STANDARD INDUSTRI PEMBINAAN

(CONSTRUCTION INDUSTRY STANDARD)

CIS 7:2014

QUALITY ASSESSMENT SYSTEM FOR BUILDING CONSTRUCTION WORKS

Descriptors: quality of workmanship, structural, architectural, mechanical and electrical, external works, benchmark, site inspection, field testing, sampling

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Committee representation

This Construction Industry Standard (CIS) was developed and reviewed by the Construction Industry Development Board Malaysia with the assistance of the Technical Committee and working groups on Quality Assessment System for Building Construction Works which comprises representatives from the following organisations:-

Association of Consulting Engineers Malaysia
Canaan Building Inspection Sdn Bhd
Construction Industry Development Board of Malaysia
Jabatan Kerja Raya Malaysia
Kementerian Kesejahteraan Bandar, Perumahan dan Kerajaan Tempatan
Malaysia Air-Conditioning & Refrigeration Association
Master Builders Association Malaysia
National House Buyers Association of Malaysia
Persatuan Kontraktor Melayu Malaysia
Persatuan Pengilang, Pembekal, Kontraktor, Industrial Elektrik, Elektronik, Mekanikal dan ICT Melayu dan Bumiputra Malaysia
Pertubuhan Akitek Malaysia
Real Estate and Housing Developers' Association Malaysia
Royal Institution of Surveyors Malaysia
Sime Darby Property Berhad
Sunway Integrated Properties Sdn Bhd
The Electrical and Electronic Association of Malaysia
Universiti Sains Malaysia

FOREWORD

The Malaysian Construction Industry Standards (CIS), hereby referenced as CIS 7:2014, was developed as a quality assessment system for building construction works standard by the Technical Committee on Quality Assessment in Construction, with the assistance of Construction Industry Development Board Malaysia (CIDB), which acted as a moderator and facilitator for the technical committee throughout the development process of this standard. CIS 7:2014 is an improved and updated version of the CIS 7:2006 standard.

While the CIS 7:2014 on quality assessment system for building construction works adopts several components with reference to CONQUAS – The BCA Construction Quality Assessment System (Eighth Edition 2012): Building and Construction Authority, Singapore, it is also dependent on new and/or updated information and developments concerning this subject area made available through the Technical Committee and Working Groups.

The use of this CIS 7:2014 is voluntary and compliance with this document does not in itself confer immunity from legal and contractual obligations.

QUALITY ASSESSMENT SYSTEM FOR BUILDING CONSTRUCTION WORKS

SECTION 1: GENERAL

1.1 Introduction

Quality Assessment System for Building Construction Works is an independent method to assess and evaluate primarily on the quality of workmanship of building projects based on this standard.

1.2 Normative references

The following normative reference is indispensable for the application of this construction industry standard. The latest edition of the normative reference (including any amendments) shall apply.

- Uniform Building By-Laws 1984 (Amendment 2007)
- CIDB Act 520 1994 (Amendment 2011)

1.3 Definition

For the purpose of this Construction Industry Standard, the following definitions apply.

1.3.1 Approved standards

Approved standards shall mean standards specified in the CIS 7, unless specified otherwise by the qualified person for the project.

1.3.2 Competent person

A person who possesses a valid certificate from an accredited institution.

1.3.3 Component

General building works are divided into four different components, which are structural works, architectural works, mechanical and electrical (M&E) works and external works.

1.3.4 Elements

A subdivision of a component, for example concrete for structural works, floor finishing for architectural works, drains for external works, performance test for M&E works and others.

1.3.5 QLASSIC

An acronym for quality assessment system in construction.

1.3.6 Qualified Person (QP) or Principal-Submitting Person (PSP)

A QP as defined in the Uniform Building By-Laws 1984 (Amendment 2007). Hereon, wherever QP appears in this document, it also refers to PSP.

1.3.7 Superintendent Officer (SO)

The SO shall be the person appointed to administer the contract during construction.

1.4 Objectives of Quality Assessment System for Building Construction Works

Quality Assessment System for Building Construction Works was designed and developed to enable the user to achieve any of the following objectives:

a) to benchmark the level of quality of the construction industry in Malaysia

b) to have a standard quality assessment system for quality of workmanship of building projects

c) to assess quality of workmanship of a building project based on CIS 7 standard

d) to evaluate the performance of contractors based on quality of workmanship

e) to compile data for statistical analysis

1.5 Use of Quality Assessment System for Building Construction Works

Quality Assessment System for Building Construction Works is intended to complement the normal contractual drawings and specifications in a project. It is not intended to be used independently as working specifications. Unless specified in the building contract, qualified persons should not use Quality Assessment System for Building Construction Works to decide if the building or parts of the building project are in accordance with the relevant by-laws. It is still the responsibility of the qualified person to ensure that the quality of the construction works conforms to approved standards, practices, specifications and drawings, as specified in the contract.

1.6 Scope of Quality Assessment System for Building Construction Works

This standard sets out the quality of workmanship for the various aspects of the construction elements for the general building works. The Quality Assessment System for Building Construction Works covers four main components, which are **structural works, architectural works, M&E works and external works.** Assessments on the workmanship are carried out based on CIS 7 standard and marks are awarded if the workmanship complies with the quality standard. These marks are then summed up to give a total quality score (%) for the building project.

However, the assessment excludes works such as piling, foundation and substructure works, which are heavily equipment-based and called under separate contracts or subcontracts.

The building is assessed primarily on workmanship standards achieved through site inspection and field testing. For structural and M&E works, assessment is carried out throughout the construction process. For completed building projects, the assessment is done for architectural, M&E fittings and external works.

Apart from site inspection on finishing works, the assessment also includes field tests, test results on the materials and the functional performance of selected services and installations. These tests help to ascertain the quality of building workmanship for occupants in relation to safety, comfort and aesthetics, whereby, defects may surface only after sometime.

1.7 Assessment approach

In line with the CIDB Act (Amendment 2011), it is a prerequisite that all projects, which applied for QLASSIC assessment, submit a declaration document by the SO on the compliance to Section 33C of the said act.

In general, the assessor determines the samples (elements or locations) to be assessed prior to each assessment. The samples are selected from floor plans and site plans. The selected samples shall be

distributed as uniformly as possible throughout the project and construction stages. All locations are to be prepared for the assessment.

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 rescored. The objective of this practice is to encourage contractors towards **"doing things right the first time and every time"**.

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

SECTION 2: QUALITY STANDARD

2.1 Components to be assessed

The quality standards for building construction work are divided into four main components:-

a) Structural works

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

i) Site inspection of reinforced concrete, structural steel and prestressed concrete structures during construction

ii) Test results of compressive strength of concrete and tensile strength of steel reinforcement

iii) Non-destructive testing of the uniformity and cover of hardened concrete

The quality standards for structural works are given in Annex A.

b) Architectural works

Architectural works deal mainly with finishes. This is when the quality and standard of workmanship are most visible.

Architectural works encompass floors, internal walls, ceilings, doors, windows, fixtures, external walls, aprons, perimeter drains, structure car parks and car porches.

The quality standards for architectural works are given in Annex B.

c) M&E works

The quality of M&E works is important in view of its increasingly high-cost proportion and its impact on the performance of a building. The assessment covers electrical works, air-conditioning and mechanical ventilation works (ACMV), fire protection works, sanitary and plumbing works, and basic M&E fittings.

The quality standards for M&E works are given in Annex C.

d) External works

External works cover the general external work elements in building construction such as the link-way/ shelter, external drain, roadwork, car park on the ground, footpath, turfing, playground, court, gate, fence, swimming pool, electrical substation, guard house and bin centre.

The quality standards for external works are given in Annex D.

SECTION 3: ASSESSMENT

The assessment for building construction work is carried out through a sampling and statistical approach.

3.1 Weightage

The weightage for structural, architectural, M&E and external works are allocated in accordance to four categories of buildings (see Table 1).

Table 1. Allocation of weightage for components of building construction works according to building category

Component	Residential Building		Non-Residential Building	
	Category A Landed housing (%)	**Category B** Stratified housing (%)	**Category C** Public/ Commercial/ Industrial building (%)	**Category D** Public/ Commercial/ Industrial building (%)
Structural works	15	20	20	20
Architectural works	70	60	55	50
M&E works	5	10	15	20
External works	10	10	10	10
Total score	**100**	**100**	**100**	**100**

Note:
Category C is without centralised cooling system, Category D is with centralised cooling system.

The weightage system is aimed at making the score quantitative and represent the quality of workmanship of a building project. It has taken into consideration the distribution between the cost proportions of the four components in the various buildings and their aesthetic considerations.

The total quality score of a building project is the sum of marks awarded to the four components in each category of a building.

