ARCADIS Design & Consultancy for natural and built assets

BES CONSULTATION PAPER 2017

Buildability Evaluation System

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1 BACKGROUND

1.1 In recent years, Hong Kong's surging construction costs have become an issue of public concern. Studies conducted recently by the Development Bureau (DEVB) showed that construction costs have increased by over 50 per cent in the past few years. Some international reports also reveal that Hong Kong is listed as Asia's most expensive in terms of construction costs, and second only to New York globally.

1.2 In the 2016 Policy Address, the Chief Executive announced that the Government would strengthen cost control on public works projects and reduce unnecessary design and contractual requirements. The works departments would enhance the standardisation of project design, promote mechanisation and construction by prefabrication, and adopt the guiding principle of "design for buildability" to reduce costs without undermining safety. To take forward this initiative, the Bureau conducted a research study last year to review buildability development in Hong Kong and other jurisdictions with a view to formulating a new works policy on buildability evaluation.

2 RESEARCH STUDY

2.1 Buildability has been a research subject for decades by both academia and industry bodies. In UK, the Construction Industry Research and Information Association (CIRIA) defined the term "buildability" in 1983 as *"the extent to which the design of a building facilitates ease of construction, subject to the overall requirements for the completed building"*. Since then further studies on buildability have been conducted in various places around the world including notably Singapore, Australia and the United States.

(a) Singapore

i. Singapore has been the forerunner in Asia in respect of buildability evaluation. In 2001, the Government introduced the buildability legislation, “the Code of Practice on Buildability”. The objective is to raise construction productivity to reduce its reliance on foreign workers.

ii. This is a statutory approach which requires all construction projects to submit designs for approval under the Buildable Design Appraisal System (BDAS). Minimum “Buildable Design Scores” (stipulated by asset type) must be achieved prior to works being allowed to commence. The "Buildable Design Score" is an appraisal of the potential impact of the design on the usage of labour.

iii. The Code also stipulated the requirement for contractors to assess “the potential impact of downstream construction methods and technologies on the productivity at site” via the "Construction Appraisal System" (CAS). Again this is mandatory and requires contractors to achieve a minimum "Constructability Score" for works permit application and construction.

iv. Both BDAS and CAS place heavy emphasis on structural systems, wall systems and encourage the wider use of prefabrication technologies such as Prefabricated Prefinished Volumetric Construction (PPVC).

v. Singapore has been successful in introducing new approaches and technologies to the construction industry that have significantly improved on-site productivity and quality and negated the need to employ high levels of foreign construction labour. However, there is no evidence that the approach has reduced

construction costs which have continued to rise. The statutory approach is considered by many in the private sector as being too rigid and bureaucratic especially for non-standard projects.

(b) Other Jurisdiction

i. In the United States and Australia, the terms "buildability" and "constructability" are used interchangeably. "Constructability" as defined by the Construction Industry Institutes in 1993 is *"a system for achieving optimum integration of construction knowledge in the project delivery process and balancing the various project and environmental constraints to achieve maximization of project goals and building performance"*. Typically, a "Constructability Review" approach is adopted which is an independent and structured review of construction bid documents by construction experts to ensure that projects are biddable, buildable, cost-effective and maintainable. Constructability reviews involve the optimum use of construction knowledge and experience in the planning and development of a project. The UK which published papers via CIRIA in 1983 has never mandated a Buildability system.

(c) Hong Kong

i. In the Construction Industry Review Committee (CIRC) Report published in 2001, buildability was identified as one of the strategies to be promoted to substantially lift the quality and cost-effectiveness of the construction industry. The public-sector clients were recommended to take the lead in promoting wider use of prefabrication and other buildability measures in Hong Kong, and to enhance the capability of the private sector in this regard through training, promulgation of guidelines and codes.

ii. The Housing Authority has been adopting the prefabrication technology since mid-1980s in the delivery of public housing projects. Prefabricated components such as precast facades and staircases as well as volumetric precast units are widely used for better workmanship and quality control as well as to maximize construction efficiency. Since 2002, the Government has been launching policies to encourage the use of prefabrication technology as one of the means to promote green and innovative buildings.

iii. Over the years, various policies related to buildability have been promulgated by the DEVB through publication of Technical Circulars (Works) (TCW). Works departments are encouraged to adopt the "3S Principle" ("Standardisation", "Simplification" and "Single Integrated Elements") during planning, design and construction of public works projects with a view to increasing productivity and rationalising manpower demand of trades with expected manpower shortage.

iv. On this front, the ArchSD has been making efforts to enhance the buildability performance of public building projects under its purview by adopting a design strategy basing on the "3S Principle". In recent years, the Department has established a Knowledge Management System (KMS) (Figure 1) as a depository for design and construction knowledge gained through past project experience. As a result, ArchSD started to explore using the KMS to construct a system for evaluating buildability performance of design proposals.

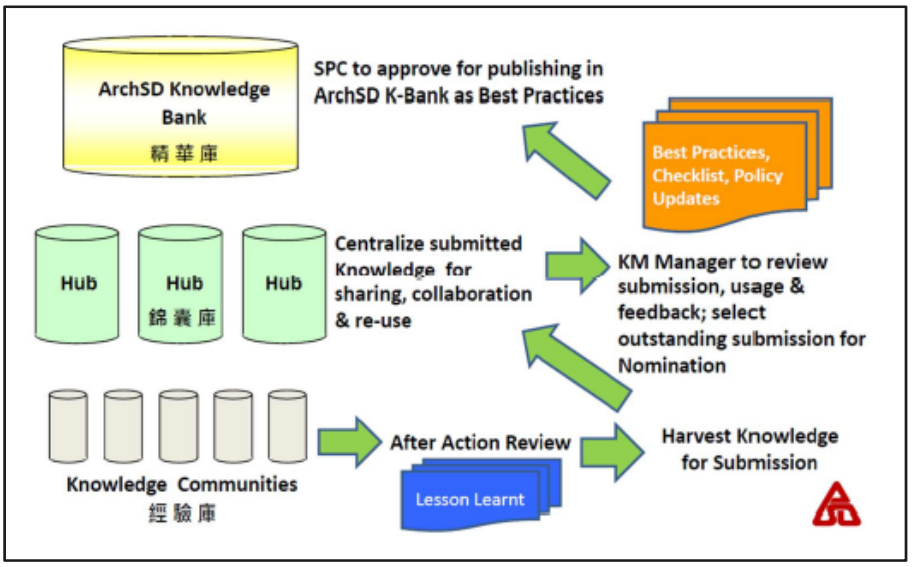


Figure 1 ArchSD Knowledge Management System

(d) Difference between Hong Kong and Singapore systems

i. It is important to understand that the Singapore BDAS and CAS systems have been created to respond to government objectives that are fundamentally different to those of Hong Kong. Singapore's BDAS approach was designed to mitigate the need to import foreign labour where as Hong Kong has the primary objective of enhancing construction productivity and cost management. These objectives are not automatically complementary. Furthermore, the design scope under BDAS historically relate back to those areas where a high degree of foreign labour was required whereas Hong Kong's objectives require consideration of a broader range of design aspects.

ii. The Singapore government has adopted an interventionist approach mandating BDAS across all construction projects including those within the private sector. Hong Kong will not adopt a statutory Buildability system though will seek to implement a best practice approach progressively influencing projects under the direct control of the various Works Departments. There will be no mandatory Buildability requirement for the Hong Kong private sector as it is believed the wider industry will progressively adopt best practices where they are demonstrated as being beneficial.

iii. The Singaporean CAS system has extended its reach to influence how contractors execute their work on site. There is no intention to follow suit in Hong Kong.

iv. Hong Kong can and will learn from Singaporean BDAS and CAS system however the approach and content needs to be specific to Hong Kong if its objectives are to be met. Simply copying BDAS and CAS will not work for Hong Kong.

3 THE PROPOSAL

3.1 To further promote the initiative of "design for buildability", the Bureau intends to formulate a new works policy on buildability evaluation. Building upon on the ArchSD experience, it is proposed to introduce a **Buildability Evaluation System (BES**) for public building projects under the purview of the Department, as the first phase development.

3.2 Objectives

(a) The goal of the buildability evaluation policy is to promote buildable design practices for public works projects, without compromising creativity, quality and construction site safety. The policy aims at achieving the following objectives:

i. enhance project cost management; and

ii. increase construction productivity

3.3 Strategy

(a) The BES is developed basing on a "3S+ Principle" (Figure 2). In addition to "Standardisation", "Simplification" and "Single Integrated Elements", 3S+ incorporates two additional aspects which are important to achieve the BES objectives:

i. Project life cycle management; and

ii. Design management and project co-ordination

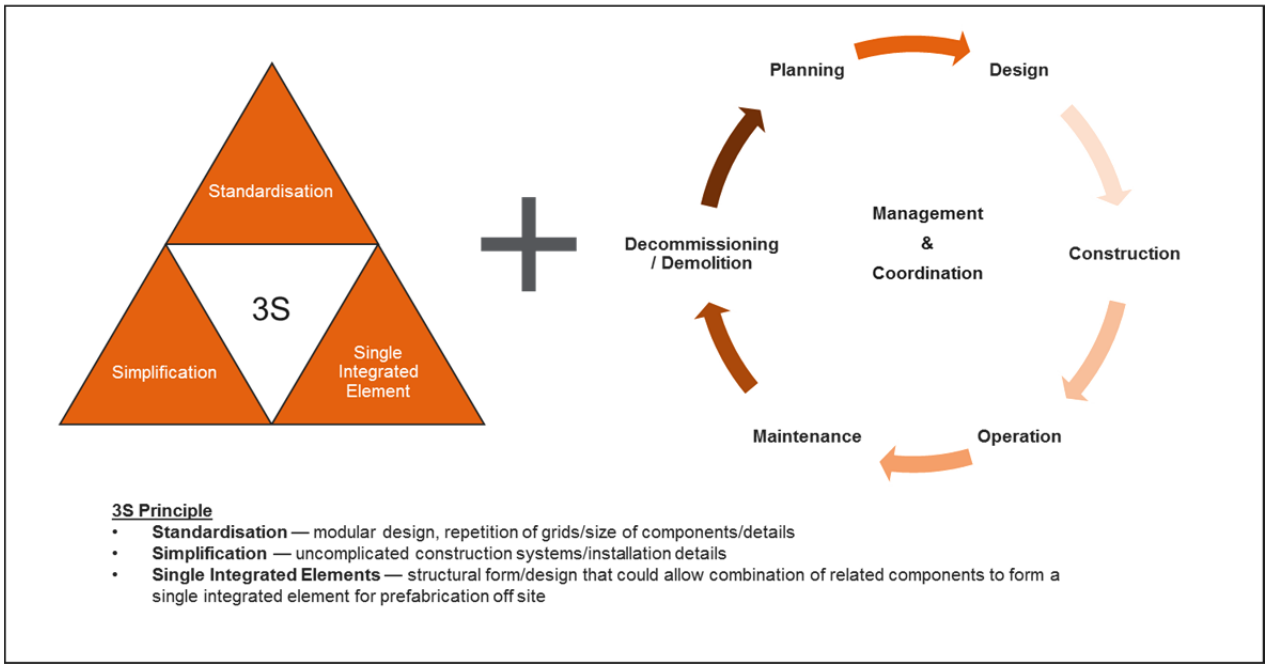


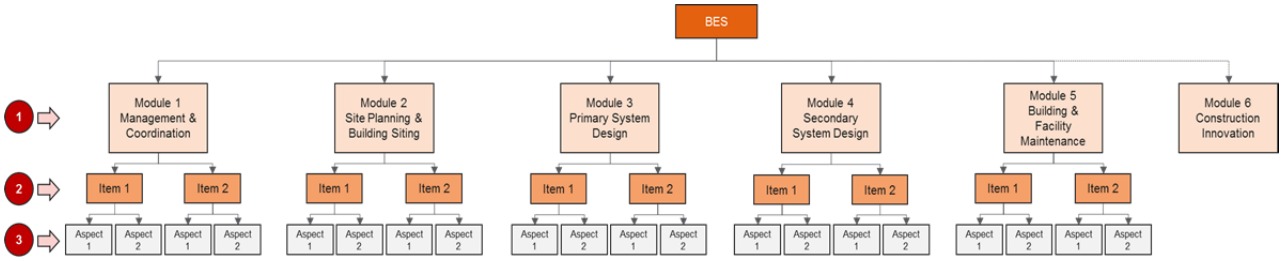
Figure 2 3S+ Principle

3.4 BES Structure

(a) The BES appraisal system contains 209 design considerations which are found across 6 Modules.

Tier	Title	Total No.
1	Module	6
2	Item	44
3	Aspect	209

(b) The System is structured using a 3-tier structure (Module → Item → Aspect) as shown below.



(c) Details of and the relationship between the three tiers are outlined below:

Structure	Total Nos.	Details
Module	6	Design decisions are categorized into 6 Modules for assessment: • Module 1 – Management & Coordination • Module 2 – Site Planning & Building Siting • Module 3 – Primary System Design • Module 4 – Secondary System Design • Module 5 – Building Maintenance • Module 6 – Construction Innovation
Item	44	Modules 1-5 comprise of 44 Items to be assessed Module 6 (Innovation) includes 4 identified Innovation items; the module by nature is open to enables new further items to be introduced.
Aspect	209	Each Item will be assessed against a different set of Aspects (total 209 Aspects)

(d) Each Module serves a specific purpose, with the same objective of reducing costs and enhancing construction productivity. Details of the Items contained within each module and their relative weightings are outlined below.

Discipline	Ref. No	Assessment Aspect	Relative Weighting
Module 1 – Management and Co-ordination (Weighting: 200)			
All	1.M1	Construction period	40
	1.M2	Liaison, documentation and statutory approval	50
	1.M3	Cross-discipline design coordination	30
	1.M4	Contractor design items	30
	1.M5	Facilitating construction	30
	1.M6	Multiple work fronts	20
Module 2 – Site Planning and Building Siting (Weighting: 200)			
All	2.M1	Site formation / geotechnical works	30
	2.M2	Natural terrain hazard	10
	2.M3	Building siting	30
	2.M4	Building form	30
	2.M5	Foundation system	40
	2.M6	Basement	40
	2.M7	Construction and demolition waste disposal	20
Module 3 – Primary System Design (Weighting: 250)			
Architecture	3.MA1	Façade	25
	3.MA2	Major fixtures	25
	3.MA3	Non-structural internal walls / partitions	35
	3.MA4	Wall / floor ratio	25
Structural	3.MS1	Structural framing system	30
	3.MS2	Structural grid, columns and floor height	15
	3.MS3	Structural floor beams and slabs	15
	3.MS4	Transfer structures	10

Discipline	Ref. No	Assessment Aspect	Relative Weighting
	3.MS5	Large voids	10
	3.MS6	Further design provisions to enhance buildability	10
BS/E&M	3.MB1	Space for BS / E&M installations	20
	3.MB2	Design for testing & commissioning of BS / E&M installations	10
	3.MB3	Checking availability of equipment / products / materials for BS / E&M installations	10
	3.MB4	Optimization of BS / E&M design	10
Module 4 – Secondary System Design (Weighting: 200)			
Architecture	4.MA1	Finishes	30
	4.MA2	Toilets / kitchens / pantries	20
	4.MA3	Architectural elements	20
Structural	4.MS1	Detail structural arrangement	30
	4.MS2	Design efficiency for structural elements	10
	4.MS3	Secondary systems	10
	4.MS4	Detailing – reinforced concrete	30
	4.MS5	Detailing – steelwork	
BS / E&M	4.MB1	Types of BS / E&M equipment / materials	25
	4.MB2	Packaged type / prefabricated BS / E&M equipment / materials	25
	4.OB1	Supporting provisions	5
	4.OB2	Design and installation detail	5
Module 5 – Building and Facility Maintenance (Weighting: 150)			
All	5.M1	Maintenance accessibility and facilities	100
	5.M2	Space planning for maintenance	20
	5.M3	Durability of building systems/components / materials	30
	5.O1	Documentation for ease of future maintenance of	20

Discipline	Ref. No	Assessment Aspect	Relative Weighting
		building works	
	5.O2	Provision to facilitate preventive maintenance of BS/E&M installations	10

(e) Module 6 provides designers with an opportunity to obtain bonus points. Module 6 includes 4 areas of known current industry innovation that are to be encouraged. The Module is open to encourages designers to introduce new ideas both in respect of design solutions and application of technologies that will result in improved cost management and construction productivity.

