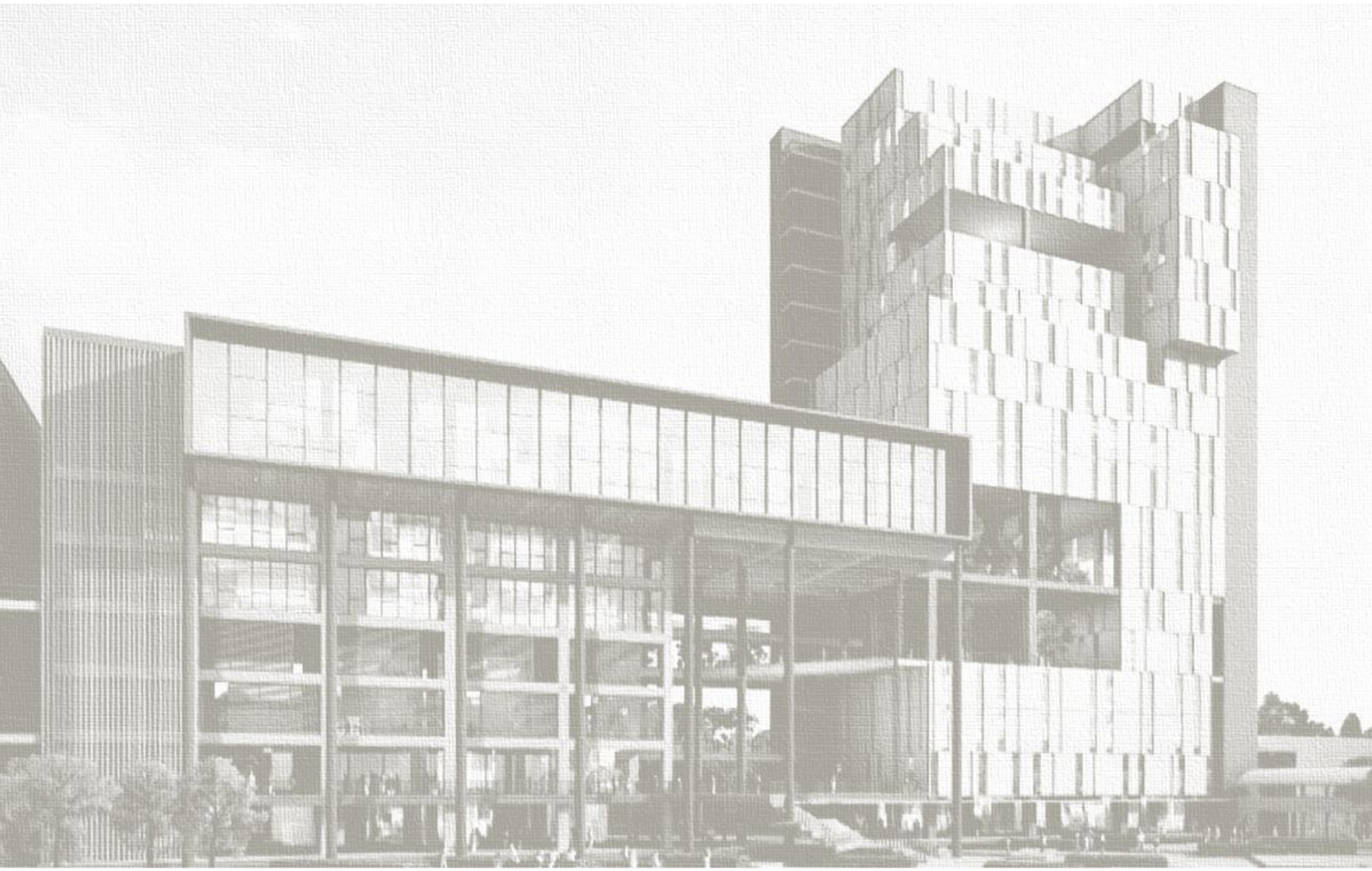
Building and Construction Authority



Code of Practice on

BUILDABILITY - 2022 Edition

Guide to Buildable Design Appraisal System (BDAS) and Outcome-based Options

The Guide to the Buildable Design Appraisal System is electronically published by the Construction Productivity and Quality Group of the Building and Construction Authority.

This Guide should be read in conjunction with the prevailing Code of Practice on Buildability and is subject to revision. Nothing herein shall be construed to exempt the person from submitting an application or any plan from otherwise complying with the provisions of the Building Control Act (Cap 29) or any rules and/ or guidelines made thereunder or any Act or rules and/ or guidelines for the time being in force.

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Introduction

This guide serves as a resource for industry professionals, detailing approaches to meet the requirements outlined in the Code of Practice (COP) on Buildability 2022. It covers:

(i) **Computation of Buildable Design Score (B-Score)** using the Buildable Design Appraisal System (BDAS),
(ii) **Streamlined preparation of implementation plans** to substantiate meeting the B-Score and outcome-based requirements.

Designers are encouraged to prepare clear implementation plans, referencing the illustrations and examples provided in this guide. These plans should substantiate the extent of prefabrication and buildable design principles such as standardisation, modularisation, and repetition. Documentation should include:

(i) Marked-up plans showing the location and extent of adoption
(ii) Computation of coverage
(iii) Supporting documents such as drawings and schedules

CORENET X (CX) is a one-stop digital platform designed to streamline and enhance coordination in regulatory submission processes. Since October 2025, submissions via CX have been made mandatory, starting with projects with Gross Floor Area (GFA) ≥ 30,000 m^2. This guide also makes reference to the various CX gateways applicable to Buildability submissions.

For further clarification regarding this guide, please contact the Buildable Design Department, Construction Productivity and Quality Group of the Building and Construction Authority (BCA), Singapore via the feedback form available on BCA's website.

1 Submission Guidelines in CORENET X (CX)

CORENET X is a redesigned regulatory approval process for building works, streamlining over 20 approval touchpoints across seven regulatory agencies into three key sequential submission gateways to promote upstream design coordination and minimise downstream issues. For Buildable Design Score (B-Score) and Constructability Score (C-Score) submissions, Qualified Persons (QPs) and Builders are involved in the various gateways (refer to Figure 1 in green). To ensure timely issuance of Temporary Occupation Permit (TOP), project teams are strongly encouraged to submit the as-built B-Score and C-Score for clearance prior to TOP applications (e.g. at least two months in advance).

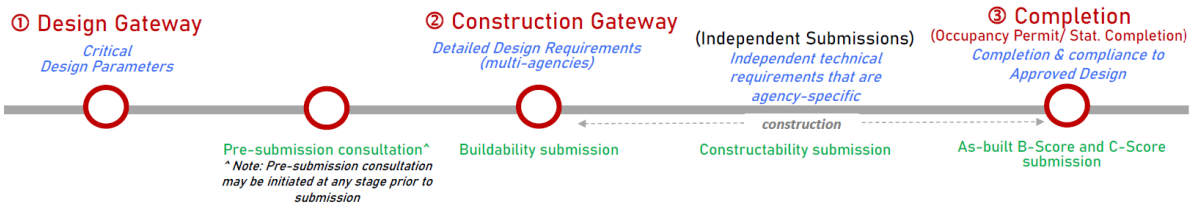


Figure 1: Regulatory Approval Process for Building Works (RABW) in CX

Submissions made in Building Information Modelling (BIM) format should incorporate buildability attributes for features such as precast components, prefabricated reinforcement, industry-standard sizes, and other construction elements.

For more information on CORENET X, please refer to https://info.corenet.gov.sg/.

2 Options to Comply with Buildability Requirements

Projects have the flexibility to comply with Buildability requirements through one of the following three options:

a. Meeting minimum (min.) B-Score and minimum C-Score;
b. Meeting minimum level of prefabrication / Design for Manufacturing and Assembly (DfMA) technology; or
c. Meeting minimum productivity improvement (over 2010 level)

For each of these options, designers should also ensure that their projects comply with all the applicable Buildability pre-requisites outlined in the Code of Practice on Buildability 2022 Edition (COP), where applicable.

The table below shows the submission requirements including documentation for the different compliance options.

All projects with GFA ≥ 5,000m²	**For large projects with GFA ≥ 25,000m²** *(To refer to Section 4 Annex C of COP 2022 for the requirements)*	
Meeting min. B-Score using Buildable Design Appraisal System (BDAS) **and min. C-Score**	**Meeting min. prefabrication/ DfMA levels** through Deemed-acceptable Solution	**Meeting min. Productivity Improvement** through Open Option
Construction Gateway		
1. Coordinated BIM model 2. B-Score form with B-Score computation (BS01) 3. Buildability Detailed Design and Implementation Plan (BDIP), including mark-ups on plans with computation on coverage of building systems / components	1. Coordinated BIM model 2. B-Score form for declaration of chosen compliance option (BS01) 3. Deemed-acceptable Proposal (DAP), including mark-ups on plans with computation on coverage of prefabrication / DfMA / system formwork level	1. Coordinated BIM model 2. B-Score form for declaration of chosen compliance option (BS01) 3. Project Productivity Improvement Plan (PPIP) to demonstrate the design adopted, including: i. Productive technologies/ systems ii. Level of prefabrication, buildable features, off-site finishes iii. Innovative features, robotics and automation iv. Construction process, construction management v. Project productivity computation vi. Manpower utilisation plan and histogram

Independent Submission		
(a) To submit the following **3 months or 6 months** from application for Permit to commence structural works for non-design and build (D&B) projects and D&B projects respectively:		
1. Constructability Score form (CS01) and Constructability Implementation Plan (CIP), including mark-ups on plans with computation of coverage of prefabrication/ system formwork level (by builder)	-	-
(b) To submit the following documents **60 days** before Temporary Occupation Permit (TOP) application		
1. As-built coordinated BIM model 2. As-built B-Score form with B-Score computation (BS03) 3. As-built Buildability Detailed Design and Implementation Plan (BDIP) 4. Site photos as supporting documents, if applicable 5. As-built Constructability Score form (CS01) and Constructability Implementation Plan (CIP) (by builder) 6. Certificate of Compliance of C-Score (CCS01) (by builder) 7. Completed productivity data submission via electronic Productivity Submission System (ePSS) (by builder)	1. As-built coordinated BIM model 2. As-built B-Score form for declaration of chosen compliance option (BS03) 3. As-built Deemed-acceptable Proposal (DAP) 4. Site photos as supporting documents, if applicable 5. Certificate of Compliance of C-Score (CCS01) (by builder) 8. Completed productivity data submission via electronic Productivity Submission System (ePSS) (by builder)	1. As-built coordinated BIM model 2. As-built B-Score form for declaration of chosen compliance option (BS03) 3. As-built Project Productivity Improvement Plan (PPIP) 4. Site photos as supporting documents, if applicable 5. Certificate of Compliance of C-Score (CCS01) (by builder) 6. Completed productivity data submission via electronic Productivity Submission System (ePSS) (by builder)

Note: Construction productivity data shall be submitted to BCA on a monthly basis through the Electronic Productivity Submission System (ePSS)

Part 1

Buildable Design Appraisal System (BDAS)

1 Pre-requisites

Designers must comply with the minimum coverages for all pre-requisites, where applicable depending on the category of projects. For any deviation from the minimum required level, prior approval must be sought from BCA before making Building Plan / Construction Gateway CG (in CX) submission and before commencement of works on site.

1.1 Floor Mesh

For all developments, at least 65% of all cast in-situ (CIS) slab areas shall be constructed with floor mesh. Projects should adopt factory-welded floor mesh (not fabricated on site) for both top and bottom reinforcement. Additional reinforcement may be provided using loose rebars where necessary. Exemptions may be granted for the following cases:

- Areas where floor mesh with larger diameter rebar sizes (non-standard mesh) are required e.g. due to heavy floor loading; or
- Areas with technical challenges for welded mesh installation.

