personnel Deployed | Bonus Point |
|---|---|
| Certified CONQUAS Supervisor x1 | 0.15 |
| Certified QM/CONQUAS Supervisor x1 | 0.30 |
| Certified QM/CONQUAS Manager x1 | 0.60 |
| **Total** | **1.05 (max awarded 1.0)** |

### Step 5: Computation of Final CONQUAS Score

| Area of Works/Component | (A) Actual Score | (B) CAT B (Private Housing) | (A) X (B) |
|---|---|---|---|
| Structural Works | 92.6 | 10% | 9.26 |
| Architectural Works | 77.8 | 85% | 66.13 |
| M&E Works | 84.5 | 5% | 4.23 |
| Certified QM/CONQUAS Personnel | - | - | 1.0 |
| **Total Score** | | 100% | **80.62** |
| **CONQUAS Score** | | | **80.6** |

## 3.9 Publication of CONQUAS Scores

The overall CONQUAS scores of projects are published and accessible for viewing on the IQuas (Information on Construction Quality) Portal at BCA's website. Projects scoring 95 CONQUAS points or higher will only be shown as "CONQUAS★". Higher CONQUAS scores generally reflect better workmanship. However, scores beyond 95 points are often achieved at significant cost and effort disproportionate to the incremental achievement in quality. The "CONQUAS★" rating facilitates setting realistic quality benchmarks balanced with productivity and cost considerations.

**Appendix 1a**

# QUALITY STANDARDS FOR STRUCTURAL WORKS

## Part 1: Reinforced Concrete Structures

| | Item* | | Standards |
|---|---|---|---|
| **1** | **Formwork** | | |
| **1a** | Formwork dimensions and openings for services | 1) | Tolerance for cross-sectional dimensions of cast in-situ & precast elements: +10mm / -5mm |
| | | 2) | Tolerance for penetration / opening for services: +10mm for size and ±25mm for location |
| | | 3) | Tolerance for length of precast members (major dimension of unit):<br>• Up to 3m: ±6mm<br>• 3m to 4.5m: ±9mm<br>• 4.5m to 6m: ±12mm<br>• Additional deviation for every subsequent 6m: ±6mm |
| **1b** | Alignment, plumb and level | 1) | Tolerance for departure of any point from its position: 10mm |
| | | 2) | Tolerance for plumb: 3mm / m, maximum 20mm |
| | | 3) | Maximum deviation of mean level of staircase thread to temporary bench mark: ±5mm |
| | | 4) | For cast in-situ elements, the deviation of level of any point from the intended level: ±10mm |
| **1c** | Condition of formwork, props & bracing | 1) | Formwork must be free from defects |
| | | 2) | Before concreting, the interior must be free from debris |
| | | 3) | All formwork joints must not have gaps to prevent leakage |
| | | 4) | There must be adequate support, bracing and tie-back for the formwork to prevent bulging or displacement of structural elements |
| **2** | **Reinforcement (cast in-situ & Precast)** | | |
| **2a** | Main & Secondary rebars | 1) | According to structural drawings (numbers / sizes) |
| | | 2) | Spacing of bars not more than that specified |
| **2b** | Anchorages & lap lengths | 1) | Required lap length not less than that specified |
| **2c** | Cover provision | 1) | According to specifications with tolerance of +5mm |
| **2d** | Links, stirrups and trimming bars | 1) | According to structural drawings (numbers / sizes) |
| | | 2) | Spacing of links not more than specified |
| **2e** | Rebar Condition | 1) | Rebars must be securely and properly tied in place |

| | Item* | | Standards |
|---|---|---|---|
| | | 2) | Rebars must be freed from concrete dropping, corrosion etc |
| **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 |
| | | 2) | Tolerance for opening: +10 for size and ±25mm for location |
| | | 3) | Tolerance for length of precast members (major dimension of unit):<br>• Up to 3m: ±6mm<br>• 3m to 4.5m: ±9mm<br>• 4.5m to 6m: ±12mm<br>• Additional deviation for every subsequent 6m: ±6mm |
| | | 4) | Straightness or bow (deviation from intended line) of precast member:<br>• Up to 3m: 6mm<br>• 3m to 6m: 9mm<br>• 4.5m to 6m: 12mm<br>• Additional for every subsequent 6m: 6mm |
| | | 5) | Squareness of precast member – Difference between the greatest and shortest dimensions should not exceed the following:<br>Length of shorter sides<br>• Up to and including 1.2m: 6mm<br>• Over 1.2m but less than 1.8m: 9mm<br>• 1.8m and over: 12mm |
| | | 6) | Twist of precast member – Any corner should not be more than the deviation stated from the plane containing the other 3 corners:<br>• Up to 600mm wide and 6m in length: 6mm<br>• Over 600mm wide and for any length: 12mm |
| | | 7) | Flatness: 6mm per 1.5m |
| **3b** | Alignment, plumb and level | 1) | Tolerance for departure of any point from its position: ±10mm |
| | | 2) | Tolerance for plumb: 3mm / 1m, maximum 20mm for floor to floor height and 40mm for the entire building height |
| | | 3) | Maximum deviation of mean level: ±10mm |
| | | 4) | For cast in-situ elements, the maximum deviation of levels within the element: 10mm |
| | | 5) | Camber at mid-span: according to specification |
| **3c** | Exposed surface | 1) | Should not have visual exposure of groups of coarse |

| | Item* | Standards |
|---|---|---|
| | | aggregates resulting from grout leakage<br>2) Cold joint & formwork joint must be smooth<br>3) No bulging of structural elements<br>4) All formwork, nails, zinc strips, etc must be removed<br>5) No cracks or damages |
| **4** | **Precast Specific Requirements** | |
| **4a** | Lifting points/inserts | 1) Tolerance for position: ±20mm from centre line location in drawing<br>2) Lifting devices and inserts free from damages |
| **4b** | Sleeve system/connections | 1) Tolerance for position: ±6mm from centre line location in drawings<br>2) Bar protrusion length according to requirements. No bending, cranking or damages to bars<br>3) Bars free from concrete droppings or corrosion<br>4) Sleeves, grout holes, grout tubes not congested with debris |
| **4c** | Interface/joint requirements | 1) Joint taper:<br>• Over 3m length: 6mm<br>• Maximum for entire length: 9mm<br>2) Alignment of horizontal and vertical joint: ±6mm<br>3) Jog in alignment of matching edges: 6mm<br>4) Sitting of element: according to specifications<br>5) Installation of sealant and waterproofing: according to specifications |
| **4d** | Cast-in steel items/welded & bolted connections | 1) Tolerance for position of cast-in steel items: ±6mm from centre line location in drawings<br>2) Tolerance for position of openings for bolt connections: ±3mm from centre line location in drawings<br>3) Relevant requirements in CONQUAS steelwork standards to be used where applicable |

