STANDARD INDUSTRI PEMBINAAN

(CONSTRUCTION INDUSTRY STANDARD)

CIS 7:2006

QUALITY ASSESSMENT SYSTEM FOR BUILDING CONSTRUCTION WORK

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

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CONTENTS

Tables

Annexes

Committee representation

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

Association of Consulting Engineers Malaysia
Construction Industry Development Board of Malaysia
Guild of Bumiputra Contractors Berhad
Institution of Surveyors Malaysia
Jabatan Kerja Raya Malaysia
Jabatan Perumahan Negara
Malay Contractors Association of Malaysia
Master Builders Association Malaysia
National House Buyers Association of Malaysia
Pertubuhan Akitek Malaysia
Real Estate and Housing Developers Association
Syarikat Perumahan Negara Berhad
Universiti Sains Malaysia

FOREWORD

This Malaysian Construction Industry Standards (CIS) hereby referenced as CIS 7: 2006 was developed as a quality assessment system for building construction work 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.

While this CIS 7: 2006 on quality assessment system for building construction work adopts several components with reference to CONQUAS 21 – The BCA Construction Quality Assessment System (Sixth Edition 2005): Building and Construction Authority, Singapore, it is also dependent on new or updated information and developments concerning this subject area made available through this Technical Committee.

The use of this CIS 7: 2006 is voluntary and compliance with this document does not in itself confer immunity from legal obligations.

QUALITY ASSESSMENT SYSTEM FOR BUILDING CONSTRUCTION WORK

SECTION 1: GENERAL

1.1 Introduction

Quality Assessment System for Building Construction Work is an independent method to assess and evaluate 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. For dated reference, only the edition cited applies. For undated reference, the latest edition of the normative reference (including any amendments) applies.

Uniform Building By-Law 1984.

1.3 Definition

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

1.3.1 QLASSIC is the acronym for quality assessment system in construction.

1.3.2 Component

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

1.3.3 Elements

A sub-division of a component, for example formwork for structural works, tiled finishes for architectural works, drains for external works, surface conduits for mechanical and electrical (M & E) works and others.

1.3.4 Qualified person

A qualified person as defined in the Uniform Building By-Laws 1984.

1.3.5 Approved standards

Approved standard shall mean standard specified by the qualified person for the project.

1.4 Objectives of Quality Assessment System for Building Construction Work

Quality Assessment System for Building Construction Work 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 the approved standards;

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

e) to compile data for statistical analysis.

1.5 Use of Quality Assessment System for Building Construction Work

Quality Assessment System for Building Construction Work 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 Work 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.

1.6 Scope of Quality Assessment System for Building Construction Work

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 Work cover four main components: **Structural works, Architectural works, Mechanical and Electrical (M & E) works and External works**. Assessments on the workmanship are carried out based on this standard and marks are awarded if the workmanship complies with the standards. These marks are then summed up to give a total quality score (%) for the building project.

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

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

Apart from site inspection, the assessment also includes field tests, test results on the material 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; these defects may surface only after sometime.

1.7 Assessment approach

In general, the assessor determines the samples (elements or locations) to be assessed prior to each assessment. The samples are selected from drawings and plans. The selected samples shall be distributed as uniformly as possible throughout the project and construction stages. All locations are to be offered 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 re-scored. The objective of this practice is to encourage contractors towards *"doings things right the first time and every time*".

When an assessed item does not comply with the corresponding QLASSIC standards, it is considered failed and an "X" will be noted in the assessment form. Likewise a "**v**" is given for an item meeting the standards. A "**-**" will be given to indicate that the item is not applicable. The score is computed based on the number of "**v**" 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 formwork, steel reinforcement, prefabricated or pre-cast elements, etc. during construction.

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 Annex A.

b) Architectural works

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

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

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

c) Mechanical and Electrical (M & E) works

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

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-ways/shelters, drains, road works, car parks, footpaths, turfings, playgrounds, gates and fences, swimming pools, hardscapes and electrical substation.

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 below.

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

Components	**Category A** (Landed housing)	**Category B** (Stratified housing)	**Category C** (Public building)	**Category D** (Special public building)
Structural works	25 %	30 %	30 %	30 %
Architectural works	60 %	50 %	45%	35 %
M & E works	5 %	10 %	15 %	25 %
External works	10%	10 %	10 %	10 %
Total score	**100 %**	**100 %**	**100 %**	**100 %**

The weightage system, which is aimed at making the score quantitative in representing 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 comprise as follow:

i) **Category A** (Landed Housing) – Detached, Semi-Detached, Terrace and Cluster House.

ii) **Category B** (Stratified Housing) – Flat, Apartment, Condominium, Service Apartment and Town House.

iii) **Category C** (Public Building) – Office Building, Schools and other related facilities/ buildings built intended for public use.

iv) **Category D** (Special Public Building) – Hospitals and Airports only.

3.2 QLASSIC assessors

Assessors must attend the QLASSIC training course before being qualified to carry out the actual assessment at the construction sites. The QLASSIC assessors are continuously updated 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) of the building and 10 m length section or per location for external work is to ensure that the assessment adequately represents the entire building project.

3.4 Architectural works assessment

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

The weightage for architectural elements are allocated as per Table 2.

Table 2. Weightage for architectural element

Architectural elements		Weightage %	
		Total	**Breakdown**
Internal Finishes		**56**	
	Floor		16
	Internal wall		16
	Ceiling		6
	Door		6
	Window		6
	Fixtures (Internal)		6
Roof		**10**	
External wall		**10**	
Apron and perimeter drain		**4**	
Material and Functional tests		**20**	
	Skim coat or Pre-packed plaster		3
	Field window water tightness test (WTT)		6
	Wet area water-tightness test		6
	Pull-off-test for internal wall tiles		5
Total		**100**	

NOTE:
A weightage of 3 % is automatically awarded to projects where skim coat or pre-packed plaster is used. This is to encourage the use of these products in the industry.

The assessment is based on the sampling guidelines. See Table 3.

Table 3. Sampling guidelines for architectural work

No.	Items	GFA per sample	Min Sample	Max Sample	Remarks
1a	Internal Finishes	70 m^2	30	700	For landed housing
1b	Internal Finishes	70 m^2	30	600	For stratified housing
1c	Internal Finishes	500 m^2	30	150	For public building
1d	Internal Finishes	500 m^2	30	100	For special public building
2	External wall	-	50 %	-	50 % of the blocks/units
3	Skim coat and Pre-packed plaster	-	-	-	Declaration by qualified person
4	Roof	-	50 %	-	50 % of the blocks/units
5	Apron and perimeter drain	-	2	-	10 m length section per sample
6a	Field window water-tightness test (WTT)	1 000 m^2	20	100	Independent testing
6b	Field window water-tightness test (WTT)	-	25 %	-	Self-testing with declaration by qualified person
7a	Wet area water-tightness test	-	20	100	- 10 % of all bathrooms and/or toilets (by location) - all will be tested if < 20 nos.
7b	Wet area water-tightness test	-	100 %	-	- Self-testing with declaration by qualified person
8	Pull-off test for internal wall tiles	10 000 m^2	1 Set	5 Sets	5 tiles per set (by location)
NOTE. GFA means Gross Floor Area					

A location for **Internal Finishes** assessment is a functional space of a building such as a 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** include 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 4.