Each category of a building comprises as following:

i) **Category A** (Landed housing) – Detached, semi-detached, terrace and cluster houses

ii) **Category B** (Stratified housing) – Flats, apartments, condominiums, service apartments, small office home office (SOHO) and town houses

iii) **Category C** (Public/commercial/industrial buildings without centralised cooling system) – Office buildings, schools, factories, warehouses, workshops, hangers, small office flexible office (SOFO), small office virtual office (SOVO), religious buildings, stadiums, community halls, hospitals, airports, universities, colleges, police stations, etc

iv) **Category D** (Public/commercial/industrial buildings with centralised cooling system) – Office buildings, schools, factories, warehouses, workshops, hangers, small office flexible office (SOFO), small office virtual office (SOVO), religious buildings, stadiums, community halls, hospitals, airports, universities, colleges, police stations, etc

3.2 QLASSIC assessors

The QLASSIC assessors are accredited and regulated by CIDB. They are updated with the latest relevant information on a regular basis to ensure consistency and effective implementation of the assessment.

3.3 Sampling

As it is impractical to assess all elements in a building project, the assessment is carried out through a sampling approach. The sampling, which is based on the gross floor area (GFA) for the building and 10 m length section or per location for the external works, is to ensure that the assessment adequately represents the entire building project.

3.4 Structural works assessment

Assessment of structural works is carried out during construction of the building project. The assessment covers performance testing.

Table 2. Weightage for reinforced concrete structure elements

Reinforced Concrete Structure Elements	**Weightage Cast In-situ** (%)	**Weightage Precast** (%)
Formwork	20	0
Rebar	15	5
Finished concrete	25	35
Concrete quality	5	0
Steel reinforcement quality	5	0
Precast specific requirement	-	20
NDT– UPV test for concrete uniformity	15	20
NDT – Electro-covermeter test for concrete cover	15	20
Total	**100**	**100**

Note:
If total precast concrete volume exceeds 20% of total structural concrete volume, assessment will be carried out for precast concrete construction. The marks will be distributed proportionately between cast in-situ assessment and precast concrete assessment based on the respective concrete volume percentage. The qualified person is required to declare the concrete volume for reinforced concrete and precast concrete construction.

For a typical reinforced concrete structure, selection of samples for assessment is based on Table 3. Each sample represents a beam, column, slab or reinforced concrete wall.

Table 3. Sampling guidelines for reinforced concrete structure works

<table>
<tr><th>Item</th><th>Category A
Landed Housing</th><th>Category B
Stratified Housing</th><th>Category C
Public/ Commercial/ Industrial Building</th><th>Category D
Public/ Commercial/ Industrial Building</th><th>Remark</th></tr>
<tr><td>1. Structural elements</td><td colspan="2">GFA/1,500 m^2
(Min 30 samples; max 50 samples)</td><td colspan="2">GFA/500 m^2
(Min 30 samples; max 50 samples)</td><td>-</td></tr>
<tr><td rowspan="2">2. Concrete compressive strength</td><td colspan="4">100% testing</td><td>50% weightage provided for declaration by QP</td></tr>
<tr><td colspan="4">Verification of test records for assessed samples</td><td>50% weightage provided for on-site verification of test records</td></tr>
<tr><td rowspan="2">3. Steel reinforcement tensile strength</td><td colspan="4">Every bar size and welded steel fabric per supplier per project</td><td>50% weightage provided for declaration by QP</td></tr>
<tr><td colspan="4">Verification of mill certificates for assessed samples</td><td>50% weightage provided for on-site verification of test records</td></tr>
<tr><td>4. NDT - UPV test for concrete uniformity</td><td colspan="4">Min 2 sets; max 10 sets</td><td>-</td></tr>
<tr><td>5. NDT - Electro-Covermeter test for concrete cover</td><td colspan="4">Min 2 sets; max 10 sets</td><td>-</td></tr>
<tr><td colspan="6">Note:
1. The computed number of elements to be checked must be evenly distributed throughout the entire block and cover at least 50% of the floors in a block. It should also, as far as possible, cover the different types of structural elements.
2. Concrete compressive and steel reinforcement tensile strength - self testing with declaration by qualified person. On-site verification by assessor.</td></tr>
</table>

The resulting scores for 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 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 the structural works consist of structural steelworks, which constitute more than 20% of the structural cost, assessment will be required for the latter and the marks will be distributed proportionately. This applies to prestressing works as well. In any case, the distribution should follow the cost composition for these three types of structural works in the projects.

The weightage for structural steel works and prestressed concrete are allocated as per Table 4 and Table 5. If the structural steel in all structural works is to be casted, the assessment shall be performed prior to the covered works.

Table 4. Weightage for structural steel elements

Structural steel work	Weightage (%)
Main member/Partially-assembled components	40
Metal decking	20
Erection tolerance	10
Corrosion and fire protection	10
Welding test report	20
Total	**100**

Note:
Assessment for structural steel roof truss is compulsory, regardless of the 20% costing criteria.

Table 5. Weightage for prestressed concrete elements

Prestressed concrete work	Weightage (%)
Tendon and anchorage	25
Sheathing	25
Stressing and grouting	25
Debonding	25
Total	**100**

The selection of sample for structural steel works assessment is based on the following guidelines:

Table 6. Sampling guidelines for structural steel works

Item	Steel tonnage per sample	Min sample
Structural elements • Main member/partially-assembled components	250	5
• Metal decking	250	5
• Erection tolerances	500	5
• Corrosion and fire protection	500	5
Material and functional test • Welding test report	All critical welding joints	All critical welding joints
Note: Samples will be taken before and after installation. All critical welding joints need to be determined by a structural engineer.		

3.5 Architectural works assessment

Assessment of architectural works is carried out upon completion of the building project and before the handover of the project.

The weightage for architectural elements are allocated as per Table 7.

Table 7. Weightage for architectural elements

Architectural elements		Weightage (%)	
		Breakdown	Total
Internal finishes			68
	Floor	18	
	Internal wall	18	
	Ceiling	8	
	Door	8	
	Window	8	
	Fixtures	8	
External finishes			26
	Roof	10	
	External wall	10	
	Apron and perimeter drain	3	
	Car park/Car porch	3	
Material and functional tests			6
	Skim coat or prepacked plaster	3	
	Wet area water-tightness test - QP declaration and report	3	
Total		**100**	
Note: A weightage of 3% is automatically awarded to projects, where skim coat or prepacked plaster is used. This is to encourage the use of these products in the industry			

The assessment is based on the sampling guidelines, as outlined in Table 8.

Table 8. Sampling guidelines for architectural works

No.	Item	GFA per	Min sample	Max sample	Remark
1a	Internal finishes	70 m^2	30	700	Category A
1b	Internal finishes	70 m^2	30	600	Category B
1c	Internal finishes	500 m^2	30	150	Category C
1d	Internal finishes	500 m^2	30	100	Category D
2	Roof	-	50%	-	50% of the blocks/units
3	External walls	-	50%	-	50% of the blocks/units
4	Apron and perimeter drain	-	2	-	10 m length section per sample
5	Car park/Car porch	-	2	-	10 m length section per car park floor
6	Skim coat or prepacked plaster	-	-	-	Declaration by QP
7	Wet area water-tightness test	-	-	-	Declaration by QP

Note:
1. GFA means Gross Floor Area.
2. This sampling guideline is not applicable to mock-up unit/sample unit. It requires a full assessment to be carried out.

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

- Principal locations are major functional places such as halls and rooms

- Circulation locations are passages and areas of human traffic such as lift lobbies, corridors and staircases

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

The total number of locations will be distributed according to “Principal”, “Circulation” and “Service” based on the percentage set out in the four categories of buildings in Table 9.

Scoring of internal finishes is based on the defects groups shown in Annex E ‘Defects Group for Assessment of Architectural Works (Internal Finishes)’. In general, any item which is not available in a project will not be considered for scoring. For such cases, the architectural score will be prorated accordingly.

Table 9. Weightage for location of architectural works according to building category

Locations	**Category A** Landed Housing (%)	**Category B** Stratified Housing (%)	**Category C** Public/ Commercial/ Industrial building (%)	**Category D** Public/ Commercial/ Industrial building (%)
Principal	40	40	60	60
Service	40	40	15	15
Circulation	20	20	25	25

Note:
For other types of building, the distribution of percentage shall be in accordance to Category C.

An item under assessment will be considered to have 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 (for instance, excessive cracks on a wall).

For the assessment of external wall, a minimum 50% of the total number of building will be assessed. For a building, the external wall will be divided into four walls for assessment.

The use of skim coat or prepacked plaster for all plastering works and wet area water tightness test (WTT) are based on the declaration by the project QP. Further site evidences of WTT need to be provided.

3.6 M&E works assessment

Assessment of M&E works is carried out during construction and upon completion of the building project and before the handover of the project. The assessment covers basic M&E fittings and performance tests.