(f) Module 6 has a maximum of 300 Bonus Points available to be awarded based on the degree of the impact the proposed innovation will have on the project. PQDVC will assess the innovation scores on a case by case basis

Module 6	
Field	**Examples**
Construction Technologies	• Prefabricated Volumetric Building System including Prefabricated Prefinished Volumetric Construction (PPVC) technologies • Construction robotics
Information Technologies	• Building Information Modelling (BIM) • Cloud collaboration
Planning & Design	• Integrated development for maximising site utilisation
Operations, Maintenance or Process	• Life Cycle Planning and Costing • Integration of BIM into operations and maintenance use with Building Automation System
Other New Ideas and Innovation	• Designers are encouraged to consider Innovation that will help the project reduce cost and construction productivity.

3.5 Relative Weighting of Points within Modules

(a) Relative weightings are assigned to each Module/Item to reflect their significance in achieving productivity gain and cost saving.

(b) The intention is the Policy will be supported by Relative Weightings that wherever possible based on quantitative measurements reflecting cost and productivity achievements. The basic principle of this measurement is shown in the example below:

Example: Precast façade vs Curtain Wall

Design Decisions / Approach	Cost Index (A)	Productivity Index (B)	Relative Weighting (C) = (A)~(B)
Precast Façade 	$/m2	Manday/m2	RW1
Curtain Wall 	$/m2	Manday/m2	RW2

(c) The quantitative measurement requires a large amount of supporting data which is currently unavailable. ArchSD has already started the process of collecting/collating the necessary cost and productivity data. The Bureau has also taken the initiative to liaise with key stakeholder groups of the construction industry including the Construction Industry Council to establish a platform for sharing buildability knowledge and productivity data with a view to setting up a Buildability Knowledge Bank for buildability evaluation purposes (Figure 3)

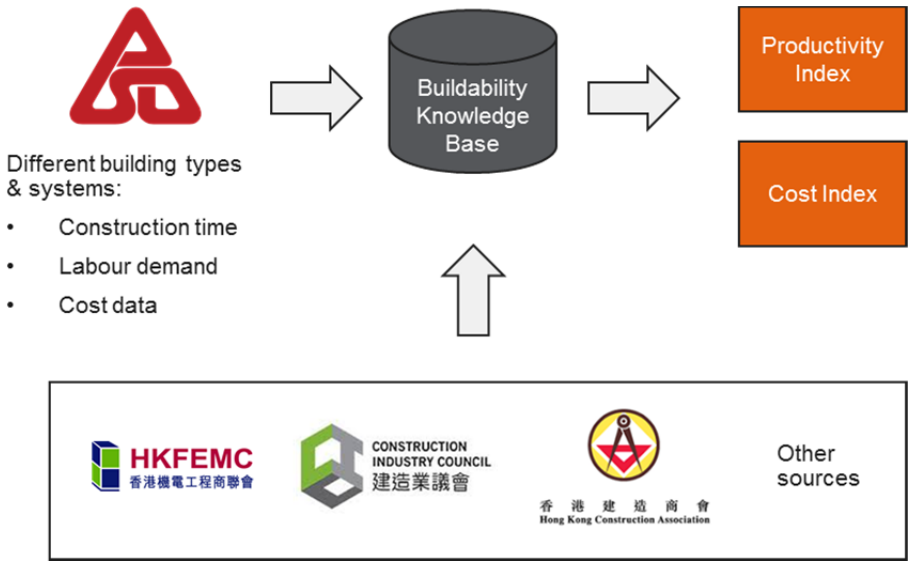


Figure 3 Buildability Knowledge Base

(d) As such, the Relative Weightings in this proposal are at this point determined primarily by professional judgement. With implementation of the BES and as the System continues to develop, Productivity Index and Cost Index will be compiled for

benchmarking different design decisions/approaches. The Relative Weightings of the BES will then be verified/adjusted accordingly as the supporting data emerges.

(e) The relative weightings of the six Modules are shown below:

Module	Description	Max. BES Points
1	Management & Coordination	200
2	Site Planning & Building Siting	200
3	Primary System Design	250
4	Secondary System Design	200
5	Building Maintenance	150
	Total:	**1,000**
6	Construction Innovation (Bonus Points)	300

(f) For Modules 1 to 5, the maximum BES points allocated amount to 1,000. For Module 6, a maximum of 300 bonus points can be awarded to innovative design solutions. The total BES points that a design proposal can score is, however, capped at 1,000.

3.6 Assessment Approach and Scoring Method

(a) The scoring approach is specific to the nature of each item. Assessments are therefore a mixture of “Quantitative” and “Qualitative” approaches as appropriate to best reflect the nature of the design item under consideration. (see figure 4).

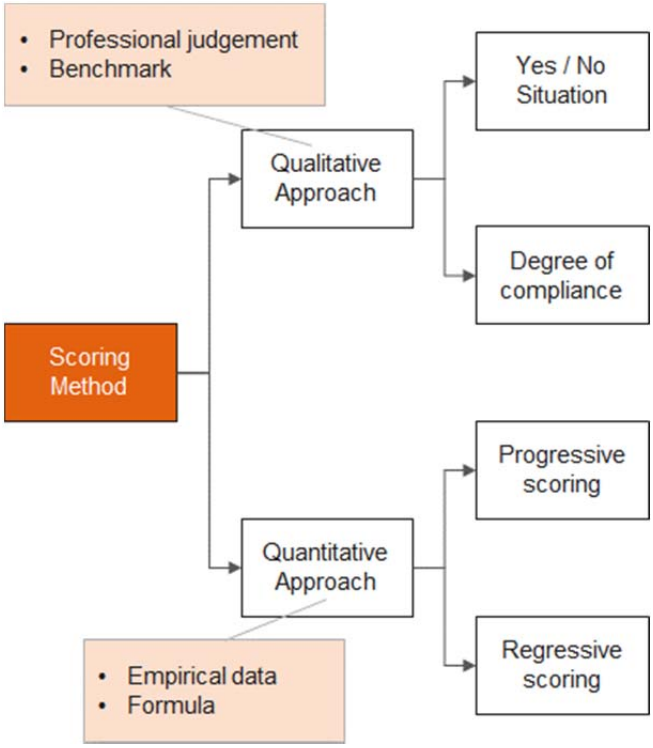


Figure 4 Assessment Approaches

(b) For design decisions with quantifiable parameters (e.g. area, length, type and number etc.) and for those items where benchmarks are available, the "Quantitative Approach" will be adopted for assessment. The score of such items will be computed by applying a formula reflecting the design parameters and the relevant benchmarks. Design decisions which improve buildability will be allocated more marks ("Progressive Scoring"). Conversely, those considered less buildable will have marks deducted ("Regressive Scoring").

(c) A "Qualitative Approach" will be adopted for assessing those design decisions which cannot be quantified and/or where benchmarks are currently not available. The score of an Item will be determined by assessing the degree to which the proposed design decision has achieved against the specified requirements.

(d) Examples of scoring types A, B, C & D as annotated in the above figure are provided in **Appendix A** for reference.

3.7 Imposed Conditions

(a) The buildability of a design proposal is affected by a large number of design decisions which may or may not be within the control of the project team. The latter includes

design decisions made by the project team to address imposed conditions which may be in the form of site constraints (e.g. substantial geotechnical works required to mitigate geotechnical hazard), operational requirements (e.g. school/sports halls with large voids) or other situations.

(b) In assessing design proposals which are subject to imposed conditions, the BES has adopted a positive approach. If it is demonstrated that reasonable efforts have been made by the project team to address the constraints imposed, such design decisions can still be awarded high or even full marks.

(c) Furthermore, if the project team is able to demonstrate innovative solutions and design decisions to mitigate the aspect in question, they will be awarded with bonus points in Module 6 Construction Innovation section. Please see **Appendix B** for examples.

3.8 Buildability Score

(a) The result of the BES assessment is expressed in the form of two Buildability Scores:

i. Buildability Score (1) – Design Team Score

- Excludes those design decisions affected by Imposed Conditions; represents the performance of the project team in practising buildable design upon those aspects which are fully within their control.

ii. Buildability Score (2) – Project Score/

- The overall buildability performance of a design proposal. Includes all aspects including imposed conditions which may or may not have been fully mitigated by the design team.

(b) In the initial implementation phase of the BES, a minimum Buildability Score will not be imposed for design vetting. As the System continues to develop, buildability standards for different building types of projects under ArchSD's purview will be set. Design proposals submitted to the ArchSD Project Quality and Design Vetting Committee (PQDVC) for vetting will then need to achieve a minimum Buildability Score in order to proceed to the next work stage.

(c) It is also the intention that over time a Buildability Performance Rating (BPR) will be developed to reflect Design Team performance using the data collated on Buildability Score (1). The BPR will monitor and compare the performance of consultants and contractors in implementing buildable design practices.

(d) The current BES marking scheme with full details including the Assessment Aspects, scoring methods, scoring guidelines and submission requirements are provided in **Appendix C**.

4 TRIAL RUN

4.1 ArchSD has recently conducted a trial run of the BES on five sampled projects (three completed projects, one project under construction and one project at tender documentation stage). Whilst this is a small sample, the assessments of the completed projects indicate strong correlation between the Buildability Scores awarded and the actual on-site labour input recorded (i.e. High BES scores correlate to lower levels of on-site labour required and

vice versa). Despite the current small sample size, the trial run suggests that BES may be able to reflect construction productivity. These datasets will continue to be collated to further understand the correlation between BES and productivity.

4.2 Attention is drawn to the fact that two of the sampled projects have received design awards. The relatively high Buildability Scores of these two projects shows that the BES apparently has no adverse impact on creativity. The trial run results are enclosed at **Appendix D**.

5 SCOPE OF APPLICATION

5.1 The BES contains comprehensive information on buildable design practices to be used by project teams as a tool to assess different design options throughout the design lifecycle.

5.2 At Departmental level, the BES will be deployed by the PQDVC in assessing the buildability performance of design proposals.

5.3 Design vetting will be undertaken by the PQDVC during the various work stages of each project, the quantitative assessment method as detailed in **Appendix C** will be adopted only for vetting Detail Design proposals. As for the proposals at the Technical Feasibility Study and Sketch Design stages, with the limited design information, a simplified qualitative assessment method will be adopted.

5.4 As demonstrated in the trial projects the BES can also be used in post occupancy evaluation to facilitate continuous updating of the Buildability Knowledge Bank and BES system enhancement.

5.5 With experience gained and as datasets are established, the BES may be applied for other purposes, including:

(a) tender assessment (consultancies and works contracts); and

(b) setting up a Buildability Performance Rating system to monitor and compare the performance of consultants and contractors in implementing buildable design practices.

5.6 As a second phase development, it is the Bureau's intention to extend the application of the BES to public works engineering projects, making reference to the ArchSD experience. While the BES framework of strategy, 3S+ principles and modules can be easily adopted by other public works engineering projects, the detailed items and assessment aspects will be different and are tailored to the needs of respective departments. It is as such that the study and preparation of such application to public works engineering projects may take place soon.

5.7 In the long run, if the BES is supported by stakeholders of the construction industry, with concerted efforts, it may become a territory-wide standard for buildability evaluation.

5.8 An overview of possible applications of the BES under the ArchSD environment including the design vetting is shown in Figure 5.

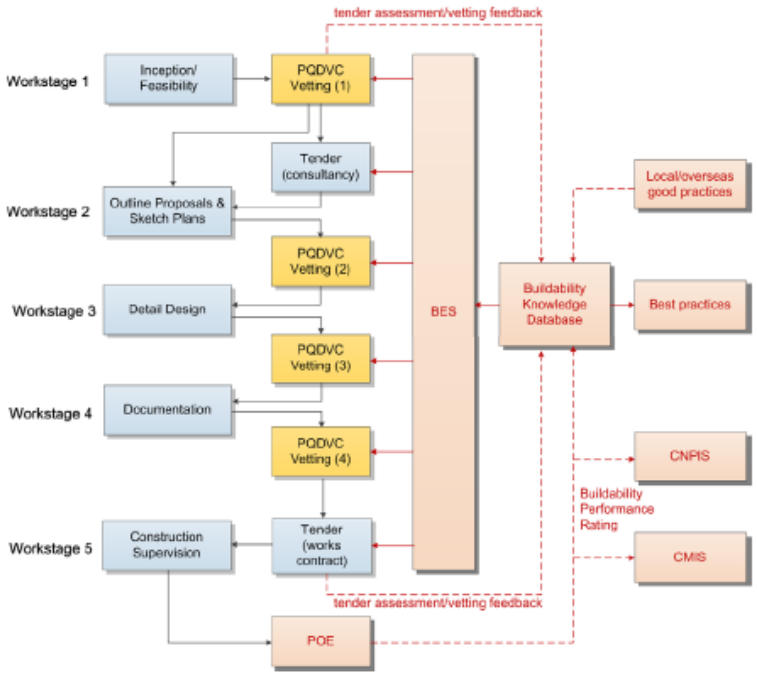


Figure 5 Possible applications of the BES under the ArchSD environment

6 BES VETTING PROCESS

6.1 The BES Vetting Process will come in 3 stages:

(a) **Self-assessment by the project teams** – The BES self-assessment should be made by the project teams and should be complied by submitting the required documents to ArchSD's BES Team for pre-vetting.

(b) **Pre-vetting by BES Team** – The BES Team will pre-vet to ensure that all the BES design requirements are met. Once the requirements are fulfilled, the submission will be made to PQDVC for assessment.

(c) **Vetting by PQDVC** – The formal vetting by PQDVC will be the final stage of the BES Evaluation Gateway in each workstage.

6.2 The design of BES Vetting Process strongly promotes mutual dialogues between project team and BES Team / PQDVC. Project Teams will be encouraged to provide a presentation on their submission and hold meetings and communications with the BES Team / PQDVC. It is the Bureau and ArchSD's plan to encourage such mutual dialogues at every stage in the BES Vetting Process.

7 MANAGEMENT AND OPERATIONAL STRUCTURE

7.1 The ArchSD plans to set up a dedicated multi-disciplinary team to implement the buildability evaluation policy. The main duties and responsibilities of the team are to:

(a) conduct pre-vetting of design proposals and self-assessment results submitted by project teams;

(b) develop qualitative assessment schemes for vetting design proposals at the Technical Feasibility Study and Sketch Design stages;

(c) collect/collate site productivity and cost data to establish benchmarks for building types/work trades as well as to compile the Productivity Index/Cost Index and maintain the Buildability Knowledge Bank;

(d) review the effectiveness of the BES and refine the design and methodology of the System; and

(e) prepare and update the BES guidelines and user references.

8 CONSULTATION AND ENGAGEMENT

8.1 Five number of informal exchange sessions with the following key stakeholder groups of the construction industry were conducted in August and September 2017 to seek their views on the proposal:

i. Construction Industry Council

ii. The Hong Kong Institute of Architects

iii. The Association of Architectural Practices

iv. The Hong Kong Institution of Engineers

v. The Association of Consulting Engineers of Hong Kong

vi. The Association of Registered Engineering Consultants Ltd.

vii. The Hong Kong Construction Association

viii. The Hong Kong Federation of Electrical & Mechanical Contractors Ltd.

ix. The Hong Kong General Building Contractors Association

8.2 The overall feedback received from stakeholders was positive. Comments and suggestions offered by stakeholders during the exchange sessions have been incorporated as appropriate.

8.3 In the coming Open Forum event, all 9 key stakeholders as mentioned above will be invited to attend to seek their views and endorsements. Along with them, 2 additional stakeholders will also be invited:

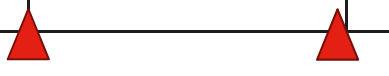
x. The Hong Kong Institute of Surveyors

xi. The Hong Kong Registered Contractors Association

9 IMPLEMENTATION PLAN

9.1 It is proposed to implement the BES in ArchSD in stages in order to allow the Department to achieve continuous improvement through practice as well as for the construction industry stakeholders to adapt to the new policy. A 3-Stage implementation plan is proposed as outlined below:

Scope	Stage 1 Q1 to Q2 / 2018	Stage 2 Q3/2018 to Q1/2019	Stage 3 Q2 to Q4/2019
1) System development / Enhancement	• BES assessment schemes for TFS and Sketch Design stages • Collect / collate site productivity and cost data	• BES assessment schemes for D&B contracts and refurbishment projects • Collect / collate site productivity and cost data	Collect / collate site productivity and cost data and complete initial Buildability Knowledge Base development
2) Design Vetting (by PQDVC)	Selected new building projects covering: • All building types • Projects designed in-house and by consultants	All new building projects required to be vetted by PQDVC, except D&B contracts, refurbishment projects & entrustment projects which ArchSD is not the Controlling Officer.	All new building projects required to be vetted by PQDVC, except entrustment projects which ArchSD is not the Controlling Officer.
3) Procurement (Tender Assessment)	Explore feasibility of incorporating buildability as a tender assessment criterion for AACSB consultancies	Revise marking scheme with buildability as a tender assessment criterion for AACSB consultancies.	• Trial run on selected new AACSB consultancies • Explore feasibility for D&B projects
4) Promotion initiatives	Establish platform with stakeholders for knowledge and experience sharing	Set up Buildability Performance Rating System (AACSB consultants)	Organise 1st Buildable Design Award



9.2 Upon completion of each Stage, a comprehensive review will be carried out to assess the effectiveness of the BES. The results of the reviews will be shared with stakeholders with a view to continue enhancing the design and operation of the System.

