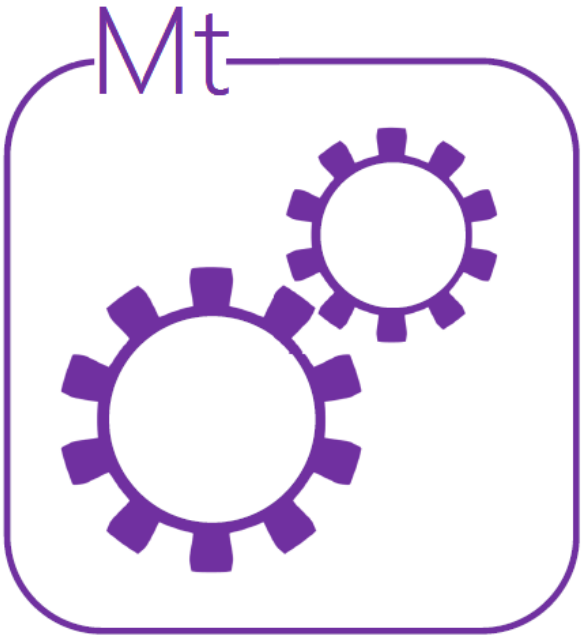

Green Mark 2021

Maintainability Framework

For New Non-Residential Buildings (NRB)

Mt
Maintainability

Maintainability (New Non-residential Building) Revision Log

S/N	Brief description of changes	Effective date
01	Pilot version	20 Apr 2021
02	First issue (Version 1.0)	01 Nov 2021
03	Second issue with minor updates (Version 1.1)	01 Nov 2021
04	Third issue with minor updates (Version 1.2)	01 Nov 2021

CRITERIA			Points Allocation
Section 0 – GENERAL			
0.1	General Project Requirement		7
	Sub-total score for Section 0		7
Section 1 – ARCHITECTURAL EXTERIOR			
1.1	General Façade	Part A	0.5
	Part A: Subtotal of 1.1		0.5
1.2	Cladding system: Tile / Stone / Metal / Others	Part B: Façade System	4
1.3	Curtain Wall: Glazing/Others		4
1.4	Masonry, Lightweight Concrete Panels, and Precast components		4
	Part B: Subtotal of 1.2 to 1.4		4 (Max)
1.5	Façade Features / other façade considerations		3
1.6	Entrance lobby		3
1.7	Roof		-
	Part C: Subtotal of 1.5 to 1.7		6
	Sub-total score for Section 1 (Part A + Part B+ Part C)		10.5
Section 2 – ARCHITECTURAL INTERIOR			
2.1	Floors		2.5
2.2	Walls and Partitions		1
2.3	Ceilings		4
2.4	Wet Rooms and Storage		8
2.5	Basements		4
2.6	Loading Bay/ Back of House Service Areas		1.5
	Sub-total score for Section 2		21
Section 3- MECHANICAL			
3.1	Chiller Plant	Part A: Cooling Systems	9.5
3.2	Unitary Air Conditioning System – Variable Refrigerant Flow (VRF)		1
	Part A: Subtotal for cooling systems (apportioning of 3.1 and 3.2)		9.5 (Max)

3.3	Air Distribution System	Part B	4
3.4	Domestic Water Supply		-
3.5	Fire Protection System		2
3.6	Sanitary System		2
3.7	Building Management System		1
	Part B: Subtotal of 3.3 to 3.7		9
	Sub-total score for Section 3 (Part A + Part B)		18.5
Section 4- ELECTRICAL			
4.1	Lighting System		2
4.2	Power Distribution System		2
4.3	Extra Low Voltage (ELV) System		3
4.4	Lightning Protection System		1
4.5	Vertical Transportation System		2
4.6	Solar PV System		0.5
	Sub-total score for Section 4		10.5
Section 5 - LANDSCAPE			
5.1	Softscape		1.5
5.2	Hardscape		3.5
5.3	Vertical Greenery		-
5.4	Roof, Sky Terraces, and Planter boxes on building edge/façade		1.5
5.5	Water Retaining Structure		2
5.6	Standalone Structures		2
	Sub-total score for Section 5		10.5
Section 6 – SMART FM			
6.1	Good practices		2
6.2	Cybersecurity		1
6.3	Innovation		3
6.4	Advanced Smart FM		4
6.5	Robotics & Automation		3
	Sub-total score for Section 6		13
	Overall Maintainability Points		***91***

ASSESSMENT APPROACH

Category 1 (Cat 1)

Assessment: Full points for solutions only with 100% applicability in area of application or number of instances.

Category 2 (Cat 2)

Assessment:

a. Apportioned points for solutions with 15% to 85% coverage (partial or apportioning) in area of application or number of instances.

b. Full points for solutions with >85% coverage in area of application or number of instances.

c. No points for solutions with <15% coverage in area of application or number of instances.

o GENERAL

Design Factor	General Requirements		
Design Strategies & Collaboration	Promote inclusion of Design for Maintainability (DfM) at planning and design stage (7 points)	Points Available	Points Scored
	a. Promote integrated design approach and stakeholder engagement at planning and key design stages. i) Conduct at least 3 design charrettes during the concept/ detail design stage involving minimally 3 stakeholders from the following group: o Building owner/ representative o Facilities manager (FM)/operator o Design consultants (minimally one representative each from the various disciplines – architecture, civil & structural, mechanical and electrical, landscape, quantity surveyor, etc.) o Other specialist consultant / supplier (i.e. environmentally sustainable design, lighting specialist, material specialists, façade access consultant, etc.)	Prerequisite	
	ii) Use of 5-step SMART process to evaluate building's potential to implement Smart FM, and to identify suitable solutions that will streamline FM maintenance process, improve productivity and service delivery.	Prerequisite	
	iii) Design for maintainability report, as part of the O&M manual, outlining the key maintainability considerations and provisions.	1 (Cat 1)	
	b. Use of life cycle cost (LCC) approach to identify solutions with better economic and maintainability benefit throughout the building life span. i) Undertake project-specific LCC analysis on adopted LCC-related solutions listed in this appraisal system for o At least 5 solutions (1 point) o More than 10 solutions (2 points)	Up to 2 (Cat 1)	

