SUPERVISION GUIDE
For Mechanical Engineering Works



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Jan 2012 Edition

architectural I civil I electrical I **mechanical** I structural

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1 Introduction

This book serves to guide our Consultants in supervising mechanical engineering works for new HDB development projects. HDB's general requirements and some examples cited are only for reference purposes. The Consultants shall develop their own comprehensive supervision system and specific checklists/forms for each project.

The Consultant shall submit the following to HDB Project Director according to the proposed timeline to ensure timely completion of works:

S/n	Description	Timeline
1	QP's responsibility in checking different stages of works	Before start of Contract
2	Inspection forms for mechanical engineering works for Site Supervisors	Before work starts
3	Material selection and testing	
4	Workshop drawings	
5	Instructions and records	Upon resolution of each item / issue *

* HDB Project Director is to be consulted on the issues in advance if necessary.

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2 Material Selection

Material List

A wide selection of products which have met HDB's requirements are found in the HDB Material List. The list serves to help Consultants choose products with good track records in quality and reliability for use in HDB Residential Housing. The HDB Materials List can be viewed from the web address: http://ml.eptc.sg.

The HDB Material List includes pipes & pipe fittings, pumps & motors, valves, sanitary fixtures and refuse handling system.

Consultants may also propose products which are not in HDB Materials List. However, these products are subject to HDB's concurrence and must meet the specified performance / quality criteria.

Approval of Material

The Consultant shall approve all mechanical material samples as specified in the Contract before setting up of timber mock up and sample units.

Before approving any product, the Consultant must ensure that it conforms to Specifications and Drawings, the relevant Code of Practice and any other statutory requirements.

The approved samples must bear the Consultant's endorsement and be displayed in the site office's sample display room for verification against those installed on site.



The Consultant shall supervise and ensure all mechanical fittings are carried out with the approved material and using approved installation methods.

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Material Testing

The Consultant shall randomly select material listed in “Schedule of Material Tests” at the site for testing in a timely manner. Selected samples are to be marked for identification before sending to the relevant test laboratory. The test laboratory must be accredited for the test in question.

The tests are to ascertain that the material complies with the performance standard stated in the Specifications. All test results must be reviewed by the Consultant. If there is a test failure, Consultant must inform HDB immediately and follow up with a re- test at no additional cost to HDB. If the re-test fails, Consultant shall recommend follow-up actions for HDB’s concurrence.

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3 Timber Mock-Up

Purpose

With the extensive use of precast components in HDB residential building, it is important to provide timber mock-ups on site at the beginning of construction. This allows adjustments to be made to the workshop drawings before precast production and thus prevents abortive works. Problems related to design, maintenance and practicality of the proposed layout could also be addressed during the timber mock-up inspection.

The mock-up is to be constructed accurately to scale. The mock-up should show the proposed locations of sanitary pipes and electrical points in the kitchen, toilets, air-con ledge and service yard so that openings and recesses for concealed services could be confirmed.

Some common issues to look out for are:

a) floor waste/trap not obstructed by structural beam;

b) lighting points not obstructed by ceiling-mounted clothes drying rack;

c) use of external clothes drying rack not hindered by air-con ledge;

d) sufficient clearance for access to the air-con ledge for installation and maintenance of the air-con compressors;

e) toilet vent and other fittings do not obstruct future installation of shower screen; and

f) any other practical considerations.

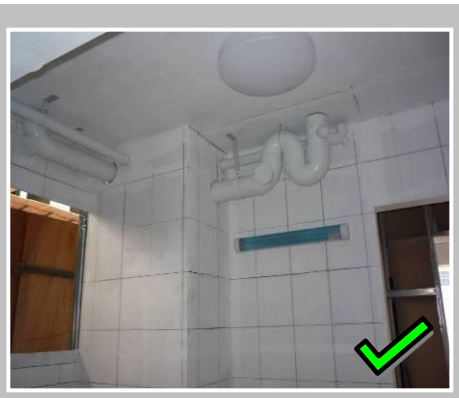
Mechanical Items in Timber Mock-Up

The timber mock-ups should include water cistern, wash basin, bath mixer with shower assembly, basin mixer, sample water heater, sanitary pipes & fittings, floor trap and floor waste.

Timeline for Setting Up Timber Mock Up

The Consultant shall ensure that the Contractor erects the timber mock-up for each unit type within three months from the start of the Contract.

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Inspection of Timber Mock Up

The Consultant shall inspect and verify the position of all mechanical provisions before approving the precast drawings.

The following are some of the mechanical items to be checked by the Consultant:

(a) layout conform to sales brochure with no deviation on the locations of water cistern and wash basin;

(b) no pipes or mixers to be mounted on household shelter wall;

(c) allow space provision for future installation of water heater by owner / tenant;

(d) door swing is not obstructed by wash basin, bath mixer or future water heater;

(e) ducts for sanitary pipes do not cause obstruction or ovelap with windows;

(f) location of floor trap is not more than 2.5m from stack and not obstructed by beam;

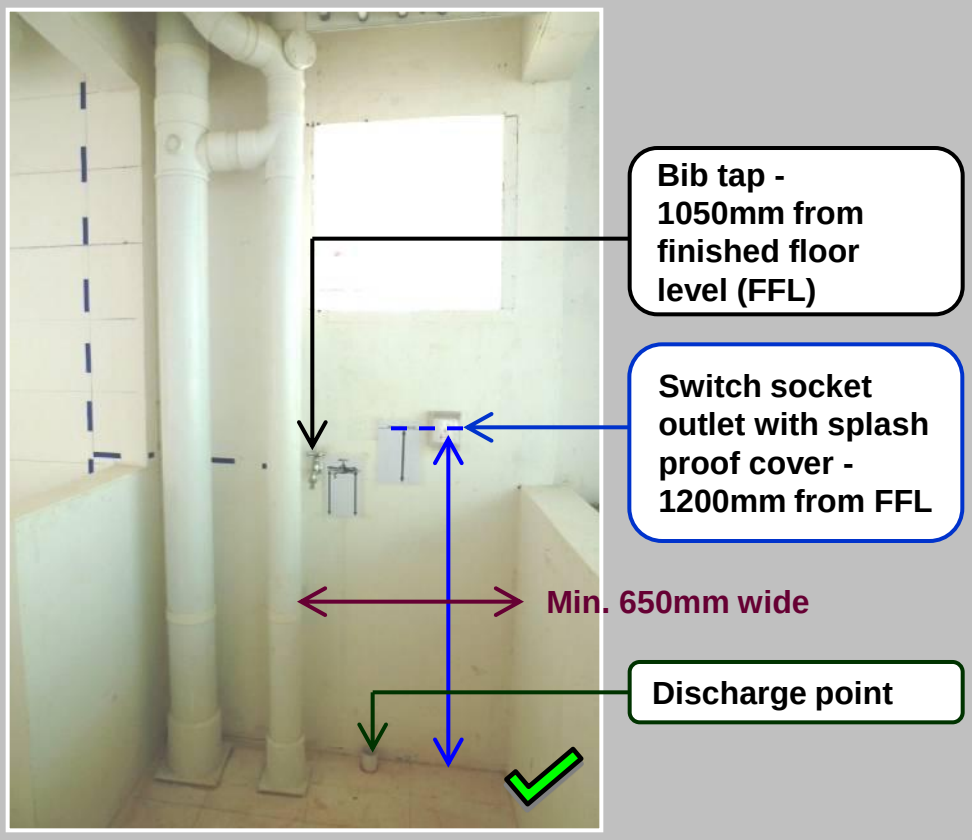
(g) shower area does not pose any issue for future installation of shower screen by owner / tenant;

(h) piping arrangement is optimal and allows for easy maintenance;

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(i) check weep hole position for service duct to ensure that any leak in the concealed sanitary pipes could be detected and water is able to drain out towards the floor trap; and

j) location of the bib tap and discharge point shall accommodate the placement of washing machine in the service yard.



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4 Sample Units

Purpose

Sample units are set up to ensure that the position, height and quantity of mechanical fittings are constructed according to specifications, drawings and sales brochure before mass production. In the event of discrepancies between drawings and sales brochures, the latter will take precedence. The sample units also serve as a reference for workmanship standard.

Timeline for Setting Up

Construction of the sample units should commence when structural work reaches the 5th storey and be completed within two to three months. A sample unit is to be provided for each flat type.

Marking of Concealed Pipes

All concealed pipes must be marked using coloured tape (blue for cold water, red for hot water and black for overflow discharge pipe) as shown in the photos below.



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Inspection by City Gas

The Licensed Gas Service Worker shall arrange for City Gas to view the gas piping in the sample unit and follow up with any rectification works. The consultant shall obtain the quotation from City Gas for the gas connection after clearing the the inspection and put up the request for works order through HDB.