End of Paper

APPENDIX A

Assessment Approach and Scoring Method

Qualitative Approach

The Qualitative Approach consists of two methods: “Yes / No Situation” and the “Degree of Compliance”.

1. Yes / No Situation

The example below shows the type of items where Yes / No situation will be applied. The scoring for such approach will be Yes = 100% points, No = 0% points.

For example: 1.M2 – Liaison, documentation and statutory approval

Make pre-construction arrangements before tender

Aspect (4)

(For foundation design in Scheduled Areas) design ready and GEO/SCU approval obtained

2. Degree of Achievement

The example below shows the type of items where a degree of achievement will be required. The scoring for such requirement will be based on the percentage / degree that is achieved, multiplied by the score available.

For example: 1.M1 Construction Period

Aspect (3)

Float time allowed for the critical events.

Quantitative Approach

The Quantitative Approach consists of two methods: “Progressive Scoring” and “Regressive Scoring”.

1. Progressive Scoring

The progressive scoring is designed in such a way to encourage the use of good practices / methods. For example, the item below encourages the use of prefabricated façade. The scoring for this item will be based on the coverage area of which the item is applied. The wider the coverage area will attract higher points.

For example: 3.MA1 Façade

Aspect (1)

Adopt prefabricated construction

e.g. 1: prefabricated modular external wall (including curtain wall, precast concrete wall etc.)

e.g. 2: prefabricated cladding system with dry fixing (including cladding of aluminium, stone, glass reinforced concrete etc.)

Score = Apew / Atew x Factor x 80

Atew = 80% of total area of external walls

Apew = Area of external walls which adopted prefabricated construction in 80% of total area of external wall

2. Regressive Scoring

The regressive scoring is designed in such a way to discourage practices / methods that are detrimental to buildability. For example, the item below focuses on minimising different types of storey heights. The aim of this is to achieve standardisation of floor to floor height throughout a building. The scoring for this item will be based on the proposed number of storey height types. The less the number will attract higher points.

For example: 3.MS2 Structural grid, columns and floor height

Aspect (1)

Uniform / minimise storey height types

Score = [1 – (Npf-1)/Ntf] x 30

Npf = No. of types of floor height

Ntf = Total no. of floor to floor

APPENDIX B

Imposed Condition

Apart from the scoring method and weighting system, the Buildability Evaluation System (BES) also acknowledged the possibility of imposed conditions that may impact the assessments made by the Project Team. The imposed conditions that have been addressed are:

- Site conditions / constraints
- User / operational requirements

Site Conditions / Constraints

The development of BES recognised that there are many various types of site constraints including site formation/geotechnical works, non-buildable area, height limits and etc. The assessment on site constraints hence aim to encourage the avoidance of extensive works. However, it also recognised that such Assessment Item depending on project site conditions, cannot be avoided. As such, an example is illustrated below using item 2.M1 Site Formation / Geotechnical Works.

Module 2 Site Planning and Building Siting			
Ref. No	**Assessment Item**	**Max. Available BES Points**	**Aspects**
2.M1	Site formation/ geotechnical works	30	(1) Site conditions and planning that renders no or only minor site formation / geotechnical work needed. If site formation/geotechnical works is needed, minimize the scope of works by effective planning and design – 3 aspects: (2) Effective site formation proposal with balanced or optimized cut and fill. (3) Effective design of cut/fill slopes and soil nails in terms of layout and factor of safety provided. (4) Effective design of retaining walls in terms of layout, factor of safety provided, structural efficiency and the amount of temporary excavation and shoring works needed.

Table 1 Example 2.M1 - Site Conditions / Constraints

To reflect that the Aspect (1) may not be achievable due to imposed site conditions / constraints, the BES provided an alternative to the scoring, that the Aspect (2) to (4) will be assessed. The weighting allocation will then be as follow:

Aspect	Max %
(1)	100
(2)	Max % of Aspects (2)-(4) is 100 in total. Max % for each Aspect, if applicable, takes equal share in the 100%
(3)	
(4)	

It is important to note that when such assessment cannot be avoided, provided that reasonable efforts are made to address the imposed site constraints, the Design Team can still achieve full marks for this assessment. *(For example, the ability to provide reasonable efforts in Aspect (2) to (4) to overcome Aspect (1).)*

User / operational requirements

The same applies to the user / operational requirements. An example using the Item 3.MS5 Large Voids is use to illustrate the imposed condition and the alternate assessment for this scenario. While the BES encourages the avoidance of large voids, it also recognised that in certain condition, it may not be avoidable.

Module 3 Primary System Design			
Ref. No	**Assessment Item**	**Max. Available BES Points**	**Aspects**
3.MS5	Large Voids	10	(1) No large void that requires extensive temporary works exceeding 1.5 floor height for the construction of the covering floor and the side enclosure. or (2) If large voids are proposed, the structural design shall allow for ease of construction which avoid/minimize the need for extensive temporary works and prefabrication shall be considered. The structural design and reference method statement shall be incorporated in the tender drawings.

Table 2 Example 3.MS5 Avoidance of Large Voids

The scoring method to reflect Aspect (1) may not be achievable is shown below:

Aspect	Max %
(1)	100
(2)	80

If void exceeds 2 floor height and extensive temporary works are required for the construction, the Aspect (2) shall be assessed as 0%.

Item Score = % of (1) or (2) x 10

APPENDIX C

Module 1 Management and Coordination

Module 1 (Management & Co-ordination)

Maximum Available BES Points : 200

<table>
<tr><th>Ref.</th><th>Assessment Item</th><th>Assessment Aspects</th><th>Scoring Method</th><th>Submission Requirements and Scoring Guidelines</th></tr>
<tr><td colspan="5">Mandatory</td></tr>
<tr>
<td>1.M1</td>
<td>Construction period

(Weighting:40)</td>
<td>Allow adequate construction period for the works contract – 5 Aspects:

(1) The contract period as assessed by considering the size and building type of the project is achievable but not over-generous and meets the handover date for the project.

(2) Breakdown of the construction programme with major events identified, sequenced and adequate time allocated.

(3) Float time allowed for the critical events.

(4) Adequate time allowed for the submission and processing of the contractor’s design submissions required under the contract.

(5) Adequate time allowed for connection and diversion (if applicable) of the utilities services.</td>
<td>
<table>
<tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr>
<tr><td>(1)</td><td>20</td><td>YN</td></tr>
<tr><td>(2)</td><td>30</td><td>YN</td></tr>
<tr><td>(3)</td><td>15</td><td>DA</td></tr>
<tr><td>(4)</td><td>20</td><td>DA</td></tr>
<tr><td>(5)</td><td>15</td><td>DA</td></tr>
</table>
Item Score =
Sum of % of Aspects x 40

Assessment method :
YN – Qualitative, Yes or No
DA – Qualitative, by degree of achievement
QF – Quantitative, by formula computation
</td>
<td>(1) The proposed contract period is assessed as a whole taking into account of the proposed size and building type, and past similar projects. Allow also for possible slippage.

(2) A bar chart programme showing the major events, with their respective time duration, sequencing / overlapping.
(a) Major events may comprise: demolition, diversion of major services, site formation, geotechnical works, piling, basement, superstructure frame, building enclosure, BS installation, T&C.
(b) Site conditions affecting construction (e.g. limited access, rock excavation, dewatering) and complexity of the proposed works (e.g. high floor height, transfer/large span structure) shall be taken into consideration when assessing the time duration. Qualitative assessment by judgement and past projects may suffice.
(c) Duration for piling and basement construction should be assessed quantitatively. Refer to SEB Guidelines for assessment.

(3) Critical events to be identified from the programme at (2). Scoring according to the % of critical events to which float time have been added.

(4) Scoring apply to the major items which require contractor’ design input and submission, e.g. piling, ELS, curtain wall, skylight and working platform. Demonstrate that time for design submission and approval is allowed for in the programme. Scoring to % of number of major items achieved.

(5) Apply to connection or diversion of all utilities / BS services. Scoring to % of number of services achieved.</td>
</tr>
<tr>
<td>1.M2</td>
<td>Liaison, documentation and statutory approval

(Weighting: 50)</td>
<td>Make pre-construction arrangements before tender – 11 Aspects:

(1) Sufficient G.I. information available.

(2) U/g utilities records available.

(3) Topographical survey plan available.

(4) (for foundation design in Scheduled Areas) Design ready, GEO and SCU approval obtained.

(5) (for sites with natural terrain hazard) Natural Terrain Hazard study completed and mitigation works approved by GEO and SCU.

(6) (for sites with site formation or geotechnical works) Design ready and GEO approval obtained.</td>
<td>
<table>
<tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr>
<tr><td>(1)</td><td rowspan="11">Max % of Aspects (1) – (10) is 100 in total.
Max % for each Aspect, if applicable, takes equal share</td><td rowspan="11">YN</td></tr>
<tr><td>(2)</td></tr>
<tr><td>(3)</td></tr>
<tr><td>(4)</td></tr>
<tr><td>(5)</td></tr>
<tr><td>(6)</td></tr>
<tr><td>(7)</td></tr>
<tr><td>(8)</td></tr>
<tr><td>(9)</td></tr>
<tr><td>(10)</td></tr>
<tr><td>(11)</td></tr>
</table>
Item Score =
</td>
<td>Aspect (1) to (3) must be assessed.
Aspects (4) to (10) must be assessed if applicable.

Assessment for all aspects (1) to (11) is on Yes /No basis.</td>
</tr>
</table>

Module 1 (Management & Co-ordination)

Maximum Available BES Points : 200

<table>
<tr><th>Ref.</th><th>Assessment Item</th><th>Assessment Aspects</th><th>Scoring Method</th><th>Submission Requirements and Scoring Guidelines</th></tr>
<tr><td></td><td></td><td>(7) (If demolition works required) Structural record/survey available. Asbestos survey completed. Demolition specification ready / demolition method statement indicated in the tender as reference scheme.

(8) (If A&A works required) Record and condition survey available. Asbestos survey completed. Concrete repair / strengthening scope and workable specification for the anticipated works ready. Method statement for critical elements indicated in the tender as reference scheme.

(9) (If diversion works required) Design ready and utilities companies’ approval obtained.

(10) (for sites interfacing with MTRC, Highways, drainage/waterworks reserves or Port Works) Design ready and approval obtained from the relevant authority.

(11) Essential services (water/ electricity) available at commencement of works.</td><td>Sum of % of Aspects x 50</td><td></td></tr>
<tr><td>1.M3</td><td>Cross-discipline Design co-ordination

(Weighting: 30)</td><td>Establish cross-discipline co-ordination at design stages – 4 Aspects:

(1) Floor to floor height co-ordinated between architectural, structural and building services requirements

(2) Architectural, BS and structural systems at critical locations identified and conflicts if exist are resolved.

(3) Combined services layout/section for complex services areas incorporated in the tender drawings as reference.

(4) Buildable details incorporated in the structural tender drawings to accommodate interfacing with BS services.</td><td><table><tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr><tr><td>(1)</td><td>30</td><td>YN</td></tr><tr><td>(2)</td><td>30</td><td>YN</td></tr><tr><td>(3)</td><td>20</td><td>YN</td></tr><tr><td>(4)</td><td>20</td><td>DA</td></tr></table>Item Score =
Sum of % of Aspects x 30</td><td>(1) The floor height should be optimized and should meet the functional use but not over-generous. Refer to Arch SD Design Guidelines for common floor height in various building types. Different Floor height due to specific functions of the building type may be accepted but the scope of difference should be minimized. An overall assessment on Yes / No basis.

(2) The project team to identify the critical locations and demonstrate no conflict or if any, could be resolved among architectural, BS and structural systems. Several critical locations to be identified and assessment on Yes / No basis.

(3) Complex services areas to be identified by the project team. Combined Services Layout/Section for such areas (e.g. locations with major/ multiple BS/E&M services distribution/ runs) showing BS/E&M services arrangements to meet available space/ height to be provided to demonstrate achievement. Project team should also demonstrate the Combined Services Layout/Section have been included in the tender documents. Assessment on Yes / No basis

(4) The % coverage of the buildable structural details will be assessed according to (i) sizes of openings and (ii) structural elements including beam, slab and wall.</td></tr>
<tr><td>1.M4</td><td>Contractor design items

(Weighting: 30)</td><td>Assess necessity for contractor design input – 3 Aspects:

(1) Number and scope of works items requiring contractor design input are minimized and limited to those necessary.

(2) For contractor design items, scope of design work with specification and drawings</td><td><table><tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr><tr><td>(1)</td><td>50</td><td>QF</td></tr><tr><td>(2)</td><td>20</td><td>DA</td></tr><tr><td>(3)</td><td>30</td><td>DA</td></tr></table></td><td>(1) Works items which may be specified as contractor design items are listed in Arch SD Project Administration Handbook Annex 6.A.23 Type A and B Works. Extra contractor design items, N, will each deduct 10% from the assessment as follows.
Aspect % = 50 – 10 x N, subject to lower bound as 0

(2) Apply to the above items requiring contractor design</td></tr>
</table>

Module 1 (Management & Co-ordination)

Maximum Available BES Points : 200

<table>
<tr><th>Ref.</th><th>Assessment Item</th><th>Assessment Aspects</th><th>Scoring Method</th><th>Submission Requirements and Scoring Guidelines</th></tr>
<tr><td></td><td></td><td>as appropriate are included in the tender.

(3) Outline structural scheme and supporting member sizes are available in the tender drawings for works items which require contractor design.</td><td>Item Score =
Sum of % of Aspects x 30</td><td>input. Assessment according to % of items where scope of design works with specification and drawings as appropriate are included in the tender.
If no item requiring contractor design input, accord max. Aspect %.

(3) Assessment according to % of items where contractor’s input requires structural scheme and supporting system. If no such item, accord max. Aspect %.</td></tr>
<tr><td>1.M5</td><td>Facilitating construction

(Weighting: 30)</td><td>Address key issues for constructability and smooth construction – 3 Aspects:

(1) Site constraints identified and addressed in the design.

(2) Methodology and sequence of critical work items assessed and considered.

(3) Reference foundation design with SCU approval provided in the tender</td><td><table><tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr><tr><td>(1)</td><td>30</td><td>YN</td></tr><tr><td>(2)</td><td>40</td><td>DA</td></tr><tr><td>(3)</td><td>30</td><td>DA</td></tr></table>Item Score =
Sum of % of Aspects x 30</td><td>(1) & (2) :
(a) Construction sequence shall be considered and catered for at the design stage. The sequence shall respond to the particular site constraints and the type of construction being proposed, and the design shall be configured to take account of the sequence considered.
(b) Construction sequence for the following items, if required in the works contract, shall be assessed :
i) Demolition,
ii) Site Formation and Geotechnical works,
iii) Basement construction,
iv) Long span structures,
v) Transfer structures,
vi) Elevated footbridges and walkways,
vii) Cantilever construction,
viii) Large canopy steelwork,
ix) Hanger structures,
x) Prefabricated elements, and
xi) Installation of major plant and equipment.
(1) An overall assessment on Yes / No basis.
(2) Assessment according to % number of applicable items achieved.

(3) Apply to both piling and shallow foundation. Assessment according to % of total vertical loading covered. Accord max. Aspect % if no foundation works needed.</td></tr>
<tr><td>1.M6</td><td>Multiple work fronts

(Weighting: 20)</td><td>Prepare for possibility of working on multiple work fronts – 3 Aspects:

(1) Design facilitates multiple work front construction

(2) Design facilitates early installation of building enclosure

(3) Sufficient working space available on site or additional work site secured (for site offices, storage, bending yard, mock up, handling of prefabricated units)</td><td><table><tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr><tr><td>(1)</td><td>25</td><td>YN</td></tr><tr><td>(2)</td><td>25</td><td>YN</td></tr><tr><td>(3)</td><td>50</td><td>DA</td></tr></table>Item Score =
Sum of % of Aspects x 20</td><td>(1) Examples are (i) prefabrication which may be procured off-site or outside the main floor construction cycle, e.g. staircase flight, parapet, planter and architectural features and (ii) top down construction for basement.

