

Industry Briefing on Enhanced Buildability Framework

For Builders



We shape a **safe**, **high quality**, **sustainable** and **friendly** built environment.

Programme

- Constructability Appraisal System
- Submission Procedures
- Incentive Schemes to Defray Technology Cost
- Construction Productivity Data Requirements

Constructability Appraisal System

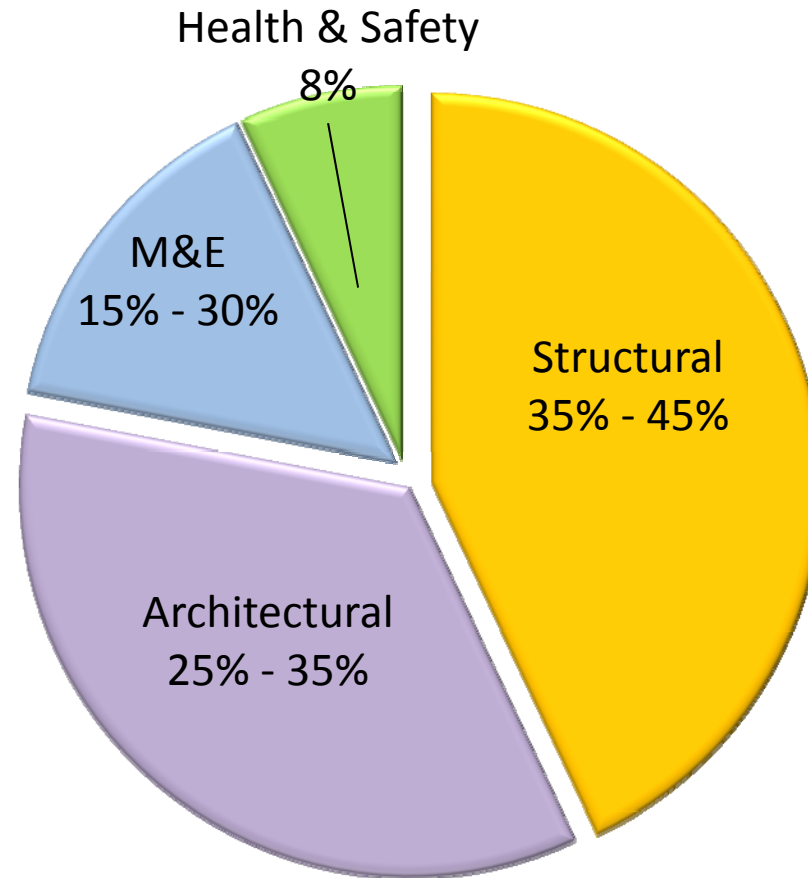
Buildability Development Department



Daphne Quek

11 May 2011

Constructability Appraisal System



Manpower used in a
building project

Constructability Appraisal System

Main Components	
1	Structural System Max 60 points
2	Architectural, Mechanical, Electrical & Plumbing System Max 50 points
3	Good Industry Practices Max 10 points



**Constructability
Score**

**Constructability
Score**

**Structural
System**

Structural System	Maximum 60 points
External Access System	15 points
Formwork System	30 points
Structural innovative methods, systems, processes, plant & equipment	15 points

Constructability
Score

Structural
System

External
Access
System

STRUCTURAL SYSTEM (MAXIMUM 60 POINTS)

Construction Technologies / Methods	Allocated Points	Computation Method
1. External Access System (Maximum 15 points)		
(a) No external scaffold	15	$\frac{\sum(\text{Length with external access system/no external scaffold} \times \text{Allocated pts})}{\text{Total Perimeter Length}}$
(b) Self-climbing perimeter scaffold	15	
(c) Crane-lifted perimeter scaffold / fly cage	14	
(d) Traditional external scaffold	1	