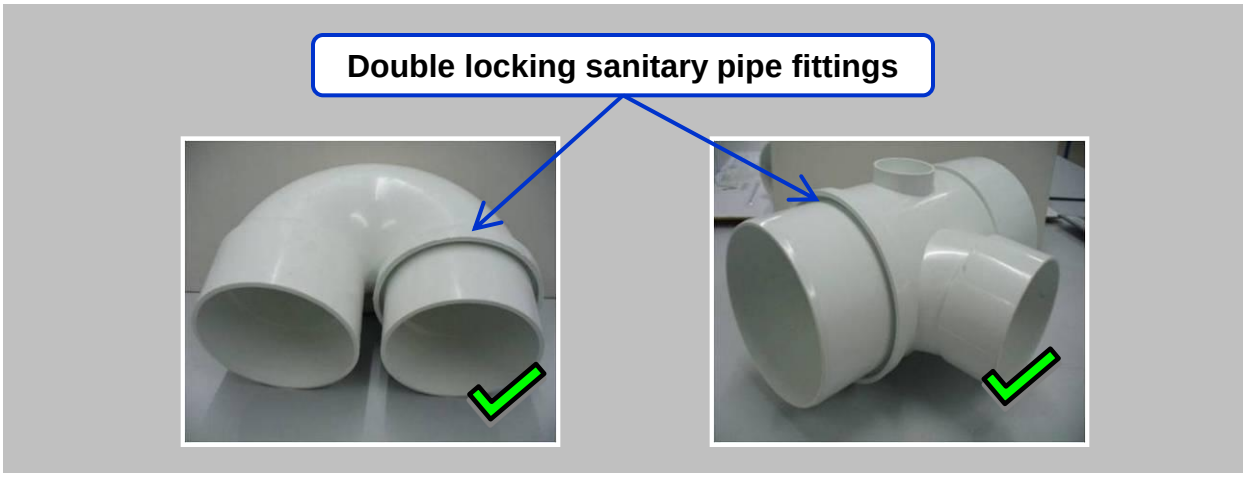
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5 HDB Requirements

Sanitary Work

The Consultant shall ensure that pipe sleeves for sanitary openings at kitchen & toilet areas are cast together with the slab in one operation. This is to minimise ceiling leakage.

The Consultant shall also ensure that double locking sanitary pipe fittings are used by Contractors to reduce the possibility of leakage at joints.



As more renovation works are expected in HDB flats which do do not come with full finishes, silt traps will need to be installed just before the last Inspection Chamber for each block to trap the renovation waste during Defects Liability Period. This is to prevent chokage to the sewer line.

Gas Pipes Installation

The Consultant shall ensure that gas pipes are not concealed in walls, beams or ceiling. This is to prevent the gas pipes from being damaged by renovation contractor during renovation. The gas pipes should also not be run in the consumer switch room or pump room.

Box-up are to be provided for gas pipes running in the living room for building contracts called after 1 Jan 12.

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Plumbing Work

Consultant shall ensure that press-fit pipe fittings are used for concealed copper water pipes so as to minimise the possibility of leakage at joints.



Press-fit pipe fitting

Unlike private projects, the water main is run by PUB to the bulk meter of each block. The water main laid by PUB must not be covered by any structure that would hinder future maintenance by PUB. In addition, sub-meters are to be pre-installed for all units by the Contractor before handover.

Provision for Future Water Heater

Proper labels are to be provided for the “cold water inlet”, “hot water inlet” & “drain out” pipes.

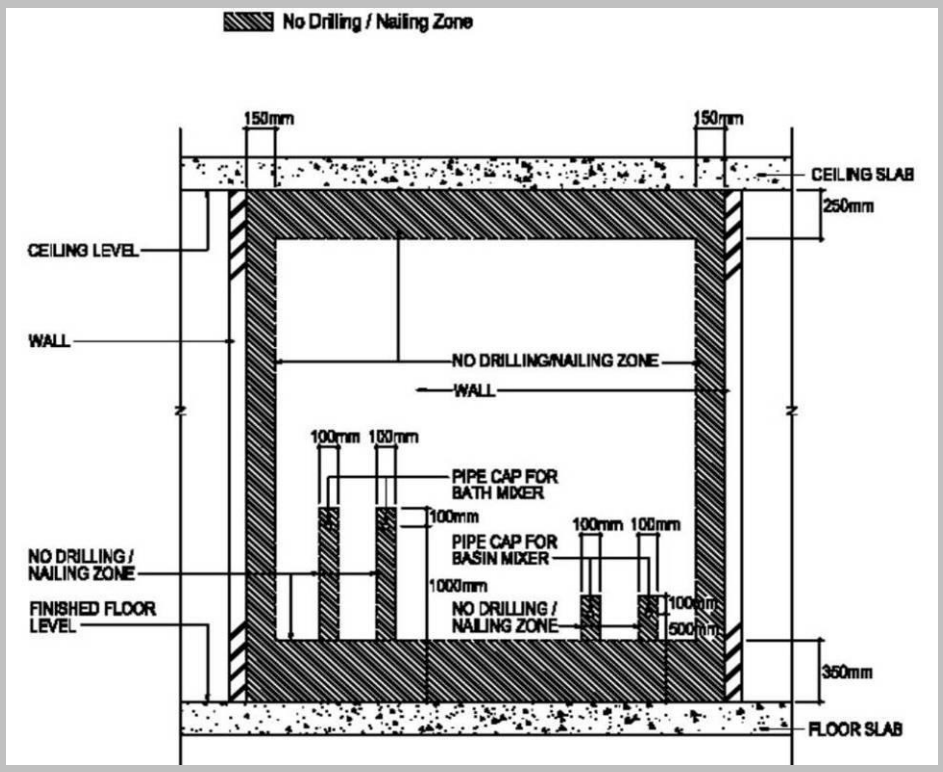


Labels are provided

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No Drill Zone

Flat owners are not allowed to drill any holes in the walls within the shaded zones in the kitchen and toilets shown in the diagram below. Running the pipes at an angle is prohibited as it would be outside the protected “no drill zone”. Consultant must ensure that the concealed piping are run correctly and marked accurately with masking tape.





Marking of concealed pipes with masking tape

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Lift Installation

The lifts for HDB projects are normally supplied and installed by HDB's Lift Term Contractor.

The Consultant shall arrange a preliminary discussion with HDB's Lift Term Contractor and finalise the following drawings within three months from start of the building works:

a) size and position of lift hoistway;
b) size, position and type of landing doors;
c) ventilation and lighting of the machine room;
d) number of floors with lift landing and floor to floor height;
e) type, speed and capacity of lift; and
f) section of lift shaft showing top clearance, pit depth, separator beam, etc.

Thereafter, the Consultant shall within a month submit the technical data with the above drawings to HDB for issuance of Works Order to HDB's Lift Term Contractor.

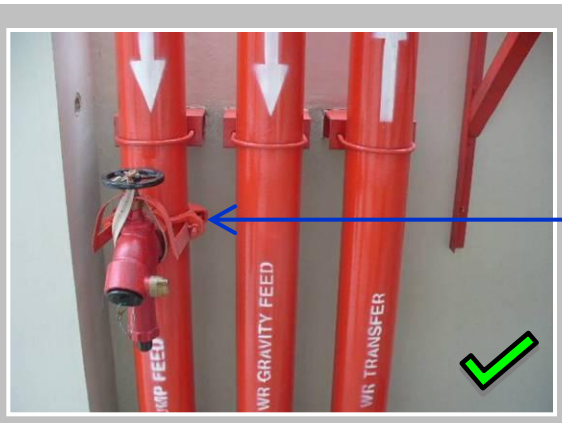
After HDB has issued the Works Order for the lifts, Consultant shall carry out the following:

a) endorse all shop drawings and as-built drawings;
b) coordinate between Building Contractor and Lift Term Contractor;
c) supervise the lift installation and resolve all site and technical issues;
d) ensures Lift Term Contractor's PE conducts preliminary testing;
e) arrange for lift testing by HDB;
f) issue notification of acceptance to Lift Term Contractor upon passing of tests;
g) certify work done for HDB to make payment to Lift Term Contractor; and
h) arrange for lift turn-on and handover to Town Councils.

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Fire Fighting System

As landing valves are installed at common areas, they have to be secured with bracket and strap to prevent theft.



Landing valves are secured to prevent theft

HDB also carries out audit of temporary fire fighting systems to ensure that the Contractor comply with the authority's requirements for buildings under construction.

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6 Delivery and Storage

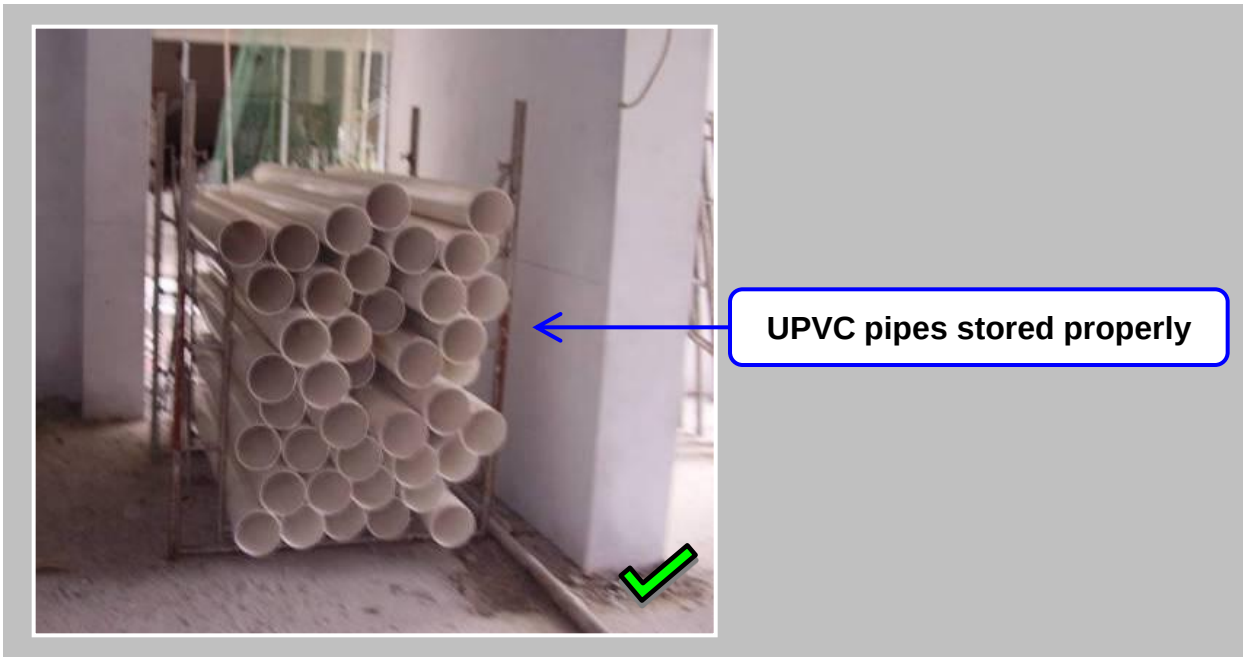
Delivery

The Consultant shall ensure that the Contractor does not deliver and install materials earlier than required to prevent theft and damage.



