CHAPTER 3

BUILDING CONSTRUCTION QUALITY ASSESSMENT IN MALAYSIA

This chapter deals with the most quality assessment for properties in Malaysia have been used, which will be study in details. The method of assessment, person who involved in the assessment and any information about the building quality assessment will be studied.

Building Quality Assessment

In accordance with The Rider Levett Bucknall (1999), Building Quality Assessment (BQA) service addresses this need with a standardized method for evaluating and quantifying building quality based on standard criteria across a number of predetermined categories.

BQA is a tool for scoring the performance of a building, relating actual performance to identified requirements for user groups in that type of building. It can be used as an aid for portfolio or asset management, rent reviews, investment appraisals, purchasing or selling properties, defining quality at briefing stage for new build and refurbishment, and judging alternative design proposals (Michael Clift, 1996).

3.1 CONSTRUCTION QUALITY ASSESSMENT SYSTEM (CONQUAS)

(Source: Building and Construction Authority, Singapore (2008) The BCA Construction Quality Assessment System (seventh Edition) Singapore)

3.1.1 CONQUAS Derivation

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

The feedback through complaint and defects listing were also considered in refining the weightages and assessment standard to match the expectations from the end users.

In developing CONQUAS 21, studies and numerous trials were conducted to fine-tune it assessment standards and new test techniques. Moderation of the scoring system was carried out along with the trials to ensure its accuracy and consistency.

3.1.2 Objectives of CONQUAS

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

CONQUAS was designed with three objectives:

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

(b) To make quality assessment objective by

-measuring constructed works against workmanship standards and specification.

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

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

Unless specified in the building contract, the builders should not take CONQUAS for decision making if the building projects are acceptable. Therefore, CONQUAS is an independent assessment.

3.1.3 Scope of CONQUAS 21

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

CONQUAS 21 covers most aspects of the general building works. The assessment consists of three components:

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

Each component is divided into different items for assessment. However, the assessment excludes works such as heavy foundation, piling 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 and on the completed building for Architectural Works.

Apart from site inspection, the assessment also includes test on the materials and the functional performance of selected services and installation. These tests help to safeguard the interest of building occupants in relation to safety, comfort and aesthetic defects which surface only after sometimes.

3.1.3.1 Structural Works

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

(i) Site inspection of formwork, steel reinforcement, prefabricated components and so on 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.

3.1.3.2 Architectural Works

Architectural works deals mainly with the finishes and component. This is the part where the quality and standard of workmanship are most visible. The assessment covers:

(i) Site inspection of internal finishes, roofs, external walls and external works at the completion stage of the building. Internal finishes include floors, internal walls, ceiling, doors, windows and components (architectural works that are not classified above).

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

3.1.3.3 Mechanical & Electrical (M& E) Works

M&E works quality of is important in view of its impact on the performance of a building and its increasingly high cost proportion and. The assessment covers Fire Protection Works, Sanitary &Plumbing Works, Electrical Works, Air-conditioning & Mechanical Ventilation Works (ACMV) and the basic M&E fittings. The stages of the assessment include:

(i) Site inspection of installed works before embedded/concealed. Such items include ACVM ductworks, Electrical conduits, and concealed pipes.

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

(ii) Performance tests on selected works such as the water pressure test, earthing test, dry riser test

3.1.4 The Weightages

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

Table 3.1(a): Weightages for Architectural, M & E Works and Structural

Components	**Category A** (Commercial, Industrial, Institution & others).	**Category B** (Commercial, Industrial, Institution & others).	**Category B** (Private Housing).	**Category C** (Public Housing).	**Category D** (Landed Housing).
Structural Works	25%	30%	25%	35%	30%
Architectural Works	55%	60%	65%	60%	65%
M & E Works	20%	10%	10%	5%	5%
CONQUAS Score	100%	100%	100%	100%	100%

Note: In general, projects with central cooling system having cooling tower, chiller system are classified under Category A. Otherwise, it will be classified under Category B.

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

3.1.5 CONQUAS Assessor

Building and Construction Authority (BCA) Singapore assessors undergo a vigorous training programme. They are required to attend calibration programme and BCA's CONQUAS training to ensure consistency and competency in the assessment

3.1.6 Sampling

It is considered impractical to assess all building elements. Therefore CONQUAS 21 uses a sampling for the assessment system. To ensure that the assessment adequately represents the entire building, the sampling system is mainly based on the gross floor area of the building.