| | Item* | | Standards |
|---|---|---|---|
| **5** | **Structure Quality** | | |
| **5a** | Concrete Cube test | 1) | For every pour of concrete, test cubes results at 28 days must satisfy the passing criteria as specified in the contract. The summary of test reports (Form A) must be endorsed by the project's structural Qualified Person (QP) |
| **5b** | Reinforcement (Rebar) | 1) | To pass the tensile strength test for all the reinforcement bars used as according to the contract specifications. The summary of test reports (Form A) must be endorsed by the project's structural QP |
| | | 2) | All the welded steel fabric used to comply with the contract specifications. |
| | | 3) | No non-conforming reinforcement detected through test records has been installed in the structure |

| | Item* | | Standards |
|---|---|---|---|
| **6** | **Non-destructive testing** | | |
| **6a** | Ultra Pulse Velocity test for Concrete Uniformity | 1) | To conduct NDT using ultrasonic pulse velocity (UPV) to check the degree of uniformity of hardened concrete |
| | | 2) | 5 columns per set and 2 readings per column |
| | | 3) | Assessment is based on the difference between the 2 UPV readings within a column shall not exceed 0.05 km/s |
| | | 4) | Method as per SS 78 |
| **6b** | Electro-Covermeter test for concrete cover | 1) | To check hardened concrete cover for reinforcement bars after casting: minimum 25mm or higher as according to specification |
| | | 2) | 5 structural samples per set including: |
| | | a | 3 for slab soffit @ 4 readings each |
| | | b | 1 for column @ 2 readings each on both axis of the column |
| | | c | 1 for beam @ 2 readings each on the soffit and one side of the beam |
| | | 3) | For each reading within a structural sample, full point for ±5mm and half point for >±5mm to ±8mm. However, no points will be awarded if any of the 4 readings within **the structural sample** exceeds ± 12mm) |
| | | 4) | Method as per SS 78 |

*For the assessment of concrete cube test results, the percentage of points shall be awarded based on the percentage of non-compliance as tabulated in the table below:*

| *Percentage of Points awarded* | *Percentage of non-compliance* |
|---|---|
| *100%* | *0 - 2.5%* |
| *75%* | *2.6 - 5.0%* |
| *50%* | *5.1 - 7.5%* |
| *25%* | *7.6 - 10%* |
| *0%* | *> 10%* |

* An item is deemed to have failed if any one of the standards is not met.

**Appendix 1b**

## QUALITY STANDARDS FOR STRUCTURAL WORKS

### Part 2: Structural Steel Works

| | Item* | Standards |
|---|---|---|
| **1** | **Main member/Partial assembled component** | |
| **1a** | **Physical dimensions** | 1) Cross sectional tolerance should not be less than the structural steel specifications or approved plan<br>2) Tolerance for length of structural steel member: ±3mm<br>3) Tolerance for bolt hole size:<br>• ≤2mm for bolt diameter < 24mm<br>• ≤3mm for bolt diameter ≥ 24mm<br>Tolerance for bolt hole position: ±2mm |
| **1b** | **Type and condition** | 1) According to the structural steel specifications<br>2) Surface preparation shall meet the surface roughness specifications<br>3) Material used must be traceable to its original mill certificates |
| **1c** | **Welding** | 1) Weld size, length and profile shall meet the structural steel specifications and drawings<br>2) Visual inspection shall meet the structural steel specifications<br>3) All weld shall follow approved welding procedures<br>4) All welding must be done by qualified welders |
| **1d** | **Bolting** | 1) Bolts and washers, type, size and number shall be according to the structural steel specifications<br>2) Drilled holes shall be free from burrs<br>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<br>4) Gap between adjacent parts shall not exceed 2mm<br>5) Bolts shall be tightened to specified torque or as specified by the structural steel specifications<br>6) Threaded bolts protruding at least one thread length with washers |

| | Item* | | Standards |
|---|---|---|---|
| **2** | **Metal decking** | | |
| **2a** | **Type and condition** | 1) | Correct type and thickness of metal decking used |
| | | 2) | All decking joints must not have gaps |
| | | 3) | All metal decking must be properly secured in place |
| | | 4) | Metal decking must be free from defects and visible damages |
| | | 5) | Before concreting, the decking must be free from grease, oil, paint, and all other foreign materials |
| | | 6) | All accessories such as pour stop, end closures and cover plates must be in place before concreting |
| **2b** | **Shear studs** | 1) | Correct number and type of shear studs used |
| | | 2) | Spacing and position according to approved plan |
| | | 3) | Strength of shear stud welds not less than specified |
| | | 4) | All welds should show a full 360-degree weld fillet. All welds free from visible damages |
| **2c** | **Lapping and deck openings** | 1) | According to structural steel specifications or approved plan |
| **3** | **Erection tolerances** | | |
| **3a** | **Column verticality** | 1) | Tolerance for verticality: ±H/600 or 5mm, maximum ±25mm; where H is the floor to floor height in mm. |
| **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 |
| **3c** | **Beam level** | 1) | Maximum deviation of level at each end of the same beam: ±5mm |
| | | 2) | The level of the top of the steelwork at any storey shall be within ±10mm of the specified level |
| **3d** | **Beam position** | 1) | Beams shall not deviate from their specified positions relative to the column to which they are connected by more than 5mm |

| | Item* | Standards |
|---|---|---|
| **4** | **Corrosion and fire protection** | |
| **4a** | **Thickness of coating** | 1) Average thickness of the coating or the protective layer must not be less than specified |
| **4b** | **Condition** | 1) No visible damages<br>2) No spalling of coating or protective layer from structural steel members |
| **5** | **Welding test reports#** | 1) Reports for all critical welding joints from the specified contract requirements must be submitted<br>2) Test reports must comply with the acceptable criteria and must be endorsed by the project structural Qualified Person. |

# For test records, the following table would be used to determine the points awarded:

| *Points awarded* | *Percentage of elements checked which does not comply* |
|---|---|
| 100% | 0% |
| 75% | 0%<x≤5% |
| 50% | 5%<x≤10% |
| 25% | 10%<x≤15% |
| 0 | x>15% |

* An item is deemed to have failed if any one of the standards is not met.