Storage

All materials delivered to site shall be stored properly and protected from weather.



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7 In-Process Checking

Purpose

The Consultant is to monitor and control the quality and finish of the mechanical installations.

It is important to check for irregularities while the works are in progress to ensure works are carried out by qualified workers according to approved work method, specifications, drawings and sample unit.

Inspection by Consultant

The Consultant shall visit the sites to check that all mechanical installations are installed correctly. This will ensure that non-conformances are detected early and reduce rectification or abortive works.

Checklist

The scope for Site Supervisors / Registered Technical Officers encompasses supervision of multiple trades as well as safety, and housekeeping. They are usually not specialised in M&E works, hence it is important for the Consultant to guide them closely in the supervision of mechanical installation works.

The Consultant shall develop their own checklists for the project and train the Site Supervisors to check on critical work including but not restricted to the following:

(a) 100% water pressure test for concealed water pipes before the works are covered up and before the handing over of flats;

(b) no chokage in sanitary pipes; and

(c) all sanitary fittings are installed correctly and in good working condition with no visible defects.

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Audits by HDB

HDB may carry out audits on the mechanical installation. The Consultant shall respond to HDB's audit within two weeks.

The Consultant shall not rely on HDB's audit but carry out their own regular audits to ensure the quality of the electrical installations.

CONQUAS

M&E installation work forms part of the assessment in Construction Quality Assessment System (CONQUAS) by BCA. For public housing, the M&E score constitutes 5% of total score. The Consultant shall check through the mechanical installations and ensure that all defects are rectified before the BCA assessment.

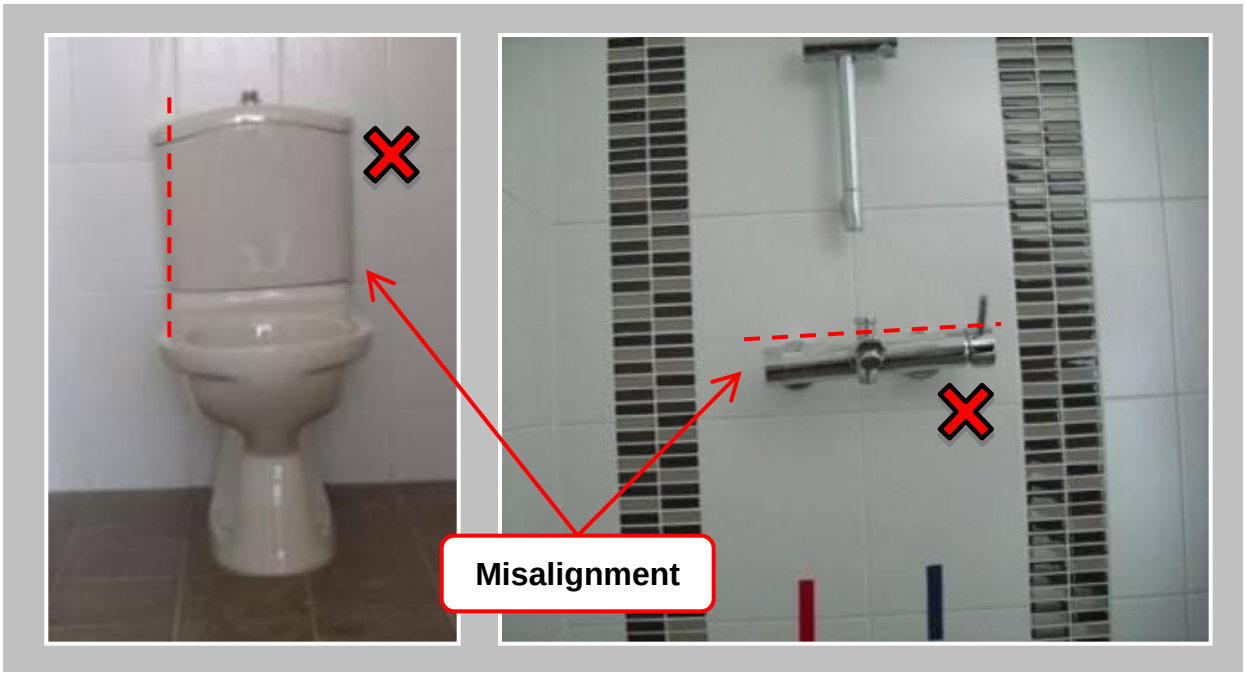
BCA will carry out two assessments for M&E installations. The first assessment is done together with the assessment of architectural works within the units. The second assessment is carried out for M&E works at pump rooms, common area and rooftop.

Within units, areas likely to lose points are damage, malfunction or misalignment of fittings as well as gaps between wash basin and wall not properly sealed.

At common areas or pump rooms, areas likely to lose points are damage or misalignment of the mechanical installations.

The mechanical engineering works to be checked by BCA assessor are summarised in the following pages.

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	Item	Standard
1	**Wet/ Dry Riser** Landing Valve	• Landing valve must be accessible • Labelling for riser door • Landing valve strapped and padlocked • Landing valve painted red for wet riser / yellow for dry riser • Automatic air release valve provided at highest point of rising main
	Pipe & Pipe Support	• Riser pipes properly supported • Labelling and painting for riser pipe • Bonding to earth provided for rising main
	Wall & Floor Penetration	• Proper wall / floor penetration
	No Visible Damage	
2	**Hosereel** Location & Installation	• Location of hosereel as per approved shop drawings • Hosereel cabinet properly labelled • Hosereel pipes properly fixed with hangers & brackets • Hosereel operation instruction properly marked on hosereel drum or door
	Paints	• Correct & proper painting for hosereel
	No Visible Damage	
3	**Concealed Pipes** Location & Installation	• Pipes properly supported, bent without distortion, kink and damage • Pipes and fittings end properly capped • Proper joints • Materials used are of approved type
	Alignment	• Vertically or horizontally aligned
	No Visible Damage	

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	Item	Standard
4	**Exposed Pipes** Location & Installation	• Location of pipes installed and labelled as per approved shop drawings • Pipes properly supported, bent without distortion, kink and damage • Joints are watertight • Pipes and fittings end properly capped • No potable pipes below non-potable water pipes • Materials used are of approved type
	Alignment	• Vertically or horizontally aligned and parallel to building surface • Inclined pipes laid to proper gradients • Plumb <3mm per 1m height
	Clearance	• Do not cause obstruction / pose safety hazard at public area • Sufficient clearance between installed pipe / ceiling and pipe / wall for accessibility • Service pipe duct accessible
	No Visible Damage	
5	**Water Tanks** Location & Installation	• Location, type and capacity as per approved shop drawings and specifications • All openings properly covered and secured • Joints and pipe connections are watertight • Not located below non-potable water pipes • Corrosion resistant external cat ladders provided for large water tank
	Netting	• Netting properly fitted for overflow / warning / vent pipes
	Clearance	• Accessible for maintenance. Minimum clearance of 600mm all rounded the water tank
	No Visible Damage	• No visible damage • Clean & free from debris

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	Item	Standard
6	**Pumps & Motors** Location & Installation	• Location and type as per approved shop drawings • No noticeable vibration / noise from pump / motor • Test certificate for alignment of Pump and Motor from manufacturer • Not located below non-potable water pipes • Corrosion resistant external cat ladders provided for large water tank
	Electrical Termination	• No bad / loose electrical termination
	No Visible Damage	
7	**Plumbing & Sanitary Fittings** Gully & Floor Trap	• No damage or chokage • Must be securely fixed • Trap's top lower than the surrounding floor level
	Pipes	• Visually aligned horizontally, vertically and parallel to building surface • Inclined pipes laid to proper gradients • No leakage at joints • Plumb < 10mm per storey height • Brackets firmly secured and adequately spaced • If painted, no drippings and with good opacity
	Fittings	• Firmly secured & joints properly sealed and pointed • No leakage at joints

8 Good Practices / Common Defects



Cement stains on pipes in G&W duct



Ductile iron pipe without primer coat prior to installation

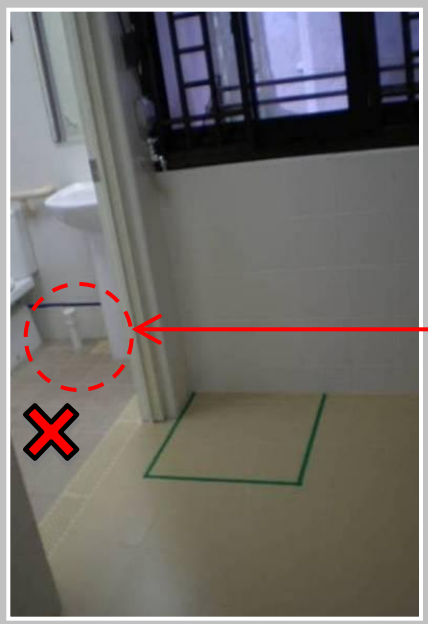


Ductile iron pipe and fittings with one coat of lead and chromate-free primer prior to installation

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Pumping system next to control panel and entrance door which facilitates maintenance work to be carried out