Any exemption request must be supported by justification and accompanying drawings for BCA's assessment.

$$\text{Coverage} = \frac{\text{CIS area using factory welded mesh (m}^2\text{)}}{\text{Total area of CIS slab (m}^2\text{)}} \times 100\%$$

Floor areas with concrete topping i.e. composite or precast slabs etc. are to be excluded from the computation. However, at least 80% of the steel reinforcement for the concrete topping of composite or precast slabs must be welded mesh.

For buildings with basements, the cast in-situ floor areas for the basement and first storey are to be considered under the basement block. Cast in-situ floor areas above the first storey are to be considered under the superstructure block.

✓ **BDIP**: Plans to indicate and demarcate locations where welded mesh is adopted, and to specify mesh size and % coverage. Site photos to be provided at as-built stage.

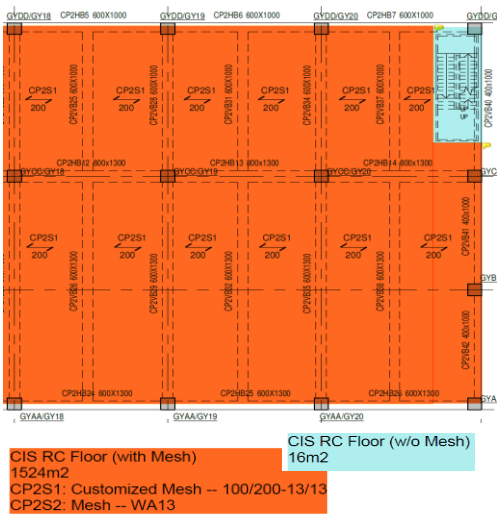


Figure 2: Plan demarcating floor areas with welded mesh adoption, and the size of floor mesh

Table A: Tabulation of % coverage of floor mesh for CIS slab areas

Block/ Storey	Floor areas using welded mesh (m²)	Floor areas using loose rebars (m²)	Total floor area (m²)	% coverage adopting floor mesh
e.g. Basement, 1st storey (transfer), E-deck, 8th storey corridor				
Total % coverage of floor mesh adopted (for CIS areas) =				*(≥ 65%)*

1.2 Repetition of Typical Floor Height in Module of 1.5M or 1.75M

For all developments, at least 80% of typical floor-to-floor heights must be repeated and the repeated floor height must be in multiples of 1.5M [1] or 1.75M. This requirement applies to all levels, including the mezzanine floors, but may exclude the top and ground floors. There should be at least two floors remaining following any floor omission.

$$\text{Coverage} = \frac{\text{No. of most repeated floor height in multiples of 1.5M or 1.75M}}{\text{Total no. of applicable floors}} \times 100\%$$

In cases where there is more than one repeated floor height meeting either 1.5M or 1.75M, only the most common repeated floor height will be considered in the numerator for computation of coverage.

✓ **BDIP**: Elevation / section to show typical floor-to-floor height and % coverage computation

[1] *M denotes a basic module of 100 mm. For example, 0.5M implies that sizes must be in multiples of 50 mm.*

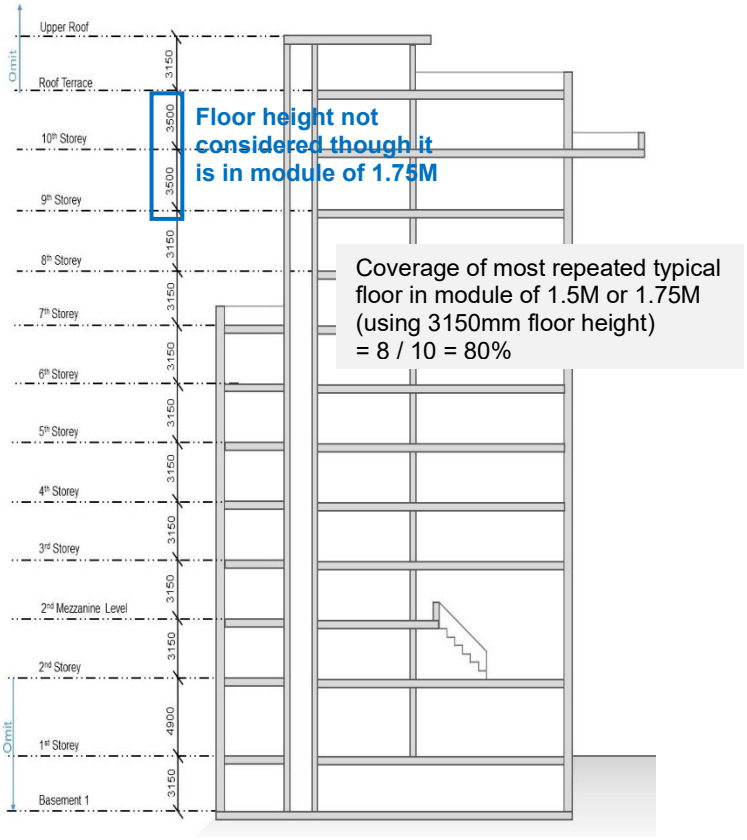


Figure 3: Elevation showing typical floor-to-floor height

1.3 Prefabricated Staircase for Typical Storeys

For all developments, at least 80% of the staircase flights at typical storeys must be prefabricated (i.e. precast or steel) and have a standard riser height of 150 mm or 175 mm, and a standard tread width of 275 mm or 300 mm. For industrial developments, a tread width of 250 mm can be adopted.

✓ **BDIP**: Architectural drawings to indicate location of staircases and staircase details specifying riser height and tread width, % coverage computation

$$\text{Coverage} = \frac{\text{No. of standard prefabricated staircase flights for typical storeys}}{\text{Total no. of staircase flights for typical storeys}} \times 100\%$$

Table B: Tabulation of % coverage of prefabricated staircases (typical storeys)

Block/ Typical storey	No. of prefabricated staircase flights	No. of staircase flights	% coverage of prefabricated staircase
e.g. Block 1			
Overall coverage of precast staircase =			*(≥ 80%)*

1.4 Prefabricated and Pre-Insulated Duct for Air-Conditioning System

All developments[2] with an air-conditioning system must adopt prefabricated and pre-insulated air-con ducts for at least 65% of the total duct length.

✓ **BDIP**: M&E drawings to indicate locations and lengths of air-con ducts, and % coverage. Site photos to be provided at as-built stage.

$$\text{Coverage} = \frac{\text{Length of prefabricated and pre-insulated air-con ducts (m)}}{\text{Total length of air-con ducts (m)}} \times 100\%$$

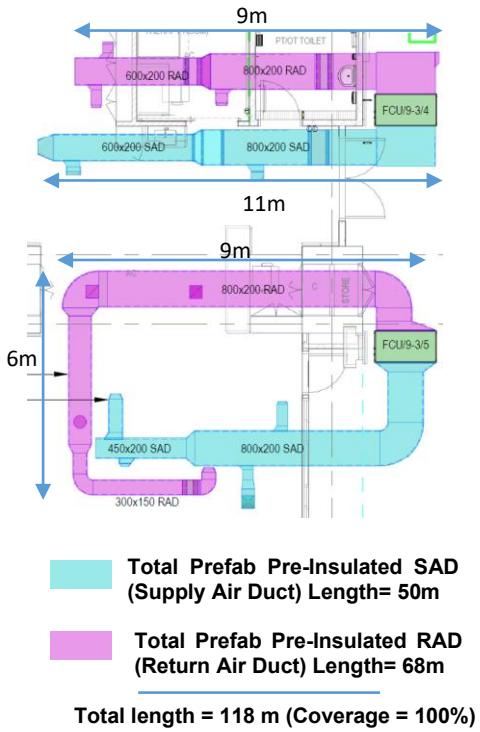


Figure 4: M&E drawings for prefab and pre-insulated air-con ducts

Table C: Tabulation of % coverage of prefabricated and pre-insulated air-con ducts

Block/ Storey	Length of prefab and pre-insulated air-con ducts (m)	Total length of air-con ducts (m)	% coverage of prefab and pre-insulated air-con ducts
e.g. Basement			
Overall coverage of prefab and pre-insulated air-con ducts =			*(≥ 65%)*

[2] *Ducts serving dual functions of Supply Air Duct (SAD) and Smoke Extraction Duct (SED), and large ducts (with either width or depth exceeding 1,000 mm), are allowed to be assembled and insulated on-site before installation.*

1.5 Drywall

All residential non-landed (RNL) developments must adopt drywalls for all internal dry areas such as between bedrooms, and between bedroom with living room etc., except for party wall, toilet wall and kitchen wall. The drywall used must achieve a performance grading of Severe Duty for strength and robustness. Quantities shall be input under the Pre-requisite section of the B-Score form and shall not be counted again under the Architectural Wall System section.

✓ **BDIP**: Architectural drawings to indicate locations of wall systems, wall lengths, % coverage. Site photos to be provided at as-built stage.

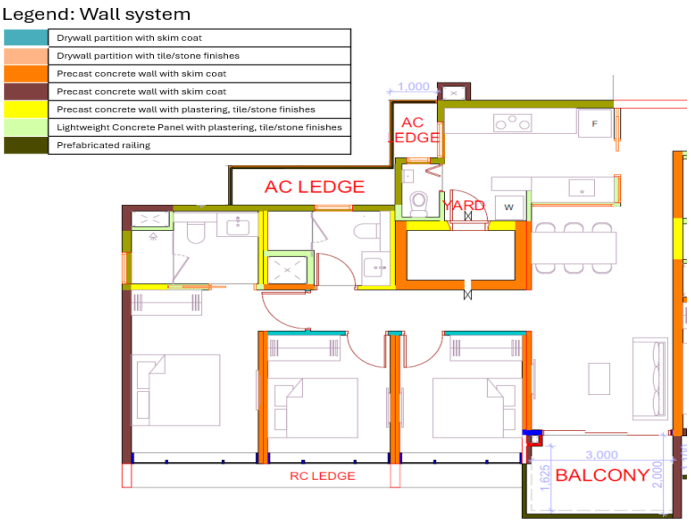


Figure 5: Plan indicating location of drywalls and other wall systems

1.6 Precast Household Shelter

RNL projects with household shelters (HS) must adopt at least 65% of precast household shelters, out of which at least 60% of these precast HS shall be of industry standard sizes. Points are awarded only if the project adopts a minimum of 80% industry standard sizes for the precast HS *(Refer to B-Score form - Structural system section A5 item 9.1).* Wall thickness of HS should be either 250mm or 300mm.

Precast HS design shall incorporate at least one hollow core in each of the four HS walls, except for the 1.2m internal dimension HS wall where the blast door is located. Design shall comply with the prevailing Technical Requirements for HS.

✓ **BDIP**: Plans to show precast household shelters and their internal dimensions (without finishes), % coverage. Site photos to be provided at as-built stage.

$$\text{Coverage for precast HS} = \frac{\text{No. of precast HS}}{\text{Total no. of HS}} \times 100\%$$

$$\text{Coverage for industry standard precast HS} = \frac{\text{No. of industry standard precast HS}}{\text{Total no. of precast HS}} \times 100\%$$

Table D: Tabulation of % coverage of precast household shelters

Block	HS type	Internal dimension	Precast HS			Total no. of HS (includes CIS HS)	% of precast HS	% of industry size precast HS
			Industry standard size	Total no. of industry HS	Total no. of precast HS			
Block 1	*HS1*	*1.3 x 2.2*	*Yes/ No*				*(≥ 65%)*	*(≥ 60%)*
	HS2							

1.7 Prefabricated Bathroom Unit

For RNL projects, at least 65% of bathrooms must be Prefabricated Bathroom Units (PBU), out of which at least 60% of these PBUs shall be of industry standard sizes. The sizes are based on internal dimensions, i.e. exclude the wall thickness and finishes of the PBUs. Sizes for master bath may also be adopted for common bathrooms, and vice versa. The location of the services shaft shall be accessible to facilitate future repairs and maintenance work of the PBUs.

The PBUs must meet the minimum level of finishes and fittings as outlined in Section 3 of Annex A of the COP and manufacturers must be accredited under the PBU Manufacturer Accreditation Scheme (MAS). For any deviation from these requirements, prior approval must be sought from BCA.