**Appendix 1c**

# QUALITY STANDARDS FOR STRUCTURAL WORKS

## Part 3: Pre-stressed Concrete

| | Item* | | Standards |
|---|---|---|---|
| 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 |
| | | 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 | **Installation of sheathing** | 1) | Sheathing properly secured and protected and free from damage or puncture |
| | | 2) | Sheathing profile according to drawings throughout the length with position tolerance: ±5mm |
| | | 3) | Splice to sheathing shall be mortar tight |
| | | 4) | Air vents or grout tubes provided according to the drawing |
| 3 | **Stressing & Grouting process** | 1) | Tendon ducts clean and free from foreign objects and tendon free moving in the duct |
| | | 2) | Strands stressed to the final pressure / elongation within the specific % accuracy of the stipulated value |
| | | 3) | All grouting operations of the tendons must be smooth and achieved without need to flush out in the first grouting |
| 4 | **Debonding** | 1) | Open ends of debond tubes over the debond length of strands sealed |
| | | 2) | Debond lengths according to the drawings |
| | | 3) | Debonding materials not punctured or damaged |

* An item is deemed to have failed if any one of the standards is not met.

**Appendix 2**

# QUALITY STANDARDS FOR ARCHITECTURAL WORKS

## Part 1: Internal Finishes

| | Item* | Standards |
|---|---|---|
| **1** | **Floors** | |
| **1a** | **General Requirements** | **1) Finishing**<br>• No stain marks<br>• Consistent colour tone<br>• Floor divider provided where required<br>**2) Alignments & Evenness**<br>• Evenness of surface (not more than 3mm per 1.2m)<br>• Falls in wet areas should be in right direction<br>• No ponding in falls for wet area<br>• For staircases, the variance in lengths of threads and risers must not exceed 5 mm; nosing must be straight<br>• Skirting size and joint aligned with floor if of same material<br>**3) Crack & Damages**<br>• No visible damage / defects<br>**4) Hollowness / Delamination**<br>• No hollow sound when tapped with a hard object<br>• No sign of delamination<br>**5) Jointing**<br>• Consistent skirting thickness<br>• No visible gap between wall & skirting |
| **1b** | **Screed finish** | 1) Surfaces should not be unduly rough or patchy<br>2) No visible trowel marks<br>3) Expansion joints should be provided at interval as stated by architect |
| **1c** | **Tiled finish** | 1) Consistent colour and neat pointing<br>2) No hollow sound when tapped with a hard object<br>3) Joints are aligned and consistent with skirting and wall tiles<br>4) Consistent joint size<br>5) Lippage between 2 tiles should not be more than 0.5 mm<br>6) Expansion joints should be provided at interval as stated by architect |

| | Item* | | Standards |
|---|---|---|---|
| **1d** | **Timber floor** | 1) | No warpage |
| | | 2) | Timber strips to rest firmly on joists or screed |
| | | 3) | No visible gaps in between timber strips |
| | | 4) | Edges of the floor to be properly sealed |
| **1e** | **Carpet** | 1) | Stretched and even surface |
| | | 2) | Joint should not be visible |
| | | 3) | Proper anchoring at all edges |
| **1f** | **Raised Floor** | 1) | No loose floor panels |
| | | 2) | No protrusion / potential of tripping over floor panels |
| | | 3) | No jolting or rocking panel |

| | Item* | Standards |
|---|---|---|
| **2** | **Internal Walls** | |
| **2a** | **General** | **1) Finishing**<br>• No stain marks<br>• Consistent colour tone<br>• No rough / patchy surface<br>**2) Alignments & Evenness**<br>• Evenness of surface (not more than 3mm per 1.2m)<br>• Verticality of wall (not more than 3mm per m)<br>• Walls meet at right angles (not more than 4mm over 300mm)<br>• Edges (wall to wall) to appear straight and aligned<br>**3) Crack & Damages**<br>• No visible damage / defects<br>**4) Hollowness / Delamination**<br>• No hollow sound when tapped with a hard object<br>• No sign of delamination<br>**5) Jointing**<br>• Straightness of corners and joints |
| **2b** | **Plaster Finish** | 1) Surface evenness (not more than 3mm over 1.2m)<br>2) No hollow sound when tapped with a hard object.<br>3) Surfaces should not be unduly rough or patchy esp no brush / trowel marks |
| **2c** | **Tiled Finish** | 1) Tile joints aligned and with consistent joint size<br>2) No hollow sound when tapped with a hard object<br>3) Consistent colour and neat pointing<br>4) Lippage between 2 tiles should not be more than 0.5mm |
| **2d** | **Cladding** | 1) Proper anchorage for panels<br>2) Joints aligned and with consistent joint size<br>3) Sealant material compatible with cladding<br>4) Consistent spacing and within allowable tolerance |
| **2e** | **Architectural Coating** | 1) Substrate - see plaster finish<br>2) Finished texture and colour to be uniform |

| | Item* | | Standards |
|---|---|---|---|
| 2f | **Painting** | 1) | Substrate - see plaster finish |
| | | 2) | Surfaces are evenly painted |
| | | 3) | Good opacity, no patchiness resulted from touch up works |
| | | 4) | Free from peeling, blister and chalkiness |
| | | 5) | No discolouration and fading |
| 2g | **Pre-cast concrete planks** | 1) | Alignment with adjacent planks not more than 3mm |
| | | 2) | Plane tolerance (3mm / 1.2m) |
| 2h | **Wall Paper** | 1) | Stretched and even surface |
| | | 2) | Joint should not be visible |
| | | 3) | Proper anchoring at all edges |
| | | 4) | Edges should be neatly laid and finished |
| 2i | **Glass Blocks** | 1) | Pointing should be satisfactory |
| | | 2) | Joint should be even |
| | | 3) | Glass blocks should be properly aligned |
| 2j | **Wood / Timber Panels** | 1) | Timber panels to rest firmly on joist or screed |
| | | 2) | No visible gaps between panels |
| | | 3) | Edges should be properly aligned and sealed |
| | | 4) | No warpage |
| | | 5) | No cracks |
| 2k | **Fair-Face Concrete** | 1) | Consistent distribution of blowholes for the same sample/ surrounding area |
| | | 2) | All blowhole sizes to be equal or less than 8mm |
| | | 3) | Consistent tonality for the same sample/ surrounding area |
| | | 4) | No exposed aggregate |
| | | 5) | No cracks and damages |

