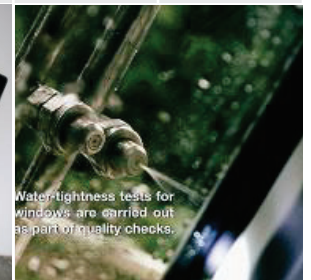
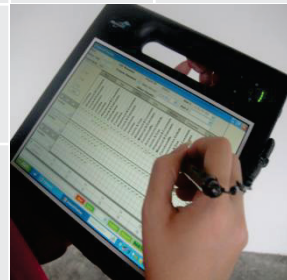


CONQUAS[®]

THE BCA CONSTRUCTION QUALITY ASSESSMENT SYSTEM



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
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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. 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.

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

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 e.g. wardrobe, kitchen cabinet, vanity top, mirror, bathtub, water closet, shower screen, basin, signage, emergency lightings, railings, unit number plates, lift fittings, letter box, lightings, metal gate, etc.
- (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 embedded/concealed. Such items include ACMV ductworks, electrical conduits, 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	CAT B		CAT C		CAT D Landed Housing
	Commercial, Industrial, Institution & others	Commercial, Industrial, Institution & others	Private Housing	Public Housing (Sold Flats)	Public Housing (Rental Flats)	
Structural Works	20%	25%	20%	30%	40%	25%
Architectural Works	60%	65%	70%	65%	55%	70%
M&E Works	20%	10%	10%	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 Housing 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 structure consists of the following items:

Reinforced Concrete Structure	Weightage %
Formwork	15
Rebar	20
Finished Concrete	25
Concrete Quality	5
Steel Reinforcement Quality	5
NDT - UPV test for concrete uniformity	15
NDT - Electro-Covermeter test for concrete cover	15
Total	100

** If total precast concrete volume exceeds 20% of total structural concrete volume, assessment will be carried out for precast concrete construction. The points will be distributed proportionately between formwork/rebar assessment and precast concrete assessment based on the respective concrete volume percentage.*

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

	Items	GFA per Sample	Min Sample	Max Sample	Remarks
1	Structural Elements	500 m ²	30	150	For Non-Housing Project
1a	Structural Elements	1500 m ²	30	50	For Housing Project
2	Concrete Compressive Strength	-	100%	-	Declaration by Qualified Person
3	Steel reinforcement Tensile Strength	-	100%	-	Declaration by Qualified Person
4	NDT- UPV test for concrete uniformity	5,000 m ²	2 sets	20 sets	5 structure members per set
5	NDT - Electro-Covermeter test for concrete cover	5,000 m ²	2 sets	20 sets	5 structure members per set

Note: The computed number of elements to be checked must be evenly distributed throughout the entire block and cover at least 50% of floors in a block. They should also as far as possible cover the different types of structural elements.

The resulting score for the formwork/rebar/precast and finished concrete will be the sum of the number of checks that meet the standards.

There is no assessment of precast components at the precast yard. The assessment is applicable for all types of precast components at site.

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).

The introduction of the non-destructive tests, i.e. on concrete uniformity and cover for steel reinforcement, is to minimise the risk of carbonation and steel corrosion which affect the durability of the concrete structures.

If Structural Works consists of structural steelwork which constitutes more than 20% of the structural cost, assessment will be required for the latter and the points will be distributed proportionately. This applies to Pre-stressing Works as well. In any case, the distribution should follow the cost composition for these three types of structural works in a project.

The distribution of points for Structural Steelwork and Pre-stressed Concrete are as follows:

Structural Steelwork	Weightage %
Main Member/Partially Assembled Component	40
Metal Decking	20
Erection Tolerances	10
Corrosion & Fire Protection	10
Welding Test Reports	20
Total	100

Note: Assessment for Structural steel roof truss is compulsory irregardless of the 20% costing criteria

Pre-stressed Concrete	Weightage %
Tendon & Anchorage	25
Sheathing	25
Stressing & Grouting	25
Debonding	25
Total	100

The selection of samples for **Structural Steelwork** assessment is based on the following guidelines:

Items	Steel tonnage per sample	Min Sample
Structural Elements		
Main member / Partial assembled component	250	5
Metal Decking	250	5
Erection Tolerances	500	5
Corrosion & Fire Protection	500	5
Material & Functional Test		
Welding Test Reports (NDT)	All critical welding joints	

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
Internal Finishes	56	
Floor		16
Internal Wall		16
Ceiling		6
Door		6
Window		6
Component		6
Roof	4	4
External Wall	11	11
External Work*	6	6
Design, Material & Functional Tests	23	
Pre-packed Plaster		1
Field Window Water-Tightness Test (WTT) (BCA Test 7 pts + Self-Testing 2 pts)		9
Wet Area Water-Tightness Test (BCA Test 4 pts + Self-Testing 1 pt)		5
Internal Wet Area Waterproofing Process		2
Pull-Off-Test for Internal Wall Tiles		4
External Facade (Precast or System Formwork or Cladding Facade)		1
Internal Wall Partition (Drywall or Precast panel partition)		1
Total		100

Note: 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.

