STANDARD INDUSTRI PEMBINAAN

(CONSTRUCTION INDUSTRY STANDARD)

CIS 18: 2018

MANUAL FOR IBS CONTENT SCORING SYSTEM (IBS SCORE)

Pusat IBS
Galeri Komponen IBS,
Lot 8, Jalan Chan Sow Lin,
55200 Kuala Lumpur
Malaysia

Tel : 603-9281 6909
Fax : 603-9281 5870

www.cidb.gov.my

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FOREWORD

In continuation of Industrialised Building System (IBS) Roadmap 2003-2010 and IBS Roadmap 2010-2015, IBS continues to be one the main focus areas of the Malaysian construction sector under the Construction Industry Transformation Programme (CITP) 2016-2020. IBS has been identified as one of the 18 initiatives under CITP 2016-2020. The IBS initiative is placed under the Productivity Thrust that has the key outcome of increasing construction productivity by 2.5 times; which amounts to USD16,500 per worker annually by the year 2020.

Indeed, the focus of productivity is aligned with the High Income goal of the 11th Malaysia Plan 2016-2020. Targets are being set including, among may others, the regulatory requirements involving usage of IBS for both the government and private building projects.

First introduced in 2005, the IBS Content Scoring System (IBS Score) is a systematic and structured assessment system that is utilised to measure the usage of IBS in any building project. It was later upgraded into a Construction Industry Standard (CIS) and known as CIS 18: 2010. IBS Score is used to satisfy the related regulatory requirements as well as for other incentive programmes.

This latest revision, CIS 18: 2018 is developed in reference to the current version of Guide to Modular Coordination in Buildings (MS 1064) as well as incorporating the latest development in the world of IBS and ICT in Construction, including usage of Building Information Modelling (BIM) and other modern methods of construction. CIS 18: 2018 will continue to be an important reference material in the IBS industry.

Chief Executive
CIDB Malaysia

Scope

This Manual for IBS Scoring System (IBS Score) sets the formulas, tables, methods, and examples to calculate the IBS Score for building projects.

Definitions

For the purpose of this manual, the following definitions shall apply:

IBS	Industrialised Building Systems
IBS Factor	A value given to a particular building system which reflects the relative difference in site labour productivity
IBS Score	The score for computing the total IBS usage in a building project as set out in the manual
Other Simplified Construction Solutions	Utilisation of innovative construction methods or solutions that can contribute towards labour savings as well as enhanced quality and productivity
MS 1064	Latest revision of Malaysian Standard - Guide to Modular Coordination in Buildings (MS1064)

Categories of Building

IBS Score can be applied to all new residential, commercial, industrial, institutional and other building projects as categorised in Table A:

Table A

CATEGORIES	TYPES OF BUILDING
Residential (landed)	• Terrace houses • Semi-detached houses • Bungalows • Clustered housing
Residential (non-landed)	• Condominiums • Flats • Serviced apartments • Apartments • Hostels

CATEGORIES	TYPES OF BUILDING
Commercial	• Banks • Departmental stores • Shopping centres • Office buildings • Supermarkets • Restaurants • Conventional halls and facilities • Exhibition halls
Industrial	• Factories • Warehouses • Sub-stations
Institutional and others	• Libraries • Hospitals • Homes for the aged • Child centres/Nurseries • Educational facilities • Terminal buildings • Campuses • Medical centres • Camps • Embassies • Museums • Crematoriums and columbariums • Club houses • Cinemas/Theaters • Sport/Recreational facilities • Stations for public transport • Places of worship

1.0 **Introduction**

To standardise the measurement of IBS usage in buildings, CIDB Malaysia formulated the Manual for IBS Content Scoring System (IBS Score) in 2005; followed by a revised edition in 2010. The early editions of the Manual introduced a systematic and structured assessment system that can be referred to measure usage of IBS in a consistent way.

Taking into account the introduction of current technologies, policies and business environment; and based on input from the construction industry stakeholders, CIDB Malaysia publishes this latest edition of the Manual, CIS 18: 2018.

This 2018 edition of IBS Score Manual replaces CIS 18: 2010.

2.0 Objective

The objective of this Manual is to provide a well-structured assessment system in calculating the IBS Score of a building. It sets outs the IBS Score formula, the IBS Factor for each of the structural and wall systems used in the building, methods of calculating the IBS Score, explanatory notes; as well as sample calculations. It provides guidance to clients, consultants, contractors, manufacturers and other related parties in calculating the IBS Score for any building project.