✓ **BDIP**: Plans to show PBUs, their internal dimensions, % coverage computation and to include MAS certification as supporting document. Site photos to be provided at as-built stage.

$$\text{Coverage for PBUs} = \frac{\text{No. of PBUs}}{\text{Total no. of bathrooms}} \times 100\%$$

$$\text{Coverage for industry standard PBUs} = \frac{\text{No. of industry standard PBUs}}{\text{Total no. of PBUs}} \times 100\%$$

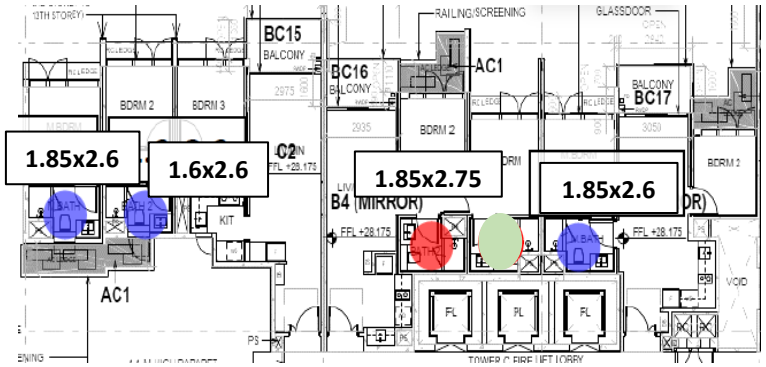


Figure 6: Details of PBU and % coverage

Industry size PBU

Non-industry size PBU

Non-PBU

Table E: Tabulation of % coverage of PBUs

Block	PBUs				Total no. of bathrooms (includes non-PBU)	% coverage of PBUs	% coverage of industry size PBUs
	Type	Internal dimension	No.	Industry standard size			
e.g. Block 1	*e.g. PBU1*	*e.g. 1.85 x 2.6m*		*Yes/ No*	*100*	*(≥ 65%)*	*(≥ 60%)*
	e.g. PBU2						

1.8 Industry Standard Door Structural Openings (Width)

For RNL projects, at least 65% of the structural door openings shall be of industry standard door structural opening widths. Points will be awarded for non-RNL projects which adopt minimum 65% industry standard door structural opening widths (based on 3 most common sizes in 0.5M) *(Refer to B-Score form - Architectural system section B6 item 14.1).*

✓ **BDIP**: Door schedule specifying door structural opening width, quantity and % coverage

$$\text{Coverage} = \frac{\text{No. of doors with industry standard structural opening width}}{\text{Total no. of doors}} \times 100\%$$

Table F: Tabulation of % coverage of industry standard door structural opening

Block	Door type	Door structural opening width (mm)	Industry standard size	No. of industry standard door	No. of doors	% coverage of industry standard door openings
	e.g. D1, D2	*e.g. 900mm*	*Yes/ No*			
					Overall coverage=	*(≥ 65%)*

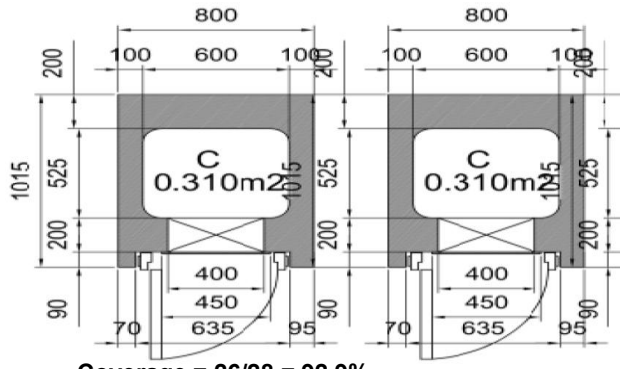
1.9 Industry Standard Precast Refuse Chutes

All RNL projects are to adopt a minimum of 80% industry standard size precast refuse chutes.

For dual/ triple precast refuse chutes, any of the industry standard inner dimensions can be adopted with wall thickness of either 100mm, 150mm or 200mm. A refuse chute within one floor is considered as one shaft.

✓ **BDIP**: Plans to show precast refuse chute and their internal dimensions, % coverage. Site photos to be provided at as-built stage.

$$\text{Coverage} = \frac{\text{No. of industry standard precast refuse chutes}}{\text{Total no. of refuse chutes}} \times 100\%$$



Coverage = 26/28 = 92.9%

Figure 7: Details of precast refuse chutes

Table G: Tabulation of % coverage of precast refuse chutes

Block	Type of refuse chutes	Size of refuse chutes (m)	Industry standard size	No. of refuse chute	% coverage of industry standard precast refuse chute
e.g. Block 1	*e.g. RC1*	*e.g. 0.8m x 0.8m*	*Yes/ No*		
				Overall coverage =	*(≥ 80%)*

2 Structural System

The following table provides an overview of the substantiation required for BDIP.

<table>
<tr><th>Items in BDAS</th><th>Substantiation required for BDIP</th></tr>
<tr><td>Section A1: DfMA structural system

Section A2: Other structural system</td><td>✓ Plans indicating locations, demarcation of floor areas of various structural systems (e.g. PPVC, MET, structural steel, APCS, prefabricated and cast in-situ components)
✓ Drawings of components/ sub-assemblies (integrated precast components, mechanical connections, large panel slab etc.)
✓ Breakdown of structural systems/features adopted for each block, each storey / typical storey and the corresponding % coverage computation in a table format

Table H: Tabulation of Structural Systems and their Constructed Floor Area (m²)
<table><tr><th rowspan="2">Block / Storey</th><th colspan="4">Constructed Floor Area, CFA (m²)</th></tr><tr><th>Item 3.1 Structural Steel/ Hybrid Steel and Precast Concrete</th><th>Item 4.1 Prefab Slab and column/ wall</th><th>Item 4.4 Prefab slab only</th><th>Item 5.2 Beam-slab system</th></tr><tr><td>1st Storey</td><td></td><td></td><td></td><td></td></tr><tr><td>Typical Storey</td><td></td><td></td><td></td><td></td></tr><tr><td>Roof</td><td></td><td></td><td></td><td></td></tr><tr><td>Total</td><td></td><td></td><td></td><td></td></tr><tr><td>Coverage (%)</td><td></td><td></td><td></td><td></td></tr></table>
✓ Where applicable, details of PPVC modules, MAS certificate, pre-assembly / delivery / site installation photos (e.g. pre-finished PPVC modules at off-site facilities, MET or hybrid sub-assemblies, APCS components, prefabricated components, mechanical connections) etc.</td></tr>
<tr><td>Section A3: Simplicity

Section A4: Modularisation

Section A5: Industry standardisation and others</td><td>✓ Plans indicating locations and extent of adoption
✓ % coverage computation
✓ Column/ beam schedule, specifying dimensions and quantity
✓ Supporting documentation of concrete grade and coverage computation of concrete volume
✓ Pre-assembly / delivery / site installation photos (e.g. prefabricated cages) etc.</td></tr>
</table>

2.1 Prefabricated Prefinished Volumetric Construction (PPVC)

For a building system to qualify as PPVC, performance requirements as specified in the COP must be met and manufacturers shall be accredited under the MAS. For any deviation from the minimum requirements for off-site finishing and fitting-out works, prior approval must be sought from BCA.

Designers can refer to the PPVC guidebook which details the key aspects of PPVC and good practices to reap the full benefits of off-site manufacturing.

(Link: https://www1.bca.gov.sg/buildsg/productivity/design-for-manufacturing-and-assembly-dfma/prefabricated-prefinished-volumetric-construction-ppvc/)

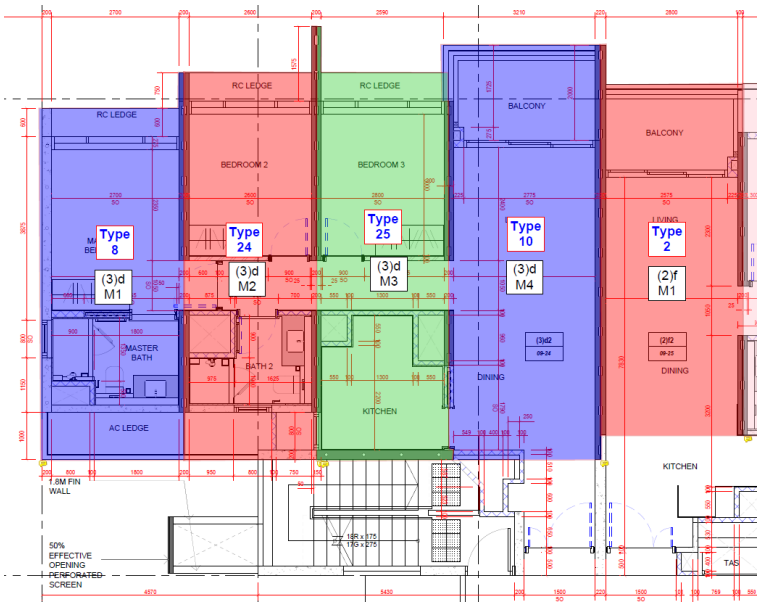


Figure 8: Sample drawing of PPVC modules

$$\text{Coverage of PPVC (\%)} = \frac{\text{CFA of PPVC system (m}^2\text{)}}{\text{Total CFA}^3\text{ of superstructure (m}^2\text{)}} \times 100\%$$

2.2 Mass Engineered Timber (MET)/ Hybrid System of MET with Structural Steel or Precast Concrete

The area of coverage is computed based on the total floor area including the roof. For a building system to qualify as an engineered timber construction, both its floor system (including roof) and column / wall must be constructed using engineered timber. For hybrid MET systems, the building must comprise MET and other prefabricated structural components (column/wall, beams or slab) which can be in the form of structural steel or precast concrete.

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[3] Total constructed floor area (CFA) shall include dwelling units, lift lobbies, corridor and staircase cores but exclude environmental-deck, void deck, swimming pool, roof, carpark, landscape area (but include residential floor area at the same storey if there are dwelling units) and hotel lobby (if applicable).

2.3 Structural Steel/ Hybrid System of Structural Steel and Precast Concrete

For a structural steel system, the column, beam and slab must be constructed using structural steel. Where composite slab is adopted, at least 80% of the steel reinforcement must be of welded mesh. Integrated metal roof, a prefabricated roofing system complete with insulation, should be installed as an entire roof section. For hybrid structural steel systems, the building must comprise structural steel and other prefabricated structural components (column/wall, beam, or slab) which can be in the form of precast concrete.

2.4 Advanced Precast Concrete System (APCS)

For a building system to qualify as APCS, a minimum of 65% of floor area shall be of precast slab and adopt ***at least 4 of the features listed below. Each feature must meet at least 65% coverage***. The APCS features must be located within the precast slab areas.

Designers can refer to the APCS guidebook which features good practices on connection design and detailing, efficient automated production, and key considerations for production planning and site management.