Weightages for internal finishes and M&E fittings assessment 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	1.6
		Jointing	2.0
Internal Wall	16 points	Finishing	2.8
		Alignment & Evenness	2.8
		Crack & Damages	4.8
		Hollowness	2.8
		Jointing	2.8
Ceiling	6 points	Finishing	0.9
		Alignment & Evenness	0.9
		Crack & Damages	1.8
		Roughness	1.5
		Jointing	0.9
Door	6 points	Joint & Gap	0.6
		Alignment & Evenness	0.6
		Material & Damages	1.8
		Functionality	1.8
		Accessories Defects	1.2
Window	6 points	Joint & Gap	0.6
		Alignment & Evenness	0.6
		Material & Damages	1.2
		Functionality	1.8
		Accessories Defects	1.8
Component	6 points	Joint & Gap	0.6
		Alignment & Evenness	0.6
		Material & Damages	1.8
		Functionality	1.8
		Accessories Defects	1.2
M&E Fitting	*15 points	Joint & Gap	*1.5
		Alignment & Evenness	*3.0
		Material & Damages	*4.5
		Functionality	*4.5
		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 as set out below:

	Items	GFA per Sample	Min Sample	Max Sample	Remarks
1	Internal Finishes	500 m ²	30	150	For Non-Housing Project & Mixed Development Project with Non-Residential GFA exceeding 50%
1a	Internal Finishes	70 m ²	30	800	For all Private Housing Project & Mixed Development Project with Residential GFA exceeding 50%
1b	Internal Finishes	70 m ²	30	600	For Public Housing Project
2	External Wall	-	50%	-	50% of the blocks / units
3	External Work	-	1	-	1 for each type of external work
4	Pre-packed Plaster	-	-	-	Only pre-packed plaster used. Declaration by Qualified Person
5	External Facade	-	-	-	Precast or System Formwork or Cladding Facade. Declaration by Qualified Person
6	Internal Wall Partition	-	-	-	Drywall or Precast panel partition. Declaration by Qualified Person
7a	Field Window Watertightness Test (WTT)	1,000 m ²	20	100	Conducted by BCA. A sample is defined as 2m length of joint.
7b	Field Window Watertightness Test (WTT)	-	25%	-	Self-Testing with declaration by Qualified Person
8a	Wet Area Water-tightness Test	-	20	100	<ul style="list-style-type: none"> • 20% of all bathrooms and/or toilets (by location) • all will be tested if < 20 nos • not required for non-housing project if < 20 nos
8b	Wet Area Water-tightness Test	-	100%	-	<ul style="list-style-type: none"> • Self-Testing with declaration by Qualified Person • Including flat roof
9	Internal Wet Area Waterproofing Process	-	-	-	In-process assessment based on approved Method Statement
10	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 Housing	CAT D Landed Properties
		Housing	Non-Housing		
Principal	60%	40%	60%	40%	40%
Service	15%	40%	15%	40%	40%
Circulation	25%	20%	25%	20%	20%

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, 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. This applies to the assessment of **external walls** where a minimum 50% of the total number of buildings will be required. 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) and the use of pre-packed plaster for all plastering works are based on declaration by the project Qualified Person (QP). In general, declaration on passing for self-testing is based on first-time-right basis.

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

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

*Allocated point is 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 in two stages: during the construction of structural works and 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	50%	50%	100%	100%
M&E Performance Test Assessment				
Performance Testing	100	100	-	-
Weightage	50%	50%	-	-
Total	100%	100%	100%	100%

Note: "-" means that no assessment on that M&E elements is required.

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

Element	Points Allocated
Electrical	
1. Embedded conduit	2
2. Main cables	1
3. Surface conduits	2
4. Cable tray, ladder & trunking	2
5. 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, is assessed based on "**Get-It-Right-First-Time**" principle. The assessment will be based on the **percentage of tests passing the first inspection** for each type of test.

The score will be pro-rated as follow:

Ave % Passing at First Attempt	% of Performance Test Score
80% or below	0%
$80\% < X < 100\%$	$(X-80)/20 \times 100\%$
100%	100%

Note: "X" means the average percentage of passing at first attempt.

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 1,000 m ² per sample	CAT B 1,500 m ² per sample	CAT C 3,500 m ² per sample	CAT D 3,500 m ² per sample
Electrical				
1. Embedded conduit	2+	2+		2+
2. Main cables	1	1		
3. Surface conduits	1+	1+	1+	1+
4. Cable tray, ladder & trunking	1+	1+	1+	1
5. 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 m² 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
<ul style="list-style-type: none"> A supervisor can only be deployed on one project at any time Supervisor must be deployed for minimum 75% of project duration 	
Certified CONQUAS Manager	0.4
Certified QM/CONQUAS Manager	0.6
<ul style="list-style-type: none"> A manager can be deployed for maximum of 2 projects at any time Manager must be deployed for minimum 75% of project duration 	
Maximum	1.0

Note:

- Both employer and employee must declare the personnel was deployed for the minimum duration as specified.
- 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 elements supplied by SCI Accredited Precasters (100% of precast elements)	1.0*
Use of Prefabricated Bathrooms (at least 65% of toilets)	1.5**

* Bonus point is subject to weightage for Structural Works.