LCC	c. Maintenance contract Use of outcome-based contracts and integrated facilities management (IFM) contracts to improve labour efficiency. i) Projects demonstrating outcome-based maintenance contract for the following services: (1 point for each item, up to 2 points) • Chiller plant • Air distribution • Cleaning (toilets, waste management, etc.) • Landscape • Security ii) Projects demonstrating integrated facilities management (IFM) contracts for the following maintenance services: (1 point for 2 maintenance services, up to 2 points) • Building maintenance services • Mechanical and Electrical maintenance services • Security services • Cleaning services • Landscape services • Pest control services	Up to 4 (Cat 1)	

1 ARCHITECHTURAL EXTERIOR

Design Factor	1.1	General Façade (0.5 points)		
Detailing	1.1.1	Reduce risk of water ingress and streaking on façade (0.5 points)	Points Available	Points Scored
	a.	Design for drip edges/grooves to mitigate streaking on exterior soffits and vertical façade surfaces e.g. leading edge of flashing, sills, overhangs or other horizontal projecting façade elements.	Prerequisite	
	b.	Design all top surface of walls to slope away from the external face of façade	0.5 (Cat 1)	
Detailing + Access	1.1.2	Access for maintenance of façade (prerequisite)	Points	
LCC	a.	Ensure entire façade is accessible for maintenance.	Prerequisite	
Access	1.1.3	Access for maintenance of façade and roof of sky bridges (prerequisite)	Points Available	Points Scored
	a.	Ensure the roof and façade of skybridges are accessible for maintenance.	Prerequisite	
	Façade Systems - Section 1.2 to 1.4 (For singular façade system, *points can be scored for 1.2, 1.3 or 1.4. In case project comprises multiple façade systems, points will be apportioned on an area basis)*			
Design Factor	1.2	Cladding – Tile / Stone / Metal / Others (4 points)		
Detailing + Material	1.2.1	Reduce risk of water ingress and streaking on façade (Up to 4 points)	Points Available	Points Scored
	a.	For streaking: Specify metals of similar properties or separators between different metal components on the exposed face of the facade to mitigate risk of bi-metallic corrosion.	Prerequisite	
LCC	b.	For water ingress – design for pressure-equalised (rain-screen) system, comprising: i) Ventilation openings of adequate dimensions to ensure pressure-equalisation of the cladding cavity ii) Drainage system to positively drain out water iii) Air cavity with a fully sealed internal backing wall behind the cladding.	2.5 (Cat 1)	
	c.	For water ingress – In face-sealed cladding: specify silicone or modified silicone sealant that is compatible and with adequate adhesion properties to the substrate.	1 (Cat 1)	

LCC	d. For streaking – specify sealant type that has non-stain, non-bleed properties.	0.5 (Cat 1)	
	e. For water ingress – specify gasket type EPDM or TPE.	1 (Cat 1)	
	f. For water ingress – design for double layer protection at façade interfaces, coping, etc.	0.5 (Cat 2)	
	Advanced effort: For water ingress – Specify anti-carbonation coating or waterproofing layer onto the backing wall behind the cladding.	1 (Bonus) (Cat 1)	
Design Factor	1.3 Curtain Wall (4 points)		
Detailing + Material	1.3.1 Reduce risk of water ingress and streaking on façade (Up to 4 points)	Points Available	Points Scored
	a. For streaking: Specify metals of similar properties or separators between different metal components on the external façade of facade to mitigate risk of bi-metallic corrosion.	Prerequisite	
LCC	b. For water ingress – design for pressure-equalised system comprising: i) Ventilation openings of adequate dimensions to ensure pressure-equalisation of the cavities ii) Drainage system to positively drain out water iii) Internal air-seal layer to pressurise internal cavities and minimise risk of water penetration	2 (Cat 1)	
	c. For water ingress - specify silicone sealant that is compatible and with adequate adhesion properties to the substrate.	1 (Cat 1)	
LCC	d. For streaking - specify sealant type that has non-stain, non-bleed properties.	0.5 (Cat 1)	
	e. For water ingress – specify gasket type EPDM or TPE.	1 (Cat 1)	
	f. For water ingress – design for double layer protection at façade interfaces, coping, etc.	0.5 (Cat 2)	
Design factor	1.4 Masonry, Lightweight Concrete Panels, and Precast components (4 points)		
Detailing	1.4.1 Reduce risk of water ingress and efflorescence formation (2 points)	Points Available	Points Scored
	a. For efflorescence: specify mortar materials to be salt free.	Prerequisite	

		b. For water ingress: design movement joints in large continuous areas, or between adjacent/different building components, to minimise the risk of damage to façade, weather seal, and waterproofing joints.	Prerequisite	
		c. For water ingress in pre-cast component joints: specify silicone or modified silicone sealant on weather-exposed joints, that is compatible and with adequate adhesion properties to the substrate.	1 (Cat 1)	
LCC		d. For efflorescence: Specify clear coat, with good resistance to water absorption, on façade surface. e.g. fair-faced or pigmented concrete. *(OR)* Specify paint with good resistance to water absorption, complying with SS500 or equivalent.	1 (Cat 1)	
Material	1.4.2	Reduce risk of façade flaking/peeling/cracking/blistering (Up to 2 points)	Points Available	Points Scored
		a. Specify for integral colours (i.e. directly mixed into the cement) or post-applied stains (impregnator) with inorganic pigments for surfaces which do not require painting.	2 (Cat 2)	
LCC		b. Specify paint finish: Top coat: Paint with good resistance to water absorption complying with SS500 or equivalent. *(OR)* Mineral paint	1 (Cat 2)	
Design Factor	1.5	Façade Features / other façade considerations (3 points)		
Access	1.5.1	Direct access to all protruding façade features, e.g. canopies, sunshades, niches, fins, ledges, BIPV, façade screens etc.(prerequisite)	Points Available	Points Scored
		a. Ensure every part of all façade features is accessible for maintenance.	Prerequisite	
		b. Ensure all glass features and their structures (e.g. glazed canopies) can withstand the maintenance-related loads.	Prerequisite	