| | Item* | Standards |
|---|---|---|
| **3** | **Ceilings** | |
| **3a** | **General Requirements** | 1) **Finishing**<br>• No stain marks<br>• Consistent colour tone<br>• No patchy surface<br>2) **Alignment & Evenness**<br>• Overall surface should be smooth, even, not wavy<br>• Straightness of corners<br>3) **Crack & Damages**<br>• No visible damage e.g spalling, leaks, cracks, etc<br>4) **Roughness**<br>• No rough surface<br>5) **Jointing**<br>Consistent, aligned and neat |
| **3b** | **Skim Coats / Boarded Ceiling** | 1) Not patchy, with no pin holes and with no trowel marks<br>2) Formwork joints are grounded smooth<br>3) Paintwork with good opacity and with no brush marks<br>4) Access door joints should be sharp and in consistent width |
| **3c** | **False ceiling / Grid System** | 1) Alignment of rails should be visually straight<br>2) Surface should be overall level and even<br>3) Chipped surfaces or corners should not be seen |

| | Item* | Standards |
|---|---|---|
| **4** | **Doors** | |
| **4a** | **General Requirements** | 1) **Joints & Gap**<br>• No visible gaps between door frame and wall<br>• Consistent & neat joints<br>• Consistent gap between door leaf and frame and not more than 5mm<br>• No visible gaps within door leaf and door frame<br>• Consistent and no visible gaps for mitre joints<br><br>2) **Alignment & Evenness**<br>• Alignment/level with walls<br>• Door frame and leaf to flush<br>• Door and frame corners maintained at right angles<br>• No rattling sound when door is closed<br><br>3) **Material & Damages**<br>• No stain marks and any visible damage<br>• No sags, warps on door leaf<br>• Fire stop provided where necessary<br>• 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)<br>• Glazing clean and evenly sealed with gasket<br>• No sign of corrosion for metal frame<br>• Consistent colour tone<br><br>4) **Functionality**<br>• Ease in opening, closing and locking<br>• No squeaky sound during swinging the leaf<br><br>5) **Accessories Defects**<br>• Lock sets with good fit and no stains<br>• No sign of corrosion in ironmongery<br>• No missing or defective accessories<br><br>Note 1: Civil defence shelter door will be considered as part of wall finishes<br><br>Note 2: Metal gate will be assessed as component |

| | Item* | Standards |
|---|---|---|
| **5** | **Windows** | |
| **5a** | **General Requirements** | 1) **Joints & Gap**<br>• No visible gap between window frame and wall<br>• Consistent gap between window leaf and frame and not more than 5mm (timber window only)<br>• No visible gaps within window leaf and frame<br>• No visible gaps between window leaf and frame<br>• Neat joint between window and wall internally and externally<br>• Consistent and no visible gaps at mitre joints<br><br>2) **Alignment & Evenness**<br>• Alignment / level with wall openings<br>• Window leaf and frame corners maintained at right angles<br><br>3) **Material & Damages**<br>• No stain marks and any visible damage / defects<br>• Louvre windows with glass panels of correct lengths<br>• Glazing clean, evenly sealed with putty or gasket for aluminium windows<br><br>4) **Functionality**<br>• Ease in opening, closing and locking<br>• No sign of rainwater leakage<br>• No squeaky sound during swinging the leaf<br><br>5) **Accessories Defects**<br>• Lock sets with good fit and aligned<br>• No sign of corrosion<br>• No missing or defective accessories<br>• Countersunk screws levelled and flushed. No over-tightened screws<br>• Stainless steel screws at hinges for swing window |

| | Item* | | Standards |
|---|---|---|---|
| **6** | **Components** | * | Internal fixtures such as wardrobe, kitchen cabinet, vanity top, mirror, bathtub, water closet, shower screen and basin |
| | | ** | External fixtures such signage, emergency lightings, railings, unit number plates, lift fittings, letter box, lightings, metal gate etc |
| **6a** | **General Requirements** | 1) | **Joints & Gap**<br>• Consistent joint width & neat joint<br>• No visible gap<br>• Welding joints grounded or flushed |
| | | 2) | **Alignment & Evenness**<br>• Level and in alignment |
| | | 3) | **Material & Damages**<br>• No stain marks<br>• No visible damage / defects<br>• Consistent in colour tone |
| | | 4) | **Functionality**<br>• Functional, secured and safe |
| | | 5) | **Accessories Defects**<br>• No missing accessories<br>• No sign of corrosion<br>• No visible damages / defects |

* An item is deemed to have failed if any one of the standards is not met

# QUALITY STANDARDS FOR ARCHITECTURAL WORKS

## Part 2: Roof

| | Item* | Standards |
|---|---|---|
| **1** | **Construction** | |
| **1a** | **General Requirements** | 1) **Stain / Painting**<br>• No stain marks<br>• Good paint works<br>2) **Rough / Uneven / Falls**<br>• Look smooth and with no tool marks<br>• Even and level esp no potential in tripping<br>• Good falls in right direction<br>3) **Crack / Chip / Damage**<br>• No visible damages / defects<br>4) **Joint / Sealant / Alignment**<br>• Consistent joint width, neat & aligned<br>5) **Chokage / Ponding**<br>• No sign of chokage and ponding<br>6) **Construction**<br>• No sign of leaking<br>• Proper dressing for any protrusion<br>• Neat & secured installation of fixtures |
| **1b** | **Flat Roof** | 1) Ponding less than 3mm<br>2) Surface to level to avoid tripping<br>3) Proper dressing for any protrusion<br>4) Openings to be sealed to prevent pest invasion<br>5) Clean and no stain marks |
| **1c** | **Pitched Roof** | 1) No leaking<br>2) No rust or stains<br>3) Good painting to roof structural members<br>4) Roof tiles in alignment<br>5) Openings to be sealed to prevent pest invasion<br>6) Consistent colour tone<br>7) Proper dressing for any protrusion |

| | Item* | | Standards |
|---|---|---|---|
| **1d** | **Waterproofing (exposed)** | 1) | Should be evenly installed, no sharp protrusion |
| | | 2) | Complete adhesion to base |
| | | 3) | Good laps at joints and proper vertical abutment details |
| | | 4) | No leaking and sign of damage to membrane/coating |
| | | 5) | Clean and no mortar stains |
| | | 6) | No paint defects |
| **1e** | **Gutters** | 1) | No ponding and chokage |
| | | 2) | No cracks, chips and any other visible damages / defects |
| | | 3) | RWDP inlet should be lower than the surrounding gutter invert level |
| | | 4) | Gutter and RWDP inlet to be covered to prevent chokage where practical |
| | | 5) | Clean and no cement stains |