** 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*
<u>QM STAR</u>	1.5
<u>QM EXCELLENT</u>	1.0
<u>QM MERIT</u>	0.5

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

3.6 Computation of CONQUAS Score

Below is an example of how a project's CONQUAS score will be computed:

Scenario:

- 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 Accredited Precaster)
- External Wall - Cladding system
- Internal Wall - Brickwall

Step 1: Computation of Structural Score

Structural Works (Reinforced Concrete Structure)	Weightage %	Score
Formwork/Rebar (69% concrete volume)	$0.69 \times 35\% = 24.1\%$	22.3
Precast (31% concrete volume)	$0.31 \times 35\% = 10.9\%$	8.0
Finished Concrete	25	20.5
Concrete Quality	5	5.0
Steel Reinforcement Quality	5	5.0
NDT - UPV for concrete uniformity	15	10.5
NDT - Electro-Covermeter test for concrete cover	15	12.5
Total	100	83.8

Structural Works (Structural Steelwork)	Weightage %	Score
Main Member/Partially Assembled Component	40	33.2
Metal Decking (not used)	-	NA
Erection Tolerances	10	8.3
Corrosion & Fire Protection	10	10.0
Welding Test Reports	20	19.5
Total	80	71
Pro-rated Total	100	88.8

The Structural Score will be **proportioned by the cost ratio** as follows:

Structural System	(A) Individual Score	(B) Cost Proportion	(A) X (B)
Reinforced Concrete Works	83.8	75%	62.9
Structural Steelworks	88.8	25%	22.2
Accredited Precaster	1.0	-	1.0
Structural Score			86.1

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	11	9.3
External Works	6	4.5
Pre-packed Plaster	1	1.0
Field Window Water-tightness Test (WTT)		
- BCA Testing	7	5.8
- Self-Testing	2	1.4
Wet Area Water-Tightness Test		
- BCA Testing (NA as <20 nos for non-residential)	-	NA
- Self-Testing	1	1.0
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 = (100-4)	96	68.1
Pro-rated Total = (68.1/96)	100	70.9
100% Prefabricated Bathroom		1.5
Architectural Total	100	72.4

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
Weightage (a)	50%	42.3
M&E Performance Test Assessment		
Performance Test	100%	86.9
Weightage (b)	50%	43.4
Total (a+b):	100%	85.7

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	0.3
Certified QM/CONQUAS Manager x1	0.6
Total	1.0 (max)

Step 5: Computation of Final CONQUAS Score

Area of Works/Component	(A) Actual Score	(B) CAT A	(A) X (B)
Structural Works	86.1	20%	17.22
Architectural Works	72.4	60%	43.44
M&E Works	85.7	20%	17.14
Certified QM/CONQUAS Personnel	-	-	1.0
CONQUAS Score		100%	78.8

3.7 Publication of CONQUAS Scores

The overall CONQUAS scores of projects are published and accessible for viewing at BCA's website. However projects scoring 95 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.

QUALITY STANDARDS FOR STRUCTURAL WORKS

Part 1: Reinforced Concrete Structures

	Item*	Standards
1	Formwork	
1a	Formwork dimensions and openings for services	<ol style="list-style-type: none"> 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): <ul style="list-style-type: none"> • Up to 3m: ± 6mm • 3m to 4.5m: ± 9mm • 4.5m to 6m: ± 12mm • Additional deviation for every subsequent 6m: ± 6mm
1b	Alignment, plumb and level	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1) According to structural drawings (numbers / sizes) 2) Spacing of bars not more than that specified
2b	Anchorage & lap lengths	<ol style="list-style-type: none"> 1) Required lap length not less than that specified
2c	Cover provision	<ol style="list-style-type: none"> 1) According to specifications with tolerance of +5mm
2d	Links, stirrups and trimming bars	<ol style="list-style-type: none"> 1) According to structural drawings (numbers / sizes)

	Item*	Standards
2e	Rebar Condition	2) Spacing of links not more than specified 1) Rebars must be securely and properly tied in place 2) Rebars must be freed from concrete dropping, corrosion etc
3 3a 3b	Finished Concrete (cast in-situ & Precast) Dimension for elements / opening for services Alignment, plumb and level	1) Tolerance for cross-sectional dimension of cast in-situ and precast elements: +10mm / -5mm 2) Tolerance for opening: +10 for size and ± 25 mm for location 3) Tolerance for length of precast members (major dimension of unit): <ul style="list-style-type: none"> • Up to 3m: ± 6mm • 3m to 4.5m: ± 9mm • 4.5m to 6m: ± 12mm • Additional deviation for every subsequent 6m: ± 6mm 4) Straightness or bow (deviation from intended line) of precast member: <ul style="list-style-type: none"> • Up to 3m: 6mm • 3m to 6m: 9mm • 4.5m to 6m: 12mm • Additional for every subsequent 6m: 6mm 5) Squareness of precast member – Difference between the greatest and shortest dimensions should not exceed the following: Length of shorter sides <ul style="list-style-type: none"> • Up to and including 1.2m: 6mm • Over 1.2m but less than 1.8m: 9mm • 1.8m and over: 12mm 6) Twist of precast member – Any corner should not be more than the deviation stated from the plane containing the other 3 corners: <ul style="list-style-type: none"> • Up to 600mm wide and 6m in length: 6mm • Over 600mm wide and for any length: 12mm 7) Flatness: 6mm per 1.5m 1) Tolerance for departure of any point from its position: ± 10 mm 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: ± 10 mm 4) For cast in-situ elements, the maximum deviation of levels