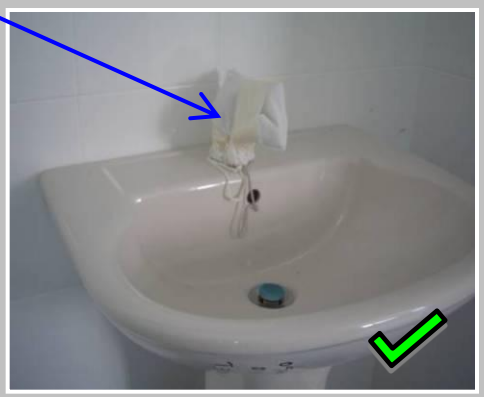


Washing machine drain outlet pipe is located in toilet while both the tap and switch socket outlet are located in kitchen

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Tap mixers are wrapped before handover to minimise tarnishing & scratches







Use of blue color solvent cement to enable visual inspection



The window is positioned badly as owner / tenant will face difficulty in installing a shower screen



The pedestal pan is installed too close to the vanity top

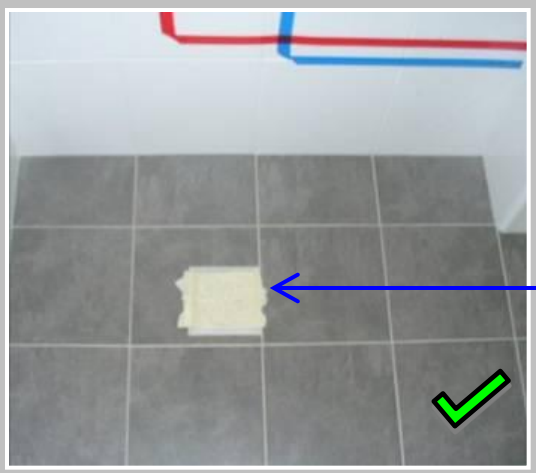
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Toilet bowl sealed with plastic wrapping and seat cover closed to prevent mosquito breeding



Toilet bowl filled with abate before sealing to prevent mosquito breeding



Floor waste sealed to prevent mosquito breeding

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Overflow outlet sealed to prevent mosquito breeding

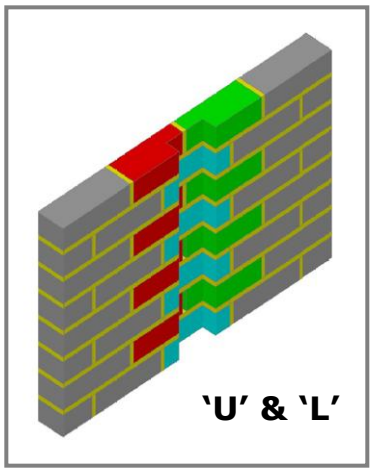
Pop up waste cover closed to prevent mosquito breeding

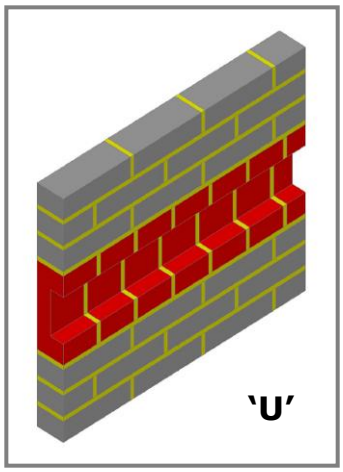
Gap between water cistern and wall is unacceptable

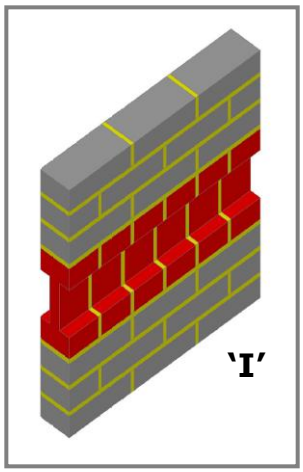


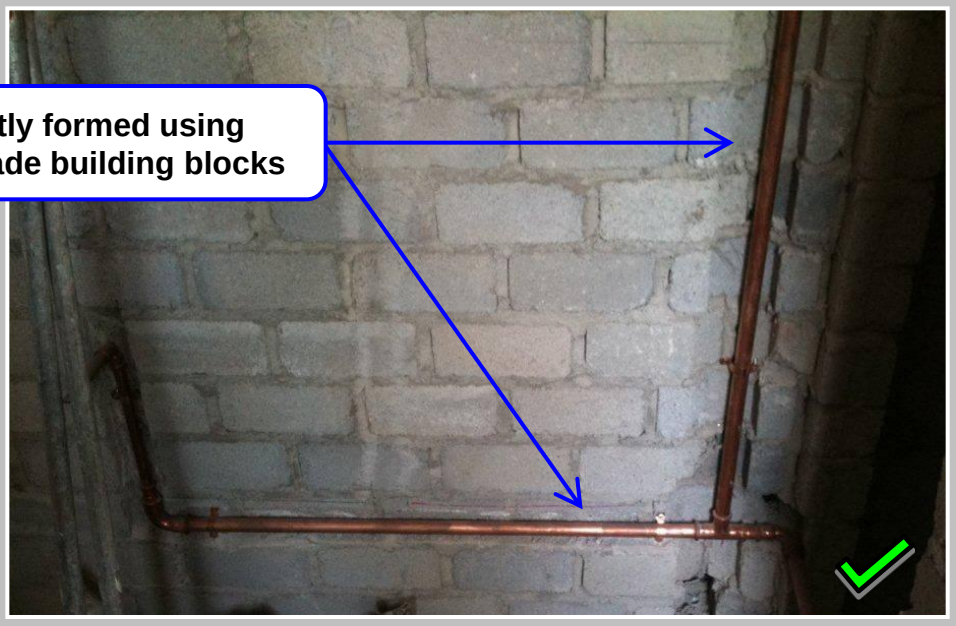
The recesses on concrete block walls should not be created by hacking. It can be created during casting (for both precast and in situ components) or created by purpose-made building blocks (for toilet or infill wall) as illustrated below:

(a) 'U' & 'L'-shaped blocks to form vertical recess;
(b) 'U'-shaped block to form horizontal recess; and
(c) 'I'-shaped block to form horizontal recesses for both sides of the wall.



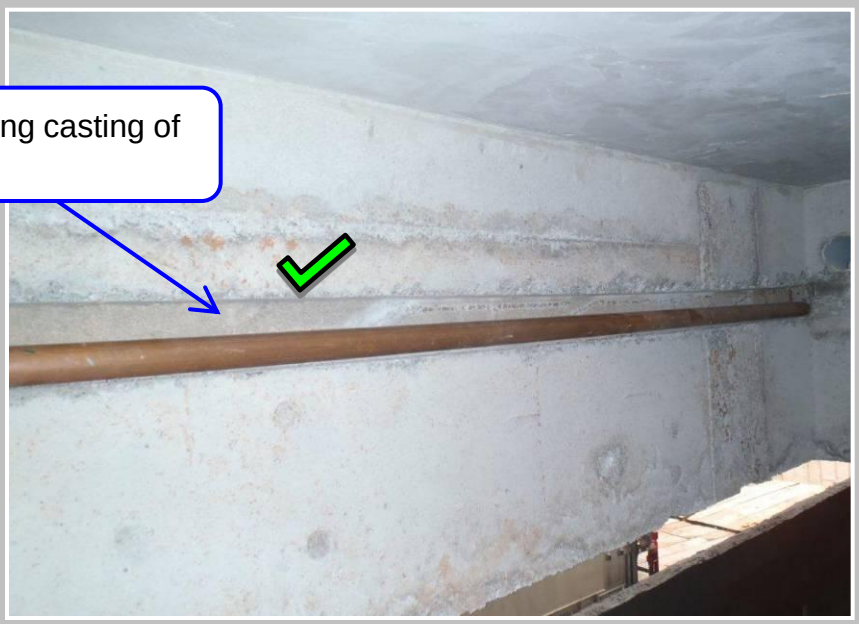




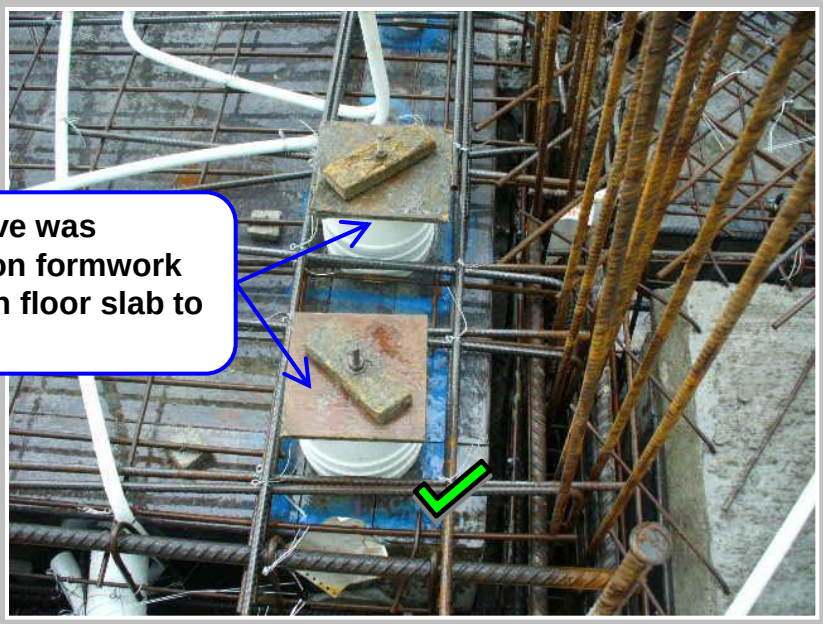


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Recess created during casting of beam



Sanitary pipe sleeve was properly secured on formwork before casting with floor slab to minimise leakage



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9 Inspection, Testing & Handover

Introduction

On completion of the mechanical installations, the Consultant shall carry out appropriate tests and inspections to verify that the mechanical installations meet all requirements of relevant codes and Technical Specifications.