The assessment covers the following area, with their weightages allocated in accordance with the four categories of projects (see Table 10).

Table 10. Weightage for M&E elements according to building category

M&E element	**Category A** Landed Housing	**Category B** Stratified Housing	**Category C** Public/ Commercial/ Industrial Building	**Category D** Public/ Commercial/ Industrial Building
M&E Works Assessment (%)				
Electrical works	15	15	20	20
ACMV works	10	10	20	25
Fire protection works	NA	10	10	10
Plumbing & sanitary works	25	25	25	20
Basic M&E fittings	50	40	25	25
Subtotal	**100**	**100**	**100**	**100**
Weightage A	60	60	50	50
M&E Works Performance Test Assessment (%)				
Verification records	50	50	50	50
Functional/ performance test	50	50	50	50
Subtotal	**100**	**100**	**100**	**100**
Weightage B	40	40	50	50
Total (Weightage A+B)	**100**	**100**	**100**	**100**

Note:
1. "NA" means that no assessment on M&E element is required.
2. Performance tests will be done for electric power supply, water supply and sanitary flushing system.
3. The sampling for basic M&E fittings will be based on internal finishes guideline for architectural works. Refer to Table 8 and Table 9.

Just as architectural works, sampling for M&E works in progress will be determined based on the four categories of building as per the guidelines in Table 11.

Table 11. Sampling guidelines for M&E works

Item	**Category A** Landed Housing (GFA/3,500 m^2)	**Category B** Stratified Housing (GFA/3,500 m^2)	**Category C** Public/ Commercial/ Industrial Building (GFA/1,000 m^2)	**Category D** Public/ Commercial/ Industrial Building (GFA/1,000 m^2)
Electrical				
1. Main cables			1	1
2. Surface conduits	1+	1+	1+	1+
3. Concealed conduit system	1+	1+	1+	1+
4. Cable tray, ladder and trunking		1+	1+	1+
5. Distribution board	2+	2+	2+	2+
6. Wiring system	1+	1+	1+	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	3+	3+	2+	2+
7. Air conditioner comfort	2+	2+	1+	1+
8. Ductwork			3+	3+
9. Fire-rated duct			1	1
10. Dampers			1+	1+
11. Fire dampers			1	1
Fire protection				
1. Wet/Dry riser		1+	1+	1+
2. Sprinkler			1+	1+
3. Fire alarm			1	1
4. Hose reel		1+	1+	1+
Plumbing and sanitary				
1. Concealed pipes	2+	3+	1	1+
2. Exposed pipes	2+	4+	4+	4+
3. Water tank	1	1	1	1
4. Pump and motor		1	1+	1+
Minimum Sample	15	22	27	32
Maximum Sample	22	35	40	47

Note:
1. Remarks: "+" means to be repeated for additional samples required.

3.7 External works assessment

Assessment of external works is carried out upon completion of the building and before the handover of the project.

The assessment consists of the following locations:

a)	Link-ways/shelters	- 10 m length section per sample and minimum 2 samples
b)	External drains	- 10 m length section per sample and minimum 2 samples
c)	Roadwork and parking bay on the ground	- 10 m length section per sample and minimum 2 samples
d)	Footpaths and turfing	- 10 m length section per sample and minimum 2 samples
e)	Playground	- 1 location
f)	Court	- 1 location
g)	Fence and gate	- 10 m length section per sample and minimum 1 sample
h)	Swimming pool	- 10 m length section per sample and minimum 1 sample
j)	Electrical substation	- 1 location
k)	Guard house	- 1 location
l)	Bin centre	- 1 location

Each item in the external works will be assessed separately and all the listed locations must be assessed, where applicable. The total QLASSIC score for external works shall be the marks achieved divided by the total achievable marks.

ANNEX A
(Informative)

QUALITY STANDARDS FOR STRUCTURAL WORKS

PART 1: REINFORCED CONCRETE STRUCTURES

Item	Element	Standard	Tolerance	Assessment Method
I.		**FORMWORK**		
1.	**Formwork dimensions and openings for services**	i. Tolerance for cross-sectional dimensions of cast in-situ and precast elements	+ 10 mm/ - 5 mm	Steel measuring tape
		ii. Tolerance for penetration/ opening for services	+ 10 mm for size and ± 25 mm for location	Steel measuring tape
		iii Tolerances for length of precast members (major dimensions of unit)		Steel measuring tape
		• Up to 3 m	± 6 mm	
		• 3 m to 4.5 m	± 9 mm	
		• 4.5 m to 6 m	± 12 mm	
		• Additional deviation for every subsequent 6 m	± 6 mm	
2.	**Alignment, plumb and level**	i. Tolerance for departure of any mark from its position	± 10 mm	Steel measuring tape
		ii. Tolerance for plumb	≤ 3 mm per 1 m, maximum 20 mm	Steel measuring tape and plumb bob
		iii. Maximum deviation of mean level of staircase tread to temporary bench mark	± 5 mm	Steel measuring tape
		iv. For cast in-situ elements, the deviation of level of any mark from the intended level	± 10 mm	Precise levels

QUALITY STANDARDS FOR STRUCTURAL WORKS (Continued)

PART 1: REINFORCED CONCRETE STRUCTURES

Item	Element	Standard	Tolerance	Assessment Method
3.	**Condition of formwork, props and bracing**	i. Formwork must be free from defects		Visual
		ii. Before concreting, the interior must be free from debris		Visual
		iii. All formwork joints must not have gaps to prevent leakage		Visual
		iv. There must be adequate support, bracing and tie-back for the formwork to prevent bulging or displacement of structural elements		Visual
II.	**REINFORCEMENT (CAST IN-SITU AND PRECAST)**			
1.	**Main and secondary rebars**	i. According to structural drawings (numbers/sizes)		Visual and caliper
		ii. Spacing of bars not more than specified		Steel measuring tape
2.	**Anchorages and lap lengths**	Required lap length and not less than specified		Steel measuring tape
3.	**Cover provision**	According to specifications	+ 5 mm	Steel measuring tape
4.	**Links, stirrups and trimming bars**	i. According to structural drawings (numbers/sizes)		Visual and caliper
		ii. Spacing of links not more than specified		Steel measuring tape
5.	**Rebar condition**	i. Rebars must be securely and properly tied in place		Visual
		ii. Rebars must be free from concrete dropping, corrosion, etc		Visual

QUALITY STANDARDS FOR STRUCTURAL WORKS (Continued)

PART 1: REINFORCED CONCRETE STRUCTURES

Item	Element	Standard	Tolerance	Assessment Method
III.	**FINISHED CONCRETE (CAST IN-SITU & PRECAST)**			
1.	**Dimension for elements/opening for services**	i. Tolerance for cross-sectional dimension of cast in-situ and precast elements	+ 10 mm/ - 5 mm	Steel measuring tape
		ii. Tolerance for opening	+ 10 mm for size and ± 25 mm for location	Steel measuring tape
		iii. Tolerance for length of precast members (major dimension of unit):		Steel measuring tape
		• Up to 3 m	± 6 mm	
		• 3 m to 4.5 m	± 9 mm	
		• 4.5 m to 6 m	± 12 mm	
		• Additional deviation for every subsequent 6 m	± 6 mm	
		iv. Straightness or bow (deviation from intended line) of precast member:		Steel measuring tape, spirit level and L-square
		• Up to 3 m	± 6 mm	
		• 3 m to 6 m	± 9 mm	
		• 4.5 m to 6 m	± 12 mm	
		• Additional deviation for every subsequent 6 m	± 6 mm	

QUALITY STANDARDS FOR STRUCTURAL WORKS (Continued)

PART 1: REINFORCED CONCRETE STRUCTURES

Item	Element	Standard	Tolerance	Assessment Method
		v. Squareness of precast member - difference between the greatest and shortest dimensions should not exceed the following: Length of shorter sides		
		• Up to and including 1.2 m	± 6 mm	Steel measuring tape
		• Over 1.2 m but less than 1.8 m	± 9 mm	
		• 1.8 m and over	± 12 mm	
		vi. Twist of precast member-corners should not be more than the deviation stated from the plane containing the other 3 corners:		
		• Up to 600 mm wide and 6 m in length	± 6 mm	Steel wedge, L-square and spirit level
		• Over 600 mm wide and for any length	± 12 mm	
		vii. Flatness	≤ 6 mm per 1.2 m	Steel wedge and spirit level
2.	**Alignment, plumb and level**	i. Tolerance for departure of any mark from its position	± 10 mm	Steel measuring tape
		ii. Tolerance for plumb: maximum 20 mm for floor to floor height and 40 mm for the entire building height	3 mm/1 m	Plumb bob and steel measuring tape
		iii. Maximum deviation of mean level	± 10 mm	Precise levels
		iv. For cast in-situ elements, the maximum deviation of levels within the elements	± 10 mm	Steel measuring tape
		iv. Chamber at mid-span: according to specifications		Steel measuring tape and L-square