* An item is deemed to have failed if any one of the standards is not met

# QUALITY STANDARDS FOR ARCHITECTURAL WORKS

## Part 3: External Wall

| | Item* | Standards |
|---|---|---|
| 1 | **General Requirements** | 1) **Evenness / Roughness**<br>• Overall surface should be even, not wavey & not patchy<br>2) **Staining / Painting**<br>• No visible stain marks<br>• Good paint works<br>3) **Cracking / Damages**<br>• No visible damage / defects<br>4) **Jointing / Alignment**<br>• External features visually in alignment<br>• Corners of wall maintained at right angles and straight<br>• Consistent joint width, neat & aligned |
| 2 | **Plaster Finish** | 1) As above |
| 3 | **Tiled Finish** | 1) Tile joints aligned and between 2-4mm wide unless specified<br>2) Plumb tolerance and evenness of surface (3mm / 1.2m) |
| 4 | **Claddings / Curtain Walls** | 1) Gaps around openings to be properly sealed<br>2) Joints of regular widths as specified<br>3) Plumb tolerance as specified<br>4) Evenness of surface, no dents or scratches<br>5) Sealant material compatible with cladding |
| 5 | **Facing Brickwork** | 1) 10mm joint with pointing<br>2) Weepholes are provided as specified<br>3) No mortar droppings and other stains<br>4) No efflorescence |

| | Item* | | Standards |
|---|---|---|---|
| **6** | **Architectural Coating** | 1) | Substrate - see plaster finish |
| | | 2) | Finished texture and colour to be uniform |
| | | 3) | No paint drips and other stains |
| **7** | **Painting** | 1) | Substrate - see plaster finish |
| | | 2) | Surfaces are evenly painted; no patchiness due to touch up work |
| | | 3) | Good opacity, no discolouring and free from peeling |
| **8** | **Fair-Faced Concrete** | 1) | No exposed aggregate |
| | | 2) | Consistent tonality when viewed as a whole |

* An item is deemed to have failed if any one of the standards is not met

# QUALITY STANDARDS FOR ARCHITECTURAL WORKS

## Part 4: External Works

| | Item* | Standards |
|---|---|---|
| 1 | **General Requirements** (basis for assessment) | 1) No stain marks and visible damages / defects<br>2) Finishes must be even, level , align & consistent<br>3) Consistent joints width and neat<br>4) Paintworks with good opacity, no patchiness and brush marks<br>5) Constructed according to Contract Specifications<br>6) Fixtures installed must be safe, secured and functional<br>7) Standards defined under Part 1: Internal Finishes, Part 2: Roof and Part 3: External Wall shall apply for similar items |
| 1a | **Link-Way / Shelter** | 1) **Floor** as per Internal Finishes - Floor<br>2) **Column** as per Internal Finishes - Wall<br>3) **Ceiling** as per Internal Finishes – Ceiling<br>4) **Other Finishes** as per Internal Finishes – Components<br>5) **M&E Fitting** as per M&E Works – Part 5 Basic M&E Fittings |
| 1b | **Apron & Drain** | 1) **Drain**<br>• Free flowing and no ponding of water<br>2) **Drain Cover**<br>• level and do not jolt or rock<br>• Gaps between drain covers and side of drain between 5-10mm wide<br>• Drain grating properly painted<br>3) **Apron 1**<br>• Bitumen joints with neat edges and sufficient length<br>• No ponding<br>4) **Apron 2** – as per Apron 1<br>5) **Inspection Chamber**<br>• Inspection chambers are level with surrounding without depression and with tolerance of<br>• Covers to be level with frames |

| | Item* | Standards |
|---|---|---|
| **1c** | **Roadwork & Carpark** | 1) **Side Drain** as per 1b Apron & Drain<br><br>2) **Road Surface**<br>• No ponding<br>• Road painting according to drawings; dimensional tolerance of 5mm<br>• Gaps between aeration slabs properly filled up with sand<br>• Aeration slabs stable and not broken<br><br>3) **Kerbs** – as per General Requirements<br><br>4) **Road Sign**<br>• Provided according to specifications<br>• Firm and secured at base – with footing if required<br>• Metal parts below ground are corrosion treated<br><br>5) **Lightings** – as per 1c Road Sign |
| **1d** | **Footpaths & Turfing** | 1) **Footpath** as per Internal Finishes - Floor<br><br>2) **Turfing**<br>• No depression or bald patches<br>• Turfing done evenly, no dead grass or weeds<br><br>3) **Lightings** as per 1c Road Sign<br><br>4) **Fencing & Railing**<br>• As per 1c Road Sign<br>• Wire fencing is PVC covered<br>• Footings provided for supports<br>• Vertical tolerance (4mm / 1.2m)<br><br>5) **Other Fixtures**<br>• as per Internal Finishes - Components |
| **1e** | **Playground** | 1) **Floor** as per Internal Finishes - Floor<br><br>2) **Permanent Fixture1** as per Internal Finishes - Components<br><br>3) **Permanent Fixture2** as per Internal Finishes - Components<br><br>4) **Lightings** as per 1c Road Sign<br><br>5) **Signage** as per Internal Finishes - Components |

| | Item* | | Standards |
|---|---|---|---|
| **1f** | **Court** | 1) | **Floor 1** as per Internal Finishes - Floor |
| | | 2) | **Floor 2** as per Internal Finishes - Floor |
| | | 3) | **Signage** as per Internal Finishes - Components |
| | | 4) | **M&E Fitting** as per M&E Works – Part 5 Basic M&E Fittings |
| | | 5) | **Permanent Fixture** as per Internal Finishes - Components |
| **1g** | **Fences & Gates** | 1) | **Fence Left** as per 1d – item 4) |
| | | 2) | **Gate** as per Internal Finishes - Components |
| | | 3) | **Fence Right** as per 1d – item 4) |
| | | 4) | **M&E Fitting** as per M&E Works – Part 5 Basic M&E Fittings |
| | | 5) | **Signage** as per Internal Finishes - Components |
| **1h** | **Swimming Pool** | 1) | **Side Drain** as per Internal Finishes - Floor |
| | | 2) | **Foot Path 1** as per Internal Finishes - Floor |
| | | 3) | **Floor Path 2** as per Internal Finishes - Floor |
| | | 4) | **M&E Fitting** as per M&E Works – Part 5 Basic M&E Fittings |
| | | 5) | **Other Fixture** as per Internal Finishes - Components |
| **1i** | **Club House** | 1) | **External Wall 1** as Part 3 External Wall |
| | | 2) | **External Wall 2** as Part 3 External Wall |
| | | 3) | **External Wall 3** as Part 3 External Wall |
| | | 4) | **External Wall 4** as Part 3 External Wall |
| | | 5) | **Apron & Drain** as per 1b |

| | Item* | | Standards |
|---|---|---|---|
| **1j** | **Guard House** | 1) | **External Wall 1** as Part 3 External Wall |
| | | 2) | **External Wall 2** as Part 3 External Wall |
| | | 3) | **Apron & Drain** as per 1b |
| | | 4) | **Gantry** as per Internal Finishes - Components |
| | | 5) | **Other Fixture** as per Internal Finishes - Components |
| **1k** | **Electrical Substation** | 1) | **External Wall 1** as Part 3 External Wall |
| | | 2) | **External Wall 2** as Part 3 External Wall |
| | | 3) | **External Wall 3** as Part 3 External Wall |
| | | 4) | **External Wall 4** as Part 3 External Wall |
| | | 5) | **Apron & Drain** as per 1b |