Detailing	1.5.2	Reduce risk of corrosion of exposed steel structures, e.g. linkways (1 point)	Points Available	Points Scored
	a.	Design to avoid direct contact of a steel base with the ground (raised by at least 100mm) to mitigate corrosion and entrapment of moisture and dirt.	1 (Cat 2)	
Detailing	1.5.3	Reduce risk of water ingress in open joint cladding *(i.e. cladding serving as a decorative feature and not as a water barrier)* (1 point)	Points Available	Points Scored
	a.	For features such as open-joint cladding: provide flashings at regular intervals (not exceeding 3 floors) to positively drain out the cladding cavities and prevent the accumulation of water.	1 (Cat 1)	
Detailing	1.5.4	Reduce risk of tile/stone from detaching off façade (1 point)	Points Available	Points Scored
	a.	Design for mechanically-fixed individual tile/stone panels with stainless steel fixings.	1 (Cat 1)	
Design Factor	1.6	Entrance Lobby (3 points)		
Detailing	1.6.1	Reduce risk of water ingress at entrances (Up to 3 points)	Points Available	Points Scored
	a.	Design for raised internal level of at least 100mm from the external datum.	Prerequisite	
LCC	b.	Design canopy/overhang (minimally 1:50 slope) to shelter against wind-driven rain, with canopy angled at least 45° to the entrance line or with drop panel if canopy/overhang does not shelter to entrance line.	2 (Cat 2)	
		Advanced efforts: Numerical simulation (wind-driven rain penetration) studies specific to location and context of surroundings of entrances	1 (Bonus)	
LCC	c.	Design entrances with transition/buffer zone, e.g. vestibule design *(Solution c & d work as an integrated system and are not mutually exclusive, i.e. both must be scored for.)*	2 (Cat 2)	
LCC	d.	Design for aluminium drain pan with walk-off mats. *(Solution d must be integrated with solution b or c to be eligible for scoring.)*	1 (Cat 2)	
Design Factor	1.7	Roof (prerequisite)		
Detailing	1.7.1	Reduce risk of water ponding on roofs (prerequisite)	Points Available	Points Scored
	a.	For concrete flat roofs - design slope not gentler than 1:150 and with scupper drains/gutter.	Prerequisite	

	b. For metal sheet profiles – Design slope to manufacturer's specifications (*OR)* Design slope for different sheet profiles based on the roof pitch table (refer to table in technical guide) (*OR)* Design slope for different sheet profiles determined by rainwater drainage capacity calculation.		Prerequisite	
Material + Detailing	1.7.2	Reduce risk of waterproofing decay/failure on concrete roofs (prerequisite)	Points Available	Points Scored
	a.	Specify bitumen/polymer elastomer preformed waterproofing membrane (design for overlap and proper termination of waterproofing membrane). *(OR)* Specify water-based/solvent-based liquid applied waterproofing membrane.	Prerequisite	
Material + Detailing	1.7.3	Reduce risk of corrosion on metal roofs (prerequisite)	Points Available	Points Scored
	a.	Specify metal of similar properties or separators between different materials to mitigate risk of bi-metallic corrosion between roof and other metal components or accessories.	Prerequisite	

2 ARCHITECTURAL INTERIORS

Design Factor	2.1 Floors (2.5 points)		
Material	2.1.1 Reduce risk of damage to floors in common areas within the building (1.5 points)	Points Available	Points Scored
LCC	a. Specify flooring materials with minimum Mohs hardness value of 7, in areas of high pedestrian traffic such as entrances, lobbies, corridors and connecting walkways.	1.5 (Cat 2)	
Material	2.1.2 Reduce maintenance works in common areas within the building (1 point)	Points Available	Points Scored
LCC	a. Specify flooring material – e.g. homogenous tiles – with water absorption rate not exceeding 0.5 % to reduce settling of stains in areas of high pedestrian traffic such as entrances, lobbies, corridors and connecting walkways.	1 (Cat 2)	
Design Factor	2.2 Walls and Partitions (1 point)		
Material	2.2.1 Reduce risk of stains on wall surfaces in common areas within the building (up to 1 point)	Points Available	Points Scored
LCC	Specify for finishing to be: a. water-resistant wall materials, e.g. laminate and tile (1 point); or b. Stain-resistant paint or hydrophobic paint (0.5 point)	1 / 0.5 (Cat 2)	
Design Factor	2.3 Ceilings (4 points)		
Access	2.3.1 Access to services within double slab areas for maintenance purposes (2 points)	Points Available	Points Scored
	a. Provide double slabs with minimum clear headroom of 1.8m	Prerequisite	
	b. Provide double slabs with minimum clear headroom of 2 m.	2 (Cat 2)	
Detailing	2.3.2 Access to services within the ceiling in non-tenanted indoor spaces (up to 1 point)	Points Available	Points Scored
	a. Specify open ceiling design.	1 (Cat 2)	
LCC	b. Specify suspended modular ceiling system that is easily demountable.	0.5 (Cat 2)	

Access	2.3.3	Access to ceiling for maintenance (prerequisite)	Points Available	Points Scored
	a.	Provide access to all parts of the ceiling *(including weather-exposed ceiling)* for general maintenance.	Prerequisite	
Material	2.3.4	Reduce risk of warping/deterioration of ceiling panel system that are weather-exposed, e.g. sky terraces, entrance porches, corridors and canopies. (up to 1 point)	Points Available	Points Scored
LCC	a.	Specify suspended metal panel modular ceiling system, e.g. baffle metal panels and metal mesh panels.	1 (Cat 2)	
LCC	b.	Specify moisture-resistant suspended non-metallic modular ceiling panels with water absorption rate not exceeding 5 %.	1 (Cat 2)	
	c.	Specify open ceiling design.	1 (Cat 2)	
Design Factor	2.4	Wet Rooms and Storage (8 points)		
Detailing	2.4.1	Provide permanent space to store cleaning tools and toilet supplies (up to 1 point)	Points Available	Points Scored
	a.	Design for storage rooms for cleaning tools, carts, and supplies such as tissue rolls and soap refill for every male and female toilet cluster.	1 (Cat 1)	
	b.	Design for at least one storage space within the male and female toilet clusters to store supplies such as tissue rolls and soap refill. *(Point cannot be scored if already scored for solution a)*	0.5 (Cat 1)	
Detailing + Material	2.4.2	Reduce risk of mould and fungus formation on walls in wet rooms (up to 1 point)	Points Available	Points Scored
LCC		Specify wall finishes with a. tiles e.g. glazed ceramic tiles or homogenous tiles. (1 point) b. anti-mould top-coat (0.5 point)	1 / 0.5 (Cat 2)	
Detailing + Material	2.4.3	Reduce risk of damage to toilet cubicle partitions and enable ease of cleaning (1 point)	Points Available	Points Scored
	a.	Specify water-resistant, partition panels with water absorption rate not exceeding 5 %, e.g. phenolic panels.	0.5 (Cat 1)	
	b.	Design for raised partition walls with minimum of 150mm gap from the finished floor level.	0.5 (Cat 1)	