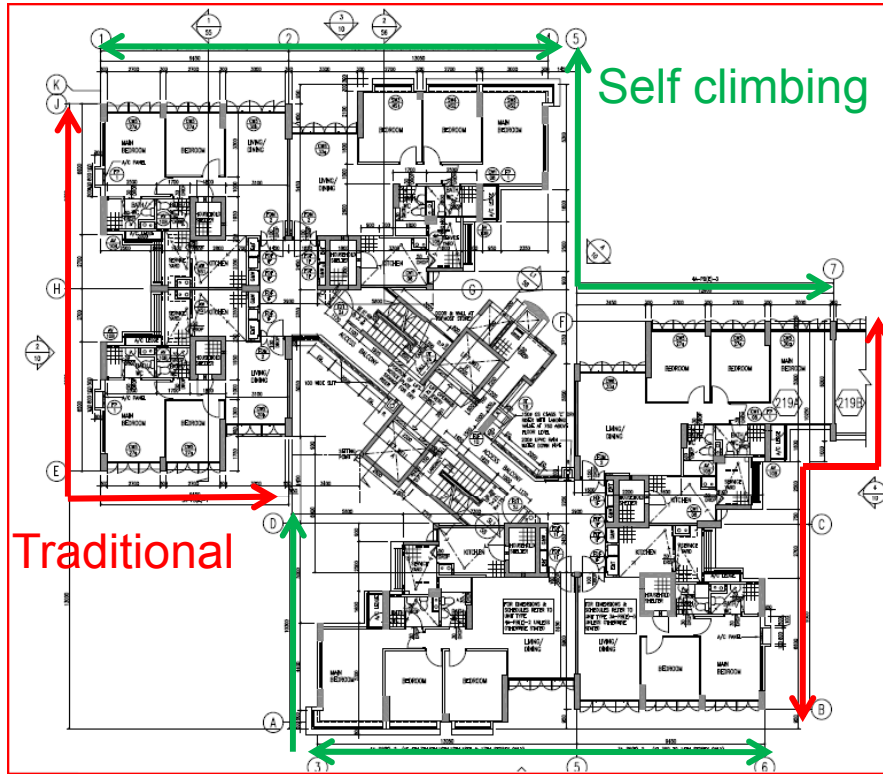
Table 1 Structural System



Climbing Scaffold



Traditional



Example

A 16-storey high building uses both self-climbing perimeter scaffold and traditional external scaffolding.

Type of External Access System Used

% of Building Perimeter

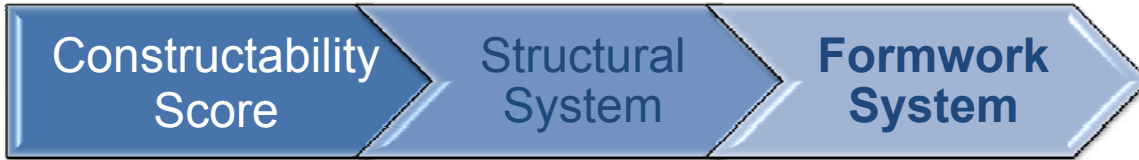
Self-climbing scaffold

60%

Traditional external scaffolding

40 %

Score(External Access System) = $(0.6 \times 15\text{points}) + (0.4 \times 1\text{point}) = 9.40$ points



STRUCTURAL SYSTEM (MAXIMUM 60 POINTS)			
Construction Technologies / Methods	Allocated Points	Computation Method	
2. Formwork System (Maximum 30 points)			
A. Vertical Contact Area			
(i) No formwork (precast construction)	15	$\frac{\Sigma(\text{Vertical Formwork Contact Area} \times \text{Allocated points})}{\text{Total Vertical Formwork Contact Area}}$	
(ii) Traditional timber/metal formwork	1		
(I) Vertical Formwork¹			
(i) System Formwork (Band 1)	15		
(ii) System Formwork (Band 2)	14		
(iii) System Formwork (Band 3)	13		
(iv) System Formwork (Band 4)	11		
(v) System formwork (Band 5)	8		
B. Floor Area			
			Floor Area
(i) No formwork (precast construction)	15	$\frac{\Sigma(\text{Floor Area} \times \text{Allocated points})}{\text{Total Floor Area}}$	
(ii) Traditional timber/metal formwork	1		
(I) Horizontal Formwork¹			
(i) System Formwork (Band 1)	15		
(ii) System Formwork (Band 2)	14		
(iii) System Formwork (Band 3)	13		
(iv) System Formwork (Band 4)	11		
(v) System formwork (Band 5)	8		