3.0 Principles of IBS Score

IBS Score puts emphasis on the following attributes:

a) usage of IBS components;
b) utilisation of standardised components based on MS 1064;
c) repetition of structural layout; and
d) usage of other productivity enhancing solutions such as volumetric modular units, Building Information Modelling (BIM) and Modular gridlines.

Higher IBS Score is a reflection of higher productivity, reduction of site labour, lower wastages, less site materials, cleaner environment, better quality, neater and safer construction sites, faster project completion as well as lower total construction costs.

The method of determining the IBS Score is designed to be a simple but effective process. Points are awarded based on the IBS Factors of the structural and wall elements that are used. The high repetitiveness in the design as well as other simplified construction solutions shall also contribute to the total score. The points are summed-up to give the IBS Score of a building. The method of calculating IBS Score for the whole project that consists of a group of buildings is also provided in this Manual.

4.0 The IBS Content Scoring System

The maximum IBS Score for a building is capped at 100 points. The IBS Score is made up of the following components:

a) Part 1 – Structural Systems (Maximum score is 50 points)

Points are awarded for various types of structural system that are used in the building.
e.g. combination of precast concrete beams, columns and slabs, combination of load bearing blocks and in-situ concrete using reusable formwork; and other combinations as listed in Table 1 (A). Points are also given based on the usage of Roof's Structural Systems as per Table 1 (B).

b) Part 2 – Wall Systems (Maximum score is 20 points)

Points are awarded based on various types of wall systems that are utilised.
e.g. precast concrete panel, dry wall system, blockwork system; and other wall systems as listed in Table 2.

c) Part 3 – Other Simplified Construction Solutions (Maximum score is 30 points)

Points are awarded based on usage of other simplified construction solutions.
e.g. standardised components based on MS 1064, repetition of structural layout and other productivity enhancing solutions such as volumetric modular units, BIM and Modular gridlines.

The formula
IBS SCORE = $$50\sum\left[\frac{Q_S}{Q_{ST}}F_S\right]+20\sum\left[\frac{Q_W}{Q_{WT}}F_W\right]+S$$

SCORE FOR STRUCTURAL SYSTEMS

+

SCORE FOR WALL SYSTEMS

+

SCORE FOR OTHER SIMPLIFIED CONSTRUCTION SOLUTIONS

Where :

Σ - Sum of
Q_S - Construction area of a structural system
Q_{ST} - Total construction area of building; including roof
F_S - IBS Factor for structural system from Table 1 (A) & Table 1 (B)
Q_W - Length of a wall system (external and internal wall)
Q_{WT} - Total wall length (external and internal wall)
F_W - IBS Factor for wall system from Table 2
S - IBS Score for other simplified construction solutions from Table 3

4.1 IBS Score for Structural Systems

$$50\sum\left[\frac{Q_S}{Q_{ST}}F_S\right]$$

Where :

Q_S / Q_{ST} - the percentage of the construction area of which a particular structural system is used; out of the total construction area of the building; including roof

F_S - IBS Factor for the particular structural system from Table 1 (A) and Table 1 (B)

i. The maximum IBS Score for this part is 50 points.

ii. The IBS Score for a particular structural system is the product of the percentage of construction area covered by the system and the corresponding IBS Factor from Table 1 (A) and Table 1 (B). In order to arrive at the IBS Score, it is multiplied by the score of 50 points.

iii. In identifying the IBS Factor from Table 1 (A), we need to determine the type of slabs that is being used and the combination of types of beams and columns that are supporting the slabs.

iv. IBS Score calculation only covers superstructure elements of a building. Sub-structure works, basement, driveway, apron and landscape areas are not taken into account in the calculations. However, porches and balconies are included.

v. For a building that uses multi-structural systems, the contribution of each system is calculated and summed up to arrive at the total IBS Score for the combination of the structural systems.

vi. Table 1 (A) provides the IBS Factors for common combinations of slabs with the columns and beams while Table 1 (B) lists the types of the roof's structural systems. For a particular structural system that is not commonly used and not mentioned in the tables, the F_s can be obtained from IBS Centre, CIDB Malaysia.