QUALITY STANDARDS FOR STRUCTURAL WORKS (Continued)

PART 1: REINFORCED CONCRETE STRUCTURES

Item	Element	Standard	Tolerance	Assessment Method
3.	**Exposed surface**	i. Should not have visual exposure of groups of coarse aggregates resulting from grout leakage		Visual
		ii. Cold joints and formwork joints must be smooth		Visual
		iii. No bulging of structural element		Visual
		iv. All formwork, nails, zinc strips, etc, must be removed		Visual
		v. No cracks or damages		Visual
		vi. No exposed rebar		Visual
IV.		**PRECAST SPECIFIC REQUIREMENTS**		
1.	**Lifting points/ inserts**	i. Tolerance for position	± 20 mm from centre line location in drawing	Steel measuring tape
		ii. Lifting devices and inserts free from damages		Visual
2.	**Sleeve system/ connections**	i. Tolerance for position	± 6 mm from centre line location in drawings	Steel measuring tape
		ii. Bar protrusion length according to requirements. No bending, cranking or damages to bars		Visual
		iii. Bars free from concrete droppings or corrosion		Visual
		iv. Sleeves, grout holes, grout tubes not congested with debris		Visual
3.	**Interface/joint requirement**	i. Joint taper: • Over 3 m length	± 6 mm	Steel measuring tape
		• Maximum for entire length	± 9 mm	
		ii. Alignment of horizontal and vertical joint	± 6 mm	Steel measuring tape
		iii. Jog in alignment of matching edges	± 6 mm	Steel measuring tape

QUALITY STANDARDS FOR STRUCTURAL WORKS (Continued)

PART 1: REINFORCED CONCRETE STRUCTURES

Item	Element	Standard	Tolerance	Assessment Method
		iv. Sitting of element	According to specifications	Visual
		v. Installation of sealant and waterproofing	According to specifications	Visual
4.	**Cast-in steel items/welded and bolted connection**	i. Tolerance for position of cast-in steel items	± 6 mm from centre line location in drawings	Steel measuring tape
		ii. Tolerance for position of openings for bolt connections	± 3 mm from centre line location in drawings	Steel measuring tape
V.	**STRUCTURE – CONCRETE QUALITY**			
1.	**Concrete Cube Test**	i. For every pour of concrete, test cubes results at 28 days must satisfy the passing criteria as specified in the design specification. The summary of test records must be endorsed by the QP All testing shall be carried out at QP-approved accredited laboratory		Test records
VI.	**STRUCTURE – STEEL REINFORCEMENT QUALITY**			
1.	**Reinforcement (Rebar)**	i. To pass the tensile strength test for all the reinforcement bars used as according to the contract specifications. The summary of test records must be endorsed by the QP		Test records
		ii. All welded steel fabric used are to comply with the design specifications. The summary of test records must be endorsed by the QP		Test records
		iii. No non-conforming reinforcement detected through test records has been installed in the structure All testing shall be carried out at QP-approved accredited laboratory		Test records

QUALITY STANDARDS FOR STRUCTURAL WORKS (Continued)

PART 1: REINFORCED CONCRETE STRUCTURES

Item	Element	Standard	Tolerance	Assessment Method
VII.		**NON-DESTRUCTIVE TESTING (NDT)**		
1.	**Ultrasonic pulse velocity (UPV) test for concrete uniformity**	i. To conduct non-destructive testing (NDT) using UPV to check the degree of uniformity of hardened concrete		UPV meter
		ii. 5 columns/walls per set and 2 readings per column/wall		
		iii. Assessment is based on the difference between 2 UPV readings within a column/wall not exceeding 0.05 km/s		
		iv. Method as per approved standard		
2.	**Electro-covermeter test for concrete cover**	i. To check hardened concrete cover for reinforcement bars after casting	Minimum cover according to specification	Covermeter
		ii. 5 structural members 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		
		iii. For each reading, full marks for ± 5 mm and half marks for >± 5 mm to ± 8 mm. For each location, no mark will be awarded if any of the 4 readings exceeds ± 12 mm		
		iv. Method as per approved standard		

QUALITY STANDARDS FOR STRUCTURAL WORKS (Continued)

PART 2: STRUCTURAL STEEL WORKS

Item	Element	Standard	Tolerance	Assessment Method
I.	**MAIN MEMBER/PARTIAL-ASSEMBLED COMPONENT**			
1.	**Physical dimensions**	i. Cross sectional tolerance should meet approved structural steel specification or approved plan		Steel measuring tape
		ii. Tolerance for length of structural steel member	± 3 mm	Steel measuring tape
		iii. Tolerance for bolt hole size:- • Diameter < 24 mm • Diameter ≥ 24 mm	 ≤ 2 mm ≤ 3 mm	Caliper
		iv. Tolerance for bolt hole position	± 2 mm	Steel measuring tape
2.	**Type and condition**	i. According to the structural steel specifications		Visual
		ii. Surface preparation shall meet the surface roughness specifications		Visual
		iii. Material used must be traceable to its original mill certificates		Visual and test records
3.	**Welding**	i. Welding size, length and profile shall meet the structural steel specification and drawings		Steel measuring tape and visual
		ii. Visual inspection shall meet the structural steel specifications		Visual
		iii. All welding works shall be carried out by qualified welders		Competent welder's certificate

QUALITY STANDARDS FOR STRUCTURAL WORKS (Continued)

PART 2: STRUCTURAL STEEL WORKS

Item	Element	Standard	Tolerance	Assessment Method
4.	**Bolting**	i. Bolts and washers, type, size and number shall be according to the structural steel specifications		Visual
		ii. Drilled holes shall be free from burrs		Visual
		iii. 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		Visual
		iv. Gap between adjacent parts	< 2 mm	Steel measuring tape
		v. Threaded bolts protruding at least one thread length with washers		Visual
II.		**METAL DECKING**		
1.	**Type and condition**	i. Correct type and thickness of metal decking used		Visual
		ii. All decking joints must not have gaps		Visual
		iii. All metal decking must be properly secured in place		Physical and visual
		iv. Metal decking must be free from defect and visible damages		Visual
		v. Before concreting, the decking must be free from grease, oil, paint and all other foreign materials		Visual
		vi. All accessories such as pour stop, and end closures and cover plates must be in place before concreting		Visual
2.	**Shear studs**	i. Correct numbers and type of shear studs used		Visual
		ii. Spacing and position according to approved plan		Steel measuring tape
		iii. Strength of shear stud welds not less than specified		Test records

QUALITY STANDARDS FOR STRUCTURAL WORKS (Continued)

PART 2: STRUCTURAL STEEL WORKS

Item	Element	Standard	Tolerance	Assessment Method
		iv. All welds should show a full 360° weld fillet. All welds are free from visible damages		Visual
3.	**Lapping and deck openings**	i. According to structural steel specifications or approved plan		Steel measuring tape
III.		**ERECTION TOLERANCE**		
1.	**Column verticality**	i. Tolerance for verticality (± H/600 mm or 5 mm, maximum ± 25 mm; where H is the floor to floor height in mm)		Plumb bob and steel measuring tape
2.	**Column position**	i. The position in plan of steel column at the base shall not deviate from the specified position by more than 10 mm along either of the principal setting out axes		Steel measuring tape
3.	**Beam level**	i. Maximum deviation of level at each end of the same beam	± 5 mm	Steel measuring tape
		ii. The level of the top of the steelwork at any storey shall be within ± 10 mm of the specified level		Precise levels
4.	**Beam position**	i. Beams shall not deviate from their specified positions relative to the column to which they are connected by more than 5 mm		Steel measuring tape
IV.		**CORROSION AND FIRE PROTECTION**		
1.	**Thickness of coating**	i. Average thickness of the coating or the protective layer must not be less than specified		Steel measuring tape
2.	**Condition**	i. No visible damages		Visual
		ii. No spalling of coating or protective layer from structural steel members		Visual
3.	**Welding test report**	i. Reports for all critical welding joints from the specified contract requirements shall be submitted to the QP		Test records
		ii. Test records shall comply with the acceptable criteria and to be endorsed by the QP		Test records

QUALITY STANDARDS FOR STRUCTURAL WORKS (Concluded)