	Item*	Standards
		within the element: 10mm
3c	Exposed surface	5) Camber at mid-span: according to specifications 1) Should not have visual exposure of groups of coarse aggregates resulting from grout leakage 2) Cold joint & formwork joint must be smooth 3) No bulging of structural elements 4) All formwork, nails, zinc strips, etc must be removed 5) No cracks or damages
4	Precast Specific Requirements	
4a	Lifting points/inserts	1) Tolerance for position: ± 20 mm from centre line location in drawing 2) Lifting devices and inserts free from damages
4b	Sleeve system/connections	1) Tolerance for position: ± 6 mm from centre line location in drawings 2) Bar protrusion length according to requirements. No bending, cranking or damages to bars 3) Bars free from concrete droppings or corrosion 4) Sleeves, grout holes, grout tubes not congested with debris
4c	Interface/joint requirements	1) Joint taper: <ul style="list-style-type: none"> • Over 3m length: 6mm • Maximum for entire length: 9mm 2) Alignment of horizontal and vertical joint: ± 6 mm 3) Jog in alignment of matching edges: 6mm 4) Sitting of element: according to specifications 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: ± 6 mm from centre line location in drawings 2) Tolerance for position of openings for bolt connections: ± 3 mm from centre line location in drawings 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 QP (Qualified Person)
5b	Reinforcement (Rebar)	<p>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 (Qualified Person)</p> <p>2) All the welded steel fabric used to comply with the contract specifications.</p> <p>3) No non-conforming reinforcement detected through test records has been installed in the structure</p>

	Item*	Standards
6	Non-destructive testing	
6a	Ultra Pulse Velocity test for Concrete Uniformity	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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: <ol style="list-style-type: none"> 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 $\pm 5\text{mm}$ and half point for $> \pm 5\text{mm}$ to $\pm 8\text{mm}$. However, no points will be awarded if any of the 4 readings within the structural sample exceeds $\pm 12\text{mm}$ 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.

QUALITY STANDARDS FOR STRUCTURAL WORKS

Part 2: Structural Steel Works

	Item*	Standards
1	Main member/Partial assembled component	
1a	Physical dimensions	<ol style="list-style-type: none"> 1) Cross sectional tolerance should not be less than the structural steel specifications or approved plan 2) Tolerance for length of structural steel member: $\pm 3\text{mm}$ 3) Tolerance for bolt hole size: <ul style="list-style-type: none"> • $\leq 2\text{mm}$ for bolt diameter $< 24\text{mm}$ • $\leq 3\text{mm}$ for bolt diameter $\geq 24\text{mm}$ Tolerance for bolt hole position: $\pm 2\text{mm}$
1b	Type and condition	<ol style="list-style-type: none"> 1) According to the structural steel specifications 2) Surface preparation shall meet the surface roughness specifications 3) Material used must be traceable to its original mill certificates
1c	Welding	<ol style="list-style-type: none"> 1) Weld size, length and profile shall meet the structural steel specifications and drawings 2) Visual inspection shall meet the structural steel specifications 3) All weld shall follow approved welding procedures 4) All welding must be done by qualified welders
1d	Bolting	<ol style="list-style-type: none"> 1) Bolts and washers, type, size and number shall be according to the structural steel specifications 2) Drilled holes shall be free from burrs 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 4) Gap between adjacent parts shall not exceed 2mm 5) Bolts shall be tightened to specified torque or as specified by the structural steel specifications 6) Threaded bolts protruding at least one thread length with washers

	Item*	Standards
2	Metal decking	
2a	Type and condition	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1) According to structural steel specifications or approved plan
3	Erection tolerances	
3a	Column verticality	<ol style="list-style-type: none"> 1) Tolerance for verticality: $\pm H/600$ or 5mm, maximum ± 25mm; where H is the floor to floor height in mm.
3b	Column position	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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 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 2) Test reports must comply with the acceptable criteria and must be endorsed by the project's structural QP.

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

<i>Points awarded</i>	<i>Percentage of elements checked which does not</i>
20	0%
15	0%<x≤5%
10	5%<x≤10%
5	10%<x≤15%
0	x>15%

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

QUALITY STANDARDS FOR STRUCTURAL WORKS

Part 3: Pre-stressed Concrete

	Item*	Standards
1	Condition of tendons & anchorages	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1) Sheathing properly secured and protected and free from damage or puncture 2) Sheathing profile according to drawings throughout the length with position tolerance: $\pm 5\text{mm}$ 3) Splice to sheathing shall be mortar tight 4) Air vents or grout tubes provided according to the drawing
3	Stressing & Grouting process	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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.