Table 1 (A) : IBS Factor For Structural Systems

	NO.	DESCRIPTIONS	A	B	C	D	E	F	G
MATERIALS / SYSTEMS		**SLABS / COLUMNS & BEAMS**	Precast concrete slabs(1)	In-situ concrete on permanent formwork	In-situ concrete using reusable(2) formwork	In-situ concrete using timber(3) formwork	Steel flooring system	Timber frame flooring system	No slab (4)
CONCRETE / REUSABLE FORMWORK	**1**	Precast columns and beams	1	0.8	0.6	0.5	1	1	1
	2	Precast columns and in-situ beams using reusable formwork	0.8	0.7	0.5	0.4	0.8	0.8	0.8
	3	Precast columns and in-situ beams using timber formwork	0.7	0.6	0.4	0.3	0.7	0.7	0.7
	4	Precast beams and in-situ columns using reusable formwork	0.8	0.7	0.5	0.4	0.8	0.8	0.8
	5	Precast beams and in-situ columns using timber formwork	0.7	0.6	0.4	0.3	0.7	0.7	0.7
	6	In-situ columns and beams using reusable formwork	0.6	0.5	0.4	0.2	0.6	0.6	0.6
	7	In-situ columns and beams using timber formwork	0.5	0.4	0.2	0	0.5	0.5	0.5
METAL	**8**	Metal columns and beams	1.0	0.8	0.6	0.5	1.0	1.0	1.0
TIMBER	**9**	Timber columns and beams	1.0	0.8	0.6	0.5	1.0	1.0	1.0
BLOCKWORK (5)	**10**	Load bearing blocks	0.8	0.7	0.5	0.4	0.8	0.8	0.8
INNOVATIVE	**11**	Metal framing with permanent formwork	0.7	0.6	0.4	0.3	0.7	0.7	0.7

Explanatory Notes for Table 1 (A)

1.	(1) Precast concrete slabs include half slabs, hollow core slabs, planks, etc. Precast concrete includes products of factory precasting and site precasting.
2.	(2) Reusable formwork includes plastic, fibreglass, steel, aluminium and other formworks that can be used not less than 20 times.
3.	(3) Timber formwork can be described as timber components that are cut to size and fabricated in-situ; to be used in forming concrete elements.
4.	(4) This is for structures without slabs. Refer examples in Section 6.3.
5.	(5) Load bearing blocks include interlocking blocks, concrete masonry units, hollow blocks, autoclaved lightweight blocks, etc.
6.	An additional 0.05 on top of the IBS Factor will be given if prefabricated reinforcement cages are used in all cast in-situ structures.
7.	An additional 0.05 on top of the IBS Factor will be given if self compacting concrete is used in all cast in-situ structures.
8.	The IBS Factor for tunnel formwork or self climbing formwork system that casts wall together with slab is 0.5
9.	The IBS Factor for usage of volumetric modular units (also known as Prefabricated Prefinished Volumetric Construction (PPVC)), free-standing factory-produced volumetric modules that are completed with finishes for frames/walls, floors and ceilings), is 1.0
10.	For a structural system using load bearing walls, the factor can be determined from the Table 1 (A) by referring to the beams/columns with similar construction system.
11.	For structural systems that are not mentioned in Table 1 (A), please refer to IBS Center, CIDB Malaysia for the IBS Factor.

Table 1(B) : IBS Factor for Roof's Structural Systems

NO	ROOF SYSTEM	IBS FACTOR
1.	Prefab timber roof trusses	1.0
2.	Prefab metal roof trusses	1.0
3.	Conventional timber roof trusses(1)	0

Explanatory Notes for Table 1 (B)

1.	(1) Conventional timber roof trusses consist of timber elements that are cut, sized and constructed on-site.
2.	For roof's structural systems that are not mentioned in Table 1 (B), please refer to IBS Center, CIDB Malaysia for the IBS Factor.

4.2 IBS Score for Wall Systems

$$20\sum\left[\frac{Q_{W}}{Q_{WT}}F_{W}\right]$$

Where :

Q_W / Q_{WT} - The ratio of the length of a particular wall system (external or internal) used out of the total wall length of the building

F_W - IBS Factor for the particular wall system, from Table 2.

i. The maximum IBS Score for this part is 20 points.

ii. The IBS Score for wall system is the product of the percentage of wall length covered by the wall and the corresponding IBS Factor from Table 2. In order to arrive at the IBS Score, it is multiplied by the score of 20 points.

iii. Basement walls and toilet cubicle partition walls are excluded from the calculation. For cavity walls, consider the two separate skins as a wall.

iv. Parapets and corridor/balcony walls must be included in the calculation.

v. For a building that uses multi-wall systems, the contribution of each system is calculated and summed up to arrive at the total IBS Score for the combination of the wall systems.

vi. Table 2 provides the IBS Factors for common wall systems. For a particular wall system that is not commonly used and not mentioned in Table 2, the factor can be obtained from IBS Centre, CIDB Malaysia.