Table 1 Structural System

Formwork Banding

A Vertical System Formwork

S/N	Category	Constructability Points	Supplier or Builder / Formwork System
1	Band 1	15	Dragages B96 Steel Column Formwork
2	Band 2	14	Doka Top 50 Column Formwork HKL Aluma EasySet Aluminium Column Formwork
3	Band 3	13	Lubeca Column Formwork Asiaric Aluminium Formwork (Integrated Small-panelled)
4	Band 4	11	Woh Hup Sateco Steel Column Formwork MFE Aluminium Formwork (Integrated Small-panelled)
5	Band 5	8	Ulma Orma Modular Formwork for Columns Fuvi EH Shear Wall+Honey MDC plastic moulded formwork system (Integrated Small-panelled)

B Horizontal System Formwork

S/N	Category	Constructability Points	Supplier or Builder / Formwork System
1	Band 1	15	-
2	Band 2	14	Harsco Tables on Lightshores
3	Band 3	13	HKL Alupalite Tables Asiaric Aluminium Formwork (Integrated Small-panelled)
4	Band 4	11	Doka Dokamatic Tables MFE Aluminium Formwork (Integrated Small-panelled)
5	Band 5	8	Formwork Hire Tables Ulma CC-4 Panel System+Enkoflex Fuvi EH Shear Wall+Honey MDC plastic moulded formwork system (Integrated Small-panelled)

For formwork assessment, please contact Mr Chin Kim Hong Email: chin_kim_hong@bca.gov.sg

Constructability
Score

Structural
System

Formwork
System

STRUCTURAL SYSTEM (MAXIMUM 60 POINTS)			
Construction Technologies / Methods	Allocated Points	Computation Method	
2. Formwork System (Maximum 30 points)			
A. Vertical Contact Area			
(i) No formwork (precast construction)	15	$\frac{\Sigma(\text{Vertical Formwork Contact Area} \times \text{Allocated points})}{\text{Total Vertical Formwork Contact Area}}$	
(ii) Traditional timber/metal formwork	1		
(I) Vertical Formwork			
(i) System Formwork (Band 1)	15		
(ii) System Formwork (Band 2)	14		
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(v) System formwork (Band 5)	8		
B. Floor Area			
(i) No formwork (precast construction)	15		$\frac{\Sigma(\text{Floor Area} \times \text{Allocated points})}{\text{Total Floor Area}}$
(ii) Traditional timber/metal formwork	1		
(I) Horizontal Formwork			
(i) System Formwork (Band 1)	15		
(ii) System Formwork (Band 2)	14		
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(iv) System Formwork (Band 4)	11		
(v) System formwork (Band 5)	8		

Table 1 Structural System



Example

A building project utilises a combination of precast (no vertical formwork system) and RC construction methods. For the in-situ RC works, the builder uses a Band 3 vertical system formwork.

<u>Type of Vertical Element</u>	<u>% of total vertical area</u>	<u>Allocated pts</u>
Precast Facade wall	40%	15
RC column & wall (Band 3)	60%	13

Score (*Vertical FW*) = (0.4x **15points**) + (0.6 x **13point**) = 13.80 points

Example

A building project utilises a combination of precast and RC construction methods. For the in-situ RC works, the builder uses both traditional timber and system formwork

<u>Type of Horizontal Element</u>	<u>% of total horizontal area</u>	<u>Allocated pts</u>
Precast Planks	30%	15
RC beams & slabs (Band 4 system FW)	70%	11

$$\text{Score}(\text{Horizontal FW}) = (0.3 \times \mathbf{15\text{points}}) + (0.7 \times \mathbf{11\text{point}}) = 12.20 \text{ points}$$

$$\begin{aligned} \text{Total score for Formwork System} &= \text{Score (Vertical FW)} + \text{Score (Horizontal FW)} \\ &= 13.80 + 12.20 \\ &= 26 \end{aligned}$$

Constructability
Score

Structural
System

Innovative
System

STRUCTURAL SYSTEM (MAXIMUM 60 POINTS)

Construction Technologies / Methods	Allocated Points	Computation Method
3. Structural Innovative Methods, Systems, Processes, Plant & Equipment (Maximum 15 points)		
(a) Use of self compacting concrete	2	Points are given if usage is $\geq 5\%$ of total superstructure concrete volume
(b) Use of hydraulic stationary placing boom for concreting	2	Points will be given once used
(c) Use of tower crane (tip load ≥ 10 tonnes at maximum reach)	3	Points will be given once used
(d) Strut free deep basement construction	4 (max)	Applicable for projects with restricted site access. Normal earth slope with or without concrete lining is excluded.
(e) Any other innovative methods, systems, processes, plant & equipment	Points to be awarded only for high impact items that improve labour efficiency	

Table 1 Structural System



Example

Self compacting concrete

A builder uses self compacting concrete for columns that have congested reinforcement bars.