The Consultant shall commission the mechanical installations one month before the handover of each block / precinct.

Tests by Consultant and HDB

The Consultant shall carry out testing and commissioning of the following mechanical installations about 2 to 3 months before the block is handed over:

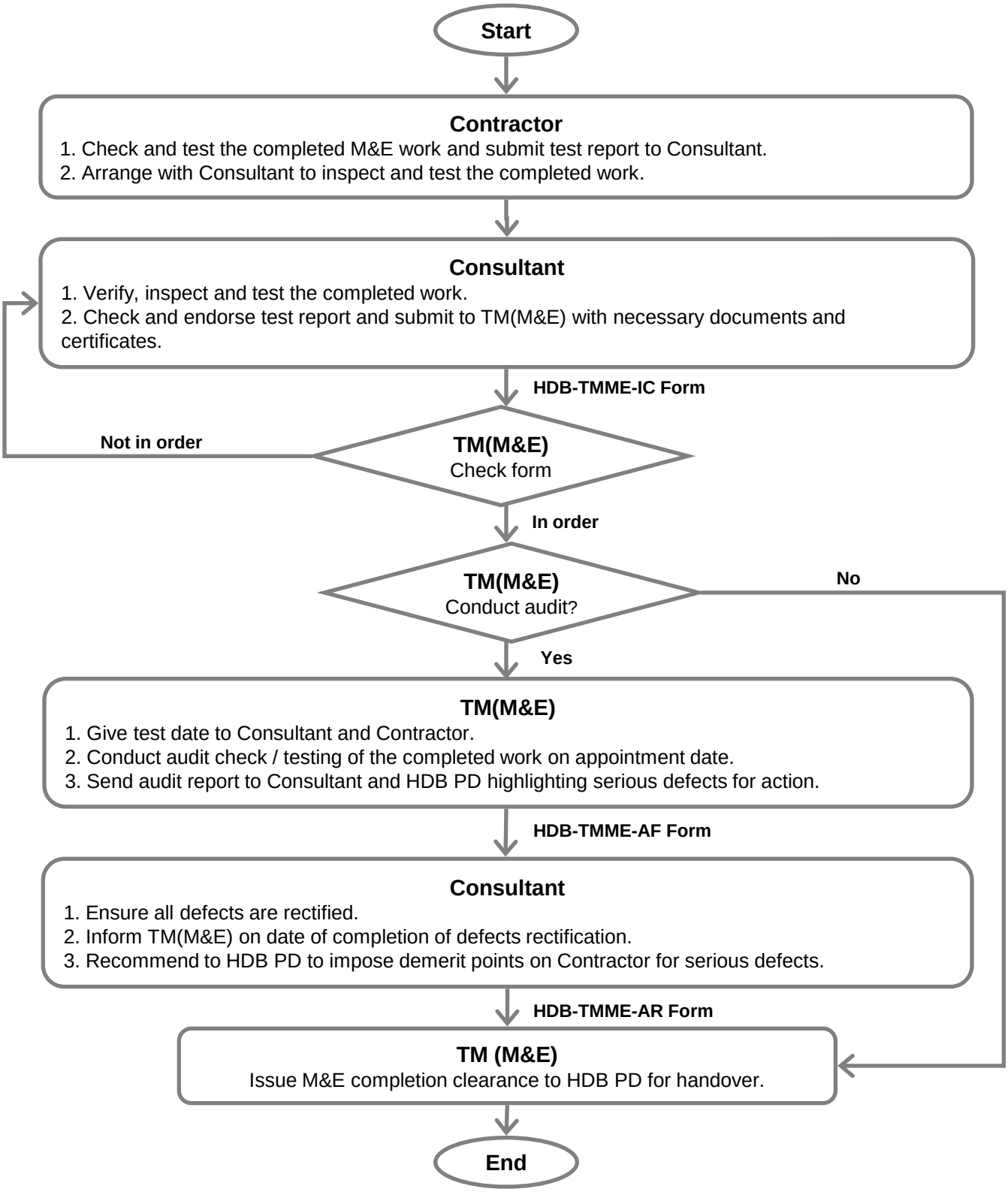
(a) transfer and booster pumping system;
(b) fire hosereel system;
(c) rainwater and waste water pumping system;
(d) divertor / ejector system;
(e) wet / dry riser system;
(f) mechanical ventilation system;
(g) automatic refuse chute flushing system; and
(h) refuse handling equipment.

HDB audit team will also carry out audit tests on the above mechanical installations.

Please refer to the flowchart on the following page for procedures on testing and seeking clearances for M&E Works.

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Audit Test & Completion Clearance for M&E Works



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Submissions to HDB

The application for HDB audit test shall be made at least one month before the handover of each phase. The following HDB's prescribed forms shall be used for HDB audit tests:

Item	HDB Forms	Description of Forms	Used By
a	HDB-TMME-IC	Declaration of completion of M&E works	Consultant
b	HDB-TMME-AD	Appointment for M&E audit testing / electrical unit testing	HDB
c	HDB-TMME-AF	M&E audit test report	HDB
d	HDB-TMME-AR	M&E audit test report reply	Consultant
e	HDB-TMME-CC(ND)	Completion clearance of M&E services	HDB
f	HDB-TMME-CC(NDPW)	Completion clearance of M&E Services for precinct work only	HDB

The above forms are enclosed in the **Annex** for your reference.

The latest forms and sample HDB test reports can be obtained from HDB Technical Management (M&E).

All forms and Certificates of Supervision by PE/LEW submitted to other authorities shall also be submitted together with the above where applicable.

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Other Considerations

Unlike private projects, HDB projects are generally handed over on block by block basis. The Consultants must ensure that Temporary Occupation Permit is obtained and the block has passed the employer's inspection before certifying completion for the block.

The Consultant shall provide HDB the information to call quotation for the Registered Inspector for Mechanical & Electrical Fire Safety Works six months before the first block handover.

The water supply shall be turned on 2 to 3 months before the first block handover so that various M&E testing can be carried out.

The gas is charged in after the first handover inspection and before hand over.

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100% Pressure Test for Concealed Water Pipes

The Consultant shall carry out 100% pressure test for concealed water pipes at the following stages:

(a) before the water pipe is concealed; and
(b) about three months before handover.

HDB Building Inspection Team will do a random audit check for concealed water pipes about one month before handover.

Tests for Sanitary Installations

The Consultant shall carry out 100% test to check for sanitary pipe leakage. After the stack pipes have been filled with water for two hours, a visual inspection is to be carried out to look for any leakages at the pipe joints.



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The Consultant shall also progressively carry out tests for drain lines to check for leakage. This is done by plugging the pipe downstream and filling up with water on an extended pipe upstream.

Drain line is plugged downstream



Extended pipe at upstream inspection chamber



Before handover of block, the Consultant shall ensure there is no chokage at the sanitary stacks. This is done by putting a hockey ball into the stack pipe through the inspection eye. The hockey ball should come out from the discharge outlet in the inspection chamber.



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The Consultant shall also ensure the following:

(a) house sewer have correct gradient and levels with no maintenance problem;

(b) underground services are laid correctly before casting of ground slab;

(c) correct tee off from distribution mains with sufficient water pressure to all units; and

(d) as-built drawings and warranties are submitted promptly to HDB.

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Annex 1 : Forms for HDB Audit Tests

HDB – TMME – IC (Pg 1/2)

DECLARATION OF COMPLETION OF M&E WORKS

Deputy Director, Development & Construction Productivity Section 3
(Technical Management M&E)
Building Quality Group
Housing & Development Board
HDB Hub, West Wing, 15th Storey
480 Lorong 6 Toa Payoh
Singapore 310480 Fax: 68543208

Instructions:

1. Fill in where applicable.
2. * Delete if not applicable.

Block No.: Address: Project Ref. No.:

Contract Title:

Main Contractor Name: Contractor Rep:
Contact Tel. no./HP:

A Completion of M&E Works

I/We declare the M&E works ticked have been completed and tested satisfactorily. Relevant test reports, certificates and drawings are enclosed.

Tick if applicable	System/Service	Installation drawings enclosed	Checklists enclosed	Test reports & certs enclosed	Remarks
	Section I: Systems related to Fire Safety				
	Automatic/Manual Fire Alarm System *				PE:
	Dry Rising Main / Down Comer / Wet Rising Main System *				PE:
	Hose Reel System				PE:
	Sprinkler System				PE:
	Mechanical Ventilation / Air-Conditioning System *				PE:
	Smoke Control / Smoke Purging / Fume Extract / Pressurisation System *				PE:
	Lift / Escalator Installation *				PE:
	Section II: Mechanical Services				
	Water Supply System				
	Gas Supply System				
	Sanitary System / Ejector Pump *				
	Refuse Handling Equipment				
	Submersible Pump For Rainwater				
	Others (please specify)				
	Section III: Electrical Services				
	Unit Wiring				LEW:
	MATV				
	Telecom Wiring				
	Electrical Installation				LEW:
	(i) Main Switchboard				
	(ii) Public Lighting				
	(iii) Outdoor Lighting				
	(iv) Exit / Emergency Lighting				
	Standby Generator				LEW:
	Lightning Protection System				PE:
	Intruder Alarm / Integrated Security System				
	Others (please specify)				

B Application for inspection and clearance by Technical Management (M&E) Section

I/We declare that the above works are ready for inspection and clearance by Technical Management (M&E) Section

Confirmation by Main Contractor:

Signed by: _____

Name: _____

Date: _____

Verified by Consultant PE:

Signed by: _____

Name: _____

Date: _____

Form HDB-TMME-IC Feb12

Annex 1 : Forms for HDB Audit Tests

HDB – TMME – IC (Pg 2/2)

Addendum to Declaration of Completion of M&E Works

Please provide and fill in the following details to facilitate correspondence

Contract Title:	Type of Project : NT / D&B / MUP / HIP / RUP / HUP / IPD / PLD / SPT * (e.g. Large Commercial premises)
Block No:	Street Name:
Block OCD:	Block PACD:
HDB PD/Officer-in-charge	Email: Contact no.
Main Contractor: Rep. name:	Email: Contact no.
Subcontractor: Rep. name:	Email: Contact no.
Design LEW name: Licence No.:	Email: Contact no.
Licensing LEW name: Licence No.:	Email: Contact no.
Licensing Telecom Installers' name: Licence No.:	Email: Contact no.
Consultant Project Manager-in-charge:	Email: Contact no.
Consultant Engineer-in-charge:	Email: Contact no.