Detailing	2.4.4 Reduce risk of water spill, splashing, and soap dripping on the counter and floor (up to 3.5 points)	Points Available	Points Scored
	a. Water spill on floor – Design for full vanity washbasin with counter-top to slope away from the user.	1.5 (Cat 1)	
	b. Water spill on floor – Design for soap and tissue dispenser within arm's reach of each faucet. (points can be scored only after scoring for solution (a))	0.5 (Cat 1)	
	c. Soap dripping on counter/floor – Design of soap dispenser location to be vertically mounted directly above basin or integrated bin.	1 (Cat 1)	
	d. Water splash on counter/floor – Specify depth of basins to be minimally 175 mm to avoid excessive splashing.	0.5 (Cat 1)	
Detailing	2.4.5 Reduce the need to replace entire mirror glass pane when damaged (0.5 point)	Points Available	Points Scored
	a. Design for individual, modular mirror panes with standard sizes that are easy to replace.	0.5 (Cat 1)	
Material	2.4.6 Reduce degradation of false ceiling system in wet rooms (up to 1 point)	Points Available	Points Scored
LCC	a. Specify moisture-resistant suspended modular ceiling panels with water absorption rate not exceeding 5 %.	1 (Cat 2)	
	b. Specify suspended metal panel modular ceiling system, e.g. baffle metal panels, aluminium trellis, and metal mesh.	1 (Cat 2)	
Design Factor	2.5 Basement (4 points)		
Detailing + Material	2.5.1 Reduce risk of water ingress/seepage in basement (up to 4 points)	Points Available	Points Scored
	a. Specify positive side waterproofing on the retaining wall, e.g. sheet-membrane systems, vapour barriers or equivalent.	Prerequisite	
LCC	b. Design for cavity wall with raised kerb of minimally 200mm and with water-resistant wall layer on the inside, e.g. calcium silicate board/ concrete block masonry, etc.	2 (Cat 1)	
	c. Specify positive side waterproofing for the base slab, e.g. sheet-membrane systems, vapour barriers or equivalent.	1 (Cat 1)	
LCC	d. Specify negative side waterproofing for walls	1 (Cat 1)	

	e. Specify integral liquid waterproofing admixture in the concrete.	1 (Cat 1)	
Design Factor	2.6 Loading Bay/Back of House Service Areas (1.5 points)		
Material	2.6.1 Reduce damage caused by impact on walls and columns in vehicular ramps, and loading bay areas (prerequisite)	Points Available	Points Scored
LCC	a. Specify wall bumpers, column guards, wheel stoppers, and bollards.	Prerequisite	
Material	2.6.2 Reduce damage to walls, columns and floors at back of house high traffic delivery areas (1.5 points)	Points Available	Points Scored
LCC	a. Specify column guards in service delivery areas.	0.5 (Cat 1)	
	b. Specify protective materials: i) for walls, e.g. chequered plate on walls *(0.33 point)* ii) for floors, e.g. epoxy flooring *(0.33 point)* iii) for doors, e.g. kickboards on doors *(0.33 point)*	1 (Cat 2)	

3 MECHANICAL

	Part A: Cooling Systems ***(Points can be scored for either 3.1 or 3.2. Points will be apportioned for projects having multiple types of cooling system or district cooling system)***		
Design Factor	3.1 Chiller Plant (9.5 points)		
Access	3.1.1 Access to chiller plant room for equipment replacement	Points Available	Points Scored
	a. Where chiller plant is located in the basement i) Provide direct access from driveway through operable openings (i.e. roller shutter). *(OR)* ii) Provide operable openings and service corridor with minimum width of 2.5 m which is directly accessible from the driveway.	Prerequisite	
	b. Where chiller plant is located on the rooftop/service floor i) Provide operable opening and adequate hoisting space.	Prerequisite	
Access	3.1.2 Access to equipment requiring frequent maintenance (3 points)	Points Available	Points Scored
LCC	a. Provide davit arm at the top of cooling tower for repair and replacement of heavy components i.e. motor, fans etc.	1 (Cat 1)	
	b. Provide cat ladder with metal enclosure (cage) to access top of the equipment i.e. cooling tower	0.5 (Cat 1)	
	c. Provide metal step-over platform at the main access leading to the plant rooms to avoid stepping on rooftop services (i.e. major ductwork, pipes above 100 mm diameter, trunking exceeding 200 mm in width etc.).	0.5 (Cat 1)	
	d. Provide minimum 1.2 m wide clear access route from the nearest lift lobby or staircase to the M&E plant rooms for regular maintenance (i.e. pump room, chiller plant room including cooling tower etc.).	1 (Cat 1)	

Material + Detailing	3.1.3 Reduce risk of corrosion and dust invasion in cooling tower (Up to 1.5 points) *(Points can be scored for3.1.3a and either 3.1.3b or 3.1.3c, points will be apportioned for projects having both cross flow and counter flow cooling towers* *General requirement – applicable to both cross and counter flow cooling tower)*	Points Available	Points Scored
	a. All components in contact with condensing water or air stream must be corrosion protected. The construction material must be either: i) FRP (fiberglass reinforced polyester with UV inhibitors). ii) 304 stainless steel. iii) For galvanized steel cooling tower, the zinc coating must comply with the following: o Hot-dip galvanized steel must comply with ASTM A123 (*OR*) G235 (*OR*) JIS H 8641 coating standards. o Continuous steel sheet must comply with ASTM A653 zinc coating thickness.	1 (Cat 1)	
LCC	b. For cross flow cooling tower, provide basin cover to mitigate dust invasion and algal growth in the upper water basin.	0.5 (Cat 1)	
	c. For counter flow cooling tower, provide air intake louvers to avoid sun light from entering the cooling tower basin and thus reducing algae formation.	0.5 (Cat 1)	
Detailing	3.1.4 Reduce risk of oil/grease deposit on the cooling tower fins (1 point)	Points Available	Points Scored
	a. The kitchen exhaust outlet must be at least 5 m away from cooling tower air intake. *(AND)* The kitchen exhaust must be directed either perpendicular or opposite to the cooling tower air intake.	Prerequisite	
	b. Provide kitchen air cleaning system (i.e. air scrubber, electrostatic precipitator filters etc.) to avoid grease deposits on the cooling towers.	1 (Cat 1)	
Detailing	3.1.5 Reduce risk of fouling issue and improve condenser water quality (2.5 points)	Points Available	Points Scored
LCC	a. Provide microprocessor based, automatic water quality monitoring and control system linked to Building Management System (BMS).	1.5 (Cat 1)	
LCC	b. Provide auto-tube cleaning for water cooled chillers.	1 (Cat 1)	