(2) Examples are modular design and prefabrication of external wall / façade.

(3) % Aspect according to size of working space on site and additional work site :<table><tr><th>Work site large enough for :</th><th>%</th></tr><tr><td>Nil</td><td>0</td></tr><tr><td>Site offices</td><td>10</td></tr><tr><td>Storage and reinforcement bending yards</td><td>25</td></tr><tr><td>Mock up, storage and handling of prefabricated units</td><td>50</td></tr></table></td></tr>
</table>

Module 2 Site Planning & Building Siting

Module 2 (Site Planning and Building Siting) Maximum Available BES Points : 200

<table>
<tr><th>Ref.</th><th>Assessment Item</th><th>Assessment Aspects</th><th>Scoring Method</th><th>Submission Requirements and Scoring Guidelines</th></tr>
<tr><td colspan="5"></td></tr>
<tr>
<td>2.M1</td>
<td>Site formation/ geotechnical works

(Weighting:30)</td>
<td>(1) Site conditions and planning that renders no or only minor site formation / geotechnical work needed.

Or

If site formation/geotechnical works is needed, minimize the scope of works by effective planning and design – 3 aspects:

(2) Effective site formation proposal with balanced or optimized cut and fill.

(3) Effective design of cut/fill slopes and soil nails in terms of layout and factor of safety provided.

(4) Effective design of retaining walls in terms of layout, factor of safety provided, structural efficiency and the amount of temporary excavation and shoring works needed.</td>
<td>
<table>
<tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr>
<tr><td>(1)</td><td>100</td><td>YN</td></tr>
<tr><td>(2)</td><td rowspan="3">Max % of Aspects (2)-(4) is 100 in total. Max % for each Aspect, if applicable, takes equal share in the 100%</td><td>DA</td></tr>
<tr><td>(3)</td><td>DA</td></tr>
<tr><td>(4)</td><td>DA</td></tr>
</table>
Item Score = [% of (1) or Sum of % of Aspects (2) to (4)] x 30

If the design is innovative in avoiding or eliminating extensive/costly site formation or geotechnical works which otherwise is likely needed given the site conditions, additional score can be accorded in Module 6.
</td>
<td>(1) Minor site formation / geotechnical works will also be assessed if (i) cut or fill or retaining wall more than 3m high or (ii) GEO design submission is required.

(2) Scoring according to sum of achievements on :
<table>
<tr><th>Cut and fill in site formation works</th><th>%</th></tr>
<tr><td>Reasonable amount of slope cutting or site formation level reduction, taking into account of the site profile and building layout</td><td>30</td></tr>
<tr><td>Reasonable amount of filling or recompaction for slope or platform</td><td>30</td></tr>
<tr><td>Amount of cut and fill for site formation works in balance, or not more than 20% difference.</td><td>40</td></tr>
</table>
(3) Scoring according to sum of achievements on :
<table>
<tr><th>Soil nails at slopes</th><th>%</th></tr>
<tr><td>Soil nail layout, length and spacing reasonable according to the inadequacy of the slope profile</td><td>50</td></tr>
<tr><td>Factor of safety not over-provided and within 15% of the required minimum</td><td>50</td></tr>
</table>
(4) Scoring according to sum of achievements on :
<table>
<tr><th>Retaining walls</th><th>%</th></tr>
<tr><td>Structural form and section sizes are efficient</td><td>40</td></tr>
<tr><td>Factor of safety not over-provided and within 15% of the required minimum</td><td>30</td></tr>
<tr><td>Amount of excavation and ELS needed not excessive</td><td>30</td></tr>
</table>
</td>
</tr>
<tr>
<td>2.M2</td>
<td>Natural terrain hazard

(Weighting:10)</td>
<td>(1) Site conditions and planning that renders no natural terrain mitigation measure needed.

Or

If natural terrain mitigation measure is needed, minimize the scope of works by effective planning and design – 3 aspects:

(2) Effective building positioning to minimize the scope of mitigation works and cost effective choice adopted among building setback, flexible barrier and fixed barrier wall

(3) Effective design of the fixed barrier wall in terms of the required loading, factor of safety provided, structural</td>
<td>
<table>
<tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr>
<tr><td>(1)</td><td>100</td><td>YN</td></tr>
<tr><td>(2)</td><td rowspan="3">Max % of Aspects (2)-(4) is 100 in total. Max % for each Aspect, if applicable, takes equal share in the 100%</td><td>YN</td></tr>
<tr><td>(3)</td><td>DA</td></tr>
<tr><td>(4)</td><td>DA</td></tr>
</table>
Item Score = [% of (1) or Sum of % of Aspects (2) to (4)] x 10
</td>
<td>(2) Assessment by rough cost comparison among setback, flexible barrier and fixed barrier wall. Accord score if the most cost effective choice is adopted.

(3) If fixed barrier wall is adopted, scoring according to sum of achievements on :
<table>
<tr><th>Fixed barrier wall</th><th>%</th></tr>
<tr><td>Structural form, embedment and section sizes are efficient</td><td>40</td></tr>
<tr><td>Factor of safety not over-provided, taken as not more than 15% of the required resistance against reasonably assessed loading</td><td>40</td></tr>
<tr><td>Amount of excavation and ELS are not excessive</td><td>20</td></tr>
</table>
(4) If flexible barrier wall is adopted, scoring according</td>
</tr>
</table>

Module 2 (Site Planning and Building Siting) Maximum Available BES Points : 200

<table>
<tr><th>Ref.</th><th>Assessment Item</th><th>Assessment Aspects</th><th>Scoring Method</th><th>Submission Requirements and Scoring Guidelines</th></tr>
<tr><td></td><td></td><td>efficiency and the amount of temporary excavation and shoring works needed.

(4) Effective design of the flexible barrier wall and other measures in terms of positioning, layout, factor of safety provided, structural efficiency and ease of construction.</td><td></td><td>to the sum of achievements on :
<table><tr><td>Flexible barrier wall</td><td>%</td></tr><tr><td>Positioning, layout and structural form are efficient</td><td>40</td></tr><tr><td>Factor of safety not over-provided, taken as not more than 15% of the required resistance against reasonably assessed loading</td><td>40</td></tr><tr><td>Ease of construction including amount of excavation and ELS</td><td>20</td></tr></table></td></tr>
<tr><td>2.M3</td><td>Building siting

(Weighting:30)</td><td>Building siting considerations for buildability and cost effectiveness – 8 Aspects:

(1) Sufficient setback/clearance from geotechnical features for buildability and access.

(2) Building positioning and formation level optimized to reduce scope of site formation /geotechnical works.

(3) (If building footprint encroaches onto slopes) Effective design/ construction method devised to minimize excavation / temporary shoring /slope strengthening works.

(4) Building positioned away from areas of complex geology/deep bearing stratum which otherwise require extensive pile length or deep/complex foundations.

(5) Building positioning and layout allow easy connection to utilities services.

(6) Building positioned or effective design devised to accommodate engineering requirements imposed by underground utilities, adjacent buildings, MTR/highway structures and seawalls, as applicable.

(7) Building positioning and layout facilitate easy access and installation of sizeable elements (e.g. link bridge, major plant equipment).

(8) Building positioning and layout facilitate construction access, logistics and reduced effect to adjacent sensitive buildings/utilities.</td><td><table><tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr><tr><td>(1)</td><td rowspan="8">Max % of Aspect (1) – (8) is 100 in total. Max % for each Aspect, if applicable, takes equal share</td><td rowspan="8">YN</td></tr><tr><td>(2)</td></tr><tr><td>(3)</td></tr><tr><td>(4)</td></tr><tr><td>(5)</td></tr><tr><td>(6)</td></tr><tr><td>(7)</td></tr><tr><td>(8)</td></tr></table>
Depending on the project and site conditions, not all Aspects are applicable to be assessed. The project team should assess all the applicable Aspects and the total max. % of the selected Aspects shall not exceed 100%.

Item Score = Sum of % of assessed Aspects x 30</td><td>(1) Access not obstructed and conveniently accessible for maintenance/inspection equipment.

(2) Extent of cutting/filling arising from building positioning and formation of multi-platforms.

(3) Assess qualitatively on the depth and scope of excavation, and the ELS and slope strengthening works required.</td></tr>
</table>

Module 2 (Site Planning and Building Siting) Maximum Available BES Points : 200

<table>
<tr><th>Ref.</th><th>Assessment Item</th><th>Assessment Aspects</th><th>Scoring Method</th><th>Submission Requirements and Scoring Guidelines</th></tr>
<tr>
<td>2.M4</td>
<td>Building form

(Weighting:30)</td>
<td>Building form considerations for buildability and cost effectiveness – 8 Aspects:

(1) Buildable and cost effective building forms (e.g. identical or similar planning grid, standardized floor height and simple structural systems)

(2) Repetitive design modules/ modular components coordinated with planning modules

(3) Adopt single integrated building components (e.g. integrated architectural/ BS/structural components, volumetric prefabrication)

(4) Avoid curved or irregular structural floor layout

(5) Avoid transfer structures

(6) Heavy floors, if needed, at lower levels

(7) Large span floor, if needed, at top floor

(8) Vertical bearing elements sufficiently set back from site boundary for ease of foundation construction</td>
<td>
<table>
<tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr>
<tr><td>(1)
(2)
(3)
(4)
(5)
(6)
(7)
(8)</td><td>Max % of Aspect (1) – (8) is 100 in total. Max % for each Aspect, if applicable, takes equal share</td><td>YN</td></tr>
</table>
Depending on the project and site conditions, not all Aspects are applicable to be assessed. The project team should assess Aspect (1) and all the other applicable Aspects and the total max. % of the selected Aspects shall not exceed 100%.

Item Score = Sum of % of assessed Aspects x 30
</td>
<td>(1) A qualitative assessment on the overall grid sizing, floor height and complexity of the structural system.

(4) Avoid curved or irregular floor beams / structural walls. Innovative score may be accorded under Module 6 if simple and buildable structural supports are devised for a creative architectural layout.

(8) The setback should facilitate open excavation or avoid extensive ELS.</td>
</tr>
<tr>
<td>2.M5</td>
<td>Foundation System

(Weighting:40)</td>
<td>A. If shallow foundation is adopted :

(1) The shallow foundation system is efficient taking into account of the imposed loading, building layout, subsoil conditions, ground water table and adjacent structures/utilities.

(2) The foundation design is cost effective in terms of utilization ratio.

(3) The foundation depth is optimized and coordinated with drainage / services routing. Extensive excavation and ELS is minimized.</td>
<td>
<table>
<tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr>
<tr><td>(1)</td><td>40</td><td>YN</td></tr>
<tr><td>(2)</td><td>30</td><td>QF</td></tr>
<tr><td>(3)</td><td>30</td><td>QF</td></tr>
</table>
For (2)
Ltv = Total vertical load
Ltp = Total allowable bearing capacity provided by the proposed foundation
% = Ltv/Ltp x 1.15 x 30, capped by 30

For (3)
% = 0 (if excavation depth > 2.5m for common footing or 5m for buoyancy footing) to 30 (if excavation depth <1.2m), interpolate linearly within range. Footings with different depth may be apportioned by area for scoring.

Item Score = Sum of % of
</td>
<td>In general, either A or B is applicable and assessed. If in rare cases of combined footing and piling, both A and B will be assessed and relative weighting assigned according to the respective loading shared between the two systems.

Buoyancy footing shall be assessed under A.

Aspect (3) may be scored if any part of the excavation depth is outside range but the design and ELS are well addressed in terms of buildability and cost effectiveness. The scoring will be on DA basis for that part.</td>
</tr>
</table>

Module 2 (Site Planning and Building Siting) Maximum Available BES Points : 200

<table>
<tr><th>Ref.</th><th>Assessment Item</th><th>Assessment Aspects</th><th>Scoring Method</th><th>Submission Requirements and Scoring Guidelines</th></tr>
<tr><td></td><td></td><td></td><td>assessed Aspects x 40</td><td></td></tr>
<tr><td></td><td></td><td>B. If piling foundation is adopted :

(1) The piling system is efficient taking into account of the imposed loading, building layout, subsoil conditions and adjacent structures/utilities.

(2) Negative skin friction economically assessed with due consideration of year after deposition and degree of consolidation of the compressible layers.

(3) Ground floor slab designed as on-grade to reduce pile load unless suspended ground slab is justified in terms of buildability and cost effectiveness.

(4) The piling estimate is cost effective in terms of utilization ratio.

(5) The pile cap depth is optimized and coordinated with drainage / services routing. Extensive excavation and ELS is minimized.

(6) Pile cap thickness is optimized by design and other effective measures (e.g. non-piling zone under lift pits).</td><td><table><tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr><tr><td>(1)</td><td>25</td><td>YN</td></tr><tr><td>(2)</td><td>10</td><td>YN</td></tr><tr><td>(3)</td><td>10</td><td>YN</td></tr><tr><td>(4)</td><td>25</td><td>QF</td></tr><tr><td>(5)</td><td>20</td><td>QF</td></tr><tr><td>(6)</td><td>10</td><td>YN</td></tr></table>
For (4)
Ltv = Total vertical load
Ltp = Total pile capacity (less NSF) provided by the proposed piling foundation
% = Ltv/Ltp x 1.2 x 25, capped by 25

For (5)
% = 0 (if excavation depth > 3.5m) to 20 (if excavation depth <1.8m), interpolate linearly within range. Pile caps with different depth may be apportioned by area for scoring.

Item Score = Sum of % of assessed Aspects x 40</td><td>(1) A qualitative assessment on the choice of piling system as per the current PQDVC submission.

(2) Assessment should be supported by ground investigation findings and site history.

(3) Buildability of suspended ground slab should address the interfacing with the drainage/utilities during construction, and the further maintenance access/works for drainage/utilities underneath the ground slab.

Aspect (5) may be scored if any part of the excavation depth is outside range but the design and ELS are well addressed in terms of buildability and cost effectiveness. The scoring will be on DA basis for that part.</td></tr>
<tr><td>2.M6</td><td>Basement

(Weighting:40)</td><td>(1) Basement construction is avoided.

Or

If basement is adopted, minimize extent of basement in terms of buildability and cost effectiveness – 10 Aspects:

(2) Basement positioned away from geotechnical features or underground utilities

(3) Basement positioned to allow open excavation or minimize the need for extensive excavation lateral support/dewatering

(4) Depth of basement minimized

(5) Basement extent minimized by locating the floor areas elsewhere in the building

(6) Ground water uplift resistance reduced by limiting the basement within the footprint of the building block

(7) Avoid the need for engaging extra mass filling or foundation piles to</td><td><table><tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr><tr><td>(1)</td><td>100</td><td>YN</td></tr><tr><td>(2)</td><td>10</td><td rowspan="8">YN</td></tr><tr><td>(3)</td><td>10</td></tr><tr><td>(4)</td><td>15</td></tr><tr><td>(5)</td><td>10</td></tr><tr><td>(6)</td><td>5</td></tr><tr><td>(7)</td><td>5</td></tr><tr><td>(8)</td><td>20</td></tr><tr><td>(9)</td><td>5</td></tr><tr><td>(10)</td><td>20</td><td>QF</td></tr></table>
For (10)
Vtr = Volume of basement in rock
Vtb = Total volume of basement
% = $(1 – Vtr/Vtb)^2$ x 20

Item Score = [% of (1) or Sum of % of Aspects (2) to (10)] x 40</td><td>If the design is innovative in avoiding or eliminating extensive/costly basement construction which otherwise is likely needed given the site conditions, additional score can be accorded in Module 6.