PART 3: PRESTRESSED CONCRETE

Item	Element	Standard	Tolerance	Assessment Method
1.	**Condition of tendons and anchorages**	i. All prestressing strands and wires should comply with the specified standards and requirements and be free from loose rust, oil, tar, paint and any foreign objects		Visual and steel measuring tape
		ii. 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		Visual
2.	**Installation of sheathing**	i. Sheathing properly secured and protected and free from damage or puncture		Visual
		ii. Sheathing profile according to drawings throughout the length with position tolerance	± 5 mm	Steel measuring tape
		iii. Splice to sheathing shall be mortar tight		Visual
		iv. Air vents grout tubes provided according to the drawing		Visual
3.	**Stressing and grouting process**	i. Tendon ducts clean and free from foreign objects and tendon free moving in the duct		Visual
		ii. All grouting operations of the tendons must be smooth and achieved without need to flush out in the first grouting		Visual
4.	**Debonding**	i. Open ends of debond tubes over the debond length of strands sealed		Visual
		ii. Debond lengths according to the drawings		Steel measuring tape
		iii. Debonding materials not punctured or damaged		Visual

ANNEX B
(Informative)

QUALITY STANDARDS FOR ARCHITECTURAL WORKS

PART 1: INTERNAL FINISHES

Item	Element	Standard	Tolerance	Assessment Method
I.		**FLOOR**		
1.	**General requirements**	i. Finishing • No stain marks		Visual
		• Consistent colour tone		Visual
		ii. Alignment and Evenness • Evenness of surface	≤ 3 mm per 1.2 m	Spirit level 1.2 m and steel wedge
		• Falls in wet areas should be in right direction		Spirit level 1.2 m
		• For staircases, the variance in lengths of treads and risers must not exceed 5 mm from dimensions specified in the approved drawings		Spirit level 1.2 m and steel wedge
		iii. Cracks and Damages • No visible damages/defects		Visual
		iv. Hollowness/Delamination • No hollow sound when tapped		Tapping rod
		• No sign of delamination		Physical
		v. Jointing • Consistent skirting thickness and no visible gaps between wall and skirting		Visual
		• Edge to be straight and aligned		Visual
2.	**Screed finishes**	• Surface should not be unduly rough or patchy		Visual
		• No permanent foreign material visually detected		Visual

PART 1: INTERNAL FINISHES

Item	Element	Standard	Tolerance	Assessment Method
3.	**Tiled floor**	• Joints are aligned with skirting tiles or wall tiles		Visual
		• Joints are aligned between tiles and consistent in size		Visual
		• Consistent and neat marking		Visual
		• Lippage between two tiles	≤ 1 mm	Tapping rod or L-square (200 mm x 300 mm) and steel wedge
4.	**Timber floor**	• No warpage		Visual
		• Timber strips to rest firmly on joists or screeds		Visual
		• No visible gaps between timber strips		Visual
		• Edges of the floor are properly sealed		Visual
5.	**Carpet**	• Surface should be stretched firm and even		Visual
		• Joints should not be visible		Visual
		• All edges should be properly anchored		Visual
6.	**Special floor finish**	• Finished texture and colour to be uniformed		Visual
		• Follow general requirement, where applicable		Visual
7.	**Raised floor**	• No loose floor panels or rocking		Visual
		• No protrusion/potential of tripping over floor panels		Visual

QUALITY STANDARDS FOR ARCHITECTURAL WORKS (Continued)

PART 1: INTERNAL FINISHES

Item	Element	Standard	Tolerance	Assessment Method
II.		**INTERNAL WALL**		
1.	**General requirements**	i. Finishing • No stain marks		Visual
		• Consistent colour tone and good paintwork		Visual
		• No rough/patchy surface		Visual
		ii. Alignment and Evenness • Evenness of surface	≤ 3 mm per 1.2 m	Spirit level 1.2 m and steel wedge
		• Verticality of wall		Visual
		• Walls meet at right angle	≤ 4 mm over 300 mm	L-square (200 mm x 300 mm) and steel wedge
		iii. Cracks and Damages • No visible damages/defects		Visual
		iv. Hollowness/Delamination • No hollow sound when tapped		Tapping rod
		• No sign of delamination		Physical
		v. Jointing • Edges to be straight, aligned and consistent		Visual
2.	**Plaster finishes**	• No visual cracks		Visual
3.	**Tiled finishes**	• Joints are aligned between tiles and consistent size		Visual
		• Consistent and neat marking		Visual
		• Lippage between two tiles	≤ 1 mm	Tapping rod or L-square (200 mm x 300 mm) and steel wedge

QUALITY STANDARDS FOR ARCHITECTURAL WORKS (Continued)

PART 1: INTERNAL FINISHES

Item	Element	Standard	Tolerance	Assessment Method
4.	**Painting**	• Surfaces are evenly painted		Visual
		• Good opacity, no patchiness resulted from touch-up work		Visual
		• Surface should be free from peeling, blister, chalkiness (no discolouration and fading)		Visual and physical
		• No brush marks to be seen		Visual
5.	**Wall paper**	• Wall paper should be stretched and even surface		Visual
		• Joints should not be visible		Visual
		• Edges should be neatly laid and finished		Visual
		• Proper anchoring at all edges		Visual
6.	**Wood/timber panels**	• Timber panels should rest firmly on joists or screed		Visual and physical
		• No gaps can be detected between panels		Visual
		• Edges should be properly aligned and sealed		Visual
		• Surface should be smoothly finished		Visual
		• Cracks and warpage should not be detected		Visual
7.	**Cladding**	• Proper anchorage for panels		Visual
		• Joints aligned and with consistent joint size		Visual
		• Sealant material compatible with cladding		Visual
		• Consistent spacing and within allowable tolerance		Visual
		• No sign of corrosion		Visual
8.	**Glass blocks/ glass panels**	• Consistent and neat marking		Visual
		• Joints should be even		Visual
		• Glass blocks/panels should be properly aligned		Visual
9.	**Architectural coating**	• Finished texture and colour to be uniformed		Visual

PART 1: INTERNAL FINISHES

Item	Element	Standard	Tolerance	Assessment Method
III.		**CEILING**		
1.	**General requirements**	i. Finishing • No stain marks		Visual
		• Consistent colour tone		Visual
		• Paintwork with good opacity and with no brush marks		Visual
		ii. Alignment and Evenness • Surface should be smooth, even, not wavy and not sagging		Visual
		• Straight and aligned ceiling edges		Visual
		iii. Cracks and Damages • No visible damages, e.g., spalling, leaks, cracks, etc		Visual
		iv. Roughness/Patchiness • No rough or patchy surfaces		Visual
		v. Jointing • Consistent, aligned and neat		Visual
2.	**Plaster/skim coat ceiling**	• No pin holes and with no trowel marks		Visual
		• Formwork joints are grounded smooth		Visual
		• No gap between wall and ceiling		Visual
3.	**False ceiling/grid system**	• Alignment of rails should be visually straight		Visual
		• Chipped/cracked surfaces or corners should not be detected		Visual
		• Gap between ceiling and wall should not be detected		Visual
		• Panels should not warp and laid neatly into grids		Visual
		• No sign of corrosion		Visual
		• Access opening joints should be neat and have consistent width		Visual

PART 1: INTERNAL FINISHES

Item	Element	Standard	Tolerance	Assessment Method
IV.		**DOOR**		
1.	**General requirements**	i. Joints and Gaps • Consistent gap between bottom of door leaf and finished floor	≤ 5 mm	Steel wedge
		• No visible gaps between door frame and wall		Visual
		• Neat joints		Visual
		• Consistent gap between door leaf and frame	≤ 5 mm	Steel gauge
		• Consistent and no visible gaps for joints at door leaf and frame		Visual
		ii. Alignment and Evenness • Aligned and level with walls		Visual
		• Double leaf doors to flush with each other		Visual
		• Door frame and leaf to flush		Visual
		• Door leaf and frame corners maintained at right angles		L-square (200 mm x 300 mm)
		• No rattling sound when the door is closed		Physical and auditory (hearing)
		iii. Materials and Damages • No stain marks and any visible damages		Visual
		• No sags, warps on door leaf		Visual
		• Door joints and nail holes filled up, properly sanded with good paintwork		Visual
		• Glazing clean and evenly sealed with gasket		Visual
		• No sign of corrosion		Visual
		• Good paintwork (including top and bottom of door leaf)		Angle mirror
		• Consistent colour tone		Visual
		iv. Functionality • Ease in opening, closing and locking		Physical
		• No squeaky sound during opening and closing of the door	Tested minimum one time	Physical and auditory (hearing)
		• Lockset should be functional	Tested minimum one time	Physical

QUALITY STANDARDS FOR ARCHITECTURAL WORKS (Continued)