* An item is deemed to have failed if any one of the standards is not met

# QUALITY STANDARDS FOR ARCHITECTURAL WORKS

## Part 5: Material & Functional Tests

| | Item* | | Standards |
|---|---|---|---|
| **1** | **Plastering** | 1) | Use Pre-packed Plaster only. |
| **2** | **Field Window Water-tightness Test** | 1) | No sign of leakage using BCA's Window Water-tightness Test method. Leakage is defined as "*any appearance of uncontrolled water, other than condensation, on the indoor face of any part of the wall & window*". |
| | | 2) | BCA's Water-tightness Test parameters:<br><br>Water intensity: 300mm/hr<br>: 1 litre/min/m of joint<br>Wind Pressure: 240 Pa<br>Nozzle inclination: 90$^{o}$ to window<br>1 sample = 2m length of joint<br>Spray duration: 10 minutes |
| **3** | **Wet Area Water-tightness test (i.e. Bathrooms, toilets & flat roof)** | 1) | No sign of leakage after ponding wet areas over a minimum period of 24 hrs. |
| | | 2) | Ponding with final finish in-place |
| **4** | **Internal wet area waterproofing process** | 1) | According to approved method statement, shop drawings and related BCA's Good Industry Practices guides |
| **5** | **Pull-off test (POT)for internal wall tiles** | 1) | Minimum tensile strength of 0.15 N / mm2 |

*For the assessment of the **field window water-tightness test**, the number of points shall be awarded based on the percentage of non-compliance as tabulated in the table below :*

| *Points Awarded for BCA Field Test (100%)* | *Percentage of non-compliance* |
|---|---|
| *9* | *0%* |
| *(15-x)* 9/15* | *0% < x < 15%* |
| *0* | *≥ 15%* |

*Note: No points shall be given if test is not carried out.*
*"x" is the percentage of samples failed.*

*For the assessment of the **wet area water-tightness test**, the number of points shall be awarded based on the percentage of non-compliance as tabulated in the table below :*

| *Points Awarded for BCA Field Test (100%)* | *Percentage of non-compliance* |
|---|---|
| *5* | *0%* |
| *(2-x)* 5/2* | *0% < x < 2%* |
| *0* | *≥ 2%* |

*Note: No points shall be given if test is not carried out.*
*"x" is the percentage of samples failed.*

* An item is deemed to have failed if any one of the standards is not met.

**Appendix 3**

# QUALITY STANDARDS FOR M&E WORKS

## Part 1: Electrical Works

| | Item* | | Standards |
|---|---|---|---|
| 1 | **Embedded Conduits** | | |
| | Installation | 1) | Conduit ends properly protected |
| | | 2) | Correct type of conduit installed as per approved sample |
| | | 3) | Conduit boxes clean and open end plugged / temporarily protected |
| | | 4) | Coupling joints fastened |
| | | 5) | Bonding to earth provided for all metallic conduits |
| | Secured Properly | 6) | Conduits properly secured |
| | Bent Properly | 7) | Conduits properly bent without distortion and damage |
| | No Visible Damage | | |
| 2 | **Main Cables** | | |
| | Properly Supported | 1) | Cables adequately supported |
| | Fire Stop | 2) | Fire stops properly installed |
| | Spacing & Secure of Cable | 3) | Adequate spacing of cables |
| | No Visible Damage | | |
| 3 | **Surface Conduits** | | |
| | Installation | 1) | Conduit ends properly connected |
| | | 2) | Metallic conduits properly earthed |
| | | 3) | Correct type of conduit as per approved sample |
| | | 4) | Conduits properly bent without distortion and damage |
| | Support | 5) | Support / brackets rigidly fitted |
| | | 6) | Screw used properly fastened |
| | Fire Stop | 7) | Fire stops properly installed |
| | No Visible Damage | 8) | Conduits and accessories properly painted |

| | Item* | Standards |
|---|---|---|
| **4** | **Cable Tray, Ladder And Trunking** | |
| | Installation | 1) Joints protected against corrosion<br>2) Correct type of material used as per approved sample<br>3) Metallic trunking properly earthed |
| | Support | 4) Support / brackets rigidly fitted<br>5) Screw used properly fastened |
| | Fire Stop | 6) Fire stops properly installed |
| | No Visible Damage | |
| **5** | **Distribution Board** | |
| | Circuit Diagram | 1) Circuit diagram provided<br>2) Proper labelling for panel |
| | Cable Termination /Earthing | 3) Suitable cable termination provided<br>4) All live parts to be non-accessible<br>5) All exposed metal parts effectively earthed |
| | No Visible Damage | |

* An item is deemed to have failed if any one of the standards is not met

## Part 2: Quality Standards for ACMV Works

| | Item* | Standards |
|---|---|---|
| 1 | **Ductwork**<br>Location & Installation | 1) Location and ductwork installed according to approved shop drawings |
| | Paints | 2) Exposed ductwork and hanger properly painted to approved colour code |
| | Support | 3) Ductwork properly supported |
| | No Visible Damage | |
| 2 | **Fire-Rated Ducts**<br>Location & Installation | 1) Location and ductwork installed according to approved shop drawings<br>2) No hanging of other services |
| | Access Panel | 3) Fire-resistant sealed access panel provided to fire-rated enclosure of equipment for maintenance |
| | No Visible Damage | |
| 3 | **Flexible Ducts**<br>Location & Installation | 1) Location & installation as per approved shop drawings |
| | Support | 2) Duct properly supported |
| | Sufficient Radius | 3) Bending radius sufficiently wide to prevent tensioning and restriction of the throat |
| | No Visible Damage | |
| 4 | **Flexible Connectors**<br>Location & Installation | 1) Installed as per approved shop drawings<br>2) Provided at ductwork, between AHU/FCU/Fans and related ductwork |
| | Length Limit | 3) Within 50 – 250 mm length |
| | No Visible Damage | |