(4) Qualitative assessment on the functional requirements of the basement, structural depth and BS provisions to arrive at a minimized basement depth.</td></tr>
</table>

Module 2 (Site Planning and Building Siting) Maximum Available BES Points : 200

<table>
<tr><th>Ref.</th><th>Assessment Item</th><th>Assessment Aspects</th><th>Scoring Method</th><th>Submission Requirements and Scoring Guidelines</th></tr>
<tr><td></td><td></td><td>counteract the ground water uplift pressure

(8) No external tanking which requires extra excavation for working space and complicated construction sequence

(9) Curved or irregular basement wall layout avoided

(10) Avoid or minimize basement encroaching onto rock which requires rock excavation.</td><td></td><td></td></tr>
<tr><td>2.M7</td><td>Construction & demolition waste disposal

(Weighting:20)</td><td>Reduce C&D waste disposal – 4 Aspects :
(1) Reuse of demolition and excavated materials:
• on site; or
• other identified project sites

(2) Reuse of existing structures/ foundation, if any, in the proposed development.

(3) Avoid/minimize excavation in marine mud or contamination soil, if exist, that needed treatment before disposal.

(4) Adopt measures to reduce C&D wastes, e.g. :
• precast / composite / steel construction
• dry wall
• column design that facilitates use of prefabricated mould</td><td>
<table>
<tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr>
<tr><td>(1)</td><td>40</td><td>QF</td></tr>
<tr><td>(2)</td><td rowspan="3">Max % of Aspects (2)-(4) is 60 in total. Max % for each Aspect, if applicable, takes equal share in the 60%</td><td>YN</td></tr>
<tr><td>(3)</td><td>YN</td></tr>
<tr><td>(4)</td><td>DA</td></tr>
</table>
For (1)
Vtu = Total volume of re-used demolition and excavated materials
Vtm = 40% of the total volume of demolition and excavated materials
% = Vtu/Vtm x 40, capped at 40

Aspect (4) must be assessed.

Item Score = Sum of % of assessed Aspects x 20</td><td>(4) Scoring according to the sum of achievements on :
<table>
<tr><th>Measures to reduce C&D wastes</th><th>%</th></tr>
<tr><td>Precast / composite / steel construction adopted for the main building part</td><td>30</td></tr>
<tr><td>Dry wall construction adopted</td><td>30</td></tr>
<tr><td>Column design facilitates use of prefabricated mould</td><td>10</td></tr>
<tr><td>Other effective measures proposed by the project team</td><td>30</td></tr>
</table></td></tr>
</table>

Module 3 Primary System Design

Module 3 (Primary System Design) **Maximum Available BES Points : 220**

<table>
<tr><th>Ref.</th><th>Assessment Items</th><th>Assessment Aspects</th><th>Scoring Method</th><th>Submission Requirements and Scoring Guidelines</th></tr>
<tr>
<td>3.MA1</td>
<td>Façade

(Weighting:25)</td>
<td>3 Aspects :

(1) Adopt prefabricated construction

e.g. 1: prefabricated modular external wall (including curtain wall, precast concrete wall etc.)
e.g. 2: prefabricated cladding system with dry fixing
(including cladding of aluminium, stone, glass reinforced concrete etc.)

(2) Maximize use of prefabricated modular external wall

(3) Minimize facade module types (dimension)</td>
<td>
<table>
<tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr>
<tr><td>(1)</td><td rowspan="2">80</td><td rowspan="2">QF</td></tr>
<tr><td>(2)</td></tr>
<tr><td>(3)</td><td>20</td><td>DA</td></tr>
</table>
For (1) & (2)
Atew = 80% of total area of external walls
Apew = Area of external walls which adopted prefabricated construction in 80% of total area of external wall

% = Apew/Atew x Factor x 80

<table>
<tr><th>Percentage of the area where prefabricated modular external wall are adopted within Apew</th><th>Factor</th></tr>
<tr><td>80 % or more</td><td>1</td></tr>
<tr><td>65 % – 79 %</td><td>0.8</td></tr>
<tr><td>51 % – 64%</td><td>0.7</td></tr>
<tr><td>50 % or less</td><td>0.5</td></tr>
</table>
For (3)
<table>
<tr><th>No. of façade module types (dimension) in each type of the prefabricated construction adopted in the 80% of total area of external wall*</th><th>%</th></tr>
<tr><td>4 or less</td><td>20</td></tr>
<tr><td>5 to 8</td><td>15</td></tr>
<tr><td>9 to 12</td><td>10</td></tr>
<tr><td>13 or more</td><td>0</td></tr>
</table>
* % score for (3) = Sum of % score of each type of prefabricated construction / no. of types of prefabricated construction

Item Score = Sum of % of assessed Aspects x 25
</td>
<td>Drawings indicating the location of the 80% of the total area of external wall, which is being assessed for the purpose of this calculation, shall be submitted.</td>
</tr>
</table>

Module 3 (Primary System Design) **Maximum Available BES Points : 220**

<table>
<tr><th>Ref.</th><th>Assessment Items</th><th>Assessment Aspects</th><th>Scoring Method</th><th>Submission Requirements and Scoring Guidelines</th></tr>
<tr>
<td>3.MA2</td>
<td>Major fixtures

(Weighting:25)</td>
<td>2 Aspects :

(1) Standardization of dimensions of:

• doors
• windows
• louvers

(2) Standardization of materials for :

• doors
• windows
• louvers</td>
<td>
<table>
<tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr>
<tr><td>(1)</td><td>80</td><td>DA</td></tr>
<tr><td>(2)</td><td>20</td><td>DA</td></tr>
</table>
For (1)
Table 1: For buildings with all three types of fixtures
<table>
<tr><th>No. of dimension types in 90% of total number of the fixtures.</th><th>% for Doors</th><th>% for Windows</th><th>% for Louvres</th></tr>
<tr><td>3 or less</td><td>40</td><td>20</td><td>20</td></tr>
<tr><td>4 to 6</td><td>30</td><td>15</td><td>15</td></tr>
<tr><td>7 to 9</td><td>20</td><td>10</td><td>10</td></tr>
<tr><td>10 or more</td><td>0</td><td>0</td><td>0</td></tr>
</table>
Table 2: For buildings with doors and only one other type of fixture
<table>
<tr><th>No. of dimension types in 90% of total number of the fixtures.</th><th>% for Doors</th><th>% for windows or louvers</th></tr>
<tr><td>3 or less</td><td>60</td><td>20</td></tr>
<tr><td>4 to 6</td><td>45</td><td>15</td></tr>
<tr><td>7 to 9</td><td>30</td><td>10</td></tr>
<tr><td>10 or more</td><td>0</td><td>0</td></tr>
</table>
For (2)
<table>
<tr><th>No. of material types in 90% of total number of each of the three fixtures. *</th><th>%</th></tr>
<tr><td>Less than or equal to 2</td><td>20</td></tr>
<tr><td>3 to 5</td><td>10</td></tr>
<tr><td>more than 5</td><td>0</td></tr>
</table>
* % score for (2) = Sum of % score of each type of fixtures / no. of types of fixtures

Item Score = Sum of % of assessed Aspects x 25
</td>
<td>• “Window” refers to prefabricated punch windows in external walls. It excludes curtain wall and site-assembled glass wall</td>
</tr>
</table>

Module 3 (Primary System Design) **Maximum Available BES Points : 220**

<table>
<tr><th>Ref.</th><th>Assessment Items</th><th>Assessment Aspects</th><th>Scoring Method</th><th>Submission Requirements and Scoring Guidelines</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>3.MA3</td><td>Non-structural internal walls/ partitions

(Weighting:35)</td><td>Adopt prefabricated construction for non-structural internal walls (e.g. Pre-finished dry wall / Plaster-board dry wall / Gypsum block wall or aerated concrete block walls requiring no supporting frame etc.)</td><td>Item Score by QF :

Lpns = Length of prefabricated non-structural walls/internal partitions
Ltns = Total length of non-structural walls/ internal partitions, in-situ and prefabricated

Item Score = Lpns/Ltns x 35</td><td>• In-situ concrete wall, brick wall, concrete block wall are not considered as prefabricated construction.</td></tr>
<tr><td>3.MA4</td><td>Wall-to-floor ratio

(Weighting:25)</td><td>Enhance effectiveness of external wall in enclosing a given floor area</td><td>Item Score by QF :

<table><tr><th>Wall/Floor Ratio (WFR)</th><th>Item Score</th></tr><tr><td>Equal to or less than x</td><td>25</td></tr><tr><td>Equal to or greater than y</td><td>0</td></tr><tr><td>Between x and y</td><td>[1-(WFR-x)/(y-x)] x 25</td></tr></table>where
Wall/Floor Ratio (WFR) = Aew/CFA
Aew = External wall area
CFA = Construction floor area
X and y are the lower and upper values of WFR for the respective building type</td><td>Common range of WFR for building types :

<table><tr><th rowspan="2">Building Type</th><th colspan="2">Range of WFR</th></tr><tr><th>x</th><th>y</th></tr><tr><td>Primary and Secondary Schools</td><td>0.5</td><td>0.9</td></tr><tr><td>Special Schools</td><td>0.6</td><td>1.0</td></tr><tr><td>Offices</td><td>0.3</td><td>0.8</td></tr><tr><td>Quarters</td><td>0.7</td><td>1.6</td></tr><tr><td>Others</td><td>0.5</td><td>1.1</td></tr></table></td></tr>
<tr><td>3.MS1</td><td>Structural Framing System

(Weighting:30)</td><td>Structural Framing System should be efficient in respect of the building type, functional use, cost effectiveness and buildability – 3 Aspects :

(1) Efficient structural framing system taking into account of the particular building type and functional use.

(2) Cost effective and economical structural member arrangement and sizes given the building type and the framing system

(3) Adopt prefabricated construction (precast concrete or structural steel) for main structural members:
• slab
• beam</td><td><table><tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr><tr><td>(1)</td><td>50</td><td>DA</td></tr><tr><td>(2)</td><td>25</td><td>DA</td></tr><tr><td>(3)</td><td>25</td><td>QF</td></tr></table>
Item Score = Sum of % of assessed Aspects x 30

For (3)
Npb = Number of prefabricated beams, in concrete or steel. Each beam mark counts as one beam. Semi-precast beam to be factored by 0.5.
Ntb = Total number of beams
Nps = Number of prefabricated slabs. Each slab mark counts as one slab. Semi-precast slab or composite slab with metal deck to be factored by 0.5.
Nts = Total number of slabs
% = (Npb/Ntb + Nps/Nts)/2 x25</td><td>(1) : Reference can be made to the Arch SD Design Guides for building types where efficient structural framing system for particular building form and functional use are suggested. Examples are:
School – classroom size slab panel without beam across the classroom
Quarter – slab panels inside units and without beams across living room or bedroom.
Columbarium – band beams and with edge beams inverted for promoting natural ventilation.
Office – flat slab with/without post-tensioning which suits system formwork for repetitive floors and installation of curtain wall/cladding.

(2) : Scoring according to an overall assessment of the structural member arrangement and sizing in terms of span/loading area vs member size (40%), load transfer path (30%) and buildability (30%). Structural members include slab, beam, wall and column. General assessment expected and need not down to member to member level.</td></tr>
</table>

Module 3 (Primary System Design) **Maximum Available BES Points : 220**

<table>
<tr><th>Ref.</th><th>Assessment Items</th><th>Assessment Aspects</th><th>Scoring Method</th><th>Submission Requirements and Scoring Guidelines</th></tr>
<tr>
<td>3.MS2</td>
<td>Structural grid, columns and floor height

(Weighting:15)</td>
<td>3S strategy applied to structural grid, columns and floor height – 3 Aspects

(1) Uniform / Minimize storey height types

(2) Uniform / Minimize structural grid types

(3) Uniform / Minimize column types</td>
<td>
<table>
<tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr>
<tr><td>(1)</td><td>30</td><td>QF</td></tr>
<tr><td>(2)</td><td>40</td><td>QF</td></tr>
<tr><td>(3)</td><td>30</td><td>QF</td></tr>
</table>
Item Score = Sum of % of assessed Aspects x 15

For (1)
Npf = No. of types of floor height
Ntf = Total no. of floor to floor
% = [1 – (Npf-1)/Ntf] x 30

For (2)
Npgx = No. of types of column grid along x direction
Ntgx = Total no. of column grids along x direction
Npgy = No. of types of column grid along y direction
Ntgy = Total no. of column grids along y direction
% =
[1– (Npgx-1)/Ntgx][1– (Npgy-1)/Ntgy] x 40

For (3)
Npct = Total no. of types of column size
Npcg = Total no. of types of column size where each size has repetition number more than the no. of column grid, i.e. smaller of Npgx and Npgy in (2)
Ntct = Total no. of column sections counting floor to floor
Ntc3 = Total no. of column sections of the 3 largest no. of repetition, counting floor to floor
% = (Ntct/Ntct) x (Npcg/Npct) x 30
</td>
<td>Reference can be made to the SEB Checklist No. SE01 on Adoption of 3S Concept

(1) : Except for genuine functional uses such as carpark ramps, split floor levels of more than 1.0m within one floor should be considered as additional floors and storey height types.

Special floor height as above or for other genuine functional uses, e.g. community hall may be excluded from the Ntf counting.

(2) : Inclined grid should be projected onto the x or y direction grids, whichever is the nearer.

(3) : Prefabricated columns of different sizes may be considered as one single size if the on-site connection details are similar.</td>
</tr>
<tr>
<td>3.MS3</td>
<td>Structural floor beams and slabs

(Weighting:15)</td>
<td>3S strategy applied to structural floor beam and slabs – 2 Aspects

(1) Uniform / Minimize beam size types

(2) Uniform / Minimize slab thicknesses types</td>
<td>
<table>
<tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr>
<tr><td>(1)</td><td>80</td><td>QF</td></tr>
<tr><td>(2)</td><td>20</td><td>QF</td></tr>
</table>
Item Score = Sum of % of assessed Aspects x 15

For (1)
Npbr = No. of types of beam size at r floor
Ntbr = Total no. of beams at r floor
where r = 1 to (total number of floors, n)
% =
[1 – (Npb1-1)/Ntb1] x [1 – (Npb2-1)/Ntb2] x …….x [1 – (Npbn-1)/Ntbn] x 80

For (2)
Npsr = No. of slab panel thickness types at r floor
Ntsr = Total no. of slab panels at r floor
where r = 1 to (total number of floors, n)
% =
[1 – (Nps1-1)/Nts1] x [1 – (Nps2-1)/Nts2] x …….x [1 – (Npsn-1)/Ntsn] x 20
</td>
<td>Reference can be made to the SEB Checklist No. SE01 on Adoption of 3S Concept

(1) & (2) : Prefabricated beams and slabs of different sizes may be considered as one single size respectively if the on-site connection details are similar.</td>
</tr>
</table>

Module 3 (Primary System Design) **Maximum Available BES Points : 220**

<table>
<tr><th>Ref.</th><th>Assessment Items</th><th>Assessment Aspects</th><th>Scoring Method</th><th>Submission Requirements and Scoring Guidelines</th></tr>
<tr>
<td>3.MS4</td>
<td>Transfer Structures

(Weighting:10)</td>
<td>(1) No transfer structure needed.
or
(2) If transfer structures are proposed, each transfer member shall be of adequate size and well detailed to demonstrate the buildability. Appropriate provisions in the other parts of the structure to cater for the temporary works for the transfer members shall be addressed and incorporated in the design.

(3) No inclined column is needed.
or
(4) If inclined columns are proposed, each inclined column shall be of adequate size and well detailed to demonstrate the buildability. Appropriate provisions in the other parts of the structure to cater for the temporary works for the inclined columns shall be addressed and incorporated in the design.</td>
<td>
<table>
<tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr>
<tr><td>(1)</td><td>80</td><td>YN</td></tr>
<tr><td>(2)</td><td>60</td><td>DA</td></tr>
<tr><td>(3)</td><td>20</td><td>YN</td></tr>
<tr><td>(4)</td><td>15</td><td>DA</td></tr>
</table>
Aspects (1) & (2) are mutually exclusive, (3) & (4) also.

Item Score = Sum of % of assessed Aspects x 10
</td>
<td>(2) & (4) : Scoring according to an overall assessment of the structural member arrangement and sizing in terms of buildability (40%), load transfer path (20%) and allowance for temporary works in the design at the other parts of the structure (40%).</td>
</tr>
<tr>
<td>3.MS5</td>
<td>Large voids

(Weighting:10)</td>
<td>(1) No large void that requires extensive temporary works exceeding 1.5 floor height for the construction of the covering floor and the side enclosure.
or
(2) If large voids are proposed, the structural design shall allow for ease of construction which avoid/minimize the need for extensive temporary works and prefabrication shall be considered. The structural design and reference method statement shall be incorporated in the tender drawings.</td>
<td>
<table>
<tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr>
<tr><td>(1)</td><td>100</td><td>YN</td></tr>
<tr><td>(2)</td><td>80</td><td>DA</td></tr>
</table>
If void exceeds 2 floor height and extensive temporary works are required for the construction, the Aspect (2) shall be assessed as 0%.