Volume of self compacting concrete is 10% of the total concrete volume for the super structural works.

=> 2 points allocated

Example



2 points are allocated if hydraulic stationary placing boom is being used for concreting of the major structural works.

Constructability Score

AMEP System

Architectural, Mechanical, Electrical & Plumbing (AMEP) System	Maximum 50 points
Architectural	25 points
Mechanical, Electrical & Plumbing	
AMEP innovative methods, systems, processes, plants & equipments	25 points

Constructability Score

AMEP System

Architectural

**ARCHITECTURAL, MECHANICAL, ELECTRICAL & PLUMBING SYSTEM (AMEP)
(MAXIMUM 50 POINTS)**

Construction Technologies / Methods	Allocated Points	Computation Method
1. Architectural		
<p>(a) No screeding on floors (not stipulated in tender drawing):</p> <p>(i) To immediately receive tile/stone finish using thin bed adhesive</p> <p>(ii) Carpet or raised floor finishing</p>	5	$\frac{\text{Floor Area with no screeding} \times \text{Allocated points}}{\text{Total Area (excluding wet areas)}}$
<p>(b) RC/ Block walls left unplastered to receive (not stipulated in tender drawing):</p> <p>(i) Tile/ Stone</p> <p>(ii) Wallpaper</p> <p>(iii) Paint (skim coat allowed)</p>	5	$\frac{\text{RC/Block Wall}^* \text{ Length with no plastering} \times \text{Allocated points}}{\text{Total RC/Block Wall Length}^*}$ <p><i>* Refers to walls with finishing including tile/ stone, wallpaper & paint</i></p>
(c) Use of spray painting	3	Points are given if usage \geq 50% of total internal painted area

Table 2 Architectural, Mechanical, Electrical & Plumbing System

Example



If the tender drawing did not stipulate no screed floor and a builder is able to cast the floor slabs to immediately receive tiles without the need for screed.

Description

Floor area with no screeding

Total Area (excluding wet areas)

Area

27,000 m²

30,000 m²

$$\text{Score} = \frac{27000 \times 5 \text{ points}}{30000} = 4.50 \text{ points}$$

Example

If the tender drawing did not stipulate no plaster on walls and a builder is able to cast walls to immediately receive tiles without the need for screed



Description

Wall length unplastered

Total RC wall length

Area

15,000 m

20,000 m

$$\text{Score} = \frac{15000 \times \mathbf{5 \text{ points}}}{20000} = 3.75 \text{ points}$$

Example



Use of spray painting

=> 3 points allocated

Constructability Score

AMEP System

MEP System

**ARCHITECTURAL, MECHANICAL, ELECTRICAL & PLUMBING SYSTEM (AMEP)
(MAXIMUM 50 POINTS)**

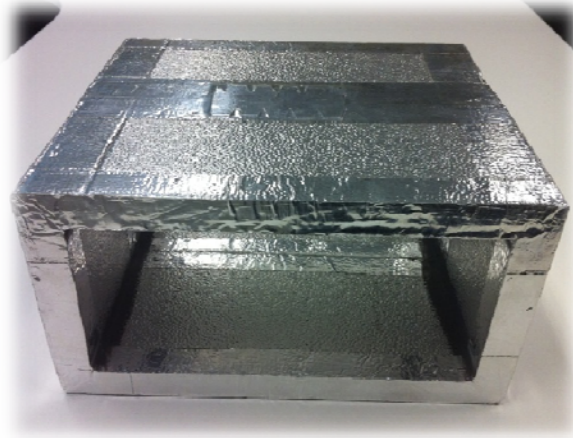
Construction Technologies / Methods	Allocated Points	Computation Method
2. Mechanical, Electrical & Plumbing (MEP)		
(a) Pipe Works (i) Pre-insulated chilled water pipes	3	Points are given if usage \geq 80% of total pipe length
(b) Air-Con Ducting (i) Prefab ducts OR (ii) Prefab & Pre-insulated ducts	3 6	Points are given if usage \geq 80% of total duct length
(c) Use of flexible pipes for domestic water system	3	Points are given if usage \geq 80% of total pipe length
(d) Use of mechanical joints for M&E piping	2	Points are given if usage \geq 80% of total pipe length