QUALITY STANDARDS FOR ARCHITECTURAL WORKS

Part 1: Internal Finishes

	Item*	Standards
1	Floors	
1a	General Requirements	<ol style="list-style-type: none"> 1) Finishing <ul style="list-style-type: none"> • No stain marks • Consistent colour tone • Floor divider provided where required 2) Alignments & Evenness <ul style="list-style-type: none"> • Evenness of surface (not more than 3mm per 1.2m) • Falls in wet areas should be in right direction • No ponding in falls for wet area • For staircases, the variance in lengths of threads and risers must not exceed 5 mm; nosing must be straight • Skirting size and joint aligned with floor if of same material 3) Crack & Damages <ul style="list-style-type: none"> • No visible damage / defects 4) Hollowness / Delamination <ul style="list-style-type: none"> • No hollow sound when tapped with a hard object • No sign of delamination 5) Jointing <ul style="list-style-type: none"> • Consistent skirting thickness • No visible gap between wall & skirting
1b	Screed finish	<ol style="list-style-type: none"> 1) Surfaces should not be unduly rough or patchy 2) No visible trowel marks 3) Expansion joints should be provided at interval as stated by architect
1c	Tiled finish	<ol style="list-style-type: none"> 1) Consistent colour and neat pointing 2) No hollow sound when tapped with a hard object 3) Joints are aligned and consistent with skirting and wall tiles 4) Consistent joint size 5) Lippage between 2 tiles should not be more than 0.5 mm 6) Expansion joints should be provided at interval as stated by architect

	Item*	Standards
1d	Timber floor	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 1) Stretched and even surface 2) Joint should not be visible 3) Proper anchoring at all edges
1f	Raised Floor	<ul style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1) Finishing <ul style="list-style-type: none"> • No stain marks • Consistent colour tone • No rough / patchy surface 2) Alignments & Evenness <ul style="list-style-type: none"> • Evenness of surface (not more than 3mm per 1.2m) • Verticality of wall (not more than 3mm per m) • Walls meet at right angles (not more than 4mm over 300mm) • Edges (wall to wall) to appear straight and aligned 3) Crack & Damages <ul style="list-style-type: none"> • No visible damage / defects 4) Hollowness / Delamination <ul style="list-style-type: none"> • No hollow sound when tapped with a hard object • No sign of delamination 5) Jointing <ul style="list-style-type: none"> • Straightness of corners and joints
2b	Plaster Finish	<ol style="list-style-type: none"> 1) Surface evenness (not more than 3mm over 1.2m) 2) No hollow sound when tapped with a hard object. 3) Surfaces should not be unduly rough or patchy esp no brush / trowel marks
2c	Tiled Finish	<ol style="list-style-type: none"> 1) Tile joints aligned and with consistent joint size 2) No hollow sound when tapped with a hard object 3) Consistent colour and neat pointing 4) Lippage between 2 tiles should not be more than 0.5mm
2d	Cladding	<ol style="list-style-type: none"> 1) Proper anchorage for panels 2) Joints aligned and with consistent joint size 3) Sealant material compatible with cladding 4) Consistent spacing and within allowable tolerance
2e	Architectural Coating	<ol style="list-style-type: none"> 1) Substrate - see plaster finish 2) Finished texture and colour to be uniform

	Item*	Standards
2f	Painting	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1) Alignment with adjacent planks not more than 3mm 2) Plane tolerance (3mm / 1.2m)
2h	Wall Paper	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1) Pointing should be satisfactory 2) Joint should be even 3) Glass blocks should be properly aligned
2j	Wood / Timber Panels	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1) Finishing <ul style="list-style-type: none"> • No stain marks • Consistent colour tone • No patchy surface 2) Alignment & Evenness <ul style="list-style-type: none"> • Overall surface should be smooth, even, not wavy • Straightness of corners 3) Crack & Damages <ul style="list-style-type: none"> • No visible damage e.g spalling, leaks, cracks, etc 4) Roughness <ul style="list-style-type: none"> • No rough surface 5) Jointing Consistent, aligned and neat
3b	Skim Coats / Boarded Ceiling	<ol style="list-style-type: none"> 1) Not patchy, with no pin holes and with no trowel marks 2) Formwork joints are grounded smooth 3) Paintwork with good opacity and with no brush marks 4) Access door joints should be sharp and in consistent width
3c	False ceiling / Grid System	<ol style="list-style-type: none"> 1) Alignment of rails should be visually straight 2) Surface should be overall level and even 3) Chipped surfaces or corners should not be seen

	Item*	Standards
4	Doors	
4a	General Requirements	<ol style="list-style-type: none"> 1) Joints & Gap <ul style="list-style-type: none"> • No visible gaps between door frame and wall • Consistent & neat joints • Consistent gap between door leaf and frame and not more than 5mm • No visible gaps within door leaf and door frame • Consistent and no visible gaps for mitre joints 2) Alignment & Evenness <ul style="list-style-type: none"> • Alignment/level with walls • Door frame and leaf to flush • Door and frame corners maintained at right angles • No rattling sound when door is closed 3) Material & Damages <ul style="list-style-type: none"> • No stain marks and any visible damage • No sags, warps on door leaf • Fire stop provided where necessary • Door joints and nail holes filled up, properly sanded down and with good paint finish (including on top and bottom of door leaf and consistent in colour) • Glazing clean and evenly sealed with gasket • No sign of corrosion for metal frame • Consistent colour tone 4) Functionality <ul style="list-style-type: none"> • Ease in opening, closing and locking • No squeaky sound during swinging the leaf 5) Accessories Defects <ul style="list-style-type: none"> • Lock sets with good fit and no stains • No sign of corrosion in ironmongery • No missing or defective accessories <p>Note 1: Civil defence shelter door will be considered as part of wall finishes</p> <p>Note 2: Metal gate will be assessed as component</p>