Item Score = % of (1) or (2) x 10
</td>
<td>(2) : Scoring according to an overall assessment of the structural member arrangement and sizing in terms of buildability (25%), extent of temporary works (25%) and incorporation of prefabrication design and reference method statement in the tender drawings (50%).

Additional innovative score may be accorded under Module 6 if efficient and buildable structural design is devised for a large void which architecturally is creative and fits the building in aspects of functional use or environmental considerations.</td>
</tr>
</table>

Module 3 (Primary System Design) **Maximum Available BES Points : 220**

<table>
<tr><th>Ref.</th><th>Assessment Items</th><th>Assessment Aspects</th><th>Scoring Method</th><th>Submission Requirements and Scoring Guidelines</th></tr>
<tr><td>3.MS6</td><td>Further design provisions to enhance buildability

(Weighting:10)</td><td>3 Aspects

(1) Adopt precast concrete construction for:
• staircase flight
• other non-structural elements (incl. external features, parapets and planters but excl. internal walls/partitions)

(2) Use same concrete grade for columns and beams to minimize construction joints.

(3) In-situ concrete slab with thickness adequate to accommodate concealed BS/E&M services.</td><td><table><tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr><tr><td>(1)</td><td>60</td><td>QF</td></tr><tr><td>(2)</td><td>20</td><td>QF</td></tr><tr><td>(3)</td><td>20</td><td>YN</td></tr></table>
Item Score = Sum of % of assessed Aspects x 10

For (1)
Npr = No. of prefabricated stair flights
Ntr = Total no. of stair flights
Vpn = Volume of prefabricated non-structural elements
Vtn = Total volume of prefabricated non- structural elements
% = (Npr/Ntr) x 30 + (Vpn/Vtn) x 30

For (2)
Njf = No. of floors with different concrete grade between supporting columns and floor beams at joints
Ntf = Total no. of floors
% = (1 - Njf/Ntf) x 20</td><td>(3) : Use of raised floor which eliminates concealed services inside in-situ concrete is one of the means to satisfy this Aspect for the building type of office.</td></tr>
<tr><td>3.MB1</td><td>Space for BS/E&M installations

(Weighting:20)</td><td>Space for BS / E&M installation in respect of suitability of plant rooms, services duct and suitable number of distribution rooms/cabinets.

3 Sub-items :</td><td><table><tr><th>Sub-item</th><th>Max %</th></tr><tr><td>(1)</td><td>50</td></tr><tr><td>(2)</td><td>30</td></tr><tr><td>(3)</td><td>20</td></tr></table>
Item Score = Sum of % of assessed Sub-items x 20 marks</td><td></td></tr>
<tr><td></td><td></td><td>Sub-item (1)

Plant rooms
(a) with suitable space
(b) are strategically located to minimize service run</td><td><table><tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr><tr><td>(a)</td><td>60</td><td>QF</td></tr><tr><td>(b)</td><td>40</td><td>YN</td></tr></table>
Sub item (1) % = Sum of % of assessed Aspects x 0.5

For (a)
Nspr = No. of plant rooms with suitable space
Ntpr = Total no. of plant rooms
% = Nspr/Ntpr x 60

For (b)
% = 40% if achieved</td><td>(a) & (b):
● Provide BS/MEP installation layout / sections and other relevant information to demonstrate achievement.</td></tr>
</table>

Module 3 (Primary System Design) **Maximum Available BES Points : 220**

<table>
<tr><th>Ref.</th><th>Assessment Items</th><th>Assessment Aspects</th><th>Scoring Method</th><th>Submission Requirements and Scoring Guidelines</th></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td>Sub-item (2)

Services ducts (cables, risers etc.) :
(a) with suitable space
(b) are vertically aligned to facilitate installation
(c) with shared use for compatible services</td><td><table><tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr><tr><td>(a)</td><td>40</td><td>QF</td></tr><tr><td>(b)</td><td>30</td><td>QF</td></tr><tr><td>(c)</td><td>30</td><td>QF</td></tr></table>
Sub item (2) % = Sum of % of assessed Aspects x 0.3

For (a)
Nsas = No. of services ducts with suitable space
Ntsd = Total no. of services ducts
% = (Nsas / Ntsd) x 40

For (b)
Nsva = No. of services ducts with vertically aligned
Ntsd = Total no. of services ducts
% = (Nsva / Ntsd) x 30

For (c)
Nssu = No. of services ducts with shared use
Ntsd = Total no. of services ducts
% = Nssu / Ntsd x 30</td><td>(a) to (c):
● BS/E&M installation layout/section, showing pipe/ cable dimensions and proper clearance, to be provided to demonstrate that the proposed pipeduct size, location and arrangement meet the assessment criteria.</td></tr>
<tr><td>Sub-item (3)

Suitable numbers of electrical / ELV distribution rooms/cabinet on each floor</td><td>Nsfc = No. of floors with suitable numbers of rooms/cabinet
Ntfc = Total no. of floors

Sub item (3) % = Nsfc/Ntfc x 20</td><td>Provide BS/E&M layout plans and other relevant information to demonstrate achievement.</td></tr>
<tr><td>3.MB2</td><td>Design for testing & commissioning of BS/E&M installations

(Weighting:10)</td><td>Adequate and strategically located devices/facilities for BS/E&M installations - 5 Sub-items:
(1) HVAC Installation
(2) Electrical Installation
(3) Fire Service Installation
(4) Plumbing Installation
(5) Other BS/E&M Installation

5 Aspects for the Sub-items :
(a) Regulating devices;
(b) measurement points;
(c) metering facilities;
(d) isolation devices; and
(e) drainage facilities</td><td><table><tr><th>Sub-item</th><th>Max %</th></tr><tr><td>(1)</td><td>25</td></tr><tr><td>(2)</td><td>25</td></tr><tr><td>(3)</td><td>25</td></tr><tr><td>(4)</td><td>15</td></tr><tr><td>(5)</td><td>10</td></tr></table>
Item Score = Sum of % of assessed applicable Sub-items / [max. total % of applicable Sub-items] x 10 marks

For Sub-items (1) to (5) :
<table><tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr><tr><td>(a)</td><td>25</td><td rowspan="5">YN</td></tr><tr><td>(b)</td><td>25</td></tr><tr><td>(c)</td><td>25</td></tr><tr><td>(d)</td><td>15</td></tr><tr><td>(e)</td><td>10</td></tr></table>
Sub-item (1) % = Sum of % assessed applicable Aspects x 0.25

Ditto for Sub-item (2) & (3)</td><td>Provide BS/E&M schematic/ layout drawings and other relevant information to demonstrate achievement.

(1) For HVAC installation, provision of regulating devices, measurement points, metering facilities, isolation devices, and drainage facilities (i.e. 5 aspects) is to be assessed.
(2) For electrical installation, provision of metering facilities and isolation devices (i.e. 2 aspects) is to be assessed.
(3) For fire services installation, provision of regulating devices, measurement points, metering facilities, isolation devices, and drainage facilities (i.e. 5 aspects) is to be assessed.
(4) For plumbing installation, provision of regulating devices, measurement points, metering facilities, isolation devices, and drainage facilities (i.e. 5 aspects) is to be assessed.
(5) For other BS/E&M installation, if any, the relevant provisions for T&C (to be determined based on the design requirement) are to be assessed.</td></tr>
</table>

Module 3 (Primary System Design) **Maximum Available BES Points : 220**

<table>
<tr><th>Ref.</th><th>Assessment Items</th><th>Assessment Aspects</th><th>Scoring Method</th><th>Submission Requirements and Scoring Guidelines</th></tr>
<tr><td></td><td></td><td></td><td>Sub-item (4) % = = Sum of % assessed applicable Aspects x 0.15

Sub-item (5) % = = Sum of % assessed applicable Aspects x 0.10

[Note: For Sub-items (1), (3) & (4), Aspects (a) to (e) are applicable. For Sub-item (2), Aspects (c) & (d) are applicable.]</td><td></td></tr>
<tr><td>3.MB3</td><td>Checking availability of equipment/ products/materials for BS/E&M installations

(Weighting:10)</td><td>Confirmed availability and technical performance of specified BS/E&M equipment/products/materials in respect of 8 Aspects:
(1) Lift
(2) Chiller
(3) Cooling tower
(4) Water pump
(5) Air Handling Unit
(6) Generator
(7) Escalator
(8) Gondola</td><td><table><tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr><tr><td>(1)</td><td>15</td><td rowspan="8">YN</td></tr><tr><td>(2)</td><td>15</td></tr><tr><td>(3)</td><td>15</td></tr><tr><td>(4)</td><td>15</td></tr><tr><td>(5)</td><td>15</td></tr><tr><td>(6)</td><td>15</td></tr><tr><td>(7)</td><td>5</td></tr><tr><td>(8)</td><td>5</td></tr></table>Item Score = Sum of % of assessed applicable Aspects / [max. total % of applicable Aspects] x 10 marks

Aspect (1) % = 15% if achieved
Ditto for Aspect (2) to (6)

Aspect (7) %= 5% if achieved
Ditto for Aspect (8)</td><td>(1) & (7):
For lift and escalator installation, confirmation / advice from local lift suppliers / manufacturers should be sought to demonstrate compliance with corresponding performance / requirements on the vertical transportation system.

Others :
Technical information / brochures / catalogues from at least 3 suppliers / manufacturers to be provided to demonstrate adequate market availability of individual BS equipment of the required rating, standard and performance.</td></tr>
<tr><td>3.MB4</td><td>Optimization of BS/ E&M design

(Weighting:10)</td><td>Optimization of BS/E&M design in respect of loading calculation, “fit-for-purpose” design.

2 Sub-items :</td><td><table><tr><th>Sub item</th><th>Max %</th></tr><tr><td>(1)</td><td>60</td></tr><tr><td>(2)</td><td>40</td></tr></table>Item Score = Sum of % of assessed Sub-items x 10 marks</td><td></td></tr>
<tr><td></td><td></td><td>Sub-item (1)

Loading calculation taken into account 5 aspects:
(a) stringent allowance for air-conditioning & electrical loading
(b) consideration of diversity factor
(c) counter-checking/validation process
(d) performance-based (for vertical transportation analysis & simulation)
(e) Use of combined central BS/E&M plant/ equipment (For building complex)</td><td><table><tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr><tr><td>(a)</td><td>25</td><td rowspan="5">YN</td></tr><tr><td>(b)</td><td>25</td></tr><tr><td>(c)</td><td>25</td></tr><tr><td>(d)</td><td>15</td></tr><tr><td>(e)</td><td>10</td></tr></table>Sub-item (1) % = [sum of % assessed applicable Aspects] / [max. total % of applicable Aspects] x 60</td><td>(a) to (e):
● Provide relevant design calculation and information for the applicable BS/E&M installations (to demonstrate achievement for each of the aspects
● Provide supporting evidences to prove counter-checking/ validation done for the design concerned.
● For lift installation, vertical transportation analysis and simulation report to be provided to demonstrate the lift performance meeting the relevant design standards and user requirements</td></tr>
</table>

Module 3 (Primary System Design) **Maximum Available BES Points : 220**

<table>
<tr><th>Ref.</th><th>Assessment Items</th><th>Assessment Aspects</th><th>Scoring Method</th><th>Submission Requirements and Scoring Guidelines</th></tr>
<tr>
<td></td>
<td></td>
<td>Sub-item (2)

“Fit-for-purpose” design with:
(a) backup provisions
(b) diversified distribution system for essential services
(c) no. of equipment optimized (e.g. use of larger capacity equipment)
(d) power sources in proximity of load centre</td>
<td>
<table>
<tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr>
<tr><td>(a)</td><td>30</td><td rowspan="4">YN</td></tr>
<tr><td>(b)</td><td>30</td></tr>
<tr><td>(c)</td><td>20</td></tr>
<tr><td>(d)</td><td>20</td></tr>
</table>

Sub-item (2) % = Sum of % of assessed Aspects x 0.4
</td>
<td>(a) to (d):
Provide BS/E&M schematic, layout drawings and/or other relevant supporting documents (e.g. design reports) to demonstrate achievement for each of the aspects.</td>
</tr>
</table>

Module 4 Secondary System Design

Module 4 (Secondary System Design) **Maximum Available BES Points : 210**

<table>
<tr><th>Ref.</th><th>Assessment Item</th><th>Assessment Aspects</th><th>Scoring Method</th><th>Submission Requirement and Scoring Guidelines</th></tr>
<tr>
<td>4.MA1</td>
<td>Finishes

(Weighting:30)</td>
<td>Minimize wet trade finishes and adopt type of wet trade with higher buildability where unavoidable
– 3 Aspects

(1) Wall

minimize plastering or rendering.

(2) Floor

minimize floor screed, except for floors which are required to be laid to fall.

(3) Ceiling

minimize plastering</td>
<td>
<table>
<tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr>
<tr><td>(1)</td><td>40</td><td>QF</td></tr>
<tr><td>(2)</td><td>40</td><td>QF</td></tr>
<tr><td>(3)</td><td>20</td><td>QF</td></tr>
</table>
(1) Wall:
Awwt = Area of internal wall finished by wet trade
Atw = Total internal wall area
% = [1- (Awwt/Atw x Wall Factor)] x 40
<table>
<tr><th>Percentage of the area where wall plastering / rendering are adopted within Awwt</th><th>Wall Factor</th></tr>
<tr><td>50 % or more</td><td>1</td></tr>
<tr><td>35 % – 49 %</td><td>0.8</td></tr>
<tr><td>21 % – 34%</td><td>0.7</td></tr>
<tr><td>20 % or less</td><td>0.5</td></tr>
</table>
(2) Floor:
Afwt = Area of internal floor finished with floor screed
Atf = Total internal floor area
% = [1- (Afwt/Atf)] x 40

(3) Ceiling:
Acwt = Area of internal ceiling finished by wet trade
Atc = Total internal ceiling area
% = [1- (Afwt/Atf x Ceiling Factor)] x 20
<table>
<tr><th>Percentage of the area where ceiling plastering are adopted within Acwt</th><th>Ceiling Factor</th></tr>
<tr><td>50 % or more</td><td>1</td></tr>
<tr><td>35 % – 49 %</td><td>0.8</td></tr>
<tr><td>21 % – 34%</td><td>0.7</td></tr>
<tr><td>20 % or less</td><td>0.5</td></tr>
</table>
Item Score = Sum of % of assessed Aspects x 30
</td>
<td>For the purpose of this assessment, skim coat and tiles fixed by adhesive are considered as wet trade finishes.</td>
</tr>
</table>

Module 4 (Secondary System Design) **Maximum Available BES Points : 210**

<table>
<tr><th>Ref.</th><th>Assessment Item</th><th>Assessment Aspects</th><th>Scoring Method</th><th>Submission Requirement and Scoring Guidelines</th></tr>
<tr><td>4.MA2</td><td>Toilets/kitchens/ pantries

(Weighting:20)</td><td>Adopt standardized designs for 3 types of facilities :

(1) Toilets

(2) Kitchens

(3) Bathrooms</td><td>Assessment by DA

Table 1: For building types with living accommodation (e.g. quarters, hospital, hostel etc.)
<table>
<tr><th>No. of standardized design for each type of facilities (toilets/kitchens/bathrooms) *</th><th>Score</th></tr>
<tr><td>4 or less</td><td>20</td></tr>
<tr><td>5 to 8</td><td>15</td></tr>
<tr><td>9 to 12</td><td>10</td></tr>
<tr><td>12 or more</td><td>0</td></tr>
</table>
* Item score = Sum of score of each type of facilities / no. of types of facilities

Table 2: For building types without living accommodation (e.g. office, school, sports complex, museum etc.)
<table>
<tr><th>No. of standardized design for each type of facilities (toilets/kitchens/bathrooms) *</th><th>Score</th></tr>
<tr><td>3 or less</td><td>20</td></tr>
<tr><td>4 to 6</td><td>15</td></tr>
<tr><td>7 to 9</td><td>10</td></tr>
<tr><td>10 or more</td><td>0</td></tr>
</table>
* Item score = Sum of score of each type of facilities / no. of types of facilities</td><td>• “Standardized design” refers to identical internal layout, finishing materials, toilet partitions and fixed furniture.

• For the purpose of this calculation, mirror repetition of the facilities is considered adopting the same standardized design.

• “Kitchens” exclude those for catering facilities, which are unique in a building.