| | Items* | | Standards |
|---|---|---|---|
| **5** | **Dampers**<br><br>Location & Installation | 1)<br><br>2) | Location of dampers as per approved shop drawings<br><br>Dampers / splitter dampers can be adjusted freely between the open and close position |
| | Access Door | 3) | Access doors provided to all dampers |
| | No Visible Damage | | |
| **6** | **Fire Dampers**<br><br>Location & Installation | 1)<br><br>2)<br><br>3) | Location of dampers as per approved shop drawings<br><br>Installed as per SS 553 and no gap around fire dampers<br><br>Dampers in open position and held in position by fusible link. |
| | Access Door | 4) | Access doors provided to all dampers according to SS 553 |
| | No Visible Damage | | |
| **7** | **Split Unit/Window Air Conditioner**<br><br>Installation | 1)<br><br>2)<br><br>3)<br><br>4) | Units are levelled when placed on plinth<br><br>Drainage provided/units slightly tilted for condensation<br><br>Drain hose connected to the drain pipe<br><br>Cool air is not blocked by wall, beam, shelving or other built-in furniture in the room |
| | Seal Penetration | 5) | Proper sealant of wall or roof opening after pipes are fixed |
| | No Leakage | 6) | No sign of leakage from pipes |
| | No Visible Damage | | |

| | Item* | Standards |
|---|---|---|
| **8** | **Air-Con Comfort** | |
| | Temperature | 1) Room temperature between 23°C - 25°C or according to specification |
| | Air Flow | 2) Room airflow rate not exceeding 0.25 m/s or according to specification |
| | Relative Humidity | 3) Room relative humidity not more than 60% or according to specification |
| **9** | **Air Handling Unit** | |
| | Location & Installation | 1) Unit location & pipe layout installed as per approved shop drawings<br>2) Inspection access door for fan, coil, motor and filter<br>3) All metal parts properly earthed<br>4) Smoke detector installed at the return air stream<br>5) Name plate installed with manufacturer's name, serial number and model number |
| | Support | 6) Pipe / duct from AHU must be supported |
| | No Visible Damage | |
| **10** | **Pump** | |
| | Location & Installation | 1) Location & pipe layout installed as per approved shop drawings<br>2) Pump & motor assembly properly installed on inertia block & spring isolator<br>3) Guard provided to exposed shafts, coupling & moving parts<br>4) Name plate installed with manufacturer's name, serial number and model number |
| | Electrical Termination | 5) No bad electrical termination |
| | No Visible Damage | |

| | Item* | Standards |
|---|---|---|
| **11** | **Cooling Tower**<br><br>Self-Earthing System | 1) Cooling tower completed with self-earthing system for connection to building lightning protection system |
| | Location & Installation | 2) Name plate installed with manufacturer's name, serial number and model number<br><br>3) Location & pipe layout installed as per approved shop drawings |
| | No Visible Damage | 4) Cooling tower clear of all debris |
| **12** | **Pipework**<br>*including Chilled water, Hot water, Steam, Condenser water, Condenser drain, Cold Water make-up, water treatment and refrigerant* | 1) Pipe works installed as per approved shop drawing & specifications |
| | Paints & Support | 2) Pipe work provided with drains at each low point and automatic air vents with manual isolating valve at each high point |
| | Fire Stop | 3) Fire stop for passage of pipes at opening for fire resistant walls and floor<br><br>4) Properly painted and supported |
| | No Visible Damage | |
| **13** | **Chiller**<br><br>Location & Installation | 1) Location & pipe layout installed as per approved shop drawing<br><br>2) Chiller to be levelled when placed on plinth or vibration isolators<br><br>3) Chiller fixed securely in position<br><br>4) Correct model, make & capacity |
| | Pipe Support & Label | 5) Pipes supported properly by hangers or brackets<br><br>6) Pipe connections follow specified flow direction |
| | No Leakage | 7) No sign of leakage |

| | Item* | Standards |
|---|---|---|
| | No Visible Damage | |

* An item is deemed to have failed if any one of the standards is not met

## Part 3: Quality Standards for Fire Protection Works

| | Item* | Standards |
|---|---|---|
| 1 | **Wet / Dry Riser** | |
| | Landing Valve | 1) Landing valve must be accessible<br>2) Landing valve strapped & padlocked<br>3) Labelling for riser door<br>4) Landing valve painted red for wet riser / yellow for dry riser<br>5) Automatic air release valve provided at highest point of rising main |
| | Pipe & Pipe Support | 6) Riser pipes properly supported<br>7) Labelling & painting for riser pipe<br>8) Bonding to earth provided for rising main |
| | Wall/Floor Penetration | 9) Proper wall / floor penetration |
| | No Visible Damage | |
| 2 | **Sprinkler** | |
| | Location & Installation | 1) Location, sprinkler and pipe layouts and sizes installed as per approved shop drawings<br>2) Double layer sprinkler for false ceiling >800mm in depth<br>3) No obstruction and painting to sprinkler heads<br>4) Correct sprinkler heads used in correct locations |
| | Pipe Support | 5) Pipe work properly supported |
| | Wall/Floor Penetration | 6) Proper wall / floor penetration |
| | No Visible Damage | |

| | Item* | Standards |
|---|---|---|
| **3** | **Fire Alarm** | |
| | Location & Installation | 1) Location of fire alarm panel, break glass & bell is correct<br>2) Location & spacing of detectors are correct<br>3) Fire alarm wiring in conduit (GI type) |
| | Paints | 4) Panel and conduit properly painted |
| | Fire Alarm Zoning Diagram | 5) Fire Alarm Zoning diagram provided near panels / sub-panels |
| | No Visible Damage | |
| **4** | **Hosereel** | |
| | Location & Installation | 1) Location of hosereel as per approved shop drawings<br>2) Hosereel cabinet properly labelled<br>3) Hosereel pipe properly fixed with hangers & brackets<br>3) Hosereel operation instruction properly marked on hosereel drum or door |
| | Paints | 4) Correct & proper painting for hosereel |
| | No Visible Damage | |