PART 1: INTERNAL FINISHES

Item	Element	Standard	Tolerance	Assessment Method
		v. Accessories Defects • Accessories with good fit and no stains		Visual
		• No sign of corrosion		Visual
		• No missing or defective accessories		Visual
		• Screws levelled and flushed. No over-tightened screws		Visual
		• For timber frame, no additional timber strip added for site adjustment should be detected		Visual
V.		**WINDOW**		
	General requirements	i. Joints and Gaps • Consistent gap between window leaf and frame (for timber window only)		Visual
		• No visible gaps between window frame and wall		Visual
		• Neat joints between window frame and wall, internally and externally		Visual
		• Consistent and no visible gaps for joints at window leaf and at frame		Visual
		ii. Alignment and Evenness • Alignment/level with wall openings		Visual
		• Window leaf and frame corner maintained at right angle		Visual
		iii. Materials and Damages • No stain marks and visible damages/ defects		Visual
		• Louvered window with glass panels of correct length.		Visual
		• Glazing clean and evenly sealed with putty or gasket for aluminium windows		Visual
		• No sign of corrosion		Visual
		• Good paintwork		Visual

PART 1: INTERNAL FINISHES

Item	Element	Standard	Tolerance	Assessment Method
		iv. Functionality • Ease of opening, closing and locking		Physical
		• No squeaky sound during opening and closing of the window	Tested minimum one time	Physical and auditory (hearing)
		• No sign of rainwater leakage		Visual
		v. Accessories Defects • Lock sets with good fit and aligned		Visual
		• No sign of corrosion		Visual
		• No missing or defective accessories		Visual
		• Screws levelled and flushed. No over-tightened screws		Visual
VI.		**FIXTURES**		
1.	**General requirements**	• Fixtures such as wardrobe, kitchen cabinet, vanity top, mirror, bathtub, water closet, shower screen, sink, basin, signage, railing, unit number plate, grill door, etc		
		i. Joints and Gaps • Consistent joint width and neat		Visual
		• No visible gaps		Visual
		• Welding joints grounded or flushed		Visual
		ii. Alignment and Evenness • Level and in alignment		Visual
		iii. Materials and Damages • No stain marks		Visual
		• No visible damages/defects		Visual
		• Consistent in colour tone		Visual
		iv. Functionality • Functional, secured and safe		Visual and physical
		v. Accessories Defects • No missing accessories		Visual
		• No sign of corrosion		Visual
		• No damages/defects		Visual

QUALITY STANDARDS FOR ARCHITECTURAL WORKS (Continued)

PART 2: EXTERNAL FINISHES

Item	Element	Standard	Tolerance	Assessment Method
I.		**ROOF**		
1.	**General requirements**	i. Finishing • No stain marks		Visual
		• Good paint work		Visual
		ii. Rough/Uneven/Falls • Smooth and with no tool marks		Visual
		• Even and level, especially with no potential of stripping		Visual
		• Falls in right direction		Visual
		iii. Cracks and Damages • No visible damages/defects, e.g., cracks, chippings, etc		Visual
		iv. Joint/Sealant/Alignment • Consistent joint width, neat and aligned		Visual
		v. Chockage/Ponding • No sign of chockage and ponding		Visual
		vi. Construction • No sign of leaking		Visual
		• Proper dressing for any protrusion		Visual
		• Neat and secured installation of fixtures		Visual
2.	**Flat roof**	• Water ponding	< 3 mm	Visual and measuring tape
		• Surface to level to avoid tripping		Visual
		• Openings to be sealed to prevent pest invasion		Visual

QUALITY STANDARDS FOR ARCHITECTURAL WORKS (Continued)

PART 2: EXTERNAL FINISHES

Item	Element	Standard	Tolerance	Assessment Method
3.	**Pitched roof**	• No rust or stains		Visual
		• Good painting to roof structural members		Visual
		• Roof tiles in alignment		Visual
		• Openings to be sealed to prevent pest invasion		Visual
		• Consistent colour tone		Visual
4.	**Waterproofing (exposed)**	• Evenly installed, no sharp protrusion		Visual
		• Complete adhesion to base		Visual
		• Good laps at joints and proper vertical abutment details		Visual
		• No signs of damage to membrane/ coating		Visual
		• No paint defects		Visual
5.	**Gutters and rain water down pipes (RWDP)**	• No ponding and chockage		Visual
		• No cracks, chips and any other visible damages/defects		Visual
		• RWDP inlet to be lower than the surrounding gutter invert level		Visual
		• Gutter and RWDP inlet to be covered to prevent chockage, where practical		Visual

QUALITY STANDARDS FOR ARCHITECTURAL WORKS (Continued)

PART 2: EXTERNAL FINISHES

Item	Element	Standard	Tolerance	Assessment Method
II.		**EXTERNAL WALL**		
1.	**General requirements**	i. Finishing • No stain marks		Visual
		• Consistent colour tone and good paintwork		Visual
		• No rough/patchy surface		Visual
		ii. Alignment and Evenness • Walls should be aligned and not wavy		Visual
		• Edges to be straight and aligned		Visual
		iii. Cracks and Damages • No visible damages/defects		Visual
		iv. Jointing • Consistent and neat marking		Visual
2.	**Plaster finishes**	• As per General requirements above		
3.	**Tiled finishes**	• Joints are aligned between tiles, and consistent in size		Visual
		• Consistent and neat marking		Visual
		• No lippage between tiles		Visual
4.	**Cladding/curtain walls**	• Gaps around openings to be properly sealed		Visual
		• Joint of regular widths as specified		Visual
		• Evenness of surface, no dent or scratches		Visual
		• Sealant material compatible with cladding		Visual
		• No sign of corrosion		Visual
5.	**Facing brickwork**	• Weep holes are provided as specified		Visual
		• No efflorescence		Visual
		• No mortar droppings		Visual

QUALITY STANDARDS FOR ARCHITECTURAL WORKS (Continued)

PART 2: EXTERNAL FINISHES

Item	Element	Standard	Tolerance	Assessment Method
6.	**Architectural coating**	• Finished texture and colour to be uniformed		Visual
		• No paint drips and other stains		Visual
7.	**Painting**	• Surfaces are evenly painted; no patchiness due to touch-up work		Visual
		• Good opacity, no discolouration and fading		Visual
		• Surface should be free from peeling, blisters and chalkiness		Visual and physical
III.	**APRON AND PERIMETER DRAIN**			
1.	**General requirements**	i. Finishing • No stain marks		Visual
		• No patchiness and brush marks		Visual
		ii. Alignment and Evenness • Finishes must be even, level, aligned and consistent		Visual
		iii. Cracks and Damages • No visible cracks and damages		Visual
		iv. Fall/Gradient • Free flowing and no water ponding		Visual
		v. Joints and Gaps • Consistent joints width and neat		Visual
2.	**Drain cover/ inspection chamber**	• Level and do not warp or rock		Visual and physical
		• Gap between drain covers	5–10 mm wide	Steel measuring tape
		• Gap between sides of drain	5–10 mm wide	Steel measuring tape
		• No sign of corrosion on the drain grating		Visual
		• Fixtures installed must be safe, secured and functional		Visual and physical

QUALITY STANDARDS FOR ARCHITECTURAL WORKS (Concluded)

PART 2: EXTERNAL FINISHES

Item	Element	Standard	Tolerance	Assessment Method
IV.		**CAR PARK/CAR PORCH**		
1.	**General requirements (as applicable)**	i. Finishing • No stain marks		Visual
		• Consistent colour tone and good paintwork		Visual
		• No rough/patchy surfaces		Visual
		ii. Alignment and Evenness • Evenness of surface		Visual
		• Edge to be straight and aligned		Visual
		iii. Materials and Damages • No visible damages/defects		Visual
		• No missing or defective accessories		Visual
		• No sign of corrosion		Visual
		iv. Functionality • Securely fixed, functional and safe		Visual and physical
		v. Joints and Gaps • Consistent joints width and neat		Visual
		• No visible gaps for M&E fittings		Visual

ANNEX C
(Informative)
QUALITY STANDARDS FOR M&E WORKS

Item	Element	Standard	Tolerance	Assessment Method
I.		**ELECTRICAL**		
1.	**Main cables** a) Support	• Cables adequately supported and properly fastened on cable tray/ladder		Visual
	b) Fire barrier	• Fire barrier properly installed		Visual
	c) Spacing of cable	• Adequate spacing between cables of different circuit Adequate spacing to be provided for overlapping cables		Visual
	d) All elements	• No visible damages		Visual
2.	**Surface conduits** a) Installation	• Conduit ends properly connected		Visual
		• Metallic conduits properly earthed		Visual
		• Conduits properly bent without distortion and damage		Visual
		• Termination of conduit to distribution board/outlet boxes effectively connected to brass		Visual
	b) Support	• Support/brackets at appropriate interval rigidly fitted		Visual and physical
		• Screw used properly fastened		Visual and physical
	c) Fire barrier	• Fire barrier properly installed		Visual
		• Conduits and accessories properly painted		Visual
	d) All elements	• No visible damages		Visual
3.	**Concealed conduit** a) Installation	• Conduit system properly protected from damages and blockages		Visual
		• Metalic conduit earthed properly		Visual
		• Termination of conduit to distribution board/outlet boxes effectively connected with brass bushes		Visual
		• Conduit properly bent without distortion and free from damages		Visual
		• Coupling joints fastened		Visual