• Male, female and accessible toilets shall be considered separately in the calculation.</td></tr>
<tr><td>4.MA3</td><td>Architectural elements

(Weighting:20)</td><td>Adopt buildable design for architectural elements – 3 Aspects

(1) Add-on projections on facade

(2) External works
• fence walls
• trellises

(3) Drainage elements
• manholes
• drainage channels</td><td>Assessment by DA

<table>
<tr><th>Aspects</th><th>Max %</th></tr>
<tr><td>(1)</td><td rowspan="3">Max % of Aspects (1) – (3) is 100 in total.
Max % for each Aspect, if applicable, takes equal share</td></tr>
<tr><td>(2)</td></tr>
<tr><td>(3)</td></tr>
</table>
For (1)

<table>
<tr><th>Percentage of each of the elements under the category, which are formed by prefabricated modules of standardized dimensions*</th><th>% of Max % of the Aspect</th></tr>
<tr><td>80% or more</td><td>100</td></tr>
<tr><td>50% - 79%</td><td>60</td></tr>
<tr><td>20% - 49%</td><td>40</td></tr>
<tr><td>Less than 20%</td><td>0</td></tr>
</table>
* the percentage of application shall be measured by length

% score for (1) = Sum of % score of each type of elements / no. of types of elements

For (2)
<table>
<tr><th>Percentage of each of the elements under the category, which are formed by prefabricated modules of standardized dimensions*</th><th>% of Max % of the Aspect</th></tr>
</table></td><td></td></tr>
</table>

Module 4 (Secondary System Design) **Maximum Available BES Points : 210**

<table>
<tr><th>Ref.</th><th>Assessment Item</th><th>Assessment Aspects</th><th>Scoring Method</th><th>Submission Requirement and Scoring Guidelines</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><td>80% or more</td><td>100</td></tr>
<tr><td>50% - 79%</td><td>60</td></tr>
<tr><td>20% - 49%</td><td>40</td></tr>
<tr><td>Less than 20%</td><td>0</td></tr>
</table>
* the percentage of application shall be measured by length

% score for (2) = Sum of % score of each type of elements / no. of types of elements

For (3)
<table>
<tr><td>Percentage of each of the elements under the category, which are prefabricated.</td><td>% of Max % of the Aspect</td></tr>
<tr><td>80% or more</td><td>100</td></tr>
<tr><td>50% - 79%</td><td>60</td></tr>
<tr><td>20% - 49%</td><td>40</td></tr>
<tr><td>Less than 20%</td><td>0</td></tr>
</table>
* the percentage of prefabrication shall be measured by number and length for manholes and drainage channels respectively.

% score for (3) = Sum of % score of each type of elements / no. of types of elements

Item Score = Sum of % of assessed Aspects x 20</td><td></td></tr>
<tr><td>4.MS1</td><td>Detail structural arrangement

(Weighting:30)</td><td>Detail structural arrangement with due consideration on 3S Strategy for less labour demand, ease of construction and enhanced productivity – 7 Aspects

(1) Avoid / Minimize structural level changes across floor.

(2) Avoid / Minimize cranked beams or beams of varying sections/sizes/ levels within one span.

(3) Avoid / Minimize use of continuous beams with vary beam width among the spans.

(4) Avoid / Minimize curved beams.

(5) Avoid / Minimize beams with depth exceeding 1500mm or width exceeding 1200mm.

(6) Avoid / Minimize beam junctions with more than two beams (or continuous beams) intersecting.

(7) Avoid cast in-situ reinforced concrete water tanks of internal dimension less than 1500mm.</td><td>
<table>
<tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr>
<tr><td>(1)</td><td>20</td><td rowspan="7">DA</td></tr>
<tr><td>(2)</td><td>30</td></tr>
<tr><td>(3)</td><td>10</td></tr>
<tr><td>(4)</td><td>10</td></tr>
<tr><td>(5)</td><td>10</td></tr>
<tr><td>(6)</td><td>10</td></tr>
<tr><td>(7)</td><td>10</td></tr>
</table>
For (1), the scoring scheme is :
<table>
<tr><td>No. of occurrences at one floor</td><td>%</td></tr>
<tr><td>Nil</td><td>20</td></tr>
<tr><td>2</td><td>15</td></tr>
<tr><td>4</td><td>10</td></tr>
<tr><td>6</td><td>5</td></tr>
<tr><td>More than 6</td><td>0</td></tr>
</table>
For (2)
<table>
<tr><td>No. of occurrences at one floor</td><td>%</td></tr>
<tr><td>Nil</td><td>30</td></tr>
<tr><td>2</td><td>25</td></tr>
<tr><td>4</td><td>20</td></tr>
<tr><td>6</td><td>15</td></tr>
<tr><td>8</td><td>10</td></tr>
<tr><td>More than 8</td><td>0</td></tr>
</table>
For (3) to (6)</td><td>Reference can be made to the SEB Checklist No. SE01 on Adoption of 3S Concept</td></tr>
</table>

Module 4 (Secondary System Design) **Maximum Available BES Points : 210**

<table>
<tr><th>Ref.</th><th>Assessment Item</th><th>Assessment Aspects</th><th>Scoring Method</th><th>Submission Requirement and Scoring Guidelines</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>No. of occurrences at one floor</th><th>%</th></tr>
<tr><td>Nil</td><td>10</td></tr>
<tr><td>2</td><td>7</td></tr>
<tr><td>4</td><td>5</td></tr>
<tr><td>6</td><td>2</td></tr>
<tr><td>More than 6</td><td>0</td></tr>
</table>
For (7)
<table>
<tr><th>No. of occurrences</th><th>%</th></tr>
<tr><td>Nil</td><td>10</td></tr>
<tr><td>2</td><td>5</td></tr>
<tr><td>More than 2</td><td>0</td></tr>
</table>
For (1) to (6), lowest % among the floors will be the Aspect score.
Item Score = Sum of % of assessed Aspects x 30
</td><td></td></tr>
<tr><td>4.MS2</td><td>Design efficiency for structural elements

(Weighting:10)</td><td>Reinforcement ratios and span to depth ratios for major members of columns/beams/slabs are satisfactory in terms of buildability and cost effectiveness.</td><td>Assessment by DA

Not detail assessment member by member but general assessment on the major members (taking 4 members per floor, generally 1 column, 2 beams and 1 slab at heavily loaded areas) with score ranges from 0 to 10 depending on :

(i) Manageable reinforcement ratio required at the critical section (40%),

(ii) Any over-provided reinforcement (20%), and

(iii) Span to depth ratio (or deflection calculation as alternative) (40%).

Item Score = average score of the major members examined.</td><td></td></tr>
<tr><td>4.MS3</td><td>Secondary systems

(Weighting:10)</td><td>2 Aspects

(1) Structural supports for secondary systems like skylight, canopy and curtain wall have been incorporated in the framing system, and loading from secondary systems allowed for in the framing design.

(2) Member sizes at supports are adequate to cope with the anticipated connections or cast-in anchorage for the secondary systems</td><td>Assessment by DA

Aspects (1) & (2) combined for assessment :
Not detail assessment member by member but general assessment on the secondary systems (taking 4 secondary systems at most) with score ranges from 0 to 10 depending on :

(i) Loading allowed in the design, (20%)

(ii) Effective and direct support for the secondary systems incorporated in the tender framing plans, (50%), and

(iii) Member sizes at supports are efficient and adequate to cope with the anticipated connections or cast-in anchorage for the secondary systems. (30%)

Item Score = average score of the secondary systems examined.</td><td></td></tr>
<tr><td>4.MS4</td><td>Detailing - reinforced concrete</td><td>3 Aspects

(1) Satisfactory reinforcement detailing at the following critical locations to facilitate</td><td></td><td>Depending on the structural system adopted, Item 4.MS4 and 4.MS5 will have 30 score mark in total and their relative weighting,</td></tr>
</table>

Module 4 (Secondary System Design) **Maximum Available BES Points : 210**

<table>
<tr><th>Ref.</th><th>Assessment Item</th><th>Assessment Aspects</th><th>Scoring Method</th><th>Submission Requirement and Scoring Guidelines</th></tr>
<tr>
<td></td>
<td>(Weighting:30)
(together with 4.MS5)</td>
<td>rebar fixing :
• shear links at pile caps, deep beams, wide beams, flat slab column panel and transfer structures
• longitudinal reinforcement at cranked section or change of section sizes/levels at beams
• beam column joint
• beam and column reinforcement intersection at edge or corner columns
• members with torsion links
• beam junctions
• opening or edge boundary zones of walls

(2) Satisfactory assessment regarding ease of concreting for the above critical locations and also at lapping of reinforcement or where the reinforcement content is high.

(3) Use of standardized reinforcement detailing for members of similar size, span and loading.</td>
<td>
<table>
<tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr>
<tr><td>(1)</td><td>50</td><td>DA</td></tr>
<tr><td>(2)</td><td>30</td><td>DA</td></tr>
<tr><td>(3)</td><td>20</td><td>YN</td></tr>
</table>
(1) & (2) : Not detail assessment member by member but general assessment on selected critical locations with score ranges from 0 to Max % in the above table.
<table>
<tr><td>Aspect</td><td>Number of critical locations to be examined</td></tr>
<tr><td>(1)</td><td>5 per floor including basement floor and foundation, taking from the list under Aspect (1)</td></tr>
<tr><td>(2)</td><td>3 per floor</td></tr>
</table>
Aspect Score = average of the critical locations examined.

(3) Assessment on yes or no basis with demonstration provided by the project team using selected examples.

Item Score =
Sum of % of assessed Aspects x 30 x Wc
where Wc + Ws = 1
</td>
<td>Wc and Ws, shall be allocated according to their respective covering floor area.</td>
</tr>
<tr>
<td>4.MS5</td>
<td>Detailing – steelwork

(Weighting:30)
(together with 4.MS4)</td>
<td>Structural steel detailing with due consideration on 3S Strategy for less labour demand, ease of construction and enhanced productivity. – 6 Aspects

(1) Detailing for structural steelwork takes into account of the anticipated prefabrication, delivery and erection. Temporary works on site are minimized. Reference construction sequence and the corresponding segment and jointing details are incorporated in the tender drawings.

(2) On-site welding minimized with efficient site bolted connection system devised at appropriate locations considering design requirements at the connection point and ease of delivery/erection.

(3) On-site welding/bolting have considered the site conditions, welding position and constrained access if any.

(4) No complicated built-up sections and steel sections specified are commonly available in the market.

(5) Major interfacing with building services routing incl. openings/ supporting provisions are checked and incorporated in the design.

(6) Efficient column beam connections devised and located away from critical/complex section</td>
<td>
<table>
<tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr>
<tr><td>(1)</td><td>40</td><td rowspan="6">DA</td></tr>
<tr><td>(2)</td><td>20</td></tr>
<tr><td>(3)</td><td>10</td></tr>
<tr><td>(4)</td><td>10</td></tr>
<tr><td>(5)</td><td>10</td></tr>
<tr><td>(6)</td><td>10</td></tr>
</table>
Not detail assessment member by member but general assessment on the respective Aspects with score ranges from 0 to Max % in the above table.

Item Score =
Sum of % of assessed Aspects x 30 x Ws
where Wc + Ws = 1
</td>
<td>Depending on the structural system adopted, Item 4.MS4 and 4.MS5 will have 30 score mark in total and their relative weighting, Wc and Ws, shall be allocated according to their respective covering floor area.</td>
</tr>
</table>

Module 4 (Secondary System Design) **Maximum Available BES Points : 210**

<table>
<tr><th>Ref.</th><th>Assessment Item</th><th>Assessment Aspects</th><th>Scoring Method</th><th>Submission Requirement and Scoring Guidelines</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="3">4.MB1</td><td rowspan="3">Types of BS/E&M equipment/ materials

(Weighting:25)</td><td>Minimize types of BS/E&M equipment / materials in respect of HVAC / Electrical / Plumbing installation – 3 Sub-items</td><td><table><tr><th>Sub-items</th><th>Max %</th></tr><tr><td>(1)</td><td>50</td></tr><tr><td>(2)</td><td>30</td></tr><tr><td>(3)</td><td>20</td></tr></table>
Item Score = Sum of % of assessed Sub-items x 25</td><td></td></tr>
<tr><td>Sub-item (1)

Minimize types of HVAC equipment/ materials:
(a) terminal A/C unit (capacity/model)
(b) air grille (types/dimension)
(c) terminal ductwork connection
(d) terminal chilled water pipe connection</td><td><table><tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr><tr><td>(a)</td><td>40</td><td>QF</td></tr><tr><td>(b)</td><td>20</td><td>QF</td></tr><tr><td>(c)</td><td>20</td><td>YN</td></tr><tr><td>(d)</td><td>20</td><td>YN</td></tr></table>
For (a)
Nact = No. of terminal A/C unit types
Ntac = Total no. of terminal A/C units
% = $[1-(Nact-1)/Ntac]^2$ x 40

For (b)
Nagt = No. of air grilles types
Ntag = Total no. of air grilles
Nlgt = No. of types of linear air grilles
Ltag = Total length. of linear air grilles
% = $\{1-[(Nagt-1)/Ntag + (Nlgt-1/ Ltag)]]^2$ x 20

For (c)
% = 20 if achieved

For (d)
% = 20 if achieved

Sub-item (1) % = Sum of % of assessed Aspects x 0.5</td><td>(a):
Provide equipment schedules to demonstrate achievement.

(b):
Provide air grille schedules and indicative layout with estimated quantity and sizes to demonstrate achievement.

(c) & (d):
Provide typical installation plan /details showing the quantity and sizes to demonstrate achievement.</td></tr>
<tr><td>Sub-item (2)

Minimize types of electrical equipment/materials:
(a) light fittings
(b) cable trunking
(c) final circuit floor box</td><td><table><tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr><tr><td>(a)</td><td>60</td><td>QF</td></tr><tr><td>(b)</td><td>20</td><td>YN</td></tr><tr><td>(c)</td><td>20</td><td>QF</td></tr></table>
For (a)
Nlft = No. of light fitting types
Ntlf = Total no. of light fittings
%= $[1-(10x(Nlft-1)/Ntlf)]^2$ x 60

For (b)
% = 20 if achieved

For (c)
Nfbt = No. of final circuit floor box types
Ntfb = Total no. of final circuit floor boxes</td><td>(a):
Provide luminaires schedules showing the types and quantity of luminaires to demonstrate achievement.