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 case, the architectural score will be pro-rated accordingly.

Table 4. Weightage for location of architectural work according to building category

Locations	**Category A** (Landed Housing)	**Category B** (Stratified Housing)	**Category C** (Public Building)	**Category D** (Special Public 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 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 external wall, a minimum 50 % of the total number of building will be assessed. For a building, the external wall will be divided into 4 walls for assessment.

Under the material & functional tests, self testing items like field window water-tightness test for 25 % of windows and the use of skim coat or 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.

3.5 External works assessment

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

The assessment consists of the following locations:

a) Link-way/Shelter - 10 m length section per sample and minimum 2 samples;

b) External Drain - 10 m length section per sample and minimum 2 samples;

c) Roadwork and Car park - 10 m length section per sample and minimum 1 sample;

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; and

i) Electrical substation - 1 location

j) Guard House - 1 location

k) Rubbish Chamber - 1 location

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

3.6 Mechanical and electrical (M & E) works assessment

3.6.1 Completed projects

Assessment of M & E works is carried out upon completion of the building project and before handing over of the project. The assessment covers basic M & E fittings and performance testing.

3.6.2 Projects In-progress

Assessment of M & E works is done throughout the construction stages.

The assessment covers the following area, with their weightages allocated in accordance with the four categories of projects. See Table 5.

Table 5. Weightage for M & E element according to building category

M & E elements	**Category A** (Landed Housing)	**Category B** (Stratified Housing)	**Category C** (Public Building)	**Category D** (Special Public Building)
M & E Works Assessment (%)				
Electrical Works	10	15	20	20
ACMV Works	10	10	25	20
Fire Protection Works	-	10	10	10
Plumbing & Sanitary Works	20	20	20	25
Basic M & E Fittings	60	45	25	25
Sub-total	100	100	100	100
Weightage	50	50	30	30
M & E Works Performance Test Assessment (%)				
Performance testing	100	100	100	100
Weightage	50	50	70	70
Total	**100**	**100**	**100**	**100**

NOTES:

1. "-" means that no assessment on that M & E element is required.
2. Refer to Annex F for details of the marks allocated under each element of the M & E works assessed.
3. Performance testing will be done for electric power supply, water supply and sanitary flushing system.
4. Basic M & E Fittings – 500 m^2 per sample with min 30 and max 150 samples.

Like the 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 6:

Table 6. Sampling guidelines for M & E work

	Category A Landed Housing 3 500 m^2 per sample	**Category B** Stratified Housing 3 500 m^2 per sample	**Category C** Public Building 1 000 m^2 per sample	**Category D** Special Building 1 000 m^2 per sample
Electrical				
1. Main cables			1	1
2. Surface conduits	1+	1+	1+	1+
3. Cable tray, ladder and trunking	1	1+	1+	1+
4. Distribution board	1		2+	2+
ACMV				
1. Split unit/ Window air conditioner	3+	3+	2+	2+
2. Air-con comfort	2+	2+	1+	1+
3. Ductwork			3+	3+
4. Fire-rated duct			1	1
5. Dampers			1+	1+
6. 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		1	1	1+
2. Exposed pipes		4+	4+	4+
3. Water tank	1	1	1	1
4. Pump and motor		1	1	1
Minimum Samples	**9**	**16**	**25**	**25**
Maximum Samples	**15**	**29**	**43**	**44**

NOTES:

1. Basic M & E fittings – **500 m^2 per sample with min 30 samples and max 150 samples**
2. Remarks: means to be repeated for additional samples required

Table 7. Weightage for reinforced concrete structure element

Reinforced Concrete Structure Elements	Weightage Cast In-situ (%)	Weightage Pre-cast (%)
Formwork	20	0
Rebar	15	5
Finished Concrete	25	35
Concrete Quality	5	0
Steel Reinforcement Quality	5	0
Precast specific requirement	0	20
NDT- UPV test for concrete uniformity	15	20
NDT – Electro-covermeter test for concrete cover	15	20
Total	100	100
NOTE: If total pre-cast concrete volume exceeds 20% of total structural concrete volume, assessment will be carried out for pre-cast concrete construction. The marks will be distributed proportionately between formwork/ rebar assessment and pre-cast concrete assessment based on the respective concrete volume percentage.		

For a typical reinforced concrete structure, selection of samples for assessment is based on Table 8.

Table 8. Sampling guidelines for reinforced concrete structure work

	Items	GFA per sample	Min sample	Max sample	Remarks
1	Structural Elements	500 m2	30	150	For Non-Housing Project
1a	Structural Elements	1 500 m2	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 m2	2 sets	20 sets	5 structure members per set
5	NDT- Electro-Covermeter test for concrete cover	5 000 m2	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. It should also as far as possible cover the different types of structural elements.					

The resulting scores for the formwork/ rebar/ pre-cast and finished concrete will be the sum of the number of checks that meet the standards.

There is no assessment of pre-cast components at the pre-cast yard. The assessment is applicable for all types of pre-cast 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 constitutes more than 20% of the structural cost, assessment will be required for the latter and the marks 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 the projects.

The weightage for structural steelwork and pre-stressed concrete are allocated as per Table 9.

Table 9. Weightage for structural steel element and pre-stressed concrete element

Structural steel work	Weightage %
Main member/ Partially assemble 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 irregardless of the 20 % costing criteria.	

Pre-stressed 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 the following guidelines:

Table 10. Sampling guidelines for structural steel work

Items	Steel tonnage per sample	Min sample
Structural elements		
• Main member/ partial 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.		

ANNEX A
(Informative)

QUALITY STANDARDS FOR STRUCTURAL WORKS

PART 1: REINFORCED CONCRETE STRUCTURES

Item	Element	Standards	Tolerance	Assessment Tool
1.	**FORMWORK**			
1a.	**Formwork dimensions and openings for services**			
		1) Tolerance for cross-sectional dimensions of cast in-situ & precast elements	+10 mm/ -5 mm	Steel measuring tape
		2) Tolerance for penetration/opening for services	+10 mm for size and ± 25 mm for location	Steel measuring tape
		3) 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	
1b.	**Alignment, plumb and level**	1) Tolerance for departure of any mark from its position	±10 mm	Steel measuring tape
		2) Tolerance for plumb	=3 mm per 1 m, maximum 20 mm	Steel measuring tape & Plumb bob
		3) Maximum deviation of mean level of staircase tread to temporary bench mark	±5 mm	Steel measuring tape
		4) 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	Standards	Tolerance	Assessment Tool
1c.	**Condition of formwork, props and bracing**	1) Formwork must be free from defects		Visual
		2) Before concreting, the interior must be free from debris		Visual
		3) All formwork joints must not have gaps to prevent leakage		Visual
		4) There must be adequate support, bracing and tie-back for the formwork to prevent bulging or displacement of structural elements		Visual
2.	**REINFORCEMENT (CAST IN-SITU & PRECAST)**			
2a.	**Main and secondary rebars**	1) According to structural drawings (numbers/sizes)		Visual and calliper
		2) Spacing of bars not more than that specified	±10 mm	Steel measuring tape
2b.	**Achorages and lap lengths**	1) Required lap length not less than that specified		Steel measuring tape
2c.	**Cover provision**	1) According to specification	+5 mm	Measurement Tape
2d.	**Links, stirrups and trimming bars**	1) According to structural drawings (numbers/sizes)		Visual
		2) Spacing of links not more than specified	±10 mm	Measurement Tape
2e.	**Rebar condition**	1) Rebars must be securely and properly tied in place		Visual
		2) Rebars must be free from concrete dropping, corrosion etc.		Visual