Notes on declaration of completion of M&E work and appointment for audit testing and unit wiring testing

1. Consultant is satisfied that the works have been satisfactory completed by Contractor when submitting the declaration.
2. Consultant has also inspected and tested the works and is satisfied that the works completed have complied to HDB and all statutory requirements.
3. All test reports and certificates submitted are in order and have been verified and endorsed by Consultant.
4. Consultant confirm the works have been installed according to installed drawings provided.
5. Contractor have rectified all defects pointed by Consultant before HDB audits and if defects are not rectifed during HDB audits, Consultant would recommend to impose demerit points on the Contractor.
6. For any serious defects affecting safety detected by Consultant or HDB audit, Contractor would be liable for demerit points to be imposed.
7. Consultant shall ensure all defects are not repeated and shall be rectified within 3 days. Consultant shall inform HDB when defects have been rectifed to obtain HDB clearance.
8. Consultant shall report recalcitrant LEW to EMA for committing serious defects on electrical safety.
9. Contractor shall provide qualified assistants to receive instruction during HDB audits. HDB audit would be considered fail if no assistant is present and Consultant shall recommend to impose demerit points on the Contractor.
10. For unit wiring testing, Contractor shall provide at least four assistants for HDB to conduct unit wiring testings. COC, form CS/5 and Form E and single line drawings shall be submitted to HDB before the unit wiring testing.
11. Appointment with HDB to audit the completed work or test unit wiring the work can be made with TM(M&E), HDB by phone (Tel. 64903163) or personally between 2 pm to 4 pm at HDB Hub, West Wing at 17th storey.
12. Any cancellation of audit/test appointment shall be made at least one day in advance, otherwise Consultant will recommend demerit points to be imposed on Contractor for no show.
13. If testing requires shutdown of supply, Contractor shall provide confirmed copy of shutdown date/time at least one day before the testing appointment to be faxed to TM(M&E), HDB.

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Appointment for M&E Audit Testing / Electrical Unit Testing

To: Consultant Engineer-in-charge

Consultant Project Manager

Contractor

Copy to: HDB PD/Officer-in-charge

Based on your declaration of completion of the M&E work, appointment has been made to audit test the following M&E system on the date and time as stated below. Please arrange for Contractor to provide the approved as-installed drawings and manpower to be present to receive instructions during the audit testing.

Contract Title:			
Address:			
Block No.:			Postal Code:
Type of Installation	Block No.	Date & Time of Appointment	Remark
MSB *			
Unit wiring *			
PL / FSC / LPS *			
OLS / ESS *			
SUBMAIN EXTENSION *			
Other services (Pls. State) *			
Fire safety system (Pls. State)*			
Mechanical services (Pls. State)*			

Officer Name Date
Development & Construction Productivity Section 3 (Technical Management M&E)
Tel. no.: 64903163

Note: * Delete where necessary
MSB – Main Switchboard, PL – Public Lighting, FSC – Final Sub-Circuit,
LPS – Lightning Protection System, OLS – Outdoor Lighting System

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HDB-TMME-AF

HOUSING & DEVELOPMENT BOARD
BUILDING QUALITY GROUP

M & E AUDIT TEST REPORT

CONTRACT TITLE:	
BLOCK:	STREET NAME:
MAIN CONTRACTOR:	CONTRACTOR'S REP. NAME:

To : Consultant : _____ Attn : _____

Thru' Project Mgr : _____

1.The audit test for _____, has been carried out on _____

2. The findings are listed below :

3. The audit test is passed/failed/pending verification.

4. Please follow-up on the items listed above and reply to us using TMME-AR form by _____.

Note:
For items not installed according to the contracts, please follow-up if RVO is necessary.
For serious defective work, please warn the contractor and recommend to impose demerit points if necessary.

_____ Date:_____

Building Quality Group
Development & Construction Productivity Section 3 (Technical Management M&E) cc PD

_____

Note : All the rectification details and dates must be stated clearly on your reply in TMME-AR form

Your Ref :
Our Ref :
Date :
TEL (DID) :
EMAIL :

Building Quality Group
Development & Construction Productivity Section 3 (Technical Management M&E)

Attn: _____

Dear Sir

M&E AUDIT TEST REPORT REPLY

Contract Title:	
Block:	**Street Name:**
Type of installation:	**Contractor:**

1 Please refer to your audit test report dated _____.

2 This is to inform you that the following items listed in the audit test report have been approved/rectified

(i) ☐ Modifications (item(s) _____) have been approved and updated in drawings. RVO is / is not* required.

(ii) ☐ Modifications (item(s) _____) have not been approved and were rectified on _____ (Date).

(iii) ☐ Defects (item(s) _____) have been rectified on _____ (Date).

3. We will / will not* be taking the following action:

(i) ☐ Contractor will be warned not to repeat the defects.

(ii) ☐ PD will be recommended to impose demerit points.

Remarks: _____

_____

Yours faithfully

Name & Designation
Consultant Name

cc Project Manager :
cc Project Director (HDB):

* delete where not applicable
☐ tick if applicable

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Your Ref :
Our Ref : 452-20-22-0314
Date :

Project Director: _____
Dept: _____

Tel :
Fax : 68543208

Completion Clearance of Mechanical & Electrical Services

Contract : _____ Blk No : _____

S/N	System	Testing/ Audit Check	Status	Remarks	Date of Report Submitted
1	Units				
2	Main Switch Board				
3	Public Lighting System (Excluding Linkway system)				
4	Lightning Protection System				
5	Final Sub-Circuit (Excluding Linkway system)				
6	Telecom				
7	TV System				
8	Lift				
9	Transfer Pumping System				
10	Booster Pumping System				
11	Refuse Chute Flushing System				
12	Refuse Handling Equipment				
13	Rain Water Sump Pump				
14	Ejector System				
15	Dry/Wet Rising Main System				
16	Manual/Automatic Fire Alarm System				
17	Automatic Sprinkler Protection System				
18	Hose Reel System				
19	Mechanical Ventilation System				
20	Others				

(R.I.'s Form : NA/Submitted)

YUE WENG KWONG
Principal Technical Officer
Development & Construction Productivity Section 3 (Technical Management)
Building Quality Group

cc PE Er Soh Swee Seng
SE Rajasararan s/o Lechimanah
PE Er Denis Wong
Attn: _____ (Name of Consultant)

Note : √ Test/Audit Check
X No Test/Audit Check
NA Not Applicable

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Your Ref :
Our Ref : 452-20-22-0314
Date :

Project Director: _____
Attn: _____

Tel :
Fax : 68543208

Completion Clearance of Mechanical & Electrical Services
(For Precinct Work only)

Contract : _____ Blk No : _____

S/N	System	Testing/ Audit Check	Status	Remarks	Date of Report Submitted
1	Linkway Lighting				
2	Outdoor Lighting				
3	Others				

YUE WENG KWONG
Principal Technical Officer
Development & Construction Productivity Section 3 (Technical Management M&E)
Building Quality Group

cc PE Er Soh Swee Seng
PE Er Denis Wong
Attn: _____ (Name of Consultant)

Note : √ Test/Audit Check
X No Test/Audit Check
NA Not Applicable

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TM(M&E)/DR/A

INSPECTION CHECKLIST

DRY RISING MAIN SYSTEM

Project Title: _____ Total no. of stack: 100mm / 150mm

Blk No.: _____ Address: _____ Storey: 100mm / 150mm

Breeching Inlet Type (Corresponding Diameter Of Rising Main): * 2-way (100mm) / 4-way (150mm)

S/N	Item	Status	Remarks
A	**Breeching Inlet / Box**		
i	Inlet housed in glass-fronted protective box.		
ii	Box/inlet securely installed & clear of obstruction.		
iii	The box is labelled "DRY RISING MAIN".		
iv	Inlet differentiated: “DR INLET 1-X”, etc.		
v	Centre line of inlet to floor: 0.76m to 1m.		
vi	Inlet fitted with Ø25mm drain valve complete with cap.		
vii	The breeching inlet is painted yellow.		
viii	PSB label is provided.		
B	**Rising Main**		
i	Not through unprotected area / fire rated construction.		
ii	Air release valve is provided and functions properly.		
iii	The rising main is electrically earthed.		
C	**Landing Valves**		
i	Valve securely installed & clear of obstruction.		
ii	Lowest point of valve to floor: 0.76m to 1m.		
iii	Condition of hand wheel is satisfactory.		
iv	Valve is closed and securely strapped with padlock.		
v	“O” ring & blank cap with chain are provided.		
vi	The quick release device functions properly.		
vii	The valve is painted yellow.		
viii	PSB label is provided.		
D	**Pressure Test / General / Others**		
i	Pressure constant at 200psi (13.8 bar).		
ii	No gas or electrical services in the same duct.		
E	**Emergency/ Exit Lighting Provisions**		
i	Provided near landing valve /staircases		

(Note : “√” for complied, “X” for not complied, “NA” for not applicable)

A set of earth test report and related certificates is attached.