Detailing	3.1.6 Reduce risk of dust and debris settlement inside the cooling tower basin (up to 1.5 points)	Points Available	Points Scored
	a. Provide basin sweeper system (including side stream separator) to remove coarse to fine particles and silt deposit in the cooling tower basin. *Note: The basin sweeper system must be provided for each cooling tower.* *(OR)*	1.5 (Cat 1)	
LCC	b. Provide side stream centrifugal separator or equivalent in condenser water loop to mitigate debris and dust accumulation.	1 (Cat 1)	
Design Factor	3.2 Unitary Air Conditioning System – Variable Refrigerant Flow (VRF) (1 point)		
Access	3.2.1 Access to VRF outdoor units (prerequisite)	Points Available	Points Scored
	a. For single VRF outdoor unit installation: Note: Provide access space as specified in the Technical Reference.	Prerequisite	
	b. For collective VRF outdoor unit installation: Note: Provide access space as specified in the Technical Reference.	Prerequisite	
	c. For floor-by-floor VRF outdoor unit installation Note: Provide access space as specified in the Technical Reference.	Prerequisite	
Detailing	3.2.2 Avoid damage to the refrigerant pipe and insulation (1 point)	Points Available	Points Scored
	a. Refrigerant pipe mounted outdoor (e.g. at roof level) must be mounted on inside raised trunking to avoid water ingress and damage to stepping/lateral impact.	1 (Cat 1)	
	Part B: Section 3.3 to 3.7		
Design Factor	3.3 Air Distribution System (4 points)		

Access	3.3.1 Access space for maintenance of air distribution system (prerequisite)	Points Available	Points Scored
	a. Fan coil units (FCU) i) Provide ceiling access panel with minimum 600 mm x 600 mm to access filter, cooling coil, and fan section for regular maintenance and replacement. ii) Cooling coil pipe connection access – Provide minimum 450 mm clear space after pipe connection from any obstacle. iii) FCU side clearance - Provide minimum 200 mm access space from any obstacle. iv) FCU and key components such as actuator control valve, local control panel (LCP) must be directly accessible and within maximum 600mm from the access panel.	Prerequisite	
	b. Access to FCU mounted at heights (i.e. atrium, lobby space) i) Access provisions stated in 3.3.1a. (AND) ii) Provide clear access route for Mobile Elevated Work Platforms (MEWP) to reach the lobby, atrium space from the nearest door entrance. ○ Provide clear access with entrance door/ opening of 1.8 m width x 2.4 m height and working base of 1.8 m width x 2 m length if the mounting height is less than or equal to 10.5 m. ○ Provide clear access with entrance door/ opening of 2 m width x 2.8 m height and working base of 2 m width x 2 m length if the mounting height is greater than 10.5 m. (OR) iii) Provide alternative access (e.g. maintenance platform, access from top floors etc.) without having to access from the atrium floor. (OR) iv) Locate FCU less than 3 m from FFL for easy access and maintenance.	Prerequisite	
Detailing	3.3.2 Reduce risk of water ponding and algae growth in the AHU room (0.5 point)	Points Available	Points Scored
	a. AHU drain pipe must be terminated directly above the floor trap to avoid any water spillage.	Prerequisite	
	b. AHU room floor to be provided with epoxy coating to avoid algae and mould growth.	0.5 (Cat 1)	

Detailing	3.3.3 Reduce risk of choke of condensate drain pipes (prerequisite)	Points Available	Points Scored
	a. The horizontal drain pipes must have minimum slope of 1:100 for easy flow of condensate drain.	Prerequisite	
	b. Provide T-joint before terminating the individual drain pipe from AHU to the main drain stack for periodic cleaning.	Prerequisite	
Detailing	3.3.4 Reduce frequency of replacement for AHU filters (up to 1.5 points)	Points Available	Points Scored
	a. Provide differential pressure switch linked to BMS for real-time monitoring of filter choke condition. *Note: Differential pressure switch must be provided for both primary and secondary filter for PAHUs and AHUs. The filters must also be compliant to ASHRAE 52.2:2017 / ISO 16890. Filter holding frame must be equipped with gasket to prevent any by-pass. The filters must have minimum MERV rating of MERV 8 / ISO ePM10 50% (Primary filter) and MERV 14 / ISO ePM1 80% (Secondary filter).*	Prerequisite	
LCC	b. Specify fibre glass filter media with average initial resistance not greater than 90 Pa for primary filter (MERV 8 and ISO ePM10 50%) and 145 Pa for secondary filter (MERV 14 and ISO ePM1 80%). *Note: Synthetic media with initial static charge is not acceptable*.	0.5 (Cat 1)	
LCC	c. Specify filters with better Life Cycle cost for increased service life and lower cost of ownership. LCC should capture the key parameters such as "Total cost of ownership, service life, Energy consumption details and Indoor Air Quality performance". *Note:* *i. Total cost of ownership must be in Singapore dollars* *ii. Energy consumption is based on S$0.20 / KWh* *iii. Filters must be complaint to ISO 16890 / ASHRAE 52.2:2017*	1 (Cat 1)	
Detailing	3.3.5 Avoid frequent re-alignment of fan parts i.e. pulley, bearings and belts (2 points)	Points Available	Points Scored
LCC	a. Specify AHU fan system with less moving parts (i.e. fans with direct drive system) for enhanced reliability and reduced downtime. *Note:* *Points will be prorated for buildings which are served predominantly (≥75%) by FCUs.*	2 (Cat 2)	