QUALITY STANDARDS FOR STRUCTURAL WORKS *(Continued)*

PART 1: REINFORCED CONCRETE STRUCTURES

Item	Element	Standards	Tolerance	Assessment Tool
3.	**FINISHED CONCRETE (CAST IN-SITU & PRECAST)**			
3a.	**Dimension for elements/opening for services**	1) Tolerance for cross-sectional dimension of cast in-situ and precast elements	+10 mm/-5 mm	Steel measuring tape
		2) Tolerance for opening	+10 mm for size and ± 25 mm for location	Steel measuring tape
		3) Tolerance for length of precast members (major dimension of unit):		Steel measuring tape
		• Up to 3 m	±6 mm	Steel measuring tape
		• 3 m to 4.5 m	± 9 mm	Steel measuring tape
		• 4.5 m to 6 m	± 12 mm	Steel measuring tape
		• Additional deviation for every subsequent 6 m	±6 mm	Steel measuring tape
		4) Straightness or bow (deviation from intended line) of precast member:		Steel measuring tape, sprit 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	Standards	Tolerance	Assessment Tool
		5) Squareness of precast member- Difference between the greatest and shortest dimensions should not exceed the following:		Steel measuring tape
		Length of shorter sides		
		• Up to and including 1.2 m	±6 mm	
		• Over 1.2 m but less than 1.8 m	±9 mm	Steel measuring tape
		• 1.8 m and over	±12 mm	Steel measuring tape
		6) Twist of precast member - Any corner should not be more than the deviation stated from the plane containing the other 3 corners:		Steel rule, L-square & spirit level
		• Up to 600 mm wide and 6 m in length	±6 mm	
		• Over 600 mm wide and for any length	±12 mm	
		7) Flatness	=6 mm per 1.2 m	Steel rule and spirit level
3b.	**Alignment, plumb and level**	1) Tolerance for departure of any mark from its position	±10 mm	Steel measuring tape
		2) Tolerance for plumb: maximum 20 mm for floor to floor height and 40 mm for the entire building height	3 mm/1 m	Plum bob and Steel measuring tape
		3) Maximum deviation of mean level	±10 mm	Precise levels
		4) For cast in-situ elements, the maximum deviation of levels within the elements	±10 mm	Steel measuring tape
		5) Chamber at mind-span: according to specifications		Steel measuring tape and L-square

QUALITY STANDARDS FOR STRUCTURAL WORKS *(Continued)*

PART 1: REINFORCED CONCRETE STRUCTURES

Item	Element	Standards	Tolerance	Assessment Tool
3c.	**Exposed surface**	1) Should not have visual exposure of groups of coarse aggregates resulting from grout leakage		Visual
		2) Cold joint & formwork joint must be smooth		Visual
		3) No bulging of structural element		Visual
		4) All formwork, nails, zinc strips, etc must be removed		Visual
		5) No cracks or damages		Visual
		6) No exposed rebar		Visual
4.	**PRECAST SPECIFIC REQUIREMENTS**			
4a.	**Lifting marks/inserts**	1) Tolerance for position	±20 mm from centre line location in drawing	Steel measuring tape
		2) Lifting devices and inserts free from damages		Visual
4b.	**Sleeve system/connections**	1) Tolerance for position	±6 mm from centre line location in drawings	Steel measuring tape
		2) Bar protrusion length according to requirements. No bending, cranking or damages to bars		Visual
		3) Bars free from concrete droppings or corrosion		Visual
		4) Sleeves, grout holes, grout tubes not congested with debris		Visual
4c.	**Interface/joint requirement**	1) Joint taper:		Steel measuring tape
		• Over 3 m length	±6 mm	
		• Maximum for entire length:	±9 mm	
		2) Alignment of horizontal and vertical joint	±6 mm	Steel measuring tape
		3) Jog in alignment of matching edges:	±6 mm	Steel measuring tape

	Element	Standards	Tolerance	Assessment Tool
		4) Sitting of element	according to specifications	Visual
		5) Installation of sealant and waterproofing	according to specifications	Visual
4d.	**Cast-in steel items/welded & bolted connection**	1) Tolerance for position of cast-in steel items	±6 mm from centre line location in drawings	Steel measuring tape
		2) Tolerance for position of openings for bolt connections	±3 mm from centre line location in drawings	Steel measuring tape
5.	**STRUCTURE QUALITY**			
5a.	**Concrete Cube test**	1) According to specifications; for every pour of concrete, test cubes results at 28 days must satisfy the passing criteria in relevant approved standard		Test records
5b.	**Reinforcement (Rebar)**	1) To pass the tensile strength test for all the reinforcement bars used as according to: • Approved Standard for Grade 500 ribbed bars • Approved Standard for Grade 460 ribbed bars		Test records
		2) All the welded steel fabric used to comply with approved standard in their respective specified characteristic strength of not less than 250 N per mm^2, 460 N per mm^2 and 485 N per mm^2		Test records

	Element	Standards	Tolerance	Assessment Tool
		3) No non-conforming reinforcement detected through test records has been installed in the structure		Test records
6.	**NON-DESTRUCTIVE TESTING**			
6a.	**Ultra Pulse Velocity (UPV) test for Concrete Uniformity**	1) To conduct NDT using ultrasonic pulse velocity (UPV) to check the degree of uniformity of hardened concrete 2) 5 columns/walls per set and 2 readings per column/wall 3) Assessment is based on the difference between 2 UPV readings within a column/wall not exceeding 0.05 km/s 4) Method as per approved standard		UPV meter
6b.	**Electro-Covermeter test for concrete cover**	1) To check hardened concrete cover for reinforcement bars after casting 2) 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 3) For each reading, full mark for ±5 mm and half mark for >±5 mm to ±8 mm. For each location, no mark will be awarded if any of the 4 readings exceeds ±12 mm 4) Method as per approved standard	minimum according to specification	Cover meter

QUALITY STANDARDS FOR STRUCTURAL WORKS *(Continued)*

PART 2: STRUCTURAL STEEL WORKS

Item	Element	Standards	Tolerance	Assessment Tool
1.	**MAIN MEMBER/ PARTIAL ASSEMBLED COMPONENT**			
1a.	Physical dimensions	1) Cross sectional tolerance should meet approved structural steel specification or approved plan		Steel measuring tape
		2) Tolerance for length of structural steel member	±3 mm	Steel measuring tape
		3) Tolerance for bolt hole size:-		Caliper
		• Diameter <24 mm	=2 mm	
		• Diameter = 24 mm	=3 mm	
		4) Tolerance for bolt hole position	±2 mm	
1b.	**Type and condition**	1) According to the structural steel specifications		Visual
		2) Surface preparation shall meet the surface roughness specifications		Visual
		3) Material used must be traceable to its original mill certificates		Visual
1c.	**Welding**	1) Welding size, length and profile shall meet the structural steel specification and drawings		Steel measuring tape and visual
		2) Visual inspection shall meet the structural steel specifications		Visual
		3) All welding must be done by qualified welders		Evidence of welders certificate