3.1.7 THE ASSESSMENT

3.1.7.1 Assessment Approach

Normally, the assessor selects the location to be assessed prior to each assessment. Selection of samples is based on location plans and drawings/layout and, the samples are distributed as uniformly as possible throughout the construction stages.

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

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

3.1.7.2 Architectural Works Assessment

Assessment of Architectural works is carried out upon completion of the building and before handing over of the project to the owner. The assessment consists of the following items:

Table 3.1 (b): Assessment of Architectural Elements

Architectural Elements	Weightage %	
	Total	Breakdown
Internal Finishes	56	
Floor		16
Internal Wall		16
Ceiling		6
Door		6
Window		6
Component		6
Roof	4	4
External Wall	12	
External Work	6	
Material & Functional Tests	22	
Pre-packed Plaster		1
Field Window Water –Tightness Test (WTT) (BCA test 8 pts +Self-Testing 2 pts)		10
Wet Area Water – Tightness Test (BCA Test 4pts + Self – Testing 1 pt)		5
Internal Wet Area Waterproofing Process		2
Pull-Off-Test for internal wall tiles		4
Total	100	

The assessment is based on the sampling guidelines as follow:

Table 3.1 (c): Architectural Works Sampling Guidelines.

	Items	**GFA per Sample**	**Min Sample**	**Max Sample**	**Remarks**
1	Internal Finishes	500m²	30	150	For Non-Housing Project
1a	Internal Finishes	70m²	30	800	For all Private Housing Project
1b	Internal Finishes	70m²	30	600	For Public Housing
2	External Wall	-	50%	-	50% of the blocks/units
3	External Work	-	1	-	1 for each type pf external work
4	Pre-packed Plaster	-	-	-	Only pre-packed plaster used. Declaration by Qualified Person
5a	Field Window Water-tightness Test (WTT)	1,000m²	20	100	Conducted by BCA
5b	Field Window Water-tightness Test (WTT)	-	25%	-	Self-testing with declaration by Qualified Person
6a	Wet Area Water-tightness Test	-	20	100	-10% of all bathrooms and/or toilets (by location) -All will be tested if <20nos -not required for non-housing project if <20nos
6b	Wet Area Water-tightness test	-	100%	-	-Self-Testing with declaration by Qualified Person -Including flat roof
7	Internal Wet Area Waterproofing Process	-	-	-	In-process assessment based on approved Method Statement
8	Pull-Off Test for Internal Wall Tiles	10,000m²	1 Set	5 Sets	5 tiles per set (by location)

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

Principal locations are major functional places such as halls and rooms. Service locations are utility areas such as toilets, kitchens, balconies and yards. Circulation locations include lift lobbies, corridors and staircases.

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

Table 3.1 (d): Percentage set out in the four building categories.

Locations	**Category A** Commercial Industrial Institution Others	**Category B**		**Category C** Public Housing	**Category D** Landed Housing
		Housing	Non-Housing		
Principal	60%	40%	60%	40%	40%
Service	15%	40%	15%	40%	40%
Circulation	25%	20%	25%	20%	20%

Normally, any item which is not available in a project will not be considered for scoring. Therefore the architectural score will be pro-rated accordingly.

If an item under assessment do does not meet the standards, it will be considered failed. In addition, any item found to be defective functionally, 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 roof assessment, a minimum 50% of the total number of building will be assessed. This applies to the external walls assessment where a minimum 50 % of the total number of buildings will be required.

The external works assessment consists of the following locations:

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

All the locations listed above must be assessed where applicable and each item in the External Works will be assessed separately. Under the functional and material tests, self-testing item like field window water tightness test for 25% of windows and 100% wet area water-tightness test (including flat roof) and the use of pre-packed plaster for all plaster works are based on declaration by the project Qualified Person (QP).

3.1.7.3 Assessment of M & E Works

The assessment of M&E Works will be carried out in two steps: during the construction of structural works and upon completion of the building. The assessment covers the following areas, with their weightages allocated in accordance with the four projects categories:

Table 3.1 (e): Weightages for the M&E Assessment based on category.