Design Factor	3.4	Domestic Water Supply		
Access	3.4.1	Access space for maintenance of water tank (prerequisite)	Points Available	Points Scored
	a.	Provide minimum clear width of 1.2 m access walkway to water tank from the nearest staircase or lift	Prerequisite	
Design Factor	3.5	Sanitary System (2 points)		
Access + Detailing	3.5.1	Access provision and design detailing for sanitary pipes for ease of maintenance (1 point)	Points Available	Points Scored
	a.	Provide cleaning eyes with viewing panel for better maintenance.	0.5 (Cat 1)	
	b.	Specify hubless elbows for sanitary stacks with horizontal transfers.	0.5 (Cat 1)	
Detailing	3.5.2	Reduce risk of chokes in the sanitary pipe (1 point)	Points Available	Points Scored
	a.	For buildings with food and beverage (F&B) units, the AHU condensate drain must not be linked to kitchen waste discharge pipes.	Prerequisite	
	b.	Provide at least 75% of the risers with continuous vertical run without any offsets to reduce the additional bends/joints. *Note: Above requirement is applicable only to all typical floors in building*	1 (Cat 1)	

Design Factor	3.6	Fire Protection System (2 points)		
Access	3.6.1	Access to fire detectors at height (Pre-requisite)	Points Available	Points Scored
	a.	Provide alternative access for fire detector maintenance (e.g. maintenance platform) without having to access from the atrium floor. *(OR)* Provide clear access route for Mobile Elevated Work Platforms (MEWP) to reach the lobby or atrium space from the nearest entrance door. ○ Provide clear access with entrance door/ opening of 1.8 m width x 2.4 m height and working base of 1.8 m width x 2 m length if the mounting height is less than or equal to 10.5 m. ○ Provide clear access with entrance door/ opening of 2 m width x 2.8 m height and working base of 2 m width x 2 m length if the mounting height is greater than 10.5 m.	Prerequisite	
Detailing	3.6.2	Prevent the lack of flexibility for maintenance and testing of sprinkler system (1 point)	Points Available	Points Scored
	a.	Locate the flow switch drain valve in rooms with floor trap (i.e. toilet, AHU room etc.).	Prerequisite	
LCC	b.	Provide smart features such as the automatic flow switch testing system to automate the functional test for the fire sprinkler system.	1 (Cat 1)	
Material + Detailing	3.6.3	Reduce risk of damage and periodic replacement of fire-rated boards due to exposure to high humidity and water (1 point)	Points Available	Points Scored
	a.	Specify the use of weatherproof fire-rated materials for services such as kitchen exhaust ducts, wet/dry riser pipes etc.	1	
Design Factor	3.7	Building Management System (1 point)		
Access	3.7.1	Access space above false ceiling for maintenance of sensors and actuators (1 point)	Points Available	Points Scored
	a.	Provide ceiling access panel with minimum opening of 600 mm x 600 mm.	0.5 (Cat 1)	
	b.	Sensors and actuator should be located within reachable distance of 600 mm from the access panel.	0.5 (Cat 1)	

Access	3.7.2	Access to control panels for regular maintenance (prerequisite)	Points Available	Points Scored
	a.	The top of the control panels must be maximum 1.8 m from the finished floor level (FFL) to facilitate direct access. *(OR)* The control panels located at heights must have direct access from scaffolding, ladders etc. Provide minimum 800 mm clear access space in front of the control panels.	Prerequisite	

4 ELECTRICAL

Design Factor	4.1	Lighting System (2 points)		
Access + Detailing	4.1.1	Access to light fixtures located at heights for maintenance and use of reliable light fixtures (1 point)	Points Available	Points Scored
		a. Provide access to the light fixtures mounted at heights (i.e. atrium, lobby space). i) Provide alternative means of access (e.g. access from mezzanine floor, maintenance platform) without having to access from the atrium floor. *(AND/OR)* ii) Provide clear access route for Mobile Elevated Work Platforms (MEWP) to reach the lobby, atrium space from the nearest door entrance. ○ Provide clear access with entrance door/ opening of 1.8 m width x 2.4 m height and working base of 1.8 m width x 2 m length if the mounting height is less than or equal to 10.5 m. ○ Provide clear access with entrance door/ opening of 2 m width x 2.8 m height and working base of 2 m width x 2 m length if the mounting height is greater than 10.5 m. *(OR)* iii) Provide pulley system or equivalent system for light fixtures installed at high lobby or atrium space to allow lowering for maintenance/ replacement.	Prerequisite	
LCC		b. Use reliable light fixtures such as LED light (LM80 B30 L70@ L50,000) which requires less maintenance.	1 (Cat 2)	
Material	4.1.2	Reduce risk of light flickering (0.5 point)	Points Available	Points Scored
		a. Specify constant DC output type LED driver complying with the following IEC standards to minimise flickering: i) IEC 62384. ii) IEC 61347 Part 1 and Part 2-13. b. For non-LED light fixtures, use electronic ballast to cut off power supply to mitigate flickering due to lamp failure.	0.5 (Cat 2)	
Material	4.1.3	Reduce risk of LED light colour shift (0.5 point)	Points Available	Points Scored
		a. Specify LEDs tested to ANSI/IES LM-79-19 and LM-80-15 to ensure the LED performance.	0.5 (Cat 2)	

Design Factor	4.2	Power Distribution (2 points)		
Detailing	4.2.1	Reduce risk of water Ingress into electrical room (prerequisite)	Points Available	Points Scored
	a.	Electrical room must be raised by minimum 100 mm against the outside passageway. *(OR)* Provide minimum 100 mm plinth for floor mounted electrical switchboard.	Prerequisite	
Detailing	4.2.2	Reduce risk of unnoticed failure of surge arrestor located in the LT main switchboard (1 point)	Points Available	Points Scored
	a.	Use of surge arrestor with discharge indicator.	0.5 (Cat 1)	
	b.	Provide BMS monitoring for surge arrestor status.	0.5 (Cat 1)	
Detailing	4.2.3	Reduce risk of failure of main LT switchboard due to overheating (1 point)	Points Available	Points Scored
	a.	Install heat sensor in the main LT switchboard to alert any abnormal rise in temperature with audible/visual alarm.	0.5 (Cat 1)	
	b.	Integrate sensor to building BMS system for online monitoring of temperature data.	0.5 (Cat 1)	
Design Factor	4.3	Extra Low Voltage System (3 points)		
Access	4.3.1	Provide access for CCTV camera located at heights (1 point)	Points Available	Points Scored
	a. b.	Provide access to cameras located at heights (≥ 3m) i.e. foldable poles/arms; *(OR)* Provide clear access route for mobile elevated work platforms (MEWP) to reach the camera for maintenance.	1 (Cat 1)	
Detailing	4.3.2	Provide flexibility for future expansion for CCTV system (1 point)	Points Available	Points Scored
	a.	Provide minimum 20% spare capacity in network switch to cater for future expansion.	Prerequisite	
	b.	Design that allows for future addition of data storage (either local or cloud base data storage).	1 (Cat 1)	