QUALITY STANDARDS FOR STRUCTURAL WORKS *(Continued)*

PART 2: STRUCTURAL STEEL WORKS

Item	Element	Standards	Tolerance	Assessment Tool
1d.	**Bolting**	1) Bolts and washers, type, size and number shall be according to the structural steel specifications		Visual
		2) Drilled holes shall be free from burrs		Visual
		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		Visual
		4) Gap between adjacent parts	<2 mm	Caliper
		5) Threaded bolts protruding at least one thread length with washers		Visual
2.	**METAL DECKING**			
2a.	**Type and condition**	1) Correct type and thickness of metal decking used		Visual
		2) All decking joints must not have gaps		Visual
		3) All metal decking must be properly secured in place		Physical & visual
		4) Metal decking must be free from defects and visible damages		Visual
		5) Before concreting, the decking must be free from grease, oil, paint and all other foreign materials		Visual
		6) All accessories such as pour stop, and end closures and cover plates must be in place before concreting		
2b.	**Shear studs**	1) Correct numbers 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		

QUALITY STANDARDS FOR STRUCTURAL WORKS *(Continued)*

PART 2: STRUCTURAL STEEL WORKS

	Element	Standards	Tolerance	Assessment Tool
2c	**Lapping and deck openings**	1) According to structural steel specifications or approved plan		
3.	**ERECTION TOLERANCES**			
3a.	**Column verticality**	1) Tolerance for verticality:±H/600 mm or 5 mm, maximum ±25 mm; where H is the floor to floor height in mm		Spirit level and steel rule
3b.	**Column position**	1) The position in plan of steel column at the base shall not deviate from the specified position by more than 10mm along either of the principal setting out axes		Steel measuring tape
3c.	**Beam level**	1) Maximum deviation of level at each end of the same beam	±5 mm	Steel measuring tape
		2) The level of the top of the steelwork at any storey shall be within ± 10 mm of the specified level		Precise levels
3d.	**Beam position**	1) Beams shall not deviate from their specified positions relative to the column to which they are connected by more than 5 mm		Steel measuring tape

QUALITY STANDARDS FOR STRUCTURAL WORKS *(Continued)*

PART 2: STRUCTURAL STEEL WORKS

	Element	Standards	Tolerance	Assessment Tool
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		Steel measuring tape
4b.	**Condition**	1) No visible damages		Visual
		2) No spalling of coating or protective layer from structural steel members		Visual
5	**Welding test report**	1) Reports for all critical welding joints from the specified contract requirements must be submitted		Test records
		2) Test reports must comply with the acceptable criteria and to be endorsed by client's representative		Test records

QUALITY STANDARDS FOR STRUCTURAL WORKS *(Concluded)*

PART 3: PRE-STRESSED CONCRETE

	Element	Standards	Tolerance	Assessment Tool
1	**Condition of tendons & anchorages**	1) All pre-stressing strands and wires should comply with the specified standards and requirements and be free from loose rust, oil, tar, paint and any foreign objects		Steel measuring tape
		2) All tendon anchorage are to comply with the specified standards and protected from corrosion		Visual
		Thread parts to be greased wrapped and tapped holes protected until use		Visual
2	**Installation of sheathing**	1) Sheathing properly secured and protected and free from damage or puncture		Visual
		2) Sheathing profile according to drawings throughout the length with position tolerance	±5 mm	Steel measuring tape
		3) Splice to sheathing shall be mortar tight		Visual
		4) Air vents grout tubes provided according to the drawing		Visual
3	**Stressing & grouting process**	1) Tendon ducts clean and free from foreign objects and tendon free moving in the duct		Visual
		2) All grouting operations of the tendons must be smooth and achieved without need to flush out in the first grouting		Visual
4	**Debonding**	1) Open ends of debond tubes over the debond length of strands sealed		Visual
		2) Debond lengths according to the drawings		Steel measuring tape
		3) Debonding materials not punctured or damaged		Visual

ANNEX B
(Informative)

QUALITY STANDARDS FOR ARCHITECTURAL WORKS

INTERNAL FINISHES

Item	Element	Standards	Tolerance	Assessment Tool
I.	**FLOORS**			
A.	**General Requirements**	1) Finishing		
		• No stain marks		Visual
		• Consistent colour tone		Visual
		2) Alignment & Evenness		
		• Evenness of surface	= 3 mm per 1.2 m	Spirit level and steel rule
		• Falls in wet areas should be in right direction		Water or Spirit level
		• For staircases, the variance in lengths of treads and risers must not exceed 5 mm from dimensions specified in the approved drawings		Steel Measuring Tape or Steel rule
		3) Crack and damage		
		• No visible damage/defects		Visual
		4) Hollowness/Delamination		
		• No hollow sound when tapped with a hard object		Tapping rod
		• No sign of delamination		Visual
		5) Jointing		
		• Consistent skirting thickness and no visible gap between wall & skirting		Visual
		• Edge to be straight and aligned	= 3 mm per 1.2 m	Spirit level and steel rule
B.	**Screed Finishes**	1) Finishing		
		• Surface should not be unduly rough or patchy		Visual
		• No permanent foreign material visually detected		Visual

Item	Element	Standards	Tolerance	Assessment Tool
	FLOORS			
C.	**Tiled Floor**	1) Finishes		
		• Joints are aligned with skirting and wall tiles		Visual and Caliper
		• Joints are aligned between tiles and consistent size		Visual
		• Consistent and neat marking		Visual
		• Lippage between two tiles	= 1 mm	Caliper
D.	**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 to properly sealed		Visual
				Visual
E.	**Carpet**	1) Finishes		
		• Surface should be stretched and even	= 3 mm per 1.2 m	Spirit level and steel rule
		• Joints should not be visible		Visual
		• All edges should be properly anchored		Visual
F.	**Special Floor Finish**	1) Finishes		
		• Finished texture and colour to be uniform		Visual
		• Follow general requirement where applicable		
G.	**Raised Floor**	1) Finishes		
		• No loose floor panels or rocking		Visual
		• No protrusion/ potential of tripping over floor panels		Visual

QUALITY STANDARDS FOR ARCHITECTURAL WORKS (*Continued*)

Item	Element	Standards	Tolerance	Assessment Tool
II.	**INTERNAL WALLS**			
A.	**General Requirements**	1) Finishing		
		• No stain mark		Visual
		• Consistent colour tone and good paintwork		Visual
		• No rough/patchy surface		Visual
		2) Crack and Damage		
		• No visible damage/defect		Visual
		3) Hollowness/Delamination		
		• No hollow sound when tapped with a hard object		Tapping rod
		• No sign of delamination		Visual
		4) Alignment and Evenness		
		• Evenness of surface	=3 mm per 1.2 m	Spirit level and steel rule
		• Verticality of wall	=3 mm per 1.2 m	Spirit level and steel rule
		• Walls meet at right angle	=4 mm over 300 mm	L-square and steel rule
		• Edge to be straight and aligned	=3 mm per 1.2 m	Alignment laser and steel measuring tape
B.	**Plaster Finishes**	1) Finishes		
		• No visual crack		Visual
C.	**Tiled Finishes**	1) Finishes		
		• Joint are aligned between tiles and consistent size.		Alignment laser and Caliper
		• Consistent and neat marking.		Visual
		• Lippage between 2 tiles should not be more than 1 mm.		Spirit level and Steel rule.