	Item*	Standards	
5	Windows		
5a	General Requirements	1)	<p>Joints & Gap</p> <ul style="list-style-type: none"> • No visible gap between window frame and wall • Consistent gap between window leaf and frame and not more than 5mm (timber window only) • No visible gaps within window leaf and frame • No visible gaps between window leaf and frame • Neat joint between window and wall internally and externally • Consistent and no visible gaps at mitre joints
		2)	<p>Alignment & Evenness</p> <ul style="list-style-type: none"> • Alignment / level with wall openings • Window leaf and frame corners maintained at right angles
		3)	<p>Material & Damages</p> <ul style="list-style-type: none"> • No stain marks and any visible damage / defects • Louvre windows with glass panels of correct lengths • Glazing clean, evenly sealed with putty or gasket for aluminium windows
		4)	<p>Functionality</p> <ul style="list-style-type: none"> • Ease in opening, closing and locking • No sign of rainwater leakage • No squeaky sound during swinging the leaf
		5)	<p>Accessories Defects</p> <ul style="list-style-type: none"> • Lock sets with good fit and aligned • No sign of corrosion • No missing or defective accessories • Countersunk screws levelled and flushed. No over-tightened screws • Stainless steel screws at hinges for swing window

	Item*	Standards
6	Components	
6a	General Requirements	<ol style="list-style-type: none"> 1) Joints & Gap <ul style="list-style-type: none"> • Consistent joint width & neat joint • No visible gap • Welding joints grounded or flushed 2) Alignment & Evenness <ul style="list-style-type: none"> • Level and in alignment 3) Material & Damages <ul style="list-style-type: none"> • No stain marks • No visible damage / defects • Consistent in colour tone 4) Functionality <ul style="list-style-type: none"> • Functional, secured and safe 5) Accessories Defects <ul style="list-style-type: none"> • No missing accessories • No sign of corrosion • 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	<ol style="list-style-type: none"> 1) Stain / Painting <ul style="list-style-type: none"> • No stain marks • Good paint works 2) Rough / Uneven / Falls <ul style="list-style-type: none"> • Look smooth and with no tool marks • Even and level esp no potential in stripping • Good falls in right direction 3) Crack / Chip / Damage <ul style="list-style-type: none"> • No visible damages / defects 4) Joint / Sealant / Alignment <ul style="list-style-type: none"> • Consistent joint width, neat & aligned 5) Chokage / Ponding <ul style="list-style-type: none"> • No sign of chokage and ponding 6) Construction <ul style="list-style-type: none"> • No sign of leaking • Proper dressing for any protrusion • Neat & secured installation of fixtures
1b	Flat Roof	<ol style="list-style-type: none"> 1) Ponding less than 3mm 2) Surface to level to avoid tripping 3) Proper dressing for any protrusion 4) Openings to be sealed to prevent pest invasion 5) Clean and no stain marks
1c	Pitched Roof	<ol style="list-style-type: none"> 1) No leaking 2) No rust or stains 3) Good painting to roof structural members 4) Roof tiles in alignment 5) Openings to be sealed to prevent pest invasion

	Item*	Standards
1d	Waterproofing (exposed)	<ul style="list-style-type: none"> 6) Consistent colour tone 7) Proper dressing for any protrusion 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
1e	Gutters	<ul style="list-style-type: none"> 6) No paint defects 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 <ul style="list-style-type: none"> • Overall surface should be even, not wavy & not patchy 2) Staining / Painting / Finishing <ul style="list-style-type: none"> • No visible stain marks • Good paint works 3) Cracking / Damages <ul style="list-style-type: none"> • No visible damage / defects 4) Jointing / Alignment <ul style="list-style-type: none"> • External features visually in alignment • Corners of wall maintained at right angles and straight • 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 2) Plumb tolerance and evenness of surface (3mm / 1.2m)
4	Claddings / Curtain Walls	1) Gaps around openings to be properly sealed 2) Joints of regular widths as specified 3) Plumb tolerance as specified 4) Evenness of surface, no dents or scratches 5) Sealant material compatible with cladding
5	Facing Brickwork	1) 10mm joint with pointing 2) Weepholes are provided as specified 3) No mortar droppings and other stains 4) No efflorescence