Detailing	4.3.3	Reduce risk of damage to outdoor camera and other equipment due to lightning surge (1 point)	Points Available	Points Scored
	a.	Provide surge arrestor to all outdoor cameras. Note: The surge protection must be provided at power source (AND/OR) at network switch.	1 (Cat 1)	
Design Factor	4.4	Lightning Protection System (1 point)		
Detailing	4.4.1	Reduce risk of damage of air termination tape at roof parapet wall due to operation of façade maintenance systems such as gondola (1 point)	Points Available	Points Scored
	a.	Avoid damage to the lightning protection system by proper design and installation of facade maintenance system.	1 (Cat 1)	
Design Factor	4.5	Vertical Transportation (2 points)		
Access	4.5.1	Access to lift motor room for maintenance (prerequisite)	Points Available	Points Scored
	a.	Provide permanent access (staircase with handrail) to the lift motor room.	Prerequisite	
Access	4.5.2	Access to roof level for equipment replacement and maintenance (1 point)	Points Available	Points Scored
	a.	Provide lift access to roof for maintenance of equipment such as chiller plant and pumps.	1 (Cat 1)	
Detailing	4.5.3	Reduce lift downtime and enhance reliability (1 point)	Points Available	Points Scored
LCC	a.	Provide lift predictive maintenance. Note: Monitor key parameters such as vibration, acceleration, levelling, door jams, gaps, noise, and jerk etc.	1 (Cat 1)	
Design Factor	4.6	Solar PV System (0.5 point)		
Detailing	4.6.1	Reduce risk of integration issues with BMS (0.5point)	Points Available	Points Scored
	a.	Link PV system to BMS via open communication protocol such as Modbus, BACnet/ IP for remote monitoring and data logging.	0.5 (Cat 1)	

5 LANDSCAPE

Design Factor	5.1	Softscape (1.5 points)		
Detailing + Material	5.1.1	Reduce labour-intensive irrigation for landscape (Up to 1.5 points)	Points Available	Points Scored
	a.	Design for water points with maximum 15 m radius from each point.	Prerequisite	
	b.	Specify rain sensor and auto-irrigation with timers.	1.5 (Cat 2)	
LCC	c.	Specify for auto-irrigation with timers. *(points cannot be scored if already scored in b)*	1 (Cat 2)	
		Advanced Efforts: Implement remote monitoring system for landscape irrigation along with water metering for irrigation.	1 (bonus) (Cat 1)	
Design Factor	5.2	Hardscape (3.5 points)		
Detailing + Access	5.2.1	Access for maintenance of underwater lighting systems (up to 2 points)	Points Available	Points Scored
LCC	a.	For shallow water bodies, design for easily replaceable lighting system within the underwater structure but above the waterline.	1 (Cat 1)	
	b.	For swimming pools/ shallow water bodies, design lighting fixture within a depth of 500mm and along the perimeter *(calculated from base of light to finished floor level for in-ground pool/ to point of access for above-ground pool)* (1/0.5 point)	1/0.5 (Cat 1)	
Material	5.2.2	Reduce risk of damage/degradation to outdoor landscape furniture (up to 0.5 point)	Points Available	Points Scored
	a.	Specify for engineered wood with water absorption rate not exceeding 0.5%.	0.5 (Cat 2)	
	b.	Specify for anti-corrosion coating or stainless steel or aluminium for metal selections.	0.5 (Cat 2)	
Access	5.2.3	Access for maintenance beneath decking (1 point)	Points Available	Points Scored
	a.	Design decks with demountable fixture system for maintenance of services beneath and for general cleaning.	1 (Cat 1)	

Design Factor	5.3	Vertical Greenery (prerequisite)		
Access	5.3.1	Access to all parts of vertical greenery for maintenance and replacement of perished plants	Points Available	Points Scored
LCC	a.	Provide direct maintenance access to all vertical greenery, both indoor and outdoor, e.g. catwalk, ladder, access corridor, MEWP, etc.	Prerequisite	
Design Factor	5.4	Roof, Sky Terraces, and Planter boxes on building edge/façade (1.5 points)		
Detailing + Access	5.4.1	Access for landscape on roof and sky terraces (1 point)	Points Available	Points Scored
	a.	Provide direct maintenance access to landscape on all roof and sky terraces.	Prerequisite	
	b.	For planters more than 1.8 m wide, provide minimally 300 mm obstruction-free maintenance pathway inside the planter box.	Prerequisite	
	c.	For trees: Provide 5 m clear pathway from building edge to tree trunk.	1 (Cat 2)	
Access	5.4.2	Access to planter boxes on building edge (0.5 point)	Points Available	Points Scored
	a.	Provide minimally 600mm access walkway to planter boxes for maintenance	0.5 (Cat 1)	
Design Factor	5.5	Water retaining structure (2 points)		
Access + Material	5.5.1	Reduce risk of water leakage from swimming pools/water bodies (up to 2 points)	Points Available	Points Scored
	a.	Specify prefabricated water retaining structures, e.g. fibreglass reinforced or stainless-steel pool.	2 (Cat 1)	
	b.	For concrete pools - specify Integral liquid waterproofing admixture in concrete mixes and additional layer of waterproofing layer on the inside of the pool	2 (Cat 1)	
		Advanced effort: Provision of maintenance slab below the swimming pool with headroom access of minimum 2.0 m	1.5 (bonus)	

Design Factor	5.6	Standalone structures (2 points)		
Detailing + Material	5.6.1	Reduce water ponding and degradation of outdoor standalone structures, e.g. pavilions (up to 1 point)	Points available	Points Scored
	a.	Design for outdoor standalone structure's roof slope to be not gentler than 15 degrees for efficient water run-off	Prerequisite	
	b.	Design to avoid direct contact of steel base with the ground (raised by at least 100mm) to prevent corrosion and entrapment of moisture and dirt. (Point cannot be scored if already scored in solution 1.5.2)	0.5 (Cat 1)	
	c.	Specify for engineered wood with water absorption rate not exceeding 0.5% for built-in furniture.	0.5 (Cat 1)	
Material	5.6.2	Reduce risk of warping/deterioration of ceiling panel system on standalone structure (up to 1 point)	Points available	Points scored
LCC	a.	Specify suspended modular metal panel, e.g. baffle metal panels and metal mesh panels	1 (Cat 2)	
	b.	Specify moisture-resistant suspended non-metallic modular ceiling panels with water absorption rate not exceeding 5%	1 (Cat 2)	
	c.	Specify open ceiling design	1 (Cat 2)	