QUALITY STANDARDS FOR ARCHITECTURAL WORKS (*Continued*)

Item	Element	Standards	Tolerance	Assessment Tool
	INTERNAL WALLS			
D.	**Painting**	1) Finishes		
		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
E.	**Wall Paper**	• Wall paper should be stretched and even surface	=3 mm per 1.2 m	Visual and spirit level
		• Joints should not be visible		Visual
		• Edges should be neatly laid and finished		Visual
		• Proper anchoring at all edges		Visual
F.	**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
G.	**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.	=3 mm per 1.2 m	Spirit level and steel rule
		• No sign of corrosion		Visual
H.	**Glass Blocks**	• Consistent and neat marking.		Visual
		• Joint should be even.		Visual
		• Glass blocks should be properly aligned.	=3 mm per 1.2 m	Spirit level and steel rule
J.	**Architectural Coating**	• Finished texture and colour to be uniform.		Visual

QUALITY STANDARDS FOR ARCHITECTURAL WORKS (*Continued*)

Item	Element	Standards	Tolerance	Assessment Tool
III.	**CEILING**			
A.	**General Requirements**	1) Finishing		Visual
		• No stain marks		Visual
		• Consistent colour tone		Visual
		• No patchy surface		Visual
		2) Alignment and evenness		
		• Surface should be smooth, even, not wavy		
		• Straightness of corners		Visual
		3) Crack and damages		Visual
		• No visible damage e.g. spalling, leaks, cracks, etc		Visual
		4) Roughness		Visual
		• No rough surface		Visual
		5) Jointing		Visual
		• Consistent, aligned and neat		Visual
B.	**Plaster/ Skim Coat/ Boarded Ceiling**	• No pin holes and with no trowel marks		Visual
		• Formwork joints are grounded smooth		Visual
		• Paintwork with good opacity and with no brush marks		Visual
		• Access door joints should be neat and have consistent width		Visual
		• No gap between wall and ceiling		Visual
		• No sign of corrosion		Visual

QUALITY STANDARDS FOR ARCHITECTURAL WORKS (*Continued*)

Item	Element	Standards	Tolerance	Assessment Tool
	CEILING			
C.	**False Ceiling/ Grid System**	• Alignment of rails should be visually straight • Chipped/cracked surfaces or corners should not be detected • Gap between ceiling and wall should not be detected • Panels should not warp and laid neatly into grids • No sign of corrosion		Visual Visual Visual Visual Visual

Item	Element	Standards	Tolerance	Assessment Tool
IV	**DOOR & WINDOW & FIXTURES (INTERNAL)**			
A.	**DOOR**	1) Joints & Gap		
		• Consistent gap between bottom of door leaf and finished floor	=5 mm	Caliper
		• No visible gaps between door frame and wall		Visual
		• Neat joints		Visual
		• Consistent gap between door leaf and frame	=5 mm	Caliper
		2) Alignment & Evenness		
		• Parallel to with the walls		Visual
		• Door frame to be plumb and square		Spirit level and L-square or laser beam
		• 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
		3) Material & Damages		
		• No stain marks and any visible damage		Visual
		• No sags, warps on door leaf		Visual
		• Door joints and nail holes filled up, properly sanded		Visual
		• Glazing clean and evenly sealed with gasket		Visual
		• No sign of corrosion		Visual
		• Good paintwork (including top and bottom of door leaf)		Visual
		4) Functionality		
		• Ease in opening and closing		Physical
		• No squeaky sound during opening and closing of the door	tested 5 times continuously	Physical
		• Lockset should be functional	tested 20 times continuously	Physical

Item	Element	Standards	Tolerance	Assessment Tool
	DOOR & WINDOW & FIXTURES (INTERNAL)			
		5) Accessories Defects		
		• Accessories with good fit and no stains		Visual
		• No sign of corrosion		Visual
		• No missing or defective accessories		Visual
		6) For timber frame, no additional timber strip added for site adjustment should be detected		Visual
B.	**WINDOW**	1) Joints & Gap		Visual
		• Consistent gap between window leaf and frame	=5 mm	Caliper
		• No visible gap between window frame and wall		Visual
		• Neat joint between window frame and wall internally and externally		Visual
		2) Alignment & Evenness		Visual
		• Parallel with wall opening		Visual
		• Window frame to be plumb and square		Spirit level and L-square or alignment laser
		• Window leaf and frame corner maintained at right angle	=4 mm per 300 mm	L-square and steel rule
		3) Material & Damages		
		• No stain mark & visible damage / defect		Visual
		• Louvered window with glass panels of correct length.		Visual
		• Glazing clean and evenly sealed with putty or gasket for aluminum windows		Visual
		• No sign of corrosion		Visual
		• Good paintwork		Visual

Item	Element	Standards	Tolerance	Assessment Tool
	DOOR & WINDOW & FIXTURES (INTERNAL)			
		4) Functionality		
		• Ease of opening and closing		Physical
		• No squeaky sound during opening and closing of the window	tested 5 times continuously	Physical
		5) Accessories defects		
		• Lock sets with good fit and aligned		Visual
		• No sign of corrosion		Visual
		• No missing or defective accessories		Visual
C.	**FIXTURES (INTERNAL)**	* Internal fixtures such as wardrobe, kitchen cabinet, vanity top, bathtub, water closet, shower screen, railings, basin, etc.		
i.	**General Requirements**	1) Joint & Gap		
		• Consistent joint width & neat joint		Visual
		• No visible gap		Visual
		2) Alignment & Evenness		
		• Level and in alignment		Visual
		3) Material & Damage		
		• No stain mark		Visual
		• No damage/defect		Visual
		• Consistent in colour tone		Visual
		4) Functionality		
		• Function, secured and safe		Visual and physical

Item	Element	Standards	Tolerance	Assessment Tool
	DOOR & WINDOW & FIXTURES (INTERNAL)			
		5) Accessory defect		
		• No missing accessory		Visual
		• No sign of corrosion		Visual
		• No damages/defect		Visual
		• Verticality of balusters	=3 mm per 1.2 m	Spirit level and steel rule
		• Railings should be securely anchored		Physical
		• Welding at joint must be grounded or flush		Visual

QUALITY STANDARDS FOR ARCHITECTURAL WORKS (*Continued*)

Item	Element	Standards	Tolerance	Assessment Tool
V.	**ROOF**			
A.	**General Requirements**	1) Finishing		
		• No stain marks		Visual
		• Good paint works		Visual
		2) Rough/ Uneven/ Falls		
		• Look smooth and with no tool marks		Visual
		• Even and level especially no potential in stripping		Visual
		• Falls in right direction		Visual
		3) Crack and damages		
		• No visible damage/ defects e.g. cracks, chip and etc.		Visual
		4) Joint/ Sealant/ Alignment		
		• Consistent joint width, neat and aligned		Visual
		5) Chockage/ Ponding		
		• No sign of chockage / ponding		Visual
		6) Construction		
		• No sign of leaking		Visual
		• Proper dressing for any protrusion		Visual
		• Neat and secured installation of fixtures		Visual
B.	**Flat roof**	• Ponding less than 3 mm		Steel rule
		• Surface to level to avoid tripping		Visual
		• Proper dressing for any protrusion		Visual
		• Openings to be sealed to prevent pest invasion		Visual
		• Clean and no stain marks		Visual