Other comments: _____

_____

_____ _____ _____ _____

Name of Consultants PE Registration No. Signature Date

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Annex 2 : Checklists

Wet Riser (Pg 1/2)

TM(M&E)/WR/A

INSPECTION CHECK LIST

WET RISING MAIN SYSTEM

Project Title : _____ Blk No. : _____

Stack No. : _____ Location (near unit no.) : _____ Storey : _____

S/N	ITEM	STATUS	REMARKS
A	**Breeching Inlet**		
i	Clear of Obstruction		
ii	Inlets housed in glass fronted protective enclosure		
iii	Labelled "**Wet Riser Tank Inlet**" & differentiated		
iv	About 0.76m above finished floor level		
v	Rigidly supported		
B	**Riser**		
i	Earthing provided		
ii	Not passing through unprotected area / fire rated		
iii	Air release valve provided		
C	**Landing Valves**		
i	Numbered / Labelled		
ii	Pressure reducing valve provided		
iii	Clear of Obstruction		
iv	“O” ring & blank cap with chain are provided		
v	Condition of hand wheel satisfactory		
vi	Quick release device functions properly		
vii	0.76m to 1m above finished floor level		
viii	Strapped and padlocked in closed position		
viiii	Painted bright red		
D	**Water Tank**		
i	Overflow pipe provided		
ii	Inflow pipe provided		
iii	Compartmented		
iv	Eff. water tank cap indicated on the water tank		
E	**Transfer pump**		
i	Pump can be manually tested		
ii	Auto change over from normal to secondary power supply in order		
iii	Auto changeover from duty to standby pump operation in order		

(Note : “√” for complied, “X” for not complied, “NA” for not applicable)

Name of Consultants PE _____ Registration No. _____ Signature _____ Date _____

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Annex 2 : Checklists

Wet Riser (Pg 2/2)

	ITEM	STATUS	REMARKS
F	**Pump Operation Control Panel**		
i	Pump Numbering tallied with actual control panel indicator		
ii	Clear from drain off test facilities		
iii	Power to pump indicator light “on”		
iv	Sheltered / Weather proof		
G	**Wet Rising Main Pump**		
i	Auto change from normal to secondary Power supply in order		
ii	Auto change over from duty to standby pump operation in order		
iii	All valves to pumps kept strapped and padlocked		
iv	Pressure setting chart for the pump sets provided		
v	Top most landing valve fully opened (under pump gravity feed) and flow rate in order		
vi	Discharge for the test drain pipe provided		
H	**Testing of Static Pressure And Flow Rate**		
i	Running pressure in between 3.5 bar to 5.5 bar		
ii	Static Pressure less than 8 bar		
iii	Pump room Ventilation Fan and Emergency Lighting connected to Secondary Power Supply		

(Note : “√” for complied, “X” for not complied, “NA” for not applicable)

Pressure setting: **Duty pump** start _____ bar. **Standby pump** start _____ bar.

Jockey Pump on _____ bar / stop _____ bar.

A set of Technical Detail Submission, flow & pressure test report, earth test report and related certificates is attached.

Other Comments : _____

_____

_____

_____ _____ _____ _____

Name of Consultants PE Registration No. Signature Date

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TM(M&E)/FA/A

INSPECTION CHECKLIST

MANUAL/AUTOMATIC FIRE ALARM SYSTEM

Project Title: _____

Location : _____ Blk No. _____

S/N	Description	Status	Remarks
A	**FIRE ALARM ANNUNICATION PANEL**		
i	Location according to plan & panel painted bright red		
ii	Fault / alarm indicators labelled		
iii	Alarm / fault isolation switch provided to each individual zone		
iv	Rechargeable battery provided		
v	Vents provided to the battery cabinet		
vi	'Mains on' indicator provided		
vii	Fire panels lockable		
viii	Sign "In Case of Fire, Call 995" provided if system is not required to be connected to DECAM		
viiii	Break glass call point cum alarm bell provided		
x	Emergency light provided for all alarm panels		
B	**MANUAL ALARM SYSTEM**		
B1	**CALL POINT**		
i	Location about 1.4m from the floor level		
ii	Positioned next to hose reels		
iii	Clear of obstruction		
iv	Glass face-plate provided		
v	Activated mode displayed		
vi	Wiring in conduit		
B2	**TEST ON CALL POINT (ACTIVATION)**		
i	Alarm bells in operation condition		
ii	General sounding throughout the building		
iii	Zone tested correctly indicated on the main and sub-panels		
iv	The fire alarm sounding distinguishable from any other alarm system		
v	Signal received by DECAM (if applicable)		
B3	**TEST ON ELECTRICAL SUPERVISION (SIMULATION OF FAULT IN CALL POINT)**		
i	Zone tested correctly registered on main and sub-panels		
ii	Audible fault alarm & fault indication light provided at the main and sub-panels		

(Note : "√" for complied, "X" for not complied, "NA" for not applicable)

Name of Consultants PE _____ Registration No. _____ Signature _____ Date _____

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Annex 2 : Checklists

Fire Alarm (Pg 2/2)

PROJECT REFERENCE : _____

S/N	Description	Status	Remarks
C	**AUTOMATIC ALARM SYSTEM**		
C1	**HEAT /SMOKE DETECTOR**		
i	Listed type installed		
ii	Sufficient coverage		
iii	Detector point unobstructed & not painted over		
iv	Double-layer protection provided where false ceiling depth exceeds 800mm		
v	Protection to raised floor whose depth not exceeding 400mm		
vi	System connected to DECAM		
vii	Wiring in conduit		
C2	**TEST ON DETECTOR POINT**		
i	Alarm bells in operational condition		
ii	General sounding throughout the building		
iii	Zone tested correctly indicated on the main and sub-panels		
iv	The fire alarm sounding distinguishable from any other alarm system		
v	Signal received by DECAM (if applicable)		
C3	**TEST ON ELECTRICAL SUPERVISION (SIMULATION OF FAULT IN DETECTOR POINT)**		
i	Zone tested correctly registered on main and sub-panels		
ii	Audible fault alarm & fault indication light provided at the main and sub-panels		

(Note : "√" for complied, "X" for not complied, "NA" for not applicable)

A set of COC (from PSB) for the fire alarm panels and detectors is attached.
A set of zoning diagram is attached.

Other comments : _____

_____

_____

_____

_____	_____	_____	_____
Name of Consultants PE	Registration No.	Signature	Date

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INSPECTION CHECKLIST

TM(M&E)/FHR/A

FIRE HOSEREEL SYSTEM

Project Title : _____

Location : _____ Blk No. _____

S/N	Description	Status	Remarks
A	**PUMPROOM**		
i	Pump panel painted bright red		
ii	Pump panel shall be labelled		
iii	Pump can be manually tested		
iv	Auto changeover from duty to standby pump operation in order		
v	Pump properly labelled		
vi	All piping and pump sets shall be painted bright red		
vii	Overflow pipe provided		
viii	All stop valves in the pump room shall be strap locked		
viiii	Pressure setting chart for the pump sets shall be provided		
x	Effective water tank capacity shall be indicated on the water tank		
B	**HOSE REEL**		
i	Non kinking reinforced rubber hose		
ii	Length of hose (30m)		
iii	Nozzle condition satisfactory		
iv	Condition of stopcock satisfactory		
v	Clear of obstruction		
vi	Locking device provided in order		
vii	Tempered glass provided for the cabinet		
viii	Labelling provided for cabinet & operation instruction		
viiii	Emergency Lighting provided near hose reel cabinet		
C	**Testing**		
i	No leakage		
ii	6m throw achievable at flow rate of 0.4 litre/sec		
D	**Others**		
i	Pressure at nozzle does not exceed 35 m head / pressure reducing valve installed & properly set *(For indirect supply only)*		
ii	Check valve / test cock / stop valve installed accordingly		
iii	Piping painted red / banded / marked HR		

(Note : "√" for complied, "X" for not complied, "NA" for not applicable)

Pressure setting: **Duty pump** start ____ bar / stop _____ bar. **Standby pump** start _____ bar / stop _____ bar.
Alarm on _____ bar / stop _____ bar.

A set of Technical Detail Submission and related certificates is attached.

Name of Consultants PE _____ Registration No. _____ Signature _____ Date _____

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INSPECTION CHECKLIST

TM(M&E)/MV/A

MECHANICAL VENTILATION SYSTEM

Project Title : _____

Location : _____ Blk No. _____

S/N	Description	Status	Remarks
A	**FAN & DUCTWORK**		
i	Fan control panel including overload, contactor etc in order		
ii	Air-intake provided for all rooms		
iii	Intake / discharge location with at least 5m separation		
iv	Exhaust discharge directed to external		
v	Supply and exhaust duct are labelled / marked accordingly		
vi	Duck work installed properly		
vii	Fan flow rate measured in order		
B	**FIRE DAMPERS**		
i	Fire Dampers are properly installed		
ii	No obstruction to dampers louver (blades) movement		
iii	Access door for inspection of Fire dampers provided		
iv	Fire dampers of approved rating and with PSB label		
C	**FOR CAR PARK ONLY**		
i	Connected to secondary power supply & fire alarm system		
ii	Failure of the Exhaust Fan will cut off the corresponding supply fan		

(Note : "√" for complied, "X" for not complied, "NA" for not applicable)

A set of Technical Detail Submission, flow rate measured report and COC (from PSB) for the fire dampers is attached.