Table 2 Architectural, Mechanical, Electrical & Plumbing System

Example



Pre-insulated pipe



Pre-fabricated duct



Flexible water pipe

Constructability Score

AMEP System

Innovative

**ARCHITECTURAL, MECHANICAL, ELECTRICAL & PLUMBING SYSTEM (AMEP)
(MAXIMUM 50 POINTS)**

Construction Technologies / Methods	Allocated Points	Computation Method
3. AMEP Innovative Methods, Systems, Processes, Plant & Equipment (Maximum 25 points)		
(a) Use of ceiling inserts	2	Points are given if once used for at least one complete floor
(a) Prefab plant / piping modules	3	Points are given once used for at least one plant room
(c) Use of scissor lift and/or personnel lift in lieu of traditional scaffold for AMEP works	2	Points will be given once used
(d) Use of boom lift in lieu of traditional scaffold for AMEP works	2	Points will be given once used
(e) Any other innovative methods, systems, processes, plant & equipment	Points to be awarded only for high impact items that improve labour efficiency	

Table 2 Architectural, Mechanical, Electrical & Plumbing System

Example

A builder uses the following AMEP innovative systems and equipments



Description

Allocated points

Use of boom lift	2
Use of scissor lift	2
Use of ceiling inserts for 3 floors	2
Use of prefab plant module for 1 plant room	3



Score = 2 + 2 + 2 + 3 = 9 points

Constructability Score

Good Industry Practices

GOOD INDUSTRY PRACTICES (MAXIMUM 10 POINTS)

Description	Allocated Points
(a) To use Building Information Modelling (BIM) to: <ul style="list-style-type: none"> (i) Check for clashes between M&E services, structural provision and architectural objects (ii) Produce M&E Coordination Drawings, Architectural Shop Drawings and Concrete Body Plan for construction purposes 	5
(b) To adopt a trade productivity monitoring system to: <ul style="list-style-type: none"> (i) Establish “workers’ productivity norms” (ii) Conduct work studies on the processes if the productivity levels deviate from the norm (iii) Implement measures to improve productivity whenever possible 	2
(c) To produce and distribute step by step work manuals for all trades and set up site mock-ups to show how works should be done properly for whole project duration for: <ul style="list-style-type: none"> (i) Wall installation (ii) Waterproofing (iii) Suspended ceiling installation (iv) Window installation 	2