Item	Element	Standards	Tolerance	Assessment Tool
	ROOF			
C.	**Pitched Roof**	• No leaking		Visual
		• 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
		• Proper dressing for any protrusion		Visual
D.	**Waterproofing (exposed)**	• Should be evenly installed, no sharp protrusion		Visual
		• Complete adhesion to base		Visual
		• Good laps at joints and proper vertical abutment details		Visual
		• No leaking and sign of damage to membrane / coating		Visual
		• Clean and no mortar stains		Visual
		• No paint defects		Visual
E.	**Gutters and Rain water down pipes (RWDP)**	• No ponding and chockage		Visual
		• No cracks, chips and any other visible damages/ defects		Visual
		• RWDP inlet should be lower than the surrounding gutter invert level		Visual
		• Gutter and RWDP inlet to be covered to prevent chockage where practical		Visual
		• Clean and no cement stains		Visual

QUALITY STANDARDS FOR ARCHITECTURAL WORKS (*Continued*)

EXTERNAL FINISHES

Item	Element	Standards	Tolerance	Assessment Tool
VI	**EXTERNAL WALLS**			
A.	**General Requirements**	1) Finishing		
		• No stain mark		Visual
		• Consistent colour tone and good paintwork		Visual
		2) Crack and Damage		
		• No visible damage/ defect		Visual
		3) Roughness		
		• Not wavy and not patchy		Visual
B.	**Plaster Finishes**	• As per *General Requirement* above		
C.	**Tiled Finish**	• Joint are aligned between tiles, and consistent size		Alignment laser and caliper
		• Consistent and neat marking.		Visual
		• Lippage between 2 tiles should not be more than 1mm		Caliper
D.	**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
E.	**Facing Brickwork**	• 10 mm joint with marking		Steel rule or caliper
		• Weep holes are provided as specified		Visual
		• No efflorescence		Visual

Item	Element	Standards	Tolerance	Assessment Tool
	EXTERNAL WALLS			
F.	**Architectural Coating**	• Finished texture and colour to be uniform		Visual
		• No paint drips and other stains		Visual
G.	**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, blister and chalkiness		Visual and physical
H.	**Fixtures (External)** External fixtures such as signage, emergency lightings, railings, unit nos plate, lift fittings, letter box, lightings, etc.			
		General Requirements		
		1) Joints and gaps		
		• Consistent joint width & neat joint.		Visual
		• No visible gap		Visual
		2) Alignment and evenness		
		• Even level, align and consistent		Visual
		3) Material and damages		
		• No stain mark		Visual
		• No visible damage / defect		Visual
		• Consistent in colour tone		Visual

QUALITY STANDARDS FOR ARCHITECTURAL WORKS (*Continued*)

Item	Element	Standards	Tolerance	Assessment Tool
	EXTERNAL WALLS			
		4) Functionality		
		• Function, secured and safe		Visual and physical
		5) Accessory Defect		
		• No missing accessory		Visual
		• No sign of corrosion		Visual
		• No visible damage / defect		Visual

QUALITY STANDARDS FOR ARCHITECTURAL WORKS (*Concluded*)

Item	Element	Standards	Tolerance	Assessment Tool
VII	**APRONS AND PERIMETER DRAINS**			
A.	**General Requirements**	1) No stain marks and visible damages/ defects		Visual
		2) Finishes must be even, level, align and consistent		Spirit level/ steel rule/ measuring tape/ alignment laser
		3) Consistent joints width and neat		Visual
		4) Paintworks with good opacity, no patchiness and brush marks		Visual
		5) Fixtures installed must be safe, secured and functional		Physical and Visual
		6) Standards defined under Part 1: internal finishes, Part 2: roof and Part 3: External wall shall apply for similar items		
B.	**Perimeter drains and aprons**	1) Drain		
		• Free flowing and no ponding of water		Water or visual
		2) Drain Cover		
		• Level and do not warp or rock		Visual and physical
		• Gap between drain covers	5–10 mm wide	Caliper or measuring tape
		• Gap between sides of drain	5–10 mm wide	Caliper or measuring tape
		• Drain grating properly painted		Visual
		3) Apron		
		• No visible cracks		Visual
		• No water ponding		Visual
		• Bitumen joints with neat edges and sufficient length		Visual

ANNEX C
(Informative)

QUALITY STANDARDS MECHANICAL AND ELECTRICAL (M & E) WORKS

Item	Element	Standards	Tolerance	Assessment Tool
I	**ELECTRICAL**			
1)	**Main Cables**			
i	Properly supported	• Cables adequately supported		Visual
ii	Fire stop	• Fire stops properly installed		Visual
iii	Spacing of cable	• Adequate spacing between cables and avoid overlapping of cables		Visual
iv	No visible damage			Visual
2)	**Surface Conduits**			
i	Installation	• Conduit end properly connected • Metallic conduits properly earthed • Conduits properly bent without distortion and damage		Visual Visual Visual
ii	Support	• Support / brackets rigidly fitted • Screw used properly fastened		Visual and physical Visual and physical
iii	Fire stop	• Fire stops properly installed		Visual
iv	No visible damage	• Conduits and accessories properly painted		Visual
3)	**Cable Tray, Ladder and Trunking**			
i	Installation	• Joints protected against corrosion • Metallic trunking properly earthed		Visual Visual

QUALITY STANDARDS MECHANICAL AND ELECTRICAL (M & E) WORKS *(Continued)*

Item	Element	Standards	Tolerance	Assessment Tool
	ELECTRICAL			
ii	Support	• Support / brackets rigidly fitted • Screw used properly fastened		Visual and physical Visual and physical
iii	Fire stop	• Fire stops properly done		Visual
5)	**Distribution Board**			
i	Circuit diagram	• Circuit diagram provided • Proper labeling for panel		Visual Visual
ii	Cable termination/ Earthing	• All live parts to be non-accessible • All exposed metal parts effectively earthed		Visual Visual
iii	No visible damaged			Visual

QUALITY STANDARDS MECHANICAL AND ELECTRICAL (M & E) WORKS *(Continued)*

Item	Element	Standards	Tolerance	Assessment Tool
II	**ACMV WORKS**			
1)	**Ductwork**			
i	Paints	• Exposed ductwork and hanger properly painted to approve colour code		Visual
ii	Support	• Ductwork properly supported		Visual
iii	No visible damage			Visual
2)	**Fire-rated ducts**			
i	Installation	• No hanging of other services		Visual
ii	Access panel	• Fire-resistant sealed access panel provided with fire-rated enclosure of equipment for maintenance		Visual
iii	No visible damage			Visual
3)	**Dampers**			
i	Access door	• Damper / splitter damper can be adjusted freely between the open and close position		Physical
ii	No visible damage	• Access door provided to all dampers		Visual
4)	**Fire dampers**			
i	Installation	• Dampers in open position and held in position by fusible link		Visual
ii	Access door	• Access doors provided to all dampers according to relevant code of practice		Visual
iii	No visible damage			Visual