(Link: https://www1.bca.gov.sg/buildsg/productivity/design-for-manufacturing-and-assembly-dfma/advanced-precast-concrete-system)

APCS features	**Examples for computation of coverage (%)** *Only 1 type of component is to be used for computation of coverage per feature*
(a) Integrated precast components (comprising at least 2 structural/ architectural elements) such as double bay façade wall, beam-façade wall, multi-tier column/ wall, precast household shelter, precast refuse chute, PBU, prefinished façade wall, precast external wall with cast-in windows	(i) Coverage = $\frac{\text{No. of integrated precast components}}{\text{Total no. of precast components}}$ x 100% (ii) Coverage = $\frac{\text{No. of PBU}}{\text{Total no. of bathrooms}}$ x 100% (iii) Coverage = $\frac{\text{Length of integrated precast walls (m)}}{\text{Total length of precast walls (m)}}$ x 100% *Note: Computation considers precast load-bearing walls only.*
(b) Mechanical connection for precast column/ precast wall (horizontal joints) e.g. column shoes, grouted sleeves, spiral connectors	(i) Coverage = $\frac{\text{No. of precast columns with horizontal mechanical connections}}{\text{Total no. of precast columns}}$ x 100% (ii) Coverage = $\frac{\text{Length of precast walls with horizontal mechanical connections (m)}}{\text{Total length of precast walls (m)}}$ x 100% *Note: Computation considers precast load-bearing walls only.*
(c) Mechanical connection for precast beam (e.g. telescopic beam connector, grouted sleeves)/ Integrated prefabricated	(i) Coverage = $\frac{\text{No. of precast beams with mechanical connections}}{\text{Total no. of precast beams}}$ x 100%

column and beam junction (e.g. Lotus-Root system, slim floor system e.g. Deltabeam)	
(d) Mechanical connection for precast wall (vertical joints) e.g. flexible loops	(i) Coverage = $\frac{\text{Length of precast facade and parapet walls with vertical mechanical connections (m)}}{\text{Total length of precast facade and parapet walls (m)}}$ x 100%
(e) Mechanical connections for other precast components e.g. mechanical connections for parapet walls, staircases (For staircase, the flight and landing slabs shall be precast)	(i) Coverage = $\frac{\text{Length of parapet walls with mechanical connections (m)}}{\text{Total length of precast walls (m)}}$ x 100% (ii) Coverage = $\frac{\text{No. of precast staircase flight and landing with mechanical connections}}{\text{Total no. of precast staircase flight and landing}}$ x 100% (iii) Coverage = $\frac{\text{No. of precast components with mechanical connections}}{\text{Total no. of precast components}}$ x 100%
(f) Large precast panel slab (e.g. hollow core slab/ double T slab/ precast planks) $\geq$ 2.4m width or room sized panels or panel size optimised for transportation	(i) Coverage = $\frac{\text{Area of large precast panel slab (m}^2\text{)}}{\text{Total area of precast slab (m}^2\text{)}}$ x 100%

2.5 Prefabricated Slab and Column/ Wall or Prefabricated Slab and Beam, Prefabricated Column/ Wall and Beam, Prefabricated Column/ Wall

Coverage is computed based on floor areas that incorporate the specified prefabricated elements. Only load-bearing prefabricated walls shall be considered in the computation.

2.6 Flat Plate/ Flat Slab

A flat plate (Figure 9) is a structural floor system without column heads or drop panels while a flat slab (Figure 10) is a structural floor system with column heads or drop panels.

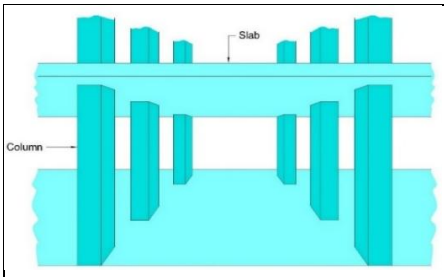


Figure 9: Perspective view of a flat plate

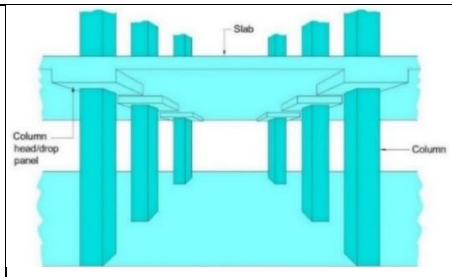


Figure 10: Perspective view of flat slab

2.7 Beam-slab System

Coverage is computed based on floor areas that adopt one-directional and / or two-directional beam-slab cast in-situ system.

2.8 Simplicity, Modularisation, Industry Standardisation and Others

2.8.1 Prefabricated reinforcement cages for beam, column, wall

Points are given if prefabricated reinforcement cages are used for at least 65% of ***cast in-situ (CIS) beams / columns / walls***. CIS staircase storey shelter walls can adopt welded mesh at the outer face of its external walls and loose reinforcing bars for the remaining faces of the walls. Reinforcement cages fabricated using individual loose bars on site are not considered as prefabricated reinforcement cages.

$$\text{Coverage} = \frac{\text{No. of CIS beams / columns / walls using prefabricated cages}}{\text{Total no. of CIS beams / columns / walls}} \times 100\%$$

2.8.2 Mechanical connections

If points are not claimed for APCS, points are given for adopting mechanical connections for the following components (refer to section 2.4 on computation of coverage):

(a) Precast column / precast wall (horizontal joints) e.g. column shoes, grouted sleeves, spiral connectors
(b) Precast beam (e.g. telescopic beam connector, grouted sleeves) / Integrated prefabricated column and beam junction (e.g. Lotus-Root system, slim floor system e.g. Deltabeam)
(c) Precast wall (vertical joints) e.g. flexible loops
(d) Other precast components e.g. mechanical connections for parapet walls, staircases (for staircase, the staircase flight and landing slabs shall be in precast concrete)

2.8.3 Precast slab with lattice girder reinforcement

Coverage is computed based on floor area of precast slab that adopts lattice girder reinforcement.

$$\text{Coverage} = \frac{\text{Precast slab area using lattice girder reinforcement (m}^2\text{)}}{\text{Total area of precast slab (m}^2\text{)}} \times 100\%$$

2.8.4 High strength concrete (at least Grade C60/75)

Points are awarded for the use of high strength concrete of grade C60/75 and above for at least 5% of the total concrete volume.

2.8.5 Columns (3 most common sizes in module of 0.5M)

The coverage of the 3 most common sizes of columns in module of 0.5M (in multiples of 50mm) should make up at least 65% of the total number of columns (exclude stumps at foundation level). If the structural element has a cross-sectional length that is more than 4 times longer than the width, the structural element is considered as a wall and not a column.

For steel columns encased in concrete, the size of the column includes the encasement. Steel columns are not required to come in modular dimensions. The modular dimension requirement for various column shapes is illustrated in Figure 11 below.

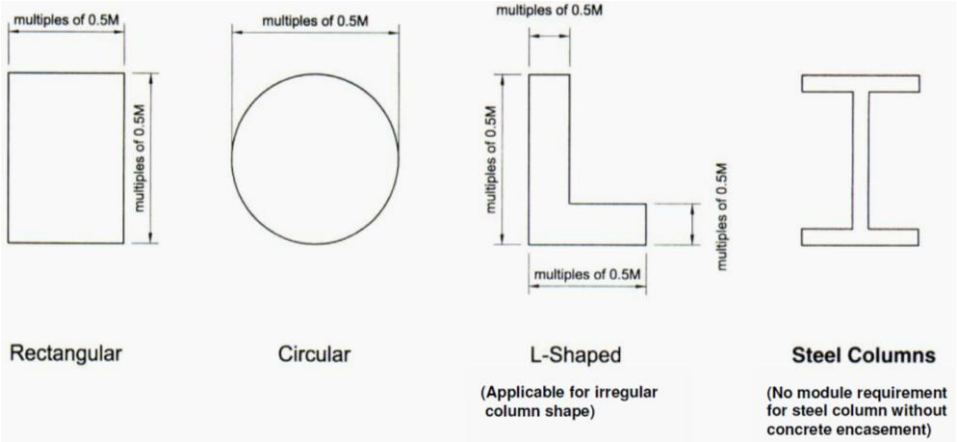


Figure 11: Module requirement for various column shapes

$$\text{Coverage} = \frac{\text{No. of 3 most common columns in 0.5M}}{\text{Total no. of columns}} \times 100\%$$

A typical floor-to-floor column is counted as 1 column. For a multi-tier precast column, each tier is counted as 1 column.

Table I: Tabulation of % coverage of 3 most common column sizes in module of 0.5M

Column markings	Column sizes	Sizes in module of 0.5M	Total no. of columns	% coverage of 3 most common column sizes in module of 0.5M
e.g. C1	*e.g. 250 x 600*	*Yes/ No*	*100*	*(≥ 65%)*
e.g. C2				

2.8.6 Beams (3 most common sizes in module of 0.5M)

The coverage of the 3 most common sizes of beams in module of 0.5M should make up at least 65% of the total number of beams. All beams (including steel, composite, and timber beams) are to be included in the computation. Steel beams are not required to meet the modular requirement of 0.5M. For steel beam encased in concrete, the overall dimension of the beam should be used in the computation**.** The module requirement for beams is illustrated in Figure 12 below.

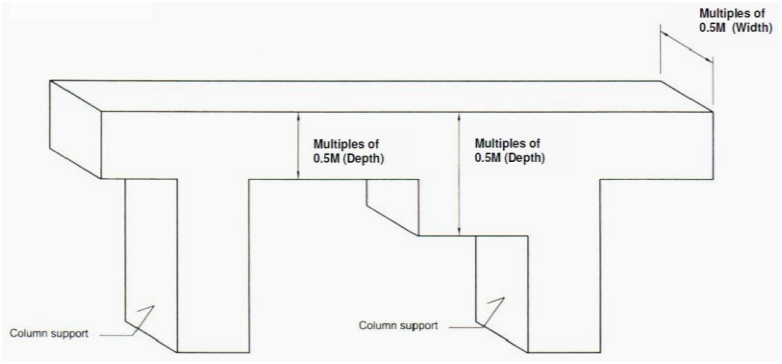


Figure 12: Module requirement for beams with 2 or more depths / widths

$$\text{Coverage} = \frac{\text{No. of 3 most common beams in 0.5M}}{\text{Total no. of beams}} \times 100\%$$

For a typical beam and a beam with different width / depth, the count for one beam is taken from support to support. For a cantilever beam, the count for one beam is taken from support to free end. This is illustrated in Figure 13 below.

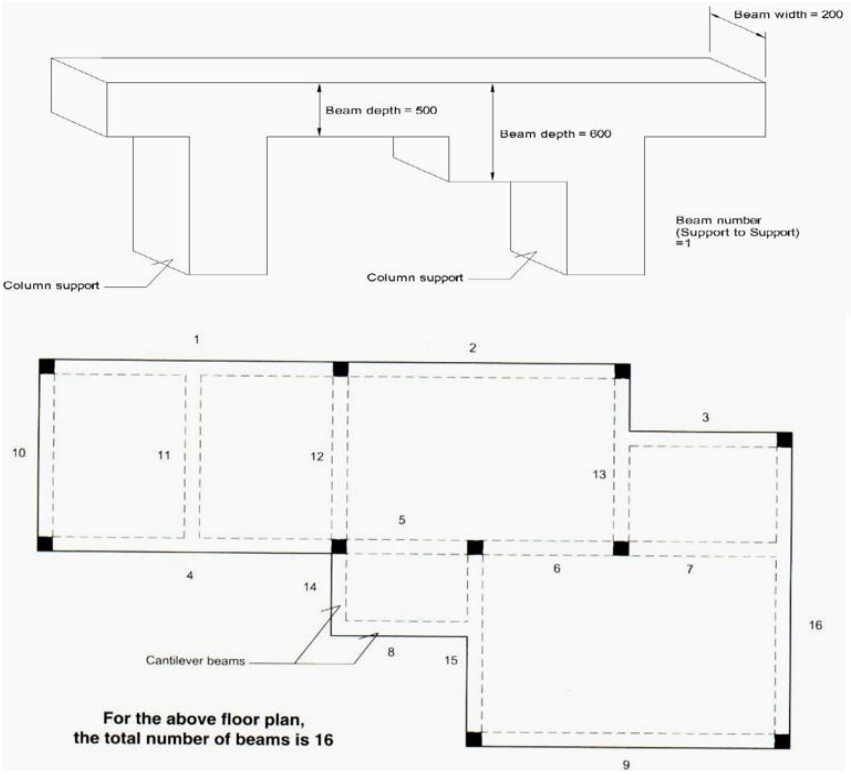


Figure 13: Number of beams to be accounted

Table J: Tabulation of % coverage of 3 most common beam sizes in module of 0.5M

Beam markings	Beam sizes	Sizes in module of 0.5M	Total no. of beams	% coverage of 3 most common beam sizes in module of 0.5M
e.g. B1	*e.g. 250 x 600*	*Yes/ No*	*100*	*(≥ 65%)*
e.g. B2				