* An item is deemed to have failed if any one of the standards is not met

## Part 4: Quality Standards for Plumbing & Sanitary Works

| | Item* | Standards |
|---|---|---|
| 1 | **Concealed Pipes** | |
| | Location & Installation | 1) Pipes properly supported, bent without distortion, kink and damage<br>2) Pipe and fitting ends properly capped<br>3) Proper joints<br>4) Materials used are of approved types |
| | Alignment | 5) Vertically or horizontally aligned |
| | No Visible Damage | |
| 2 | **Exposed Pipes** | |
| | Location & Installation | 1) Location of pipes installed and labelled as per approved shop drawing<br>2) Pipes properly supported, bent without distortion, kink and damage<br>3) Joints are watertight<br>4) Pipe & fitting ends properly capped<br>5) No potable water pipes below non-potable water pipes<br>6) Materials used are of approved types |
| | Alignment | 7) Horizontally and vertically aligned and parallel to building surface<br>8) Inclined pipes laid to proper gradients<br>9) Plumb < 3mm per 1m height |
| | Clearance | 10) Do not cause obstruction / pose safety hazard at public area<br>11) Sufficient clearance between installed pipes / ceiling and pipes / wall for accessibility<br>12) Service pipe duct accessible |
| | No Visible Damage | |

| | Item* | | Standards |
|---|---|---|---|
| **3** | **Water Tank** | | |
| | Location & Installation | 1) | Location, type & capacity as per approved shop drawing and specification |
| | | 2) | All openings properly covered and secured |
| | | 3) | Joints & pipe connections are watertight. |
| | | 4) | Not located below non-potable water pipes |
| | | 5) | Corrosion-resistant external cat ladders provided for large water tank |
| | Netting | 6) | Netting properly fitted for overflow / warning / vent pipes |
| | Clearance | 7) | Accessible for maintenance. Minimum clearance of 600mm all rounded the water tank |
| | No Visible Damage | 8) | No visible damage |
| | | 9) | Clean & free from debris |
| **4** | **Pump & Motor** | | |
| | Location & Installation | 1) | Location & type as per approved shop drawing |
| | | 2) | No noticeable vibration & noise from pump / motor |
| | | 3) | Test certificate for alignment of Pump & Motor from manufacturer |
| | Electrical Termination | 4) | No bad / loose electrical terminations |
| | No Visible Damage | | |

* An item is deemed to have failed if any one of the standards is not met

## Part 5: Quality Standards for Basic M&E Fittings

| | Item* | Standards |
|---|---|---|
| 1 | **General Requirements** | 1) **Joints & Gap**<br>• No visible gap<br>• Consistent joint width & neat<br>2) **Alignment & Evenness**<br>• Aligned, leveled and straight<br>3) **Material & Damages**<br>• No visible damage / defects<br>• No stain marks<br>• Securely fixed<br>• Consistent colour tone<br>4) **Functionality**<br>• Functional and safe<br>5) **Accessories Defects**<br>• No missing accessories<br>• No visible damage / defects |
| 2 | **Plumbing & Sanitary Fittings** | |
| 2a | **Gully & Floor Trap** | 1) No damage or chokage<br>2) Must be securely fixed<br>3) Trap's top lower than the surrounding floor level |
| 2b | **Pipes** | 1) Visually aligned horizontally, vertically and parallel to building surface<br>2) Inclined pipes laid to proper gradients<br>3) No leakage at joints<br>4) Plumb < 10mm / storey height<br>5) Brackets firmly secured & adequately spaced<br>6) If painted, no drippings & with good opacity |
| 2c | **Fittings** | 1) Firmly secured & joints properly sealed & pointed<br>2) No leakage at joints |

| | Item* | Standards |
|---|---|---|
| | | 3) No chipping or cracks<br>4) No paint drops or mortar droppings<br>5) Fittings in working condition<br>6) Accessible for maintenance<br>7) Do not cause obstruction / pose as safety hazard (e.g. sprinkler head to point inward).<br>8) No sediments / particles found in water collected at terminal water fittings (remove aerator & showerhead).<br>9) All sensor covers properly sealed against water seepage<br>10) Materials used are of approved types |
| **3** | **M&E Fittings** | e.g. power point, telephone point, air-con diffuser, fan coil unit, lighting, smoke alarm, sprinkler heads, CCTV camera, etc. |
| **3a** | **Installation** | 1) Fittings must be aligned and location as per approved drawings.<br>2) No stains<br>3) Neat patch-up for pointing / penetration |
| **3b** | **Safety** | 1) No exposed wiring within reach |
| **3c** | **Damages** | 1) No visible damage |

* An item is deemed to have failed if any one of the standards is not met

Appendix 4

# Defects Grouping Guide for Assessment of Internal Finishes

| Element | Defects Grouping | Defects Description |
|---|---|---|
| Floor<br>Wall | Finishing | Stains, Painting / Coating Defects, Tonality, Patchy & Roughness |
| | Alignment & Evenness | Alignment, Unevenness, Squareness |
| | Crack & Damages | Crack, Chip, Dent, Scratches |
| | Hollowness / Delamination | |
| | Jointing | Joints, Pointing |
| Ceiling | Finishing | Stains, Painting / Coating Defects, Patchy |
| | Alignment & Evenness | |
| | Crack & Damages | Crack, Chip, Dent, Scratches |
| | Roughness | |
| | Jointing | Joints, Pointing |
| Door<br>Window<br>Component<br>M&E Fittings | Joints & Gap | Joints, Gap etc too big, Inconsistent, Improper Seal |
| | Alignment & Evenness | |
| | Material & Damages | Crack, Chip, Dent, Scratches, Defects, Finishing, Tonality |
| | Functionality | Movement, Functionality, cannot be opened or closed properly, Loose |
| | Accessories Defects | Missing items, Improper Fixing, Stains, Corrosion, Other damages |

Appendix 5

## BUILDING GROUPING GUIDE

| CAT A<br>Commercial, Industrial, Institution & others | CAT B<br>Private Residential, Commercial, Institution, Industrial & others | CAT C<br>Public Residential | CAT D<br>Landed Residential |
|---|---|---|---|
| **In General** : *All types of building that has a central cooling system*<br><br>e.g.<br>Bank<br>Office Building<br>Shopping Complex<br>Hotel<br>Supermarket<br>Airport<br>Hospital<br>University<br>Regional Library<br>Conference Hall<br>Arts and Cultural Centre<br><br>Mixed Development with Central Cooling | **In General** : *All types of building without central cooling system*<br><br>e.g.<br>Condominium<br>Apartments<br>School<br>Factory<br>Warehouse<br><br>Mixed Development without Central Cooling | HDB Public Residential | Bungalow<br>Semi-Detached<br>Terrace Residential<br>Cluster Residential |

Note: The above is only meant to be a general guide in determining the Category of project. The actual grouping might vary depending on the project details in the application. For instance, a private *mixed development building project, i.e. one with commercial and residential components in the development without central cooling, is categorized as category B (*Residential*).*