	Item*	Standards
6	Architectural Coating	<ol style="list-style-type: none"> 1) Substrate - see plaster finish 2) Finished texture and colour to be uniform 3) No paint drips and other stains
7	Painting	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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)	<ol style="list-style-type: none"> 1) No stain marks and visible damages / defects 2) Finishes must be even, level , align & consistent 3) Consistent joints width and neat 4) Paintworks with good opacity, no patchiness and brush marks 5) Constructed according to Contract Specifications 6) Fixtures installed must be safe, secured and functional 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	<ol style="list-style-type: none"> 1) Floor as per Internal Finishes - Floor 2) Column as per Internal Finishes - Wall 3) Ceiling as per Internal Finishes – Ceiling 4) Other Finishes as per Internal Finishes – Components 5) M&E Fitting as per M&E Works – Part 5 Basic M&E Fittings
1b	Apron & Drain	<ol style="list-style-type: none"> 1) Drain <ul style="list-style-type: none"> • Free flowing and no ponding of water 2) Drain Cover <ul style="list-style-type: none"> • level and do not jolt or rock • Gaps between drain covers and side of drain between 5-10mm wide • Drain grating properly painted 3) Apron 1 <ul style="list-style-type: none"> • Bitumen joints with neat edges and sufficient length • No ponding 4) Apron 2 – as per Apron 1 5) Inspection Chamber <ul style="list-style-type: none"> • Inspection chambers are level with surrounding without depression and with tolerance of 20mm for protrusion • Covers to be level with frames

	Item*	Standards
1c	Roadwork & Carpark	<ol style="list-style-type: none"> 1) Side Drain as per 1b Apron & Drain 2) Road Surface <ul style="list-style-type: none"> • No ponding • Road painting according to drawings; dimensional tolerance of 5mm • Gaps between aeration slabs properly filled up with sand • Aeration slabs stable and not broken 3) Kerbs – as per General Requirements 4) Road Sign <ul style="list-style-type: none"> • Provided according to specifications • Firm and secured at base – with footing if required • Metal parts below ground are corrosion treated 5) Lightings – as per 1c Road Sign
1d	Footpaths & Turfing	<ol style="list-style-type: none"> 1) Footpath as per Internal Finishes - Floor 2) Turfing <ul style="list-style-type: none"> • No depression or bald patches • Turfing done evenly, no dead grass or weeds 3) Lightings as per 1c Road Sign 4) Fencing & Railing <ul style="list-style-type: none"> • As per 1c Road Sign • Wire fencing is PVC covered • Footings provided for supports • Vertical tolerance (4mm / 1.2m) 5) Other Fixtures <ul style="list-style-type: none"> • as per Internal Finishes - Components
1e	Playground	<ol style="list-style-type: none"> 1) Floor as per Internal Finishes - Floor 2) Permanent Fixture1 as per Internal Finishes - Components 3) Permanent Fixture2 as per Internal Finishes - Components 4) Lightings as per 1c Road Sign 5) Signage as per Internal Finishes - Components

	Item*	Standards
1f	Court	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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 " <i>any appearance of uncontrolled water, other than condensation, on the indoor face of any part of the wall & window</i> ". 2) BCA's Water-tightness Test parameters: Water intensity: 300mm/hr : 1 litre/min/m of joint Wind Pressure: 240 Pa Nozzle inclination: 90° to window 1 sample = 2m length of joint 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 / mm ²

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 :

<i>Points Awarded for BCA Field Test (80%)</i>	<i>Points Awarded for Self-Testing (20%)</i>	<i>Percentage of non-compliance</i>
7	2	0%
(15-x)* 7/15	(15-x)* 2/15	0% < x < 15%
0	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 :

<i>Points Awarded for BCA Field Test (80%)</i>	<i>Points Awarded for Self-Testing (20%)</i>	<i>Percentage of non-compliance</i>
4	1	0%
$(2-x) * 4/2$	$(2-x) * 1/2$	$0\% < x < 2\%$
0	0	$\geq 2\%$

*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.

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

	Item*	Standards
	No Visible Damage	8) Conduits and accessories properly painted
4	Cable Tray, Ladder And Trunking Installation	1) Joints protected against corrosion 2) Correct type of material used as per approved sample 3) Metallic trunking properly earthed
	Support	4) Support / brackets rigidly fitted 5) Screw used properly fastened
	Fire Stop	6) Fire stops properly installed
	No Visible Damage	
5	Distribution Board Circuit Diagram	1) Circuit diagram provided 2) Proper labelling for panel
	Cable Termination /Earthing	3) Suitable cable termination provided 4) All live parts to be non-accessible 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	
	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	
	Location & Installation	1) Location and ductwork installed according to approved shop drawings 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	
	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	
	Location & Installation	1) Installed as per approved shop drawings 2) Provided at ductwork, between AHU/FCU/Fans and related ductwork
	Length Limit	3) Within 50 – 250 mm length
	No Visible Damage	

	Item*	Standards
5	Dampers	
	Location & Installation	1) Location of dampers as per approved shop drawings 2) 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	
	Location & Installation	1) Location of dampers as per approved shop drawings 2) Installed as per CP13 and no gap around fire dampers 3) Dampers in open position and held in position by fusible link.
	Access Door	4) Access doors provided to all dampers according to CP13
	No Visible Damage	
7	Split Unit/Window Air Conditioner	
	Installation	1) Units are levelled when placed on plinth 2) Drainage provided/units slightly tilted for condensation 3) Drain hose connected to the drain pipe 4) 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 2) Inspection access door for fan, coil, motor and filter 3) All metal parts properly earthed 4) Smoke detector installed at the return air stream 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 2) Pump & motor assembly properly installed on inertia block & spring isolator 3) Guard provided to exposed shafts, coupling & moving parts 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 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 3) Location & pipe layout installed as per approved shop drawings
	No Visible Damage	4) Cooling tower clear of all debris
12	Pipework <i>including Chilled water, Hot water, Steam, Condenser water, Condenser drain, Cold Water make-up, water treatment and refrigerant</i>	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 4) Properly painted and supported
	No Visible Damage	
13	Chiller Location & Installation	1) Location & pipe layout installed as per approved shop drawing 2) Chiller to be levelled when placed on plinth or vibration isolators 3) Chiller fixed securely in position 4) Correct model, make & capacity
	Pipe Support & Label	5) Pipes supported properly by hangers or brackets 6) Pipe connections follow specified flow direction