(b) & (c):
Provide typical installation plan /details to demonstrate achievement.</td></tr>
</table>

Module 4 (Secondary System Design) **Maximum Available BES Points : 210**

<table>
<tr><th>Ref.</th><th>Assessment Item</th><th>Assessment Aspects</th><th>Scoring Method</th><th>Submission Requirement and Scoring Guidelines</th></tr>
<tr><td></td><td></td><td></td><td>% = [1-(Nfbt/Ntfb)]^2 x 20

Sub-item (2) % = [Sum of % of assessed Aspects / max. total % of applicable Aspects] x 30</td><td></td></tr>
<tr><td></td><td></td><td>Sub-item (3)

Minimize types of plumbing pipe connection type to sanitary fitting & fixture</td><td>Assessment by QF

Lpph = Types of plumbing water pipe to sanitary fitting
Ltpp = Total numbers of sanitary fitting & fixture

Sub-item (3) % = [1-(Lpph-1)/Ltpp]^2 x 20</td><td>Provide typical installation plan / schedules / details showing the final connection of plumbing water pipes to demonstrate achievement.</td></tr>
<tr><td>4.MB2</td><td>Packaged type / prefabricated BS/E&M equipment/ materials

(Weighting:25)</td><td>Use of single-integrated elements in respect of packaged equipment / prefabricated equipment and materials –
2 Sub-items</td><td><table><tr><th>Sub-item</th><th>Max %</th></tr><tr><td>(1)</td><td>25</td></tr><tr><td>(2)</td><td>75</td></tr></table>
Item Score = Sum of % of assessed Sub-items x 25</td><td></td></tr>
<tr><td></td><td></td><td>Sub-item (1)

Use of packaged equipment with integral control panel (e.g. PAU / AHU / chillers)</td><td>Assessment by QF

Npeq = No. of packaged BS/E&M equipment
Nteq = Total no. of BS/E&M equipment
Sub-item (1) % = (Npeq/Nteq) x 25</td><td>Provide equipment schedules to demonstrate achievement.</td></tr>
<tr><td></td><td></td><td>Sub-item (2)

Use of other packaged/ prefabricated BS/E&M equipment/ materials in respect of:
(a) pre-insulated ductwork & pipework
(b) prefabricated cable or Integral busbar system for final circuit (power track system)
(c) pre-assembled control panel
(d) prefabricated BS/E&M risers
(e) partial assembled pump sets</td><td><table><tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr><tr><td>(a)</td><td>40</td><td rowspan="5">YN</td></tr><tr><td>(b)</td><td>20</td></tr><tr><td>(c)</td><td>20</td></tr><tr><td>(d)</td><td>10</td></tr><tr><td>(e)</td><td>10</td></tr></table>
Sub-item (2) % = Sum of % of assessed applicable Aspects / [max. total % of applicable Aspect] x 75</td><td>(a) to (e):
Provide equipment schedules / layout drawings / installation details / design report showing the adoption of these provisions for the applicable sub-items to demonstrate achievement.</td></tr>
<tr><td>Optional</td><td></td><td></td><td></td><td></td></tr>
<tr><td>4.OB1</td><td>Supporting provisions

(Weighting:5)</td><td>Adopt common support provisions for BS/E&M installations incl. pipes/ cables/trays/ducts in respect of:
(a) common M&E tray/brackets
(b) common hanger system/ universal fixing system</td><td><table><tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr><tr><td>(a)</td><td>50</td><td>YN</td></tr><tr><td>(b)</td><td>50</td><td>YN</td></tr></table>
Item Score = Sum of % of assessed Aspects x 5</td><td>(a) & (b):
Provide BS/E&M installation details / layout drawings to demonstrate achievement.</td></tr>
</table>

Module 4 (Secondary System Design) **Maximum Available BES Points : 210**

<table>
<tr><th>Ref.</th><th>Assessment Item</th><th>Assessment Aspects</th><th>Scoring Method</th><th>Submission Requirement and Scoring Guidelines</th></tr>
<tr>
<td>4.OB2</td>
<td>Design and installation detail

(Weighting:5)</td>
<td>Adopt simple design and installation details in respect of:
(a) simple cable/pipe jointing methods
(b) regular services layout for open plan areas or areas with simple room configuration
(c) regular pattern of equipment connection configuration</td>
<td>
<table>
<tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr>
<tr><td>(a)</td><td>40</td><td rowspan="3">YN</td></tr>
<tr><td>(b)</td><td>30</td></tr>
<tr><td>(c)</td><td>30</td></tr>
</table>
Item Score = Sum of % of assessed Aspects x 5
</td>
<td>(a) to (c):
Provide BS/E&M layout drawings and typical installation details to demonstrate achievement.</td>
</tr>
</table>

Module 5 Building and Facility Maintenance

Module 5 (Building and Facility Maintenance) Maximum Available BES Points : 150

<table>
<tr><th>Ref.</th><th>Assessment Item</th><th>Assessment Aspects</th><th>Scoring Method</th><th>Submission Requirement and Scoring Guidelines</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>5.M1</td><td>Maintenance accessibility and facilities

(Weighting:100)</td><td>Provide effective maintenance accessibility and facilities – 20 Aspects under 3 Sub-items (A) to (C) at below :</td><td>
<table>
<tr><th>Sub-item</th><th>Max %</th></tr>
<tr><td>(A)</td><td>40</td></tr>
<tr><td>(B)</td><td>30</td></tr>
<tr><td>(C)</td><td>30</td></tr>
</table>
Item Score = Sum % of assessed Sub-items x 100
</td><td>
Scoring Guidelines
For Assessment Aspects 5.M1(A), 5.M1(C), 5.M2, 5.M3 and 5.O1, the following scoring method will be adopted.

● 100 % of the max % will be given if :
i) The criteria of giving a “75% of the max %” can be met; and
ii) The proposal is in very good quality. It gives new and additional proposal on any issue(s) which have not been mentioned in the Assessment Aspect but can effectively enhance the objective of the subject Assessment Aspect; and
iii) The proposal has been significantly and consistently better than that required by the Assessment Aspect.

● 75% of the max % will be given if :
i) The criteria of giving a “50% of the max %” can be met; and
ii) The proposal is in good quality which gives good and well supported solutions for all issues as stated in the Assessment Aspect; and
iii) The proposal is better than that required by the Assessment Aspect.

● 50% of the max % will be given if :
i) The required document as required in the submission requirements is properly submitted ; and
ii) The proposal can address all the issues as stated in the Assessment Aspect; and
iii) The submission can demonstrate the proposal adequately.

● 25% of the max % will be given if :
i) The required document as required in the submission requirements is not properly submitted; or
ii) The proposal fails to address all the issues as stated in the Assessment Aspect; or
iii) The submission fails to demonstrate the proposal adequately.

● 0% of the max % will be given if :
i) There is no proposal; or
ii) The required document as required in the submission requirements is not submitted; or
iii) The proposal fails to address any issues as stated in the Assessment Aspect; or
iv) The submission fails to demonstrate the proposal.
</td></tr>
</table>

<table>
<tr>
<td>Sub-item (A)
Provisions for building elevations, roofs, canopies & service areas – 3 Aspects:

(1) Access routes with adequate width, headroom & loading capacity, and adequate maneuverable space.

(2) Proper and cost effective maintenance facilities (e.g. gondola, platforms, cat ladders, safety anchors, lifting/hoisting devices etc.) with lower maintenance requirements and recurrent cost.

(3) To prevent lock out after office hour, maintenance access should be free of obstruction and accessible even after officer hour.</td>
<td><table>
<tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr>
<tr><td>(1)</td><td>40</td><td rowspan="3">DA</td></tr>
<tr><td>(2)</td><td>40</td></tr>
<tr><td>(3)</td><td>20</td></tr>
</table>
Sub-item (A) % =
Sum of % of assessed Aspects x 0.4</td>
<td>(1) Proposal including layout plan, section, elevation, dimension, loading capacity, working & maneuverable space, ergonomic data, etc. should be submitted to demonstrate the adequacy and effectiveness of the access routes.

(2) Proposal showing the proposed location and types of the maintenance facilities and the design details should be submitted. Information showing the future maintenance requirements and recurrent cost should be provided.

(3) Proposal including layout plan, elevation, etc. indicating the access route and the common area should be provided to demonstrate the accessibility of the maintenance access after normal office hour.</td>
</tr>
<tr>
<td>Sub-item (B)
Provisions for BS/E&M plant rooms, services ducts and equipment/plants installed at height (incl. false ceilings) – 6 Aspects:

(1) Access routes with adequate width, headroom & loading capacity.

(2) Proper and cost effective maintenance facilities (e.g. platforms, cat ladders, safety anchors, lifting/hoisting devices etc.).

(3) Adequate isolating device and bypass facility.

(4) Cleaning/draining/ air venting facility for water handling equipment piping and cleaning /draining facility for air duct/ drainage pipe.

(5) Adequate illumination for plant room areas.

(6) To prevent lock out after office hour, maintenance access should be free of obstruction and accessible even after officer hour.</td>
<td><table>
<tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr>
<tr><td>(1)</td><td>20</td><td rowspan="6">DA</td></tr>
<tr><td>(2)</td><td>20</td></tr>
<tr><td>(3)</td><td>20</td></tr>
<tr><td>(4)</td><td>20</td></tr>
<tr><td>(5)</td><td>10</td></tr>
<tr><td>(6)</td><td>10</td></tr>
</table>
Sub-item (B) % =
Sum of % of assessed Aspects x 0.3</td>
<td>● BS/E&M installation layout and other design information to be provided to demonstrate achievement for the aspects concerned.

● Major equipment sizes to be verified with supporting documents e.g. equipment catalogues and information from other reference projects.

● For “proper and cost effective maintenance facilities”, BS/E&M installation layout and details to be provided to show provision of maintenance facilities.

● BS/E&M installation layout /schematic drawing to show the provision of “adequate isolating device and bypass facility”

● For “adequate illumination for plant room areas”, design report and other relevant design information to be provided with layout drawing to show lighting provision and design illumination level to demonstrate achievement for the sub-item.</td>
</tr>
<tr>
<td>Sub-item (C)
Avoidance/improvement of common maintenance problems – 11 Aspects:

(1) Adequate roof drainage fall and extra outlets.

(2) Leakage-free movement joints and tailored made drip tray underneath the joints.

(3) Avoid condensation and leakage at roof panels of steel roof.

(4) Access platform for external BS installation or vertical greening, ease for repairs to irrigation systems and replacement of plants.

(5) Inspection access for basement drainage cavities.</td>
<td><table>
<tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr>
<tr><td>(1)</td><td rowspan="11">Max % of Aspect (1) – (11) is 100 in total. Max % for each Aspect, if applicable, takes equal share</td><td rowspan="11">DA</td></tr>
<tr><td>(2)</td></tr>
<tr><td>(3)</td></tr>
<tr><td>(4)</td></tr>
<tr><td>(5)</td></tr>
<tr><td>(6)</td></tr>
<tr><td>(7)</td></tr>
<tr><td>(8)</td></tr>
<tr><td>(9)</td></tr>
<tr><td>(10)</td></tr>
<tr><td>(11)</td></tr>
</table></td>
<td>Proposal including layout plan, section, elevation, dimension, design calculation, fixing details, type & specification of the materials, extent of application, etc. with the relevant area highlighted should be submitted to demonstrate the adequacy and effectiveness.</td>
</tr>
</table>

		(6) Provisions for inspection and maintenance of structural bearing supports (e.g. at expansion joint, at bridge structure, etc.). (7) Avoid full height water tank between floors and using twin tanks instead of single tank. (8) Safe and proper maintenance access to geotechnical features on slopes (steel platforms and stairs/ladders for access and maintenance). (9) Leakage-free jointing of glass panels at skylights/ canopies/glazing walls. (10) Fixing details of external claddings/ external ceiling panels to facilitate inspection and maintenance. (11) Proper weathering treatment and fixing of external timber boardwalks.	Sub-item (C) % = Sum of % of assessed Aspects x 0.3	
Optional				
5.M2	Space Planning for Maintenance (Weighting:20)	Provide suitable space planning for maintenance – 4 Aspects : (1) Flexibility to alter the layout for future conversion, alteration and other improvement works (2) Segregation of water carrying services from water sensitive area such as server room, computer room and switch room, etc (3) Avoidance of water sensitive plant and machinery (such as switch room, computer & server room, A/C plant room) located under roof, podium, toilets and water tank room (4) Co-location and confine the water carrying services within the area or same zone	<table><tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr><tr><td>(1)</td><td>25</td><td rowspan="4">DA</td></tr><tr><td>(2)</td><td>25</td></tr><tr><td>(3)</td><td>25</td></tr><tr><td>(4)</td><td>25</td></tr></table> Item Score = Sum % of assessed Aspects x 20	(1) Proposal should be submitted to demonstrate the method to achieve the requirements. Layout plan, section, elevation, dimension, fixing details, ergonomic data, etc. with full justifications should be provided to demonstrate the flexibility for future alteration works. (2) Proposal including layout plan, section, schematic diagram, etc. showing the alignment of pipework with water sensitive area highlighted should be provided to demonstrate the achievement. (3) Proposal including layout plan, section, etc. showing the water sensitive plant / machinery rooms and the proposed usage of upper floor should be provided to demonstrate the achievement. (4) Proposal including layout plan, section, schematic diagram, etc. with the water carrying services highlighted should be provided to demonstrate the arrangement of the water carrying services.
5.M3	Durability of building systems/components/ materials (Weighting:30)	Avoidance/improvement of common building system/component/material durability problems – 4 Aspects: (1) Standardization of the finishes material (2) Ease of maintenance and replacement of the building component (3) Materials should have good property and performance against weathering, discoloration, deformation and degradation (4) Adequate provision and tolerance of drainage facilities and other building components under extreme climate condition including extreme rainfall and heat change	<table><tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr><tr><td>(1)</td><td>25</td><td rowspan="4">DA</td></tr><tr><td>(2)</td><td>25</td></tr><tr><td>(3)</td><td>25</td></tr><tr><td>(4)</td><td>25</td></tr></table> Item Score = Sum of % of assessed Aspects x 30	(1) Proposal including a finishes schedule, etc. should be provided to demonstrate the effectiveness of standardization. (2) Proposal including the working space requirements, standard and typical design, extent of building components to be included, etc. should be provided to demonstrate the ease of maintenance and replacement of the building components and its effectiveness. (3) Proposal including the selection criteria and applicable standard for choosing the materials with good property and performance should be submitted. The extent of materials to be included should be indicated. (4) Proposal including design calculations, design assumption, design & fixing details, use of materials and applicable standard, etc. should be provided to demonstrate the achievement.
5.O1	Documentation for ease of future maintenance of Building Works (Weighting:20)	Provide suitable document, tools and information for ease of future maintenance – 4 Aspects: (1) Application of IT in facilities management including the application of high technology in preparing the documents for	<table><tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr></table>	(1) Proposal such as system proposal, etc. with proposed handover arrangement should be provided to demonstrate the effectiveness on building handover and facilities up-keeping. (2) Proposal including the proposed use of QR codes, extent of application, estimated installation & recurrent cost, etc. should be provided to demonstrate the effectiveness on easy

<table>
<tr>
<td></td>
<td></td>
<td>building handover and facilities up-keeping.

(2) Exploration of QR codes in facilities management for easy on-site identification and record retrieval.

(3) Application of IT technology in building maintenance especially for prevention/mitigation/monitoring of water damage and concrete defects (e.g. water sensitive area, area with higher chance of concrete defects, etc.).

(4) Proper demarcation (e.g. clear demarcation provided inside plant room) and labelling of all essential BS pipe works and facilities within the venue.</td>
<td>
<table>
<tr><td>(1)</td><td>25</td><td rowspan="4">DA</td></tr>
<tr><td>(2)</td><td>25</td></tr>
<tr><td>(3)</td><td>25</td></tr>
<tr><td>(4)</td><td>25</td></tr>
</table>

Item Score =
Sum of % of assessed Aspects x 20</td>
<td>on-site identification and record retrieval.

(3) Proposal showing the proposed use of IT technology to facilitate the prevention/mitigation/monitoring of water damage and concrete defect should be provided. The proposal shall show the extent of application, estimated installation & recurrent cost and the effectiveness of the proposed system.

(4) Proposal including the label design and the extent of application (e.g. extent of pipework to be covered, location, etc.) should be provided to demonstrate the achievement.</td>
</tr>
<tr>
<td>5.O2</td>
<td>Provision to facilitate preventive maintenance of BS/E&M installations

(weighting:10)</td>
<td>2 Aspects :

(1) RFID technology (tag & scanning provision) for essential BS/E&M equipment installed at not readily accessible areas (e.g. high level, ceiling void or concealed places)

(2) Enabling facilities for web-based remote monitoring of BS/E&M installations (e.g. WiFi / ZigBee wireless control interface with CCMS, dry contact provision for BS/E&M equipment etc)</td>
<td>
<table>
<tr><th>Aspect</th><th>Max %</th><th>Assessment</th></tr>
<tr><td>(1)</td><td>50</td><td>YN</td></tr>
<tr><td>(2)</td><td>50</td><td>YN</td></tr>
</table>

Item Score =
Sum of % of assessed Aspects x 10</td>
<td>(1) “RFID technology (tag & scanning provision)” means the provision allowed for interfacing with RFID scanning tools and tag designation to essential equipment.

(2) “Web-based remote monitoring” means the provision allowed for remote communication to CCMS.

(1) & (2) : BS/E&M design report, schematic drawings and other design information to be provided to demonstrate achievement for the aspects concerned.</td>
</tr>
</table>

APPENDIX D

Trial Run Results

Project Title	BES Prototype Scores						Labour Demand in man-days/CFA	Remarks
	Module 1	Module 2	Module 3	Module 4	Module 5	TOTAL		
	200	**200**	**300**	**200**	**100**	**1000**		
Project A **Office Building (Completed)**	187	191	211	155	100	**844**	4.4 (4.4 to 6.4)*	Good buildability design: Modular + flat slab
Project B **Joint Users Building (Completed)**	147	156	152	108	82	**645**	8.9 (4.5 to 8.9)*	Curved building form, transfer structures, inclined columns
Project C **Quarters (Not Completed)**	150	160	149	92	79	**630**	-	Extensive geotechnical works, transfer structures, complicated detailing
Project D **Headquarters Building (Not Completed)**	176	179	229	144	100	**828**	-	Modular design, structural steelwork and composite construction
Project E **Crematorium (Completed)**	178	153	181	107	96	**715**	10.5 (5.6 to 12.6)*	Reinforced concrete construction, beam-and-slab system

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