QUALITY STANDARDS MECHANICAL AND ELECTRICAL (M & E) WORKS *(Continued)*

Item	Element	Standards	Tolerance	Assessment Tool
	ACMV WORKS			
5)	**Split unit/ Window air conditioner**			
i	Installation	• Units are leveled when placed on plinth • Drainage provided/units slightly tilted for condensation • Drain hose connected to the drain pipe • Cool air is not blocked by wall beam, shelving or other built-in furniture in the room		Visual Visual Visual Visual
ii	Seal penetration	• Proper sealant of wall or roof opening after pipe are fixed		Visual
iii	Leakage	• No sign of leakage from pipe		Visual
iv	No visible damage			Visual
6)	**Air-con comfort**			
i	Temperature	• Room temperature between 23°C - 25°C or according to specification		Temperature meter
ii	Air flow	• Room airflow rate not exceeding 0.25 m/s or according to specification		Airflow meter
iii	Relative humidity	• Room relative humidity not more than 60 % or according to specification		Humidity meter

QUALITY STANDARDS MECHANICAL AND ELECTRICAL (M & E) WORKS *(Continued)*

Item	Element	Standards	Tolerance	Assessment Tool
III	**FIRE PROTECTION WORKS**			
A.	**Wet/Dry Riser**			
I	Landing Valve	• Landing valve must be accessible		Visual
		• Landing valve strapped & 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 highest mark of rising main		Visual
ii	Pipe & Pipe Support	• Riser pipes properly supported		Visual
		• Labeling & painting for riser pipe		Visual
		• Bonding to earth provided for rising main		Visual
iii	Wall/Floor Penetration	• Proper wall/floor penetration		Visual
iv	No Visible Damage			Visual
B.	**Sprinkler**			
i	Installation	• Double layer sprinkler for false ceiling > 800mm in depth		Visual
		• No obstruction and painting to sprinkler heads		Visual
		• Correct sprinkler heads used in correct locations		Visual
ii	Pipe Support	• Pipework properly supported		Visual
iii	Wall/Floor Penetration	• Proper wall/floor penetration		Visual
iv	No Visible Damage			Visual

QUALITY STANDARDS MECHANICAL AND ELECTRICAL (M & E) WORKS *(Continued)*

Item	Element	Standards	Tolerance	Assessment Tool
	FIRE PROTECTION WORKS			
C.	**Fire Alarm**			
i	Installation	• Fire alarm wiring in conduit (G1 type)		Visual
ii	Paints	• Panel and conduit properly painted		Visual
iii	Fire Alarm Zoning Diagram	• Fire Alarm zoning diagram provided near panel/sub-panel		Visual
iv	No Visible Damage			Visual
D.	**Hosereel**			
i	Installation	• Hosereel cabinet properly labeled • Hosereel pipe properly fixed with hanger & bracket • Hosereel operation instruction fixed on hosereel drum or door		Visual Visual Visual
ii	Paints	• Correct paint and good finish for hosereel		Visual
iii	No visible damage	• No visible damage		Visual

QUALITY STANDARDS MECHANICAL AND ELECTRICAL (M & E) WORKS *(Continued)*

Item	Element	Standards	Tolerance	Assessment Tool
IV	**PLUMBING & SANITARY WORKS**			
A.	**Exposed pipes**			
i	Installation	• Pipes properly support, bent without distortion, kink and damage		Visual
		• Joint are watertight		Visual
		• Pipe ends properly capped		Visual
		• No cold water pipes below sewerage pipes		Visual
ii	Alignment	• Horizontally, vertically and parallel aligned to building surface		Spirit level and measuring tape or alignment laser
		• Inclined pipes laid to proper gradients		Visual
		• Plumb =3 mm per 1m height		Plumb bob and measuring tape
iii	Clearance	• Do not cause obstruction / pose safety hazard at public area		Visual
		• Sufficient clearance between installed pipes / ceiling and pipes / wall for accessibility		Visual
		• Service pipe duct accessible		Visual
iv	No visible damage	• Painting with good opacity and no drippings		Visual
		• No visible damage		Visual
B.	**Water tank**			
i	Installation	• All openings properly covered		Visual
		• Joints and pipe connections are watertight		Visual
		• Not located below sewerage pipes		Visual

QUALITY STANDARDS MECHANICAL AND ELECTRICAL (M & E) WORKS *(Continued)*

Item	Element	Standards	Tolerance	Assessment Tool
	PLUMBING & SANITARY WORKS			
		• 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
ii	Netting	• Netting properly fitted for overflow/ warning/ vent pipes		Visual
iii	Clearance	• Accessible for maintenance Minimum clearance of 600 m all rounded the water tank		Visual
iv	No visible damage	• No visible damage		Visual
		• Clean & free from debris		Visual
C.	**Pump and motor**			
i	Installation	• No noticeable vibration & noise from pump/ motor		Visual
		• Test certificate for alignment of pump & motor from manufacturer		Visual
ii	Electrical termination	• No bad/ loose electrical terminations		Visual
iii	No visible damage			Visual

QUALITY STANDARDS MECHANICAL AND ELECTRICAL (M & E) WORKS *(Continued)*

Item	Element	Standards	Tolerance	Assessment Tool
V.	**BASIC M&E FITTINGS**			
A.	**General Requirements**	1) Joints and gap		
		• No visible gap		Visual
		• Consistent joint width & neat		Visual
		2) Alignment & Evenness		
		• Aligned, leveled and straight		Spirit level/ measuring tape/ steel rule/ alignment laser
		3) Material & Damages		
		• No visible damage/ defects		Visual
		• No stain marks		Visual
		• Securely fixed		Visual
		• Consistent colour tone		Visual
		4) Functionality		
		• Functional and safe		Physical and visual
		5) Accessories defects		
		• No missing accessories		Visual
		• Visible damage/ defects		Visual
B.	**Plumbing & Sanitary Fittings**			
i	Gully & Floor trap	• No damage and choked		Visual
		• Must be securely fixed		Visual
		• Trap's top lower than the surrounding floor level		Visual
ii	Pipes	• Visually aligned horizontally, vertically and parallel to building surface		Spirit level and measuring tape or alignment laser
		• Inclined pipes laid to proper gradients		Visual
		• No leakage at joints		Visual

Item	Element	Standards	Tolerance	Assessment Tool
	BASIC M&E FITTINGS			
		• Plumb <10 mm/storey height		Plumb bob and measuring tape
		• Brackets firmly secured & joints properly sealed & marked		Visual
		• If painted, no drippings & with good opacity		Visual
		• Pipes properly support, bent without distortion, kink and damage		Visual
		• Sufficient clearance between installed pipes and building surface for accessibility		Visual
iii	Fittings	• Firmly secured & joints properly sealed & 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
		• No sediments / particles found in water collected at terminal water fittings (remove aerator & showerhead)		Visual
		• All sensors covers properly sealed against water seepage		Visual
C.	**M&E Fittings**	• e.g. power mark, telephone mark, air-con diffuser, fan coil unit, lighting, smoke alarm, sprinkler heads, CATV/CCTV camera, etc.		
i	Installation	• Fittings must be aligned		Measuring tape
		• No stains		Visual

QUALITY STANDARDS MECHANICAL AND ELECTRICAL (M & E) WORKS *(Concluded)*

Item	Element	Standards	Tolerance	Assessment Tool
	BASIC M&E FITTINGS			
		• Neat patch-up for marking/ penetration • Heights of switch and marks should be consistent • Switch can properly function • No visible gaps between switch and marks and wall • Brightness of lights	On and off for 20 times non-stop.	Visual Measuring tape Physical Visual Brightness meter
ii	Safety	• No exposed wiring within reach		Visual
iii	Damages	• No visible damage		Visual