Other Comments : _____

_____

_____

_____

_____

Name of Consultants PE _____ Registration No. _____ Signature _____ Date _____

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Annex 2 : Checklists

Pumping Systems (Pg 1/3)

HOUSING & DEVELOPMENT BOARD **TM(M&E)/TBR/A**
BUILDING QUALITY GROUP
INSPECTION CHECKLIST FOR WATER SUPPLY SYSTEM

LOCATION : _____ BLOCK NO : _____

CONTRACTOR : _____ N'HOOD : _____

TRANSFER PUMP SYSTEM

		Tick if item not proper
T1	PUB INCOMING	
1.1	PUB incoming pipe joints leak	☐
1.2	PUB incoming gate valve stem cap missing	☐
*1.3	PUB incoming pipe not properly supported / painted	☐
1.4	_____	☐
T2	PUMPROOM & SUCTION TANK	
2.1	Suction tank overflow pipe elbow ends not fitted with netting	☐
2.2	Dirty pumproom to be cleaned	☐
*2.3	Pumproom not provided with tap / not properly fitted	☐
2.4	Ball float valve faulty	☐
2.5	Piping inside pumproom to be painted	☐
2.6	_____	☐
T3	PUMPROOM OVERFLOW SUMP	
3.1	Size of Overflow sump (600mm x 350mm x 500mm) - Actual _____(L) x _____(B) x _____(H)	☐
3.2	Size of discharge hole (150mm x 150mm) - Actual _____(L) x _____(B)	☐
3.3	Discharge hole not screened	☐
3.4	_____	☐

		P1	P2
T4	PUMPSETS		
4.1	Noisy & excessive vibration	☐	☐
*4.2	Dirty / Rusty pumpsets & frames to be cleaned/painted	☐	☐
4.3	Pumpset failed to deliver water to specified capacity	☐	☐
*4.4	Mounting bolts not properly tightened / too short to be recast	☐	☐
4.5	Motor flexible conduit not properly fitted	☐	☐
4.6	_____	☐	☐
T5	RUBBER EXPANSION JOINT		
5.1	Rubber expansion joint not properly fitted	☐	☐
5.2	Rubber expansion joint bolt fitted in reverse position	☐	☐
5.3	_____	☐	☐

T6	PUMPROOM PIPES & FITTINGS	
6.1	Rusty, Location : _____	☐
6.2	Leaks, Location : _____	☐
6.3	Pipes not properly supported, Location : _____	☐
6.4	Bolts & nuts of flanges not galvanised	☐
6.5	200mm short pipe not provided between 80mm gate valve & check valve	☐
6.6	300mm short pipe not provided between 100mm gate valve & check valve	☐
6.7	Gate valve stem cap not fitted	☐
6.8	Gate valve stem cap-end to reposition away from pumpset	☐
6.9	Gate valve leaks	☐
6.10	_____	☐
T7	PUMPROOM ELECTRICAL INSTALLATION & ELECTRODES	
7.1	Control panel dirty provided	☐
*7.2	Alarm bell / Warning bulb not functioning	☐
7.3	Electrodes dirty to be cleaned	☐
7.4	_____	☐

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Annex 2 : Checklists

Pumping Systems (Pg 2/3)

LOCATION : _____ BLOCK NO : _____

		Tick if item not proper
	TRANSFER PUMP SYSTEM	
T8	CONDUIT	
8.1	Conduit not properly supported/fitted	
	Location : _____	
8.2	Holes for conduit not properly patched	
	Location : _____	
8.3	Conduit inspection cover not sealed, Location : _____	
8.4	_____	
T9	ROOF-TOP ELECTRICAL INSTALLATION & ELECTRODES	
9.1	Normal/Emergency level control module system not functioning	☐
9.2	Holder bracket spring clip missing	☐
9.3	Flexible cable holder circular base not secured	☐
9.4	Flexible cable not marked	☐
*9.5	Separator stopper for electrodes not fitted / insufficient	☐
9.6	Electrodes dirty to be cleaned	☐
9.7	_____	☐
T10	ROOF-TOP PIPES & FITTINGS	
10.1	Pipes not properly supported, Location : _____	☐
10.2	Piping required to be painted	☐
10.3	Leaks, Location : _____	☐
10.4	Gate valve stem cap not fitted, Location : _____	☐
10.5	25mm overflow warning pipe not properly supported	☐
10.6	_____	☐
T11	OTHER DEFECTS & COMMENTS	
11.1	_____	☐
11.2	_____	☐
11.3	_____	☐
11.4	_____	☐
	REFUSE CHUTE FLUSHING SYSTEM	
R1	CONTROL PANEL	
1.1	No circuit diagram	☐
*1.2	Indicating light not functioning / wrong colour	☐
*1.3	MCB / ELCB without label indicating function	☐
1.4	_____	☐
R2	CONDUIT	
*2.1	Conduit not properly supported / fitted	
	Location : _____	☐
2.2	Holes for conduit not properly patched	
	Location : _____	☐
2.3	Rooftop electrical control inspection cover not sealed	☐
2.4	_____	☐
R3	PIPINGS & FITTINGS	
3.1	Rusty, Location : _____	☐
3.2	Leaks, Location : _____	☐
3.3	Pipes not properly supported, Location : _____	☐
3.4	_____	☐
R4	OTHER DEFECTS & COMMENTS	
4.1	_____	☐
4.2	_____	☐
4.3	_____	☐

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Annex 2 : Checklists

Pumping Systems (Pg 3/3)

LOCATION : _____ BLOCK NO : _____

	BOOSTER PUMP SYSTEM	Tick if item not proper	
B1	CONTROL PANEL		
1.1	Control panel dirty		
1.2	_____		
B2	PUMPSETS	P1	P2
2.1	Noisy & excessive vibration		
2.2	Terminal blocks' cables not marked		
2.3	Terminal blocks' covers without gasket		
2.4	Bolts & nuts of pump supports not galvanised		
2.5	_____		
B3	ELECTRICAL INSTALLATION & ELECTRODES		
3.1	Holder bracket spring clip missing		
3.2	Flexible cable holder circular base not secured		
3.3	Flexible cable not marked		
*3.4	Separator stopper for electrodes not fitted / insufficient		
3.5	Electrodes dirty to be cleaned		
3.6	_____		
B4	PIPINGS & FITTINGS		
4.1	Rusty, Location : _____		
4.2	Leaks, Location : _____		
4.3	Pipes not properly supported, Location : _____		
4.4	Bolts & nuts of flanges not galvanised		
4.5	_____		
B5	CONDUIT		
5.1	Conduit not properly supported/fitted		
	Location : _____		
5.2	Holes for conduit not properly patched		
	Location : _____		
5.3	Control inspection cover not sealed, Location : _____		
5.4	_____		
B6	THRUST SUPPORTS, FLANGE ADAPTORS & TAG		
6.1	Thrust supports not provided		
6.2	Flange adaptors not provided		
6.3	'DO NOT OPEN' tag not provided at 42mm ball valve		
6.4	'DO NOT OPEN' tag not provided at gate valve		
6.5	_____		
B7	OTHER DEFECTS & COMMENTS		
7.1	_____		
7.2	_____		
7.3	_____		
7.4	_____		

A set of Technical Data for transfer and booster pumping and refuse chute flushing systems is attached.

Name of Consultant PE	**Registration No.**	**Signature**	**Date**

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Annex 2 : Checklists

Refuse Handling Equipment (Pg 1/2)

HOUSING & DEVELOPMENT BOARD **TM(M&E)/RHP/A**
BUILDING QUALITY GROUP
INSPECTION CHECKLIST FOR REFUSE HANDLING PLANT

LOCATION : _____ BLOCK NO : _____

CONTRACTOR : _____ N'HOOD : _____

SUPPLIER : _____

Total nos. of dwelling units (f)	Required storage capacity for 2 days. (f x 2 days x 20 l/day)	RHE model installed	RHE capacity

R1 PHYSICAL MEASUREMENT

ITEM	DESCRIPTION	Overload Range	Overload Setting	MEASUREMENT	Tick if item not proper
1	Setting of time delay timer for automatic washing device for discharge of refuse handling plant (60 sec)			sec.	☐
2	Setting of timer for washing of discharge chute of refuse handling plant (30 sec)			sec.	☐
3	Running current of motor for gate			amp.	☐
4	Running current of motor for dust screw			amp.	☐

R2 EQUIPMENT DEFECTS

1	Leaks : _____	☐
2	Noisy : _____	☐
3	Dirty & rusty : _____	☐
4	System not functioning.	☐
5	Gully hose not installed.	☐
6	Pipes not properly supported.	☐

R3 BUILDING DEFECTS

1	Distance between centre line of refuse handling plant front support mounting bolt and the kerb at apron (2454 mm) Right : _____ mm and Left : _____ mm.	☐
2	Depth from the finished surface of driveway to the top of the chamfered RC slab (180mm) Right : _____mm and Left : _____ mm.	☐
3	Height of adjustable front chute to floor finishing :_____mm	☐
4	Kerb at apron not ready.	☐
5	Roller shutter fail to stop and reverse automatically when it is obstructed.	☐
6	Roller shutter control panel using different type of key.	☐
7	Roller shutter incoming supply not connected to the isolator.	☐
8	Roller shutter electrical isolator not installed.	☐
9	Roller shutter installation incomplete.	☐
10	Roller shutter auto / manual control not functioning properly.	☐
11	Roller shutter time delay not functioning.	☐
12	Roller shutter flexible cable too short.	☐
13	Roller shutter brand : _____	

R4 FIRE PROTECTION

1	Heat detector not functioning.	☐
2	Fire alarm bell not functioning.	☐
3	Sprinkler not functioning (Right / Left).	☐
4	Solenoid valve controlling the sprinkler not functioning.	☐

* Delete whichever is not applicable

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Annex 2 : Checklists

Refuse Handling Equipment (Pg 2/2)

LOCATION : _____ BLOCK NO : _____

R5	OTHER DEFECTS & COMMENTS	
1		
2		
3		
4		
5		
6		
7		
8		

Name of Consultant PE	Registration No.	Signature	Date

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" Together, we provide excellent project management to deliver quality homes in a sustainable environment."

Dr Johnny Wong, Er.
Director (Building Quality), HDB

© HDB

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