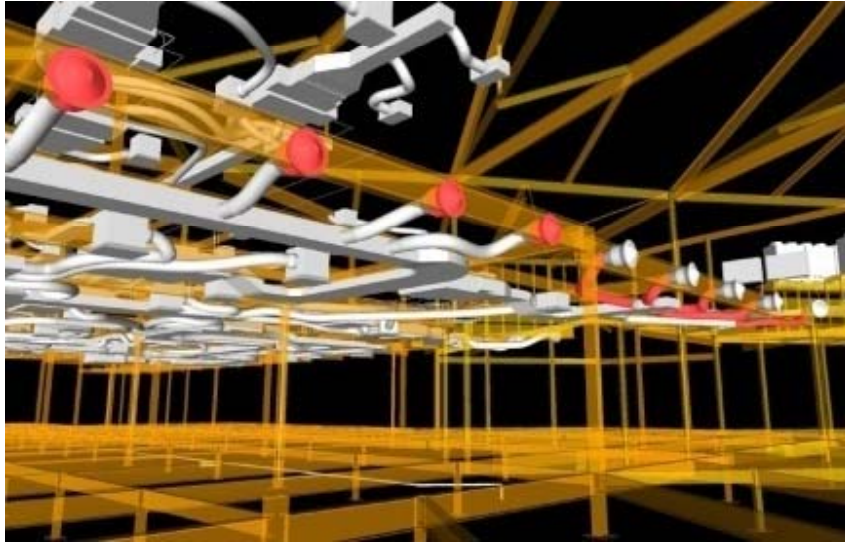
Table 3 Good Industry Practices

GOOD INDUSTRY PRACTICES (MAXIMUM 10 POINTS)	
Description	Allocated Points
(d) To conduct monthly work study sessions , to scrutinise and improve the work process on site, as well as minimising wastage and improve productivity	2
(e) To use tools like CCTV to conduct real time monitoring on site to study resource flow, schedule and work process flow	2
(f) To conduct the following daily: (i) Tool box meeting (every worker to be informed on his task for the day) (ii) Sub-contractors coordination meeting (to coordinate on work process & resource allocation)	1

Table 3 Good Industry Practices

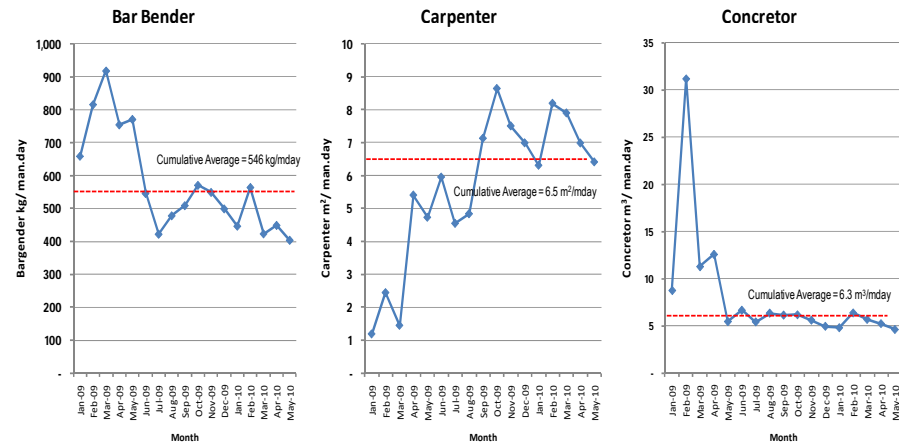
Constructability Score

Good Industry Practices



Use of BIM to check for clashes between M&E services, structural provision and architectural objects

Use of BIM to produce M&E coordination drawings, Archi. and Structural shopdrawing



Trade productivity monitoring system

Trade productivity monitoring system to:

- Establish workers productivity norms
- Conduct work studies if levels deviate from norm
- Implement measures to improve productivity

Constructability Score

Good Industry Practices

Work Manual & Mock up



Install studs

Install plaster board on one side

Install rockwool

Install plaster board on other side

step by step work manuals site mock ups to show how works should be done properly

Monthly work study session



Real time monitoring on site



Minimum Constructability Score

CATEGORY OF BUILDING WORK / DEVELOPMENT	MINIMUM CONSTRUCTABILITY SCORE	
	5,000 m ² ≤ GFA < 25,000 m ²	GFA ≥ 25,000 m ²
Residential (landed)	40 (Minimum 25 points from Structural System)	50 (Minimum 35 points from Structural System)
Residential (non-landed)		
Commercial		
Industrial		
School		
Institutional and others		

Submission Process

- Constructability Score requirement will apply to **projects with GFA $\geq 5,000\text{m}^2$**
- Builders to submit the Constructability Score:
 - when they apply for the **permit to commence work OR**
 - within **3 months (or 6 months for D&B projects)** after the permit has been issued if they require more time to plan for the type of construction methods / technologies to be adopted in the project
- Developer to submit **Certificate of Compliance** of Constructability Score at **TOP / CSC** (whichever first)

Site Record of Construction Techniques & Processes

Progress report on the types of construction techniques and processes adopted

Photographic evidence

Records of the construction processes

Departure & Deviation

Notify at least 3 days before deviation

Submit recomputed Constructability
Score

Ensure it meets the minimum
requirement

A hand is holding a bright yellow sticky note. The note has the words "Thank You!!" written on it in a black, cursive-style font. The background is a faded, halftone-style image of a construction site, showing a worker on a wooden structure against a light sky.

Thank You!!