2.8.7 Precast columns (in module of 0.5M)

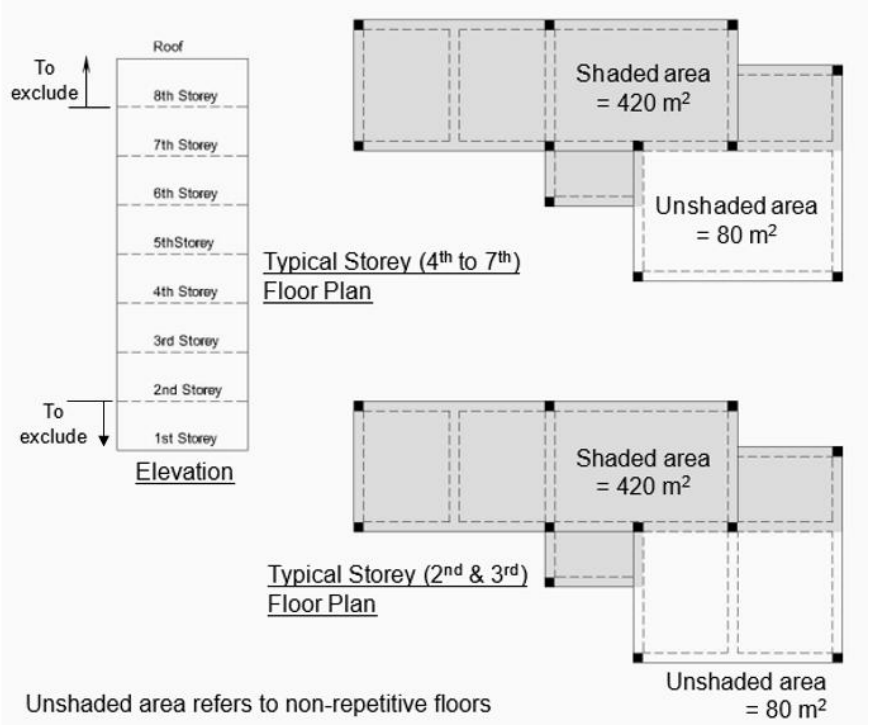
The coverage of precast columns in module of 0.5M should make up at least 65% of the total number of columns. This item will not be applicable if a project has already scored for 3 most common column sizes in module of 0.5M (refer to section 2.8.5).

$$\text{Coverage} = \frac{\text{No. of precast columns in 0.5M}}{\text{Total no. of precast columns}} \times 100\%$$

2.8.8 Vertical repetition of structural floor layout

Structural floor layout should be repeated for at least 65% of the total floor area at typical storeys.

$$\text{Coverage} = \frac{\text{Total area of repeated floors (m}^2\text{)}}{\text{Total floor area (m}^2\text{)}} \times 100\%$$



Area of repetitive floors (shaded)	= 420 m^2 / storey
Total area of repetitive floors	= 420 m^2 / storey x 6 storeys = 2520 m^2
Total floor area	= (420 m^2 + 80 m^2) x 4 + (420 m^2 + 80 m^2) x 2 = 3000 m^2
Coverage of vertical repetition of structural floor layout	= (2520 m^2) / (3000 m^2) x 100% = 84.00%

Figure 14: Example of vertical repetition of structural floor layout calculation

2.8.9 Industry standard precast household shelters

$$\text{Coverage} = \frac{\text{No. of industry standard precast household shelters}}{\text{Total no. of precast household shelters}} \times 100\%$$

2.8.10 Industry standard precast beams

This item is only applicable for RNL projects.

$$\text{Coverage} = \frac{\text{No. of industry standard precast beams}}{\text{Total no. of precast beams}} \times 100\%$$

3 Architectural System

The following table provides an overview of the substantiation required (where applicable) for BDIP during BP/ CG (in CX) submission and TOP/ Completion stage (in CX).

Items in BDAS	Substantiation required for BDIP
Section B1, B2, B3 and B4: DfMA architectural wall system and finishes	✓ Plans indicating wall lengths for all architectural wall systems and wall lengths / floor / ceiling areas for all architectural finishes ✓ Pre-assembly / delivery / site installation photos (e.g. power float concrete floor, vinyl flooring etc.)
Section B5: Simplicity Section B6: Modularisation and industry standardisation Section B7: Demerit points	✓ Architectural drawings indicating locations and extent of use (e.g. extent of void heights greater than 9m, extent of offset floors) ✓ % coverage computation ✓ Schedules (e.g. windows, doors, precast façade / walls) ✓ Drawings (e.g. unit layouts, PPVC bedroom, PKU, pole system wardrobe / modular kitchen cabinet) ✓ Pre-assembly / delivery / site installation photos (e.g. PBU)

3.1 Wall System

Wall systems shall cover external and internal walls, full-height windows and doors, lining walls to external basement wall, parapet walls, and lift shaft wall / shear wall. Handrails mounted to staircase walls, handrails mounted on parapet walls, toilet cubicle walls, non-full height doors and collapsible walls that divide rooms shall be excluded.

Type of wall system

3.1.1 PPVC

- PPVC must meet the minimum level of pre-finishes and fit-out works.

3.1.2 Prefabricated and prefinished wall with MEP services, PBU

- PBUs must meet the minimum level of pre-finishes and fit-out works.

3.1.3 Prefabricated and prefinished wall/ Precast wall off-form[4]

- Unitised curtain wall can score under this item.

3.1.4 Drywall partition for party wall / wet areas (RNL), drywall partition for other areas, curtain wall/ full height glass partition/ prefabricated railing,

[4] *Bare precast concrete wall*

precast concrete wall, precast concrete walls with finishes applied on-site, lightweight concrete panel

- The drywall length for all internal dry areas provided in the RNL pre-requisite section are to be excluded from the wall length section as no points are to be awarded for pre-requisites.
- Autoclaved lightweight concrete (ALC) panels, autoclaved aerated concrete (AAC) panels are considered as lightweight concrete panels.

3.1.5 Cast in-situ wall, precision block wall, brick wall / block wall

- The use of brick wall / block wall must be included in the computation.

If there is more than one system on a given wall length, the wall with the lowest maximum allocated points in the BDAS shall be used. For example, if a wall consists of precision block wall and cast-in situ wall, the wall length should be input under precision block wall as it has a lower maximum point allocated.

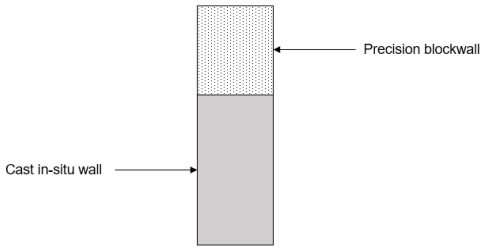


Figure 15: Wall with more than one wall systems along the same length

3.2 Architectural Finishes

Architectural finishes on walls are measured by length. For ceiling and floors, the measurement is by area.

Types of Architectural Finishes

3.2.1 PPVC

- Floor area of PPVC must meet the minimum level of pre-finishes and fit-out works.

3.2.2 Prefabricated and prefinished wall/ floor / ceiling with MEP services, PBU, Prefabricated and prefinished wall / Precast wall off-form

- Unitised curtain wall can score under this item.

3.2.3 Prefabricated and prefinished wall/ floor, curtain wall, glass wall partition

- Vitreous Enamel (VE) panel can score under this item.

3.2.4 Drywall partition, prefinished ceiling, power float concrete floor, vinyl flooring, prefinished timber flooring, carpet, raised floor, engineered stone flooring finishes and wallpaper

3.2.5 Large format tiles (larger than 600mm x 600mm), skim coat, vinyl tiles for wall, plastering and other finishes e.g. tiles

If there is more than one type of finishes on a given wall length, the finish with the lowest maximum allocated points in BDAS shall be used. For example, if a wall has a tiled finish on one side and a skim coat finish on the other side, the length of this wall should be input under tiled finishes as the finishing has a lower maximum point allocated. This is illustrated in Figure 16 below.

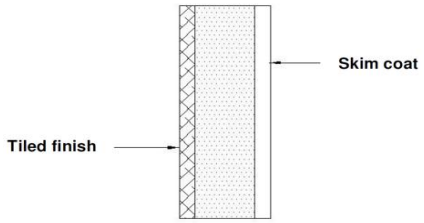


Figure 16: Wall with more than one type of finishes

3.3 Simplicity, Modularisation and Others

3.3.1 Design without high voids

High voids are defined as exposed vertical openings on the building's external profile that are greater than 9m in height. Examples of such openings are sky gardens.

$$\text{Coverage} = \frac{\text{Total height of voids} > 9\text{m (m)}}{\text{Total height of building (m)}} \times 100\%$$

An illustration of the computation is given in Figure 17 below.

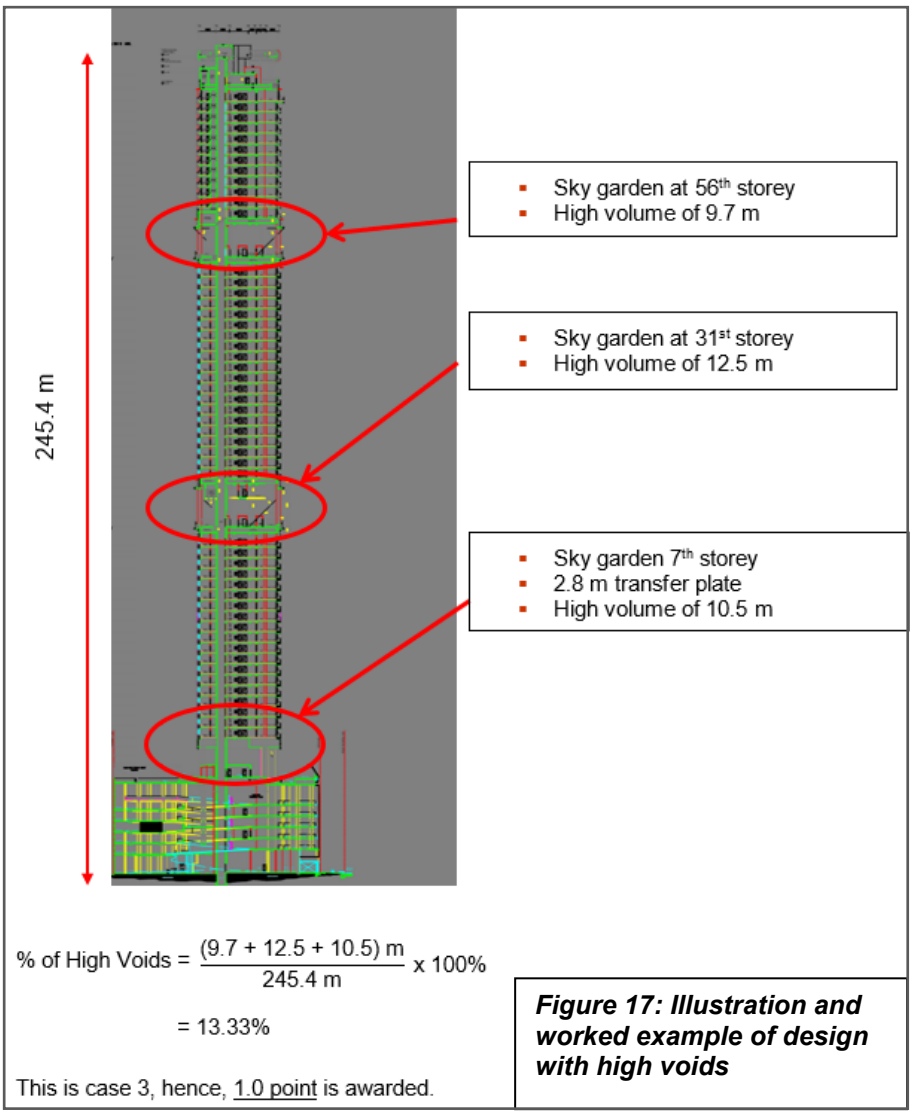


Figure 17: Illustration and worked example of design with high voids

3.3.2 Design without complex form

Complex forms are defined as buildings that are tilted, tapered, twisted or freeform which are challenging to construct. The number of direct points is determined by the worst-case scenario of:

(a) maximum offset distance from two structural floor layouts of the same block; and

(b) % of floors that are offset from a reference structural floor layout over the total no. of floors of the same block.