ANNEX D
(Informative)

QUALITY STANDARDS FOR EXTERNAL WORKS

Item	Element	Standards	Tolerance	Assessment Tool
I	**EXTERNAL WORKS**			
A.	**Link-way/Shelter**	• Floor as per internal finishes for floor where applicable • Column as per *External Wall* where applicable • Ceiling as per internal finishes where applicable • Other finishes as per *Fixtures - External* • M & E Fittings as per *Basic M & E Fittings* • No sign of corrosion		Visual
B.	**External drains**	1) Drain • Free flowing and no ponding of water		Visual
		2) Drain Cover • Level and do not warp or rock		Visual and physical
		• Gap between drain covers.	5–10 mm wide.	Caliper or steel measuring tape
		• Gap between sides of drain	5–10 mm wide.	Caliper or steel measuring tape
		• Drain grating properly painted		Visual
	-	3) Apron • No visible cracks		Visual
		• No water ponding		Visual
		4) Inspection Chamber • Inspection chambers are level with surrounding without depression and with tolerance of 20 mm for protrusion		Visual and steel measuring tape
		• Covers to be level with frames		Visual

QUALITY STANDARDS FOR EXTERNAL WORK (*Continued*)

Item	Element	Standards	Tolerance	Assessment Tool
	EXTERNAL WORKS			
C.	**Roadwork and Car park**	1) Road surface		
		• No water ponding		Visual
		• Road painting according to drawings	+ 5 mm	Measuring tape
		• Gaps between aeration slabs properly filled up with sand		Visual
		• Aeration slabs stable and not broken		Visual
		2) Kerbs		
		• Consistent joint width & neat		Visual
		• No stain marks and visible damages/ defects		Visual
		• Finishes must be even, level, align & consistent		Visual
		• Good paint works		Visual
		3) Road Sign		
		• Firm and secured at base - with footing if required		Visual
		• Metals parts below ground are corrosion treated		Visual
		4) Lightings - as per *Road Sign* above		
D.	**Footpaths and Turfing**	1) Footpath - as per *Internal Finishes - Floor*		
		2) Turfing		
		• Turfing should be according to drawing & specification – spot/close turfing		Visual
		• No depression or bald patches		Visual
		• Turfing done evenly, no dead grass or weeds		Visual

Item	Element	Standards	Tolerance	Assessment Tool
	EXTERNAL WORKS			
		3) Lighting • Firm and secured at base - with footing if required		Visual
		4) Other fixtures • As per *Fixtures- External*		
E.	**Playground**	1) Floor - as per *Internal Finishes- Floor*		
		2) Permanent Fixture - as per *External Fixtures*		
		3) Lightings • Firm and secured at base - with footing if required		Visual
		• Metals parts below ground are corrosion treated		Visual
		4) Signage - as per *External Fixtures* • Firm and secured at base - with footing if required		Visual
		• Metals parts below ground are corrosion treated		Visual
F.	**Court**	1) Floor - as per *Internal Finishes - Floor*		
		2) Signage - as per *Fixtures - External* • Firm and secured at base - with footing if required		Visual
		• Metals parts below ground are corrosion treated		Visual
		3) M & E Fittings - as per *Basic M & E Fittings*		
		4) Permanent Fixture - as per *Fixtures - External*		

QUALITY STANDARDS FOR EXTERNAL WORKS (*Concluded*)

Item	Element	Standards	Tolerance	Assessment Tool
	EXTERNAL WORKS			
G.	**Fence & Gate**	• vertical tolerance for piers to be perpendicular & straight	=5 mm per 1.2 m	Spirit level, L-Square and steel rule
		• Fencing to be plumb and straight	=5 mm per 1.2 m	Spirit level, L-Square and steel rule
		• Good paintworks		Visual
H.	**Swimming Pool**	1) Overflow drain - as per *Internal Finishes – floor and drain*		
		2) Pool deck tile - as per *Internal Finishes-Floor*		
		3) Ladder and railing properly secured - as per *External Fixtures*		
		4) Other fixtures - as per *Fixtures - External*		
		5) Signage - as per *External Fixtures*		
J.	**Electrical Substation**	1) External wall - as per architectural - external wall		
		2) Doors and windows - as per architectural		
		3) Fencing and gate - as per external -fencing and gate		

ANNEX E
(Informative)

DEFECT GROUP FOR ASSESSMENT OF

ARCHITECTURAL WORKS (INTERNAL FINISHES)

COMPONENTS	DEFECTS GROUPING	DEFECTS DESCRIPTION	TOLERANCE
Floors & Internal/ External Walls	Finishing	Stain mark	-
		Colour tone & paintwork	-
		Patchy & rough surface (for internal walls only)	-
	Alignment and evenness	Evenness of surface	=3 mm/ 1.2 m
		Falls in wet areas	-
		Variance in lengths of treads and risers for staircases	=5 mm
		Verticality of wall	=3 mm/ 1.2 m
		Walls meet at right angles	=4 mm/ 300 mm
		Edges of walls to be straight and aligned	=3 mm/ 1.2 m
	Crack and damages	Damages/ defects	-
	Hollowness/ Delamination	-	-
	Jointing	Skirting thickness	-
		Gaps between wall & skirting	-
		Edges of floors to be straight and aligned	=3 mm/ 1.2 m
Ceiling	Finishing	Stain mark	-
		Colour tone	-
		Patchy surface	-
	Alignment and evenness	Surface smooth, even & not wavy	=3 mm/ 1.2 m
		Straightness of corners	-
	Crack and damages	Spalling & leaks	-
	Roughness	Rough surface	-
	Jointing	Consistent, align & neat	-
Door & Window	Joints and Gap	Gap between bottom of door leaf & finished floor	=5 mm
		Gaps between window/ door frame & wall	-
		Neat joints between frame & wall internally & externally	-
		Gap between window/ door leaf & frame	=5 mm
	Alignment and evenness	Parallel with wall opening	-
		Window/ door frame to be plumb & square	-
		Window/ door leaf & frame corners at right angles	-
		Double leaf doors to flush with each other	-
		Door frame & leaf to flush	-
	Material and damages	Stain mark (corrosion) & defect	-
		Louvered window with glass panels of correct length	-
		Glazing clean, evenly sealed with putty or gasket	-
		Sags/ warps on door leaf	-
		Nail holes & joints proper for door	-
		Good paintwork (including top & bottom of door leaf)	-
	Functionality	Ease in opening & closing	-
		No squeaky sound during opening & closing	5 times
		Lockset for door	20 times
	Accessories defects	Lock sets are aligned with good fit & no stain (corrosion)	-
		Missing/ defective accessories	-

	-	No additional timber strip added for timber frame	-

ANNEX F
(Informative)

MARKS ALLOCATION TABLE FOR M & E WORKS ASSESSMENT

	MARKS ALLOCATED
Electrical	
1. Embedded conduit	2
2. Main cable	1
3. Surface conduits	2
4. Cable tray, ladder and trunking	2
5. Distribution board	4
ACMV	
1. Air handling unit	2
2. Pump	1
3. Cooling tower	1
4. Chillier	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

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