QUALITY STANDARDS FOR M&E WORKS (Continued)

Item	Element	Standard	Tolerance	Assessment Method
	b) Support	• Conduits properly secured		Visual
		• Coupling joints fastened		Visual
	c) All elements	• No visible damages		Visual
4.	**Cable tray, ladder and trunking** a) Installation	• All parts are protected against corrosion		Visual
		• Metallic trunking properly earthed		Visual
		• No sharp bending		Visual
		• Basic colours for identification of electrical trunking provided (either by painting over the whole length/ use coloured identification board)		Visual
	b) Support	• Support/brackets at appropriate interval rigidly fitted		Visual and physical
		• Screw used properly fastened		Visual and physical
	c) Fire barrier	• Fire barrier properly done		Visual
5.	**Distribution board** a) Circuit diagram	• Circuit diagram provided		Visual
		• Proper labeling for panel		Visual
	b) Cable management	• Internal cables neatly arranged and tied with cable tie		Visual
		• Live, neutral and earth cable properly labeled		Visual
	c) Cable termination/ earthing	• All live parts to be non-accessible		Visual
		• All exposed metal parts effectively earthed		Visual
		• Neutral and earth connection for each circuit individually connected to their respective terminal		Visual
		• Cable properly terminated using cable lug and coloured cable sleeve		Visual

QUALITY STANDARDS FOR M&E WORKS (Continued)

Item	Element	Standard	Tolerance	Assessment Method
	d) Installation	• Rubber grommet properly fitted at cable entry opening		Visual
		• Mounted on wall using bracket		Visual
	e) All elements	• No visible damages		Visual
6.	**Wiring system** a) Installation	• Installed neatly and systematically		Visual
		• Conform to space factor requirement (30% for duct, 40% for conduit, 45% for trunking)		Visual
	b) Cable termination	• No reduction of the number of cable strands at all terminals		Visual
		• No wiring joints for final subcircuit		Visual
	c) All elements	• No visible damages		Visual

QUALITY STANDARDS FOR M&E WORKS (Continued)

Item	Element	Standard	Tolerance	Assessment Method
II.		**ACMV WORKS**		
1.	**Air handling unit** a) Location and installation	• Unit location and pipe layout installed as per approved building drawings		Visual
		• Inspection access door for fan, coil, motor and filter		Visual
		• All metal parts properly earthed		Visual
		• Smoke detector installed at the return air stream		Visual
		• Name place installed with manufacturer's name, serial number and model number		Visual
	b) Support	• Pipe/duct from AHU must be supported		Visual
	c) All elements	• No visible damage		Visual
2.	**Pump** a) Location and installation	• Location and pipe layout installed as per approved building drawings		Visual
		• Pump and motor assembled properly installed on inertia block and spring isolator		Visual
		• Guard provided to exposed shafts, coupling and moving parts		Visual
		• Name plate installed with manufacturer's name, serial number and model number		Visual
	b) Electrical termination	• No bad electrical termination		Visual
	c) All elements	• No visible damage		Visual
3.	**Cooling tower** a) Self-earthing system	• Cooling tower completed with self-earthing system for connection to building lightning protection system		Visual

QUALITY STANDARDS FOR M&E WORKS (Continued)

Item	Element	Standard	Tolerance	Assessment Method
	b) Location and installation	• Name plate installed with manufacturer's name, serial number and model number		Visual
		• Location and pipe layout installed as per approved building drawings		Visual
		• Clear of all debris		Visual
	c) All elements	• No visible damage		Visual
4.	**Chiller** a) Location and installation	• Location and pipe layout installed as per approved building drawing		Visual
		• Chiller to be levelled when placed on plinth or vibration isolators		Visual
		• Chiller fixed securely in position		Visual
		• Correct model, make and capacity		Visual
	b) Pipe support and label	• Pipes supported properly by hangers or brackets		Visual
		• Pipe connections follow specified flow direction		Visual
	c) No leakage	• No sign of leakage		Visual
	d) All elements	• No visible damage		Visual
5.	**Pipework** a) Installation	• Pipe works include chilled water, hot water, steam, condenser water, condenser drain, cold water make-up, water treatment and refgrigerant; installed as per approved building drawing and specifications		Visual
	b) Paints and support	• Pipe works provided with drains at each low point and automatic air vents with manual isolating valve at each high point		Visual

QUALITY STANDARDS FOR M&E WORKS (Continued)

Item	Element	Standard	Tolerance	Assessment Method
	c) Fire stop	• Fire stop for passage of pipes at opening for fire resistant walls and floor		Visual
		• Properly painted and supported		Visual
	d) All elements	• No visible damage		Visual
6.	**Split unit/window air conditioner** a) Installation	• Units are levelled when placed on plinth		Visual
		• Drainage provided/units slightly tilted for condensation		Visual
		• Drain hose connected to the drain pipe		Visual
		• Cool air is not blocked by beam, shelving or other built-in furniture in the room		Visual
	b) Seal penetration	• Proper sealant of wall or roof opening after pipes are installed		Visual
	c) Leakage	• No sign of leakage from pipe		Visual
	d) All elements	• No visible damages		Visual
7.	**Air conditioner comfort** a) Temperature	• Room temperature between 23°C–25°C or according to specification		Temperature meter and sling psychrometer
	b) Relative humidity	• Room relative humidity not more than 60% or according to specification		Humidity meter and sling psychrometer
8.	**Ductwork** a) Paints	• Exposed ductwork and hanger properly painted to approved colour code		Visual
	b) Support	• Ductwork properly supported		Visual
	c) All elements	• No visible damages		Visual

QUALITY STANDARDS FOR M&E WORKS (Continued)

Item	Element	Standard	Tolerance	Assessment Method
9.	**Fire-rated ducts** a) Installation	• No hanging of other services		Visual
	b) Access panel	• Fire-resistant sealed access panel provided with fire-rated enclosure of equipment for maintenance		Visual
	c) All elements	• No visible damages		Visual
10.	**Dampers** a) Access door	• Damper/splitter damper can be adjusted freely between the open and close position		Physical
		• Access door provided to all dampers		Visual
	b) All elements	• No visible damages		Visual
11.	**Fire dampers** a) Installation	• Dampers in open position and held in position by fusible link		Visual
	b) Access door	• Access doors provided to all dampers according to relevant code of practice		Visual
	c) All elements	• No visible damages		Visual

QUALITY STANDARDS FOR M&E WORKS (Continued)

Item	Element	Standard	Tolerance	Assessment Method
III.		**FIRE PROTECTION WORKS**		
1.	**Wet/dry riser** a) Landing valve	• Landing valve must be accessible		Visual
		• Landing valve strapped and padlocked		Visual
		• Labeling for riser door		Visual
		• Landing valve painted red for wet riser/yellow for dry riser		Visual
		• Automatic air release valve provided at the highest mark of rising main		Visual
	b) Pipe and pipe support	• Riser pipes properly supported		Visual
		• Labeling and painting for riser pipe		Visual
		• Bonding to earth provided for rising main		Visual
	c) Wall/floor penetration	• Proper wall/floor penetration		Visual
	d) All elements	• No visible damages		Visual
2.	**Sprinkler** a) Installation	• No obstruction and painting to sprinkler heads		Visual
		• Correct sprinkler heads used in correct locations		Visual
	b) Pipe support	• Pipework properly supported		Visual
	c) Wall/floor penetration	• Proper wall/floor penetration		Visual
	d) All elements	• No visible damages		Visual

QUALITY STANDARDS FOR M&E WORKS (Continued)

Item	Element	Standard	Tolerance	Assessment Method
3.	**Fire Alarm** a) Installation	• Fire alarm wiring in GI conduit		Visual
	b) Paints	• Good condition and finishing paintwork for panel and conduit		Visual
	c) Fire alarm zoning diagram	• Fire alarm zoning diagram provided near panels/subpanels		Visual
	d) All elements	• No visible damages		Visual
4.	**Hose reel** a) Installation	• Hose reel cabinet properly labeled		Visual
		• Hose reel pipe properly fixed with hanger and bracket		Visual
		• Hose reel operation instruction fixed on hose reel drum or door		Visual
	b) Paints	• Good condition and finishing paintwork		Visual
	c) All elements	• No visible damages		Visual

QUALITY STANDARDS FOR M&E WORKS (Continued)