The degree of offset is then matched with the overall height of the building to determine the exact direct points to be awarded. An illustration of the computation is given in Figure 18.

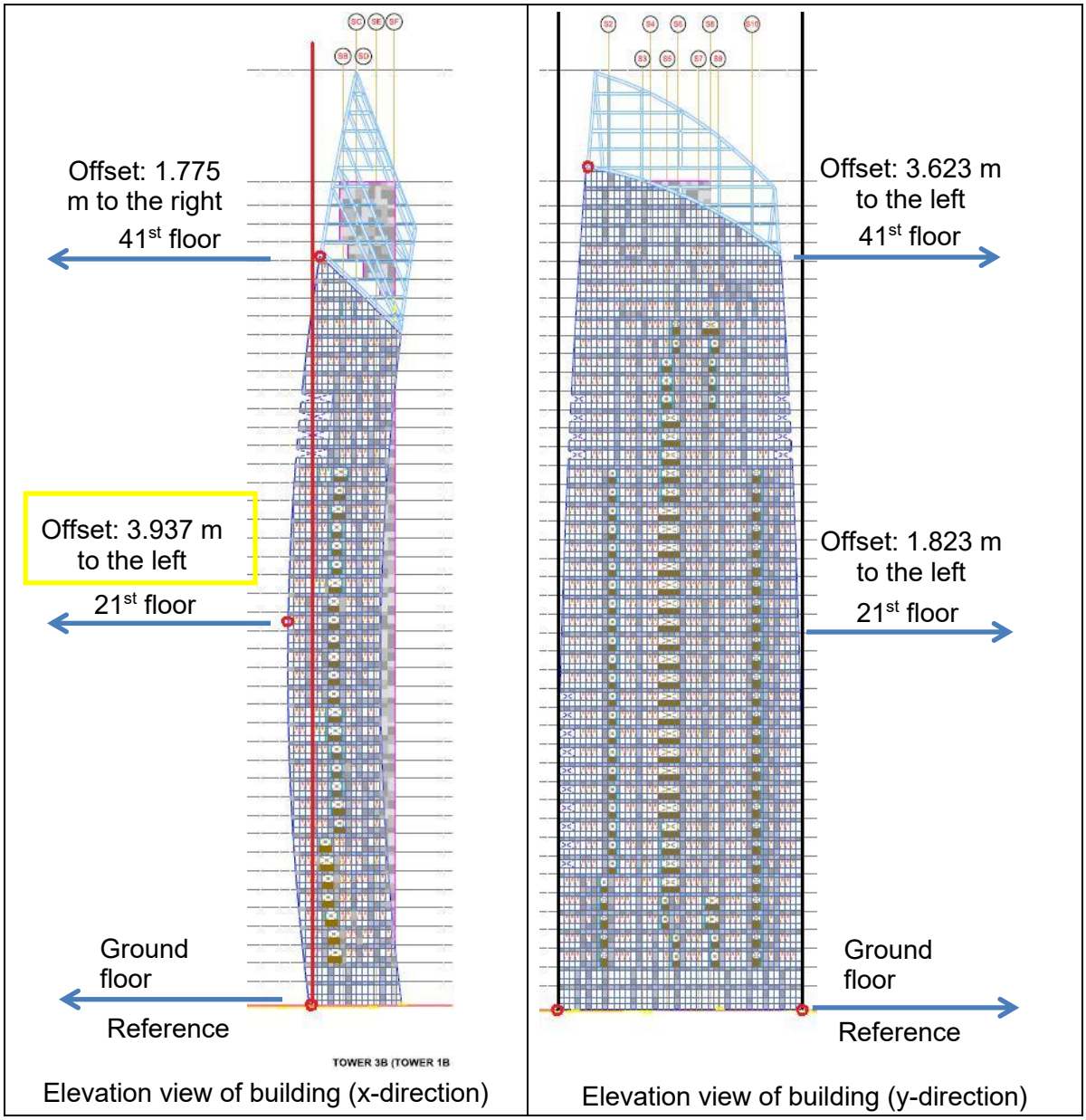


Figure 18: Worked example of design with complex form

Maximum offset from reference line = 3.937 m
% of offsets = 41 offset floors / 41 floors = 100%
Total building height = 142.0 m
Based on the worst-case scenario described above, no point is awarded.

3.3.3 Horizontal grids in module of 3M

This applies to both X and Y axis.

$$\text{Coverage} = \frac{\text{No. of horizontal grids in multiples of 3M}}{\text{Total no. of horizontal grids}} \times 100\%$$

3.3.4 Dimension of PPVC modules in module of 0.5M

Points are given if at least 65% of PPVC modules have external dimensions, both length and width, including gaps, in modules of 0.5M.

$$\text{Coverage} = \frac{\text{No. of PPVC modules with dimensions in modules of 0.5M}}{\text{Total no. of PPVC modules}} \times 100\%$$

3.3.5 Precast façade / wall with length in module of 3M

$$\text{Coverage} = \frac{\text{No. of precast facade / wall (length in module of 3M)}}{\text{Total no. of precast facade / wall}} \times 100\%$$

3.3.6 Precast service ducts with width in module of 1.5M

$$\text{Coverage} = \frac{\text{No. of precast service ducts (width in module of 1.5M)}}{\text{Total no. of precast service ducts}} \times 100\%$$

3.3.7 Windows (3 most common sizes in modules of 1M)

Points are given if the 3 most common sizes of windows in modules of 1M make up at least 65% of the total number of windows. Both the window width and height must be in 1M for the window to be counted into the 3 most common sizes, as illustrated in Figure 19.

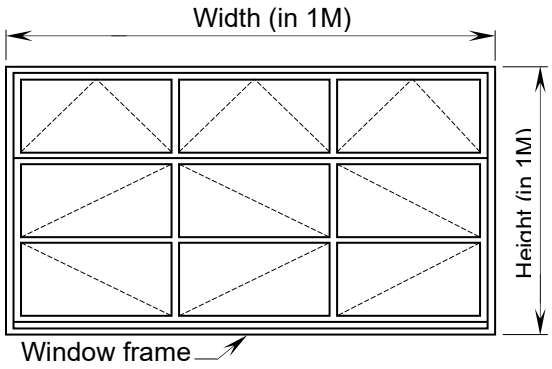


Figure 19: Dimension of window width and height in modules of 1M

All windows (including louvres) should be accounted for. Non-operable glass windows within curtain wall system are excluded from the computation. The type of window material does not affect this computation. The window size includes window frame.

$$\text{Coverage} = \frac{\text{No. of 3 most common window in 1M}}{\text{Total no. of windows}} \times 100\%$$

3.3.8 Horizontal design repetition of unit layouts

Points are given if the number of horizontal design repetitions of unit layouts (at project level) is at least 30. Mirrored unit layouts are considered unique layouts.

$$\text{Repetitions} = \frac{\text{Total no. of units in the entire project}}{\text{Total no. of unique unit layouts}}$$

3.3.9 Repetition of PPVC modules

Points are given if the number of PPVC module repetitions (at project level) is at least 50. Mirrored PPVC modules are considered as unique modules.

$$\text{Repetitions} = \frac{\text{Total no. of PPVC modules in the entire project}}{\text{Total no. of unique PPVC modules}}$$

3.3.10 Repetition of PBUs

Points are given for repetition of PBUs which is computed at block level. PBU sizes are based on their internal dimensions without finishes. Mirror images of PBUs are treated as unique size. Scoring is based on repetitions and coverage.

$$\text{Repetitions} = \frac{\text{Total no. of PBUs in the entire block}}{\text{Total no. of unique PBU modules in the entire block}}$$

Coverage is computed by block as follows:

$$\text{Coverage} = \frac{\text{No. of PBUs}}{\text{Total no. of bathrooms}} \times 100\%$$

3.3.11 Industry standard door structural openings (width) (3 most common sizes)

The coverage of 3 most common door structural openings with industry standard widths should make up at least 65% of the total number of doors. All openings for doors including roller shutters, sliding doors and glass doors, should be accounted for. Doors for services (M&E risers, TAS risers, fire service risers) are to be excluded. The type of door material does not affect this computation.

$$\text{Coverage} = \frac{\text{No. of 3 most common sizes of industry standard doors}}{\text{Total no. of doors}} \times 100\%$$

3.3.12 Industry standard prefabricated bathroom / toilet units

$$\text{Coverage} = \frac{\text{No. of industry standard PBUs}}{\text{Total no. of PBUs}} \times 100\%$$

3.3.13 Industry standard PPVC module for bedrooms (internal width) for RNL

$$\text{Coverage} = \frac{\text{No. of industry standard PPVC bedroom modules}}{\text{Total no. of PPVC bedroom modules}} \times 100\%$$

3.3.14 Industry standard windows (width) for RNL

$$\text{Coverage} = \frac{\text{No. of industry standard windows (width)}}{\text{Total no. of windows}} \times 100\%$$

3.3.15 Prefabricated Kitchen Unit (PKU)

$$\text{Coverage} = \frac{\text{No. of PKUs}}{\text{Total no. of kitchens}} \times 100\%$$

3.3.16 Pole system wardrobe / Modular kitchen cabinets

$$\text{Coverage} = \frac{\text{No. of wardrobes with pole system}}{\text{Total no. of wardrobes}} \times 100\%$$

$$\text{Coverage} = \frac{\text{No. of kitchens with modular cabinets}}{\text{Total no. of kitchens}} \times 100\%$$

3.4 Demerit Points

3.4.1 Cast In-situ floor with transfer beam / cantilever transfer beam

Demerit points are given for cast in-situ floors with transfer beam. Columns on transfer beams (where their axial / vertical loads are not transferred directly to the foundation) are to be included in the computation. Columns with eccentric axial load paths due to changes in shapes or dimensions are not considered transfer columns. This item is applicable to every storey with transfer columns on transfer beams where their vertical load paths are offset.

$$\text{Coverage} = \frac{\text{No. of transfer columns with offset vertical load path}}{\text{Total no. of columns}} \times 100\%$$

Demerit points are also given for cast in-situ floors with cantilever transfer beam. This is applicable to every storey with transfer columns on cantilever transfer beams.

$$\text{Coverage} = \frac{\text{No. of transfer columns on cantilever transfer beams}}{\text{Total no. of columns}} \times 100\%$$

3.4.2 Inclined columns

Demerit points are given for columns inclined from the vertical axis.

$$\text{Coverage} = \frac{\text{No. of inclined columns}}{\text{Total no. of columns}} \times 100\%$$

3.4.3 Non-functional void on slab

Demerit point is given for non-functional void(s) on slab. These are voids that do not serve any function (other than GFA reduction) and are enclosed by walls / columns. A void created for service duct is considered a functional void.

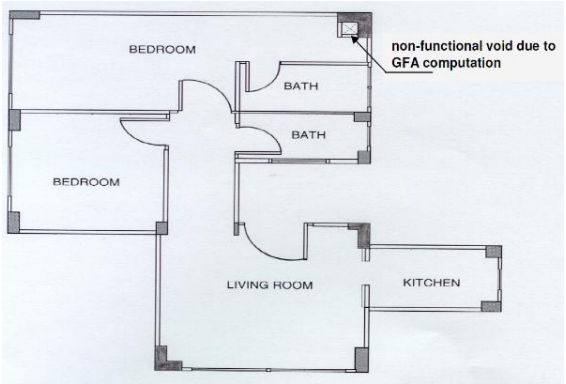


Figure 20: Illustration of a non-functional void within a dwelling unit

4 Mechanical, Electrical and Plumbing (MEP) Systems and Buildable Features

Designers can refer to the Prefab MEP guidebook which provides more details on prefabricated MEP modules, the benefits and good industry practices for such systems.