M&E Elements	**Category A**	**Category B**	**Category C**	**Category D**
M&E Works Assessment				
Electrical	15	15	10	10
ACMV	20	20	-	10
Fire Protection	10	10	10	-
Plumbing & Sanitary	15	15	20	-
Basic Fittings	15	15	60	80
Sub-total	75	75	100	100
Weightage	50%	50%	100%	100%
M&E Performance Test Assessment				
Performance Testing	100	100	-	-
Weightage	50%	50%	-	-
Total	**100%**	**100%**	**100%**	**100%**

Note 1: “-" means that no assessment on that M&E elements is required.

Covering Electrical, ACMV, Performance Testing Fire Protection and Sanitary & Plumbing, is assessed based on “Get-It-Right-First-Time” principle. The assessment will be based on the percentage of tests passing the first inspection for each type of test.

Table 3.1 (f): The score will be pro-rated.

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

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

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

Sampling of M&E works will be determined based on the four building categories as per the guidelines below:

Table 3.1 (g): M&E Works Sampling Guidelines.

	Category A 1,000m² per sample	Category B 1,500m² per sample	Category C 3,500m² per sample	Category D 3,500m² per sample
Electrical				
1. Embedded conduit	2+	2+		2+
2. Main cables	1	1		
3. Surface conduits	1+	1+	1+	1+
4. Cable tray, ladder & trunking	1+	1+	1+	1
5. Distribution board	2+	2+		1
ACMV				
1. Air handling unit	1+			
2. Pump	1			
3. Cooling tower	1			
4. Chiller	1			
5. Pipework	1			
6. Split unit/Window air conditioner	2+	2+		3+
7. Air-con confort	1+	1+		2+
8. Ductwork	3+	1		
9. Fire-rated duct	1	1		
10. Dampers	1+	1		
11. Fire Dampers	1	1		
12. Flexible ducts	2			
13. Flexible connectors	1			
Fire Protection				
1. Wet/Dry riser	1+	1+	1+	
2. Sprinkler	1+	1		
3. Fire Alarm	1	1		
4. Hosereel	1+	1+	1+	
Plumbing & Sanitary				
1. Concealed pipes	1+	1+		
2. Exposed pipes	4+	4+	4+	
3. Water tank	1	1	1	
4. Pump	1	1	1	
Minimum Samples	35	25	10	10
Maximum Sample	70	50	20	20

Remarks: + means to be repeated for additional samples required

Note: Basic M&E Fittings-500 m² per sample with min 30 and max 150 samples

3.2 QUALITY ASSESSMENT SYSTEM FOR BUILDING CONSTRUCTION WORK (QLASSIC)

(Source: Construction Industry Development Board Malaysia (2006). Quality Assessment System for Building Construction Work. Malaysia)

Quality Assessment System for Building Construction Work is a method to assess and evaluate the quality of building projects workmanship based on this standard independently.

3.2.1 Derivation of QLASSIC

This Malaysia 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 facilitator and moderator for the technical committee throughout the development process of the standard.

3.2.2 Assessment

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

3.2.3 Weightage

The weightage for external works, architectural, structural and M & E are allocated in accordance to four buildings categories as follo:

Table 3.2 (a): Weightage for structural, architectural, M&E and external works

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 is aimed at making the score quantitatively in representing the workmanship quality 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 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.

3.2.4 QLASSIC assessors

Assessors must attend the training courses which were held by the QLASSIC before being qualified to carry out the actual assessment at the construction sites. The QLASSIC assessors are continuously updated to ensure effective and consistency implementation of the assessment.

3.2.5 Sampling

The assessment is also carried out through a sampling approach. The sampling 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.

3.2.6 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 below:

Table 3.2 (b): The weightage for architectural elements

Architectural elements		Weightage %	
		Total	Breakdown
Internal Finishes		56	
	Floor		16
	Internal wall		16
	Ceiling		6
	Door		6
	Window		6
	Fixture (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 as follow.

Table 3.2 (c): Architectural Work sampling guidelines

No.	Items	GFA per sample	Min Sample	Max Sample	Remarks
1a	Internal Finishes	70 m2	30	700	For landed housing.
1b	Internal Finishes	70 m2	30	600	For stratified housing
1c	Internal Finishes	500 m2	30	150	For public building
1d	Internal Finishes	500 m2	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)	1000 m2	20	100	Independent testing
6b	Field window water-tightness test (WTT)	-	25%	-	Self-testing with declaration by qualified person
7a	Wet area water-tightness	-	20	100	- 10 % of all bathrooms and/or toilets (by location) - all will be tested if < 20 nos.
7b	Wet area water-tightness	-	100%	-	- Self-testing with declaration by qualified person
8	Pull-off test for internal wall tiles	10000 m2	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 categorized into three types, they are:

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

ii) Circulation locations include lift lobbies, corridors and staircases.