6 SMART FM

Design Factor	6.1	Good Practices (Up to 2 points)		
Detailing	6.1.1	Good practices that could be considered during design stage (2 points)	Points Available	Points Scored
		a. Building Management System ready for integration with Smart FM (up to 2 points)		
		i) Provide open communication protocol such as BACnet, MODBUS, etc for ease of integration with other Smart FM systems.	Prerequisite	
		ii) Adoption of a common and consistent naming convention for BMS data points which is handed over to the building owner.	1 (Cat 1)	
		iii) Provision of automated and schedule exports of data points to commonly used file formats which enables exchange of data between systems. For example, data export to analytics or optimization software.	1 (Cat 1)	
		iv) Provision of documentation during handover stage to ensure operational continuity	Prerequisite	
Design Factor	6.2	Cybersecurity (Applicable to both BMS and FMS System)		
Detailing	6.2.1	Lack of cyber security leading to data theft and economic impact (Up to 1 point)	Points Available	Points Scored
		a. Implement a risk-based cyber security assessment conducted by building owner's IT department/cyber security consultant Building OT system i.e., BMS and FMS system must be governed by Information Security Management System ("ISMS"). These are some basic cyber security requirements that should be included in the ISMS;	0.5 (Cat 1)	
		i) Minimum of two network tiers for BMS and FMS – web/application tier ("demilitarised zone or DMZ") and data tier separated by firewall that appropriately configured to block direct access to database from external network.		
		ii) Up-to-date anti-virus software in all machines.		
		iii) Firewalls to assess communication with 3rd-party services.		

		iv) Encryption of critical data at rest (stored data) and data in transit (transmitted data); v) User access shall have Individual user authentication and multi-level grouping to regulate the access. The login authentication to be password protected. vi) Conducting of regular Vulnerability Assessment & Penetration Testing ("VAPT") and remediation of all critical, high and medium security issues; VAPT should minimally cover the latest OWASP Top 10 vulnerabilities. vii) System audit log or audit trail to record data changes and system access. viii) Install two-factor Authentication.		
	b.	The organisation is assessed by an independent party and certified to comply with 1 of the following certifications. i) ISO 27001, the International Information Security Standard ii) SOC 2 certification, American Institute of Certified Public Accountants. iii) IEC 62443, Industrial communication networks - IT security for networks and systems.	1 (Cat 1)	
Design Factor	6.3	Innovation (3 points)		
Detailing	6.3.1	Adopt innovative technologies that improve FM labour efficiency and service delivery. **(Up to 3 points)**	Points Available	Points Scored
		a. Adopt at least one Smart FM solution (Type 1 or 2) within project. Score at least 1 point from 6.3.1b or c.	Prerequisite	
		b. Type 1 – Use of digitised workflow automation to optimize the workflow, productivity and service delivery: (1 point each) **Digitalized Workflow Automation**: When triggered by a feedback or incident, automatically initiates a process that tracks, monitors, and closes the feedback or incident. Example applications are as follows: 1. Remote monitoring systems with sensors that which will alert FM team on fault detection and critical incident alerts 2. Video analytics with incident detection that would alert security team of any abnormalities 3. Application that allows for automated temperature adjustment in accordance to user feedback 4. CMMS software for FM workflow automation 5. Smart toilets 6. Smart bins	Up to 3 (Cat 1)	

		7. Smart monitoring system for fire extinguishers 8. Smart exit lights 9. Software platform for defects management 10. Software platform for handover of as-built drawings **c. Type 2 – Use of data analytics and artificial intelligence for system optimization and predictive maintenance: (1 point each)** i) **Diagnostics AI:** Able to identify system deviations and diagnose potential causes. ii) **Predictive AI**: Able to diagnose problems and predict future states of assets and systems. Example applications are as follows: 1. M&E equipment condition monitoring with sensors and analytics for preventive/conditional-based maintenance (e.g. monitoring of embedded sensors in chiller or VRF CU to predict mechanical wear and failure) 2. Fault detection diagnostics to find failed or improperly operating equipment (e.g. using abnormalities in IAQ readings or deviation from set points to relate equipment faults)		
Design Factor	6.4	Advanced Smart FM (4 points)		
Detailing	6.4.1	Advanced Smart FM – Integrated and aggregated Smart FM solutions that improve FM labour efficiency and service delivery (up to 4 points)	Points Available	Points Scored
		a. Type 3 – Integration across systems (1 point each): Integration across multiple systems/FM services to optimize resource deployment and utilization across multiple systems/FM services Example applications are as follows: 1. Use of lift traffic and carpark gantry data to forecast and streamline cleaning regimes 2. Integration of CCTV with access control system for intrusion detection 3. Integration between CCTV system and Fire Alarm System to promptly identify occurrences of false alarms	Up to 3 (Cat 1)	

	b. Aggregated Smart FM Solution Building owners can explore areas where economies of scale can be achieved through aggregation of FM solutions. Example applications are as follows: 1. For building owners with a portfolio of buildings, Smart FM solutions or FM functions such as cleaning and security can be aggregated across the portfolio of buildings for a better overview and management of resources. 2. Building owners with a single development may explore aggregation through FM companies and solution providers through outcome-based contracts. FM companies and solution providers can better manage resources to meet service demands through the aggregation of buildings in a district.	1 (Cat 1)	
Design Factor	6.5 Robotics and Automation (3 points)		
Detailing	6.5.1 Design for Robotics and Automation (R&A) (up to 3 points)	Points Available	Points Scored
	c. Building infrastructures should be designed to optimise robot capabilities such as their range of mobility, ease of completing tasks, and ability to navigate its work environment. (up to 3 points, 0.5 point for each R&A solution) Identifying the robots of interest to be deployed and recognising their corresponding level of autonomy is important in planning for suitable infrastructure that would cater to the robots. Example use of FM robots could include the following: • Cleaning robot e.g. façade, floor, window • Concierge robot • Facade inspection robot/drone • Landscape management robot e.g. lawn mowers • Pest management robot e.g. detection, monitoring, extermination • Security robot • Waste management robot	Up to 3 (Cat 1)	