(Link:www1.bca.gov.sg/docs/default-source/docs-corp-buildsg/productivity/prefab-mep-guidebook-v2.pdf?sfvrsn=66a5fc8e_0)

The following table provides an overview of the substantiation required for BDIP.

Items in BDAS	Substantiation required for BDIP
Section C1: DfMA MEP system Section C2: DfMA MEP components Section C3: Industry standardisation	✓ Plans demarcating qualifying and prefabricated MEP areas ✓ % coverage calculations ✓ Drawings (e.g. vertical riser modules, horizontal modules, plant modules) ✓ Pre-assembly / delivery / site installation photos

4.1 Prefabricated Prefinished Volumetric Construction (PPVC)

These are PPVC modules integrated with MEP systems including embedded services in floors and walls as well as overhead services above the secondary ceilings.

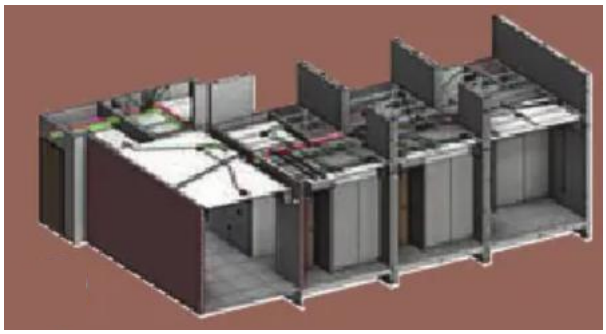


Figure 21: MEP systems integrated into PPVC modules

Qualifying Area refers to the total constructed floor area provided under Structural System. Prefabricated Area shall be the constructed floor area of PPVC modules that come integrated with MEP systems.

4.2 Prefabricated MEP Modules Integrated with Structural or Architectural System

These include prefabricated modules integrated with catwalk, riser with platform modules and prefabricated horizontal modules with ceiling board, lighting and exit signs.

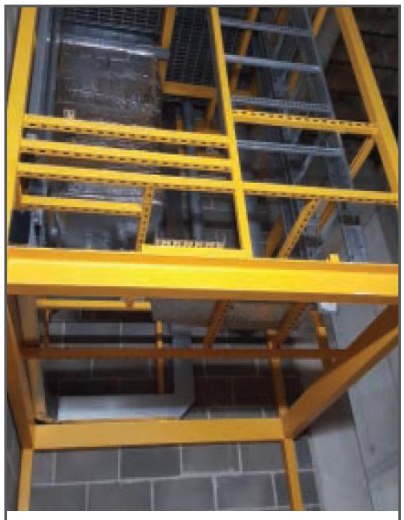


Figure 22: Prefabricated modules integrated with catwalk
(Photograph courtesy of Laing O'Rourke)

Figure 23: Riser with platform modules
(Photograph courtesy of Balfour Beatty PLC)

Figure 24: Prefabricated horizontal module with ceiling board, lighting and exit signs

Qualifying Area (QA) shall be the sum of applicable QAs of the respective MEP systems (i.e. plant, vertical risers and ceiling). Prefabricated Area shall be the total area of the prefabricated MEP modules (i.e. plant modules, vertical riser modules and horizontal ceiling modules).

4.3 Prefabricated MEP Vertical Modules

Examples of prefabricated MEP vertical modules are prefab water risers and prefab sprinkler risers.

Coverage of vertical modules (%)	**Criteria of qualifying areas**
Coverage of Vertical modules (%) = Prefabricated Vertical Area (m²) ÷ Qualifying Vertical Area (m²) *where* Prefabricated Vertical Area (m²) = Sum [Internal wall-to-wall width of Riser(s) x Total height of Riser(s) adopting prefabricated modules] Qualifying Vertical Area (m²) = Sum [Internal wall-to-wall width of Riser(s) x Total height of Riser(s)]	**Risers or service ducts comprising the following services, where available:** (a) Chilled water risers (b) Plumbing and sanitary risers (c) Firefighting services i.e. sprinkler, hose reel and dry / wet rising mains (d) Electrical risers **Exclusions:** (a) Risers within residential dwelling units (b) Mechanical risers: (i) 1 no. pipe only; or (ii) 2 no. pipes and any of them is ≤ 200 mm in overall diameter (c) Electrical risers with ≤ 2 no. components in cable containment system (d) Extra Low Voltage (ELV) and High Tension (HT) risers

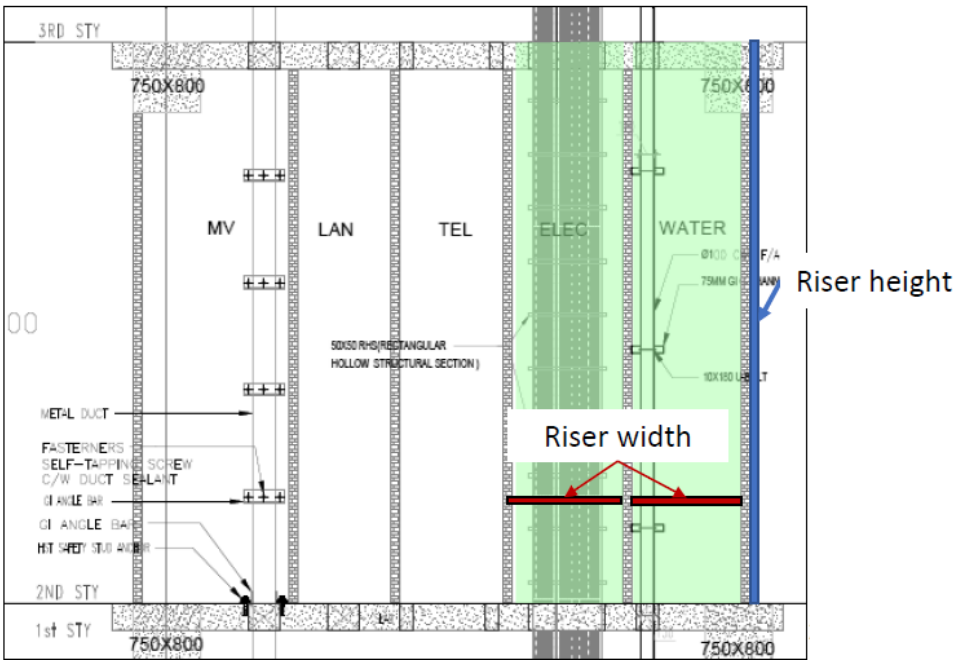


Figure 25: Qualifying area of prefabricated MEP vertical module shaded in green

4.4 Prefabricated MEP Horizontal Modules

Examples of prefab MEP horizontal modules are prefab ceiling modules.

Coverage of horizontal modules (%)	**Criteria of qualifying areas**
Coverage of Horizontal modules (%) = Prefabricated Horizontal Area (m²) ÷ Qualifying Horizontal Area (m²) *Where* Prefabricated Horizontal Area (m²) = Sum [Corridor width x Total length of the Corridor adopting prefabricated modules] Qualifying area (m²) = Sum [Corridor width x Total length of the Corridor(s)] Note: (i) On-site works of up to 35% of the length of the corridor shall be allowed to account for junctions, bends and module connections, and this length could be considered for prefabricated horizontal area	**All common corridor areas *(including lift lobbies)*** **Exclusions:** (a) Floors with a non-typical layout (b) Corridors with total length less than: (i) 12m per floor (Residential (Non-Landed)) (ii) 30m per floor (Others) (c) Corridors that only contain M&E fixtures / services that are directly mounted to the ceiling soffit

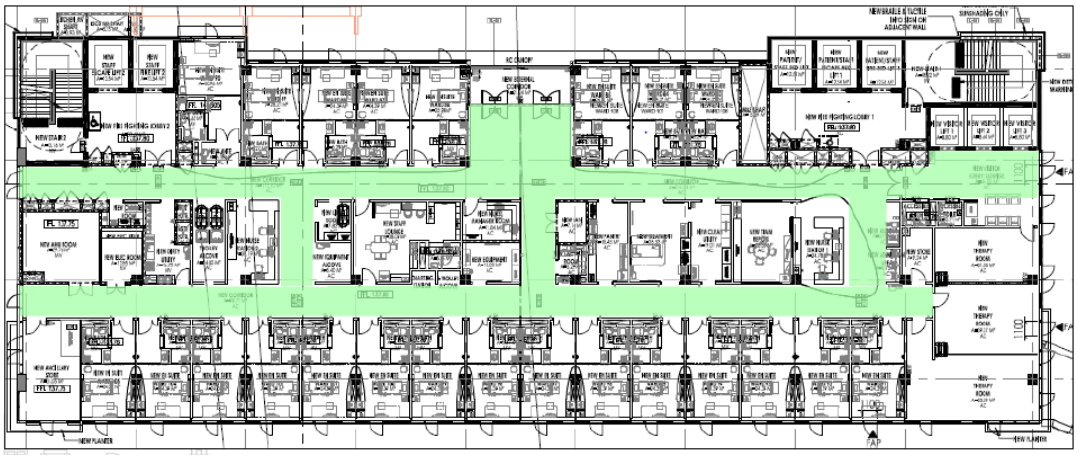


Figure 26: Qualifying area of prefabricated MEP horizontal module shaded in green

4.5 Prefabricated MEP Plant Modules

Examples include fire hose reel pumps integrated with controllers. Please refer to illustrations below for reference.

Coverage of plant modules (%)	**Criteria of qualifying areas**
Coverage of Plant modules (%) = Prefabricated Plant Area (m²) ÷ Qualifying Plant Area (m²) *where* Prefabricated Plant Area (m²) = Sum [Plan area of the Plant rooms or Skids of prefabricated M&E Equipment] Qualifying area (m²) = Sum [Plan Area of the Plant rooms or Skids in qualifying area] Note: (i) The area of plant room is considered if pump(s) are enclosed in the plant room. The area of skid is used if the pump(s) are not enclosed in a plant room. (ii) For a plant room where ≥ 65% of the equipment (by no.) is prefabricated, prefabricated plant area (m²) can be considered as the total area of that plant room. (iii) For a plant room where < 65% of the equipment (by no.) is prefabricated, prefabricated plant area shall be computed based on the following: Prefabricated plant area (m²) = Plan area of the plant room (m²) x No. of prefabricated equipment ÷ Total no. of equipment	M&E rooms / skids containing the following: a. Potable water pumps b. NEWater pumps c. Sprinkler pumps d. Hose reel pumps e. Chilled water pumps f. Condenser water pumps

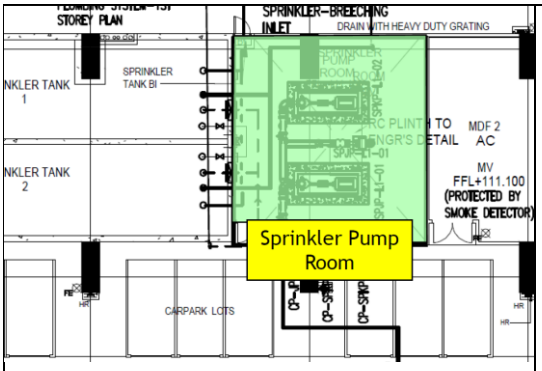


Figure 27: Qualifying area of sprinkler pump room shaded in green

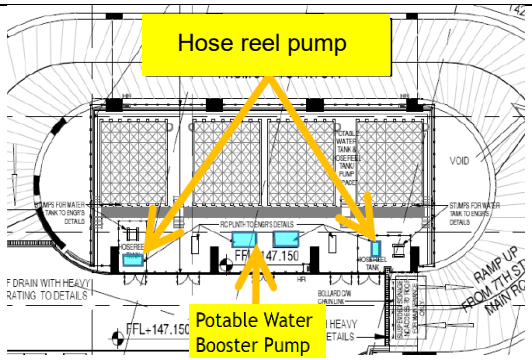


Figure 28: Qualifying area of pumps not enclosed in plant rooms (skids are considered) shaded in cyan

4.6 Flexible Sprinkler Dropper

$$\text{Coverage} = \frac{\text{No. of sprinklers with flexible droppers}}{\text{Total no. of sprinklers}} \times 100\%$$

This item is applicable for sprinklers installed within false ceiling.