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

Table 3.2 (d): 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

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"				

Scoring of internal finishes is based on the defects groups. In general, any item which is not available in a project will not be considered for scoring. The architectural score will be pro-rated accordingly.

If an item does not meet the standards under assessment, it will be considered failed. In addition, any item found to be defective functionally is considered to have failed the assessment. Likewise for a particular defect that is found excessive in an item.

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 functional and material 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).

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

b) Link-way/Shelter - 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) Court - 1 location;

f) Playground - 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) Guard House - 1 location

j) Electrical substation - 1 location

k) Rubbish Chamber - 1 location

Each item in the external works will separately be assessed 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.

3.2.8 Mechanical and electrical (M & E) works assessment

3.2.8.1 Completed projects

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

3.2.8.2 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:

Table 3.2 (e): The weightage for M&E Work elements

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

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 following:

Table 3.2 (f): M&E Works sampling Guidelines

	Category A Landed Housing 3 500 m2 per sample	**Category B** Stratified Housing 3 500 m2 per sample	**Category C** Public Building 1 000 m2 per sample	**Category D** Special Building 1 000 m2 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 m2 per sample with min 30 samples and max 150 samples** 2. Remarks: means to be repeated for additional samples required				

3.2 (g): 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 the following:

Table 3.2 (h): Typical reinforced concrete structure samples for assessment

	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 minimize 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 pre-stressed concrete and weightage for structural steelwork are allocated as per below:

Table 3.2 (i): Weightage for structural steelwork.

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.	

Table 3.2 (j): Weightage for and pre-stressed concrete.

Pre-stressed concrete work	**Weightage %**
Tendon and anchorage	25
Sheathing	25
Stressing and grouting	25
Debonding	25
Total	100

Table 3.2 (k): The selection of sample for structural steel works assessment guidelines:

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.		

3.3 BUILDING PERFORMANCE ASSESSMENT

(Source: Hong Kong Housing Authority (2006) Performance Assessment Scoring System. Hong Kong)

Hong Kong Housing Authority have developed the Performance Assessment Scoring System (PASS) and the Maintenance Assessment Scoring System (MASS) respectively, to maintain the standard of works for new building works projects and maintenance projects.

These systems were established to objectively measure the performance of the contractors and the quality of work done by the contractors for Housing Authority projects against defined standards and thus provide a fair means of comparing their individual performance.

The systems have been refined over the years and proven to be a useful tool for selecting better performing contractors to tender for upcoming projects. They have also been enhancing, reviewing and monitoring the systems to ensure that they continue to operate effectively.

3.3.1 Performance Assessment Scoring System (PASS)

Performance Assessment Scoring System (PASS) assessments are conducted through site inspections, desk-top assessments and record checks by relevant Project Team (PT) members and PASS Assessment Team (PAT). The assessments comprise:

a) Work Assessment, including:

    i) Architectural Works (Interim) Assessment

ii) Engineering Works Assessment

b) General Assessment including:

i) Environment and Other Obligations Assessment

ii) Programme and Progress Assessment

iii) Safety Assessment

iv) Management Input Assessment

c) Maintenance Period Assessment

d) Architectural Works (Final) Assessment

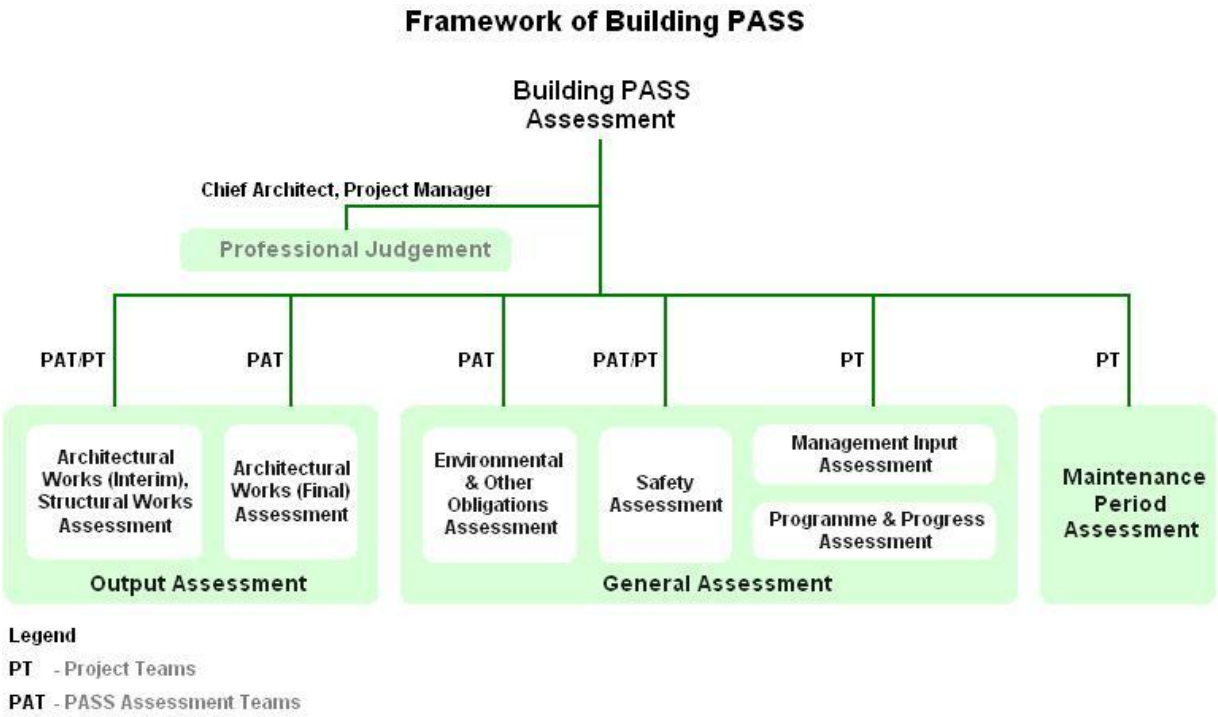

Figure 3.1 Building PASS Framework

(Source:http://www.housingauthority.gov.hk/en/common/image/business-partnerships/resources/building-pass/BPASS.jpg, 30th March 2008, 8:30pm)

3.3.1.1Engineering Work Assessment

The Engineering Works Assessment comprises Site Formation Works Assessment and Structural Works Assessment.

The Structural Works Assessment comprises on-site inspection of various key trades and site inspection records. It is composed of four main factors:

a. Formwork & Falsework;
b. Reinforcement;
c. Construction Quality & Practice; and
d. Finished concrete

The Site Formation Works Assessment comprises on-site inspection of geotechnical works and site records. It is composed of five factors:

a. Backfilling and Compaction;
b. Excavation and Lateral Support;
c. Retaining Wall;
d. Slope; and
e. Other Geotechnical Works.

3.3.1.2 Architectural Works (Interim) Assessment

The Architectural Works (Interim) Assessment comprises on-site inspection of various key trades and inspection of regular test results required under the contract to be conducted on critical items susceptible to latent defects. The assessment will cover procedural checks emanating from the inspections on site, such as compliance with specified trade procedures and standards of workmanship and finishes in progress.

The architectural Works (Interim) Assessment is composed of ten(10) factors:

a. Floor
b. External Wall Finishes
c. Internal Wall Finishes
d. Ceiling
e. Windows
f. Components
g. Plumbing/Drainage
h. Waterproofing
i. Precast Components
j. Shop Front & Cladding

3.3.1.3 Management Input Assessment

The Management Input Assessment measures the Contractor's site management capabilities directly against defined standards and provides a fair means of comparing the performance of individual contractors.

The Management Input Assessment is composed of four (4) factors:

a. Management and Organization of Works;
b. Resources;
c. Co-ordination and Control; and
d. Documentation.

3.3.1.4 Programme and Progress Assessment

The Programme and Progress Assessment is conducted mainly by referring to adequacy of the contractor's programme. Progress performance is assessed by using two (2) basic complementary "tools" to guide the actual progress achievement in the period under assessment in a more complete and wider perspective.

The Programme and Progress Assessment is composed of six factors:

a. Programming
b. Milestone Dates (Prior to Completion)
c. Milestone Dates (Building Services)
d. Milestone Dates (Architectural Works)
e. Milestone Dates (Structural Works)
f. Milestone Dates (Site Formation Works)

3.3.1.5 Environmental and Other Obligations Assessment

The Environment and Other Obligations Assessment is composed of two (2) factors:

a. Site Security, Access and Storage of Materials; and
b. Environmental, Health and Other Provisions.