Item	Element	Standard	Tolerance	Assessment Method
IV.		**PLUMBING AND SANITARY WORKS**		
1.	**Concealed pipes** a) Location and installation	• Pipes properly supported, bent without distortion, kinks and damages		Visual
		• Pipe and fitting ends properly capped		Visual
		• Proper joints		Visual
	b) Alignment	• Vertically and horizontally aligned		Visual
	c) All elements	• No visible damages		Visual
2.	**Exposed pipes** a) Installation	• Pipes properly supported, bent without distortion, kink and damage		Visual
		• Joints are watertight		Visual
		• Pipe ends properly capped		Visual
		• No cold water pipes below sewerage pipes		Visual
	b) Alignment	• Horizontally, vertically and parallel aligned to building surface		Visual
		• Inclined pipes laid to proper gradients		Visual
		• Tolerance for plumb	≤ 3 mm per 1 m height	Plumb bob and steel measuring tape
	c) Clearance	• Do not cause obstruction/pose safety hazard at public areas		Visual
		• Sufficient clearance between installed pipes/ceiling and pipes/ wall for accessibility		Visual
		• Service pipe duct accessible		Visual
	d) All elements	• No visible damages		Visual
3.	**Water tank** a) Installation	• All openings properly covered		Visual
		• Joints and pipe connections are watertight		Visual
		• Not located below sewerage pipes		Visual

QUALITY STANDARDS FOR M&E WORKS (Continued)

Item	Element	Standard	Tolerance	Assessment Method
		• Corrosion-resistant external cat ladders provided for large water tank		Visual
		• Overflow pipe to be discharged at proper location		Visual
		• Well supported on plinth or bearers		Visual
	b) Netting	• Netting properly fitted for overflow/ warning/ vent pipes		Visual
	c) Clearance	• Accessible for maintenance. Minimum clearance of 600 m all rounded the water tank		Visual
	d) All elements	• No visible damages/defects		Visual
		• Clean and free from debris		Visual
4.	**Pump and motor** a) Installation	• No noticeable abnormal vibration and noise from pump/ motor		Visual
		• Test certificate for alignment if pump and motor from manufacturer		Visual
	b) Electrical termination	• No bad/loose electrical terminations		Visual
	c) All elements	• No visible damages		Visual

QUALITY STANDARDS FOR M&E WORKS (Continued)

Item	Element	Standard	Tolerance	Assessment Method
V.		**BASIC M&E FITTINGS**		
1.	**General requirements**	i. Joints and Gaps • No visible gap		Visual
		• Consistent joint width and neat		Visual
		ii. Alignment and Evenness • Aligned, levelled and straight		Spirit level
		iii. Materials and Damages • No visible damages/defects		Visual
		• No stain marks		Visual
		• Consistent colour tone		Visual
		iv. Functionality and Safety • No operational defects		Physical and visual
		• Securely fixed		Physical
		v. Accessories Defects • No missing accessories		Visual
		• No visible damages/defects		Visual
2.	**Plumbing and sanitary fittings** a) Gully and floor trap	• No damages and chokings		Visual
		• Must be securely fixed		Visual
		• Traps top lower than the surrounding floor level		Visual

QUALITY STANDARDS FOR M&E WORKS (Continued)

Item	Element	Standard	Tolerance	Assessment Method
	b) Pipes	• Horizontal, vertical and parallel aligned to building surface		Visual
		• Brackets firmly secured and joints properly sealed and marked		Visual
		• If painted, no drippings and with good opacity		Visual
		• Pipes properly supported, bent without distortion, kinks and damages		Visual
		• Sufficient clearance between installed pipes and building surface for accessibility		Visual
	c) Fittings	• Firmly secured and joints properly sealed and marked		Physical and visual
		• No leakage at joints		Visual
		• No chipping or cracks		Visual
		• No paint drops or mortar droppings		Visual
		• Fittings in working condition		Physical and visual
		• Accessible for maintenance		Visual
		• All sensors covers properly sealed against water seepage		Visual
3.	**M&E fittings**	• These include power point, telephone point, air-con diffuser, fan coil unit, lighting, smoke alarm, sprinkler heads, CATV/CCTV camera, speakers, alarm system, etc		
	a) Installation	• Fittings must be aligned		Visual
		• No stains		Visual

QUALITY STANDARDS FOR M&E WORKS (Concluded)

Item	Element	Standard	Tolerance	Assessment Method
		• Neat patch-up for marking/ penetration		Visual
		• Heights of switch and marks should be consistent		Visual
		• Switch can properly function	Tested minimum one time	Physical
		• No visible gap between switches and walls		Visual

ANNEX D
(Informative)

QUALITY STANDARDS FOR EXTERNAL WORKS

Item	Element	Standard	Tolerance	Assessment Method
I.		**EXTERNAL WORKS**		
1.	**General requirements (as applicable)**	i. Finishing • No stain marks		Visual
		• Consistent colour tone and good paintwork		Visual
		• No rough/patchy surfaces		Visual
		ii. Alignment and Evenness • Evenness of surface		Visual
		• Edge to be straight and aligned		Visual
		iii. Materials and Damages • No visible damages/defects		Visual
		• No missing or defective accessories		Visual
		• No sign of corrosion		Visual
		iv. Functionality • Securely fixed, functional and safe		Visual and physical
		v. Joints and Gaps • Consistent joints width and neat		Visual
		• No visible gaps for M&E fittings		Visual
2.	**Link-way/shelter**	Floor, column, ceiling, fixtures and basic M&E fittings		Refer to item 1 (General requirements)
3.	**External drains**	Drain, drain cover and inspection chamber i. Drain • Free flowing and no ponding of water, no siltation		Visual
		ii. Drain Cover • Level and do not warp or rock		Visual and physical
		• Gap between drain covers.	5–10 mm wide	Steel measuring tape
		• Gap between sides of drain	5–10 mm wide	Steel measuring tape
		• Drain grating properly painted		Visual

QUALITY STANDARDS FOR EXTERNAL WORKS (Continued)

Item	Element	Standard	Tolerance	Assessment Method
		iii. Inspection Chamber • Inspection chambers are level with surroundings without depression and with tolerance of 20 mm for protrusion		Visual and steel measuring tape
		• Covers to be level with frames		Visual
4.	**Roadwork and car park on the ground**	Road surface, road marking, kerbs, road signs and road lightings i. Road surface • No water ponding		Visual
5.	**Footpaths and turfing**	Footpath, turfing, lighting and fixtures (eg., fixed benches, signange, lighting, railing, etc.) i. Turfing • No depression or bald patches		Visual
		• Turfing done evenly, no dead grass or weeds		Visual
6.	**Playground**	Floor, playground equipment, lighting, side drain and fixtures (eg., fencing, fixed bench, signage, etc.) i. Floor • No water ponding		Visual
		ii. Side drain • Free flowing of water		Visual
		• No water ponding		Visual
		• No siltation		Visual
7.	**Court**	Floor, signage, basic M&E fittings and fixtures (eg., net post, fencing, fixed bench, etc.) i. Floor • No water ponding		Visual

QUALITY STANDARDS FOR EXTERNAL WORKS (Concluded)

Item	Element	Standard	Tolerance	Assessment Method
8.	**Fence and gate**	Fence, gate, basic M&E fittings and fixtures (eg., signage, etc)		
		i. Gate • Piers and gate to be vertical, perpendicular and straight. Gate to be parallel and aligned		Visual
9.	**Swimming pool**	Overflow drain, pool deck, ladder and railing, basic M&E fittings and fixtures (eg., signage, etc)		
		i. Overflow drain • No chockage		Visual
		ii. Pool deck • No sign of delamination		Physical and visual
10.	**Electrical substation**	External wall, door and window, fence and gate, apron and drain		Visual
11.	**Guard house**	External wall, apron and drain, barrier, door and window, and roof		Visual
12.	**Bin centre**	External wall, floor, apron and drain, door and window, and roof		
		i. Floor • Fall in the right direction		Visual
		• No water ponding		Visual

ANNEX E
(Informative)

DEFECT GROUPS FOR ASSESSMENT OF ARCHITECTURAL WORKS (INTERNAL FINISHES)

ELEMENT	DEFECT GROUPING	DESCRIPTION OF DEFECT
Floor/Wall	Finishing	Stains, painting/coating defects, tonality, patchy, roughness
	Alignment and evenness	Unevenness
	Cracks and damages	Cracks, chipping, dents, scratches
	Hollowness/ delamination	Hollow sound, voids
	Jointing	Inconsistent joints, visible gaps
Ceiling	Finishing	Stains, painting/coating defects
	Alignment and evenness	Wavy, not aligned
	Cracks and damages	Cracks, chipping, dents, scratches
	Roughness/ patchiness	Rough, patchy
	Jointing	Inconsistent joints, visible gaps
Door/ Window/ Fixtures/ M&E Fittings	Joints and gaps	Joints or gaps too wide, inconsistent, improper seal
	Alignment and evenness	Not aligned, sagging, not flushed
	Materials and damages	Cracks, chipping, dents, scratches, stains, tonality, warping
	Functionality	Cannot be opened or closed properly, squeaky sound
	Accessories defects	Missing items, improper fixing, stains, corrosion, other damages, not aligned

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