4.7 Flexible Water Pipes

This item is applicable for PEX water pipes.

$$\text{Coverage} = \frac{\text{No. of water points using flexible water pipes}}{\text{Total no. of water points}} \times 100\%$$

$$\text{Coverage} = \frac{\text{No. of tap points using flexible water pipes}}{\text{Total no. of tap points}} \times 100\%$$

4.8 Common M&E Bracket (at least 3 M&E services)

This item is applicable for areas which did not adopt horizontal MEP modules.

$$\text{Coverage} = \frac{\text{Length of common bracket with at least 3 services (m)}}{\text{Length of service corridor with at least 3 services (m)}} \times 100\%$$

4.9 Pre-insulated Mechanical Piping e.g. Chilled Water Pipes

$$\text{Coverage} = \frac{\text{Length of pre-insulated mechanical pipe (m)}}{\text{Total length of mechanical pipe (m)}} \times 100\%$$

4.10 Mechanical Connection for Prefabricated MEP Modules

$$\text{Coverage} = \frac{\text{Area of prefabricated MEP modules with mechanical connections (m}^2\text{)}}{\text{Total area of prefabricated MEP modules (m}^2\text{)}} \times 100\%$$

4.11 Industry Standard Sizes for Prefabricated Pump Skids

$$\text{Coverage} = \frac{\text{No. of industry standard prefabricated pump skids}}{\text{Total no. of prefabricated pump skids}} \times 100\%$$

5 Innovation and Others

Designers are required to provide description of innovative system, brochure / product catalogue, photos, shop drawings, location on plan and % coverage computation etc. for BCA to assess on the points to be allocated.

For prefabricated components, PPVC modules, PBUs and prefabricated MEP systems which are produced or fabricated in facilities accredited under the Precaster Accreditation Scheme (PAS) / Manufacturer Accreditation Scheme (MAS)[5], the PAS / MAS certificate, drawings of modules, and photos showing pre-assembly / delivery to site should be provided.

For prefabrication systems not listed in the BDAS, the % prefabrication level should be provided and BCA shall assess on the points to be allocated.

[5] *Not applicable for projects with mandatory PAS or MAS requirements*

Part 2

Outcome-based Options for Large Projects (GFA ≥ 25,000 m²)

1 Requirements for Outcome-based Options

Outcome-based options include (a) deemed acceptable solutions and (b) open option.

(a) **Deemed acceptable solutions** for different category of building works are specified in the COP on Buildability 2022 Annex C Table 1.

(b) **An open solution** refers to a proposal which can achieve at least 25% site productivity improvement (over 2010 level). Project team is required to submit a Project Productivity Improvement Plan (PPIP) to demonstrate how the proposal can meet the minimum productivity improvement. The proposal should show compliance to buildability pre-requisites, and the types of structural, architectural and MEP systems / technologies, design modularisation and standardisation to be adopted for the project.

Type of outcome-based solutions	Information and clear demarcation of details to be included in the proposal
(i) Deemed Acceptable Proposal comprising PPVC (ii) Deemed Acceptable Proposal comprising high prefabrication level; and / or specific DfMA technology i.e. APCS, Structural Steel, MET	• Floor / elevation plan of every storey including roof that demarcates the area of structural systems (including PPVC where applicable), length of wall systems, type of wall finishes, and area of every MEP system, including the extent of use of prefabricated systems / DfMA technology • Extent of finishing and fittings to be completed off-site for PPVC modules and PBUs (where applicable) • Certificate of accreditation under MAS for PPVC / PBU • Dimension of building components and the type and extent of use of industry standard components • Coverage of system formwork adoption (horizontal and vertical) for remaining (i) CIS floor slabs and (ii) CIS walls/ columns
(iii) Open Solution – PPIP	• Details of the proposed designs / technologies / systems • Level of use of buildable features, prefabricated systems and off-site finishes • Details of the proposed construction process and construction management • Details of any innovative features • Details of how productivity improvement can be achieved • Other documents or information as may be required by the Commissioner of Building Control

Part 3

Frequently Asked Questions (FAQs)

1 Frequently Asked Questions

General

1. Where can I download the B-Score forms?

BS01 and BS03 forms can be downloaded from (link: https://www1.bca.gov.sg/download-application-forms/buildability-score).

2. Do PEs for M&E works need to encrypt the submission forms?

Yes. BS01 and BS03 forms should be encrypted by QP (Architect), QP (C&S) and PE (M&E).

3. Do I need to include clubhouse and multi-storey carpark (MSCP) in my B-Score computation?

All structures, including clubhouse and multi-storey carpark, are to be included in the B-Score computation. Minor structures not within or structurally linked to the main building(s) of a development, such as a 22kV substation, guard post, bin centre and trellis, can be excluded from the computation.

4. Do I need to submit B-Score for (a) Substation and (b) Water/ sewerage treatment plant?

No, B-Score submission is not required for these projects as stated in COP 2022 First Schedule. Notwithstanding this, these projects should still adopt buildable systems as much as possible.

5. I have a data centre project with a GFA of more than 5000m^2. Is it required to comply with minimum B-Score? If yes, under which category does a data centre building fall under?

Data centres are classified under 'Industrial' category and are required to meet the minimum B-Score requirement.

6. Can underground MRT projects score under basement works?

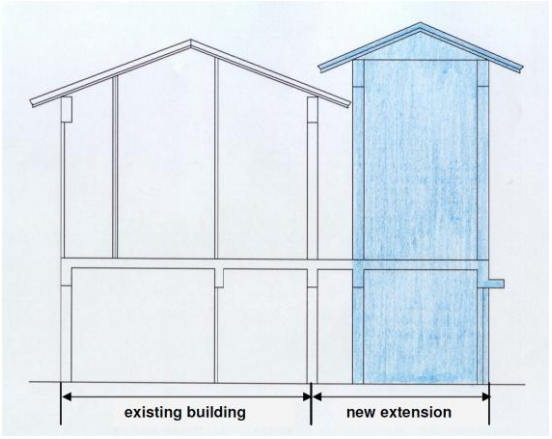
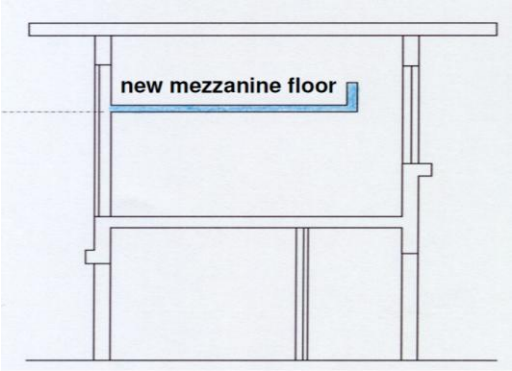
No. Underground MRT projects should comply with the minimum B-Score for superstructure works.

7. Do I need to submit B-Score for bus depot and which category does it fall under?

Bus depot is classified as an 'Institutional' facility.

8. Do I need to submit B-Score for an Addition and Alteration (A&A) project?

Yes, if the building works involve the construction of new floor and / or reconstruction of existing floor for which their total gross floor area is 5,000m^2 or more. B-Score is not required if the project only involves interior / retrofitting works. Figure 29 and Figure 30 show the extent of A&A works which are subject to minimum B-Score.

Extent of A&A works	Illustrations
a) For A&A projects where works are carried out outside the existing building, such as new extension to existing building and additional storeys over existing roof	 ***Figure 29: Project subject to minimum B-Score for new extension works to be carried out of existing building***
b) For A&A projects where works are carried out within the existing building, the minimum B-Scores in Table E of COP 2022 shall apply. Examples of such A&A works include the addition of a new mezzanine floor, the slabbing over of an existing void within a building and the replacement or reconstruction of existing floor	 ***Figure 30: Project subject to minimum B-Score for A&A work within existing building envelope, consisting of a new mezzanine floor***

For projects with A&A works carried out both within and outside of the existing building, the minimum B-Score will be pro-rated according to the GFA of the A&A works outside the existing building and the GFA of the A&A works within the existing building.

9. Do I need to submit B-Score for temporary buildings with GFA more than 5,000m^2?

No. Project classified as temporary buildings (refer to Temporary Building Regulations on the requirements) is not required to submit B-Score.

10. My project has more than 10 blocks of buildings. Can I group the blocks together?

Yes, you may group similar categories / layouts as one block. Please list down the blocks that are grouped together in the B-Score form.

11. For outcome-based options, how do I compute the prefabrication level for structural, architectural, MEP works?

Prefabrication level is measured based on superstructure works. The types of building system that would constitute towards the overall prefabrication level for each of the work disciplines are as shown below.

Prefabricated Structural Systems *(based on total CFA)*	**Prefabricated Architectural Systems** *(based on total wall length)*	**Prefabricated MEP Systems** *(based on qualifying area)*
1. PPVC 2. APCS 3. Structural Steel 4. MET 5. Hybrid Steel/ Precast Concrete/ MET 6. Prefabricated column/ wall, prefabricated beam and prefabricated slab 7. Prefabricated beam and prefabricated slab 8. Prefabricated column/ wall and prefabricated slab 9. Prefabricated slab	1. PPVC 2. PBU 3. Prefabricated and prefinished wall with MEP services 4. Prefabricated and prefinished wall/ Off-form precast wall 5. Drywall 6. Curtain wall/ Full height glass partition 7. Prefabricated railing 8. Precast wall 9. Lightweight concrete panel	1. Prefab MEP vertical modules 2. Prefab MEP horizontal modules 3. Prefab MEP plant modules

Pre-requisites

12. If loose bars are adopted in addition to floor mesh, can I still include the area in the floor mesh computation?

Projects should adopt floor mesh for both top and bottom reinforcements to the largest extent possible. Loose bars are acceptable for use as additional reinforcement. If floor mesh with larger diameter rebar sizes is unavailable in the market or there are cast in-situ floor areas that face technical challenges to install floor mesh, please provide justification for exclusion and substantiate with drawings for BCA's assessment.

13. For projects which are required to comply to minimum PBU coverage, is it computed at project or block level?

The requirement for PBU adoption is at project level. For projects that compute the B-Score by blocks, the PBU coverage is to be computed for each block.

14. Can I include powder room in my computation of PBU coverage?

Yes, only if the powder room includes a WC.

Structural system

15. For outcome-based project which is required to comply to minimum 65% PPVC coverage, is it computed at project or block level?

The 65% PPVC coverage is computed at project level, using total CFA of superstructure. Please refer to section 2.1.

16. Where should I input the use of hollow core slab / composite slab?

The slab can be included under prefabricated slab.

17. Can CIS RC column with steel beam and Bondek slab score under "Item 3.1- Structural Steel / Hybrid system of structural steel and precast concrete"?

No, the system should be scored under "Item 4.1 Prefabricated slab and beam". To score under Item 3.1, the columns have to be structural steel, composite or precast columns.

Architectural system

18. Where can I score for the use of VE (Vitreous Enamel) panel?

Under architectural wall system, the use of VE panel can be scored under Prefabricated and prefinished wall if it is not cladded to a base wall. If it is cladded to a base wall, please provide input under the respective wall system. VE panel is also applicable for prefabricated and prefinished wall under architectural finishes.

19. Is CIS transfer plate / slab subject to demerit points?

No. Only CIS transfer beam / cantilever transfer beams are subject to demerit points.

MEP system

20. For outcome-based project which is required to comply to 65% Prefab MEP coverage, how do I compute the coverage?

The coverage is computed as follows.

$$\text{Prefab MEP coverage (\%)} = \frac{\text{Total Prefabricated Area } (m^2)}{\text{Total Qualifying Area } (m^2)} \times 100\%$$

Total Prefabricated Area = Prefabricated Horizontal Area + Prefabricated Vertical Area + Prefabricated Plant Area

Total Qualifying Area = Qualifying Horizontal Area + Qualifying Vertical Area + Qualifying Plant Area