3.3.1.6 Safety Assessment

The Safety Assessment is composed of four (4) factors:

a. HASAS Score for Implementation of the Safety & Health Plan

b. Housing Authority Safety Audit Scheme (HASSA) Score for Safety & Health Management System
c. Block Related Safety
d. General Site Safety

3.3.1.7 Architectural Work (Final) Assessment

The Architectural Works (Final) Assessment will cover detailed on-site inspection of the final "as-built" workmanship and finishes to flats, public areas and external works at the completion stage of the building. It is at the stage that any evidence of poor workmanship is most patently visible, particularly in the areas of internal and external walls, doors, ceiling, components, window and so on.

The Architectural Works (Final) Assessment is composed of 14 factors:

a. Floor;
b. Internal Wall Finishes;
c. External Wall Finishes;
d. Ceiling;
e. Windows;
f. Plumbing;
g. Components;
h. Precast Components;
i. Shop Front;
j. Footpath/Pedestrian Area (External Works);
k. Roads/Emergency Access (External Works);

l. Cleanliness and Care of the Finishing Works;

m. Miscellaneous (External Works); and

n. Record Checking of Final Inspection/Tests

3.3.1.8 Maintenance Period Assessment

The Maintenance Period Assessment is to assess the contractor's performance on a project during the Maintenance Period following completion certification.

The Maintenance Period Assessment is composed of three (3) factors:

a. Management, Co-ordination and Documentation.

b. Defects and Works of Repair; and

c. Outstanding Works.

3.3.2 Building Work MASS

Building Works (BW) MASs assessments are carried out for all building works contracts (except civil engineering, geotechnical engineering demolition contracts and piling contracts) tendered out by the Estate Management Division of the Housing Department. BW MASS comprises two (2) assessments; which are Input Assessment and Output Assessment.

3.3.2.1 Output Assessment

Output Assessment is conducted monthly by professionals and senior technical staff based on site inspection records selected by sampling. Evidence of non-compliance

and compliance will be considered when assessing the contractors' output quality. It has five (5) aspects:

a. Standard & Quality Material

   -Characteristics and quality to be approved and/or as specified

b. Quality of Workmanship & Finishes

   i. Material fixing, placing, mixing, laying and connection;

   ii. Preparatory and/or temporary work to be approved and/or as specified;

   iii. Surface finish, soundness, thickness, evenness, coverage, crack, leakage, protection and cleaning; and

   iv. Alignment, plumb, level, fall and square, bonding, bedding, grouting, dressing, pattern, jointing, welding, priming and coating.

c. Job Progress

   -Milestone dates

d. Site Management

   i. Environmental protection, including storage and dumping;

   ii. Temporary protection and access operation of lifting appliance, and provision of warnings/notices;

   iii. Safety equipment and appliance for personal protection; and

   iv. Protective and hygiene measures, site cleanliness and reinstatement to works.

e. Customer Services

   i. Attitude and behaviors;

   ii. Emergency handling; and

iii. Pre-work arrangement including making appointment with tenants, punctuality of works appointment, briefing to tenants, response to tenants' queries;

iv. Protection to tenants' fixtures, furniture and post-work follow-up.

3.3.2.2 Input Assessment

The Input Assessment, carried out quarterly to assess the quality and effectiveness of contractors' input as well as the standard of their services delivered, covers the aspects as follow:

1. Management Input
    a. Organization structure & management of works

        -core management and supervisory staff

        -corporate support

        -sub-contractors

    b. Resources

        -Labour, plant and material

    c. Co-ordination and control

        -wage payment protection measures

        -communication and response

        -Co-ordination and control of works

    d. Documentation

        -material, record and document submission

2. Management of Pledges and Programmes

   -Achievement/rejection rates

3. Safety Management

   a. Compliance of safety regulations

   b. Accident rate or near-miss incident

   c. Safety system of work

4. Environmental and Other obligations

   a. Other obligations

   b. Construction Waste Management

5. Stakeholders' Feedback

   a. Services to tenants

   b. Public relation

   c. Management of complaints and/or claims

   d. Major Stakeholders' commendations/warnings