	Item*	Standards
	No Leakage	7) No sign of leakage
	No Visible Damage	

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Part 3: Quality Standards for Fire Protection Works

	Item*	Standards
1	Wet / Dry Riser Landing Valve	1) Landing valve must be accessible 2) Landing valve strapped & padlocked 3) Labelling for riser door 4) Landing valve painted red for wet riser / yellow for dry riser 5) Automatic air release valve provided at highest point of rising main
	Pipe & Pipe Support	6) Riser pipes properly supported 7) Labelling & painting for riser pipe 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 2) Double layer sprinkler for false ceiling >800mm in depth 3) No obstruction and painting to sprinkler heads 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 2) Location & spacing of detectors are correct 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 2) Hosereel cabinet properly labelled 3) Hosereel pipe properly fixed with hangers & brackets 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 2) Pipe and fitting ends properly capped 3) Proper joints 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 2) Pipes properly supported, bent without distortion, kink and damage 3) Joints are watertight 4) Pipe & fitting ends properly capped 5) No potable water pipes below non-potable water pipes 6) Materials used are of approved types
	Alignment	7) Horizontally and vertically aligned and parallel to building surface 8) Inclined pipes laid to proper gradients 9) Plumb < 3mm per 1m height
	Clearance	10) Do not cause obstruction / pose safety hazard at public area 11) Sufficient clearance between installed pipes / ceiling and pipes / wall for accessibility 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	<ol style="list-style-type: none"> 1) Joints & Gap <ul style="list-style-type: none"> • No visible gap • Consistent joint width & neat 2) Alignment & Evenness <ul style="list-style-type: none"> • Aligned, leveled and straight 3) Material & Damages <ul style="list-style-type: none"> • No visible damage / defects • No stain marks • Securely fixed • Consistent colour tone 4) Functionality <ul style="list-style-type: none"> • Functional and safe 5) Accessories Defects <ul style="list-style-type: none"> • No missing accessories • No visible damage / defects
2	Plumbing & Sanitary Fittings	
2a	Gully & Floor Trap	<ol style="list-style-type: none"> 1) No damage or chokage 2) Must be securely fixed 3) Trap's top lower than the surrounding floor level
2b	Pipes	<ol style="list-style-type: none"> 1) Visually aligned horizontally, vertically and parallel to building surface 2) Inclined pipes laid to proper gradients 3) No leakage at joints 4) Plumb < 10mm / storey height 5) Brackets firmly secured & adequately spaced 6) If painted, no drippings & with good opacity
2c	Fittings	<ol style="list-style-type: none"> 1) Firmly secured & joints properly sealed & pointed 2) No leakage at joints

	Item*	Standards
		<ul style="list-style-type: none"> 3) No chipping or cracks 4) No paint drops or mortar droppings 5) Fittings in working condition 6) Accessible for maintenance 7) Do not cause obstruction / pose as safety hazard (e.g. sprinkler head to point inward). 8) No sediments / particles found in water collected at terminal water fittings (remove aerator & showerhead). 9) All sensor covers properly sealed against water seepage 10) Materials used are of approved types
3	M&E Fittings	<p>e.g. power point, telephone point, air-con diffuser, fan coil unit, lighting, smoke alarm, sprinkler heads, CCTV camera, etc.</p>
3a	Installation	<ul style="list-style-type: none"> 1) Fittings must be aligned and location as per approved drawings. 2) No stains 3) Neat patch-up for pointing / penetration
3b	Safety	<ul style="list-style-type: none"> 1) No exposed wiring within reach
3c	Damages	<ul style="list-style-type: none"> 1) No visible damage

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

Defects Grouping Guide for Assessment of Internal Finishes

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

BUILDING GROUPING GUIDE

CAT A Commercial, Industrial, Institution & others	CAT B Private Housing, Commercial, Institution, Industrial & others	CAT C Public Housing	CAT D Landed Housing
<p><u>In General</u> : All types of building that has a central cooling system</p> <p>e.g.</p> <ul style="list-style-type: none"> Bank Office Building Shopping Complex Hotel Supermarket Airport Hospital University Regional Library Conference Hall Arts and Cultural Centre <p>Mixed Development with Central Cooling</p>	<p><u>In General</u> : All types of building without central cooling system</p> <p>e.g.</p> <ul style="list-style-type: none"> Condominium Apartments School Factory Warehouse <p>Mixed Development without Central Cooling</p>	<p>HDB Public Housing</p>	<p>Bungalow</p> <p>Semi-Detached</p> <p>Terrace House</p> <p>Cluster Housing</p>

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 *mixed development building project, ie, one with commercial and residential components in the development, where the residential GFA > 50% of the total GFA, is categorized as category B (housing).*