Table 2 : IBS Factor for Wall Systems

NO	WALL SYSTEM	IBS FACTOR
1.	Precast concrete panels(1)	1.0
2.	Wall cladding(2)	1.0
3.	Prefabricated timber panels	1.0
4.	Full height glass panels(3)	1.0
5.	Dry wall systems(4)	1.0
6.	In-situ concrete with reusable(5) system formwork	0.4
7.	In-situ concrete with permanent formwork	0.7
8.	Blockwork systems(6)	0.5
9.	Common brickwalls	0.0
10.	In-situ concrete with timber(7) formwork	0.0

Explanatory Notes for Table 2

1.	(1) Precast concrete panels include; sandwich panels, solid panels and bay windows. Precast concrete includes products of factory precasting and site precasting.
2.	(2) Wall cladding consists of panels acting as wall or façade and not as a skin to brick wall.
3.	(3) For full height windows, use the IBS factor for panel glass. For a wall with non full height windows, take the highest or widest material e.g. brickwall, precast wall, glass, etc.
4.	(4) Dry walls include cementitious panels, gypsum boards, calcium silicate boards & other types of composite panel products.
5.	(5) Reusable formwork includes plastic, fibreglass, steel, aluminium and other formworks that can be used not less than 20 times.
6.	(6) Blocks include interlocking blocks, concrete masonry units, hollow blocks, autoclaved lightweight blocks, etc.
7.	(7) Timber formwork can be described as timber components that are cut to size and fabricated in-situ; to be used in forming concrete elements.
8.	The IBS Factor for tunnel formwork or self climbing formwork system that casts wall together with slab is 0.5
9.	For structural systems that are not mentioned in Table 2, please refer to IBS Center, CIDB Malaysia for the IBS Factor.

4.3 IBS Score for Other Simplified Construction Solutions

S

i. Part 3 of the formula provides points for utilisation of construction methods or solutions that can contribute to the objectives of industrialisation through standardisations and repetitions. Points are also awarded to other productivity enhancing solutions.

ii. Points are given based on the percentage of usage or coverage of a particular solution and summed up to form the IBS Score for this section. No points are given if the usage is less than 50%.

iii. Basement structures as well as ground slabs and beams are not considered in the calculation.

iii. The individual points are summed up to form the IBS Score for Part 3. The maximum score for this section is capped at 30 points.

iv. For other simplified construction solutions that are not listed in Table 3, please refer to IBS Centre, CIDB Malaysia.

Table 3: IBS Score for Other Simplified Construction Solutions

No	DESCRIPTION	UNIT	IBS SCORE	
			PERCENTAGE OF USAGE	
			50% ≤x<75%	75% ≤x≤100%
1	**UTILISATION OF STANDARDISED COMPONENTS BASED ON MS 1064**			
	i) Beams(1)	Nos	2	4
	ii) Columns(1)	Nos	2	4
	iii) Walls(1)	m	2	4
	iv) Slabs(1)	m^2	2	4
	v) Doors(2)	Nos	2	4
	vi) Windows(3)	Nos	2	4
2	**REPETITION OF STRUCTURAL LAYOUTS**			
	a) For building more than 2 storeys			
	i) Repetition of floor to floor height	Nos	1	2
	ii) Vertical repetition of structural floor layout	Nos	1	2
	iii) Horizontal repetition of structural floor layout	Nos	1	2
	b) For building 1 or 2 storey(s)			
	iii) Horizontal repetition of structural floor layout	Nos	3	6
3	**OTHER PRODUCTIVITY ENHANCING SOLUTIONS**			
	i) Usage of prefab bathroom units (PBU)(4)	Nos	1	2
	ii) Usage of prefab staircases(5)	Nos	1	2
	ii) Usage of BIM models for IBS Score submission	Level 1(6)	3	
		Level 2(7)	6	
	iii) Usage of Modular gridlines in drawings(8)	Nos	4 (for ≥ 50% usage)	

Explanatory Notes for Table 3

1.	(1) Refer to the latest MS 1064 Part 10 : Coordinating sizes and preferred sizes for reinforced concrete components. Values to use are the preferred sizes as listed in the tables : beams and columns - width & depth, walls and slabs – thickness. The reference to Part 10 for preferred sizes is for all beams, columns, walls and slabs; including non-concrete elements.
2.	(2) Refer to the latest MS 1064 Part 4 : Coordinating sizes of wall opening for doorsets. Values to use are dimensions in the increments of 100mm (1M).
3.	(3) Refer to the latest MS 1064 Part 5: Coordinating sizes of wall opening for windowsets. Values to use are dimensions in the increments of 100mm (1M).
4.	(4) Prefab bathroom units (PBU) or prefab bathroom pods are volumetric modular units (also known as Prefabricated Prefinished Volumetric Construction (PPVC)); free-standing factory-produced volumetric bathroom modules that are completed with finishes.
5.	(5) Prefab staircases include completed staircases units made of precast, steel, engineered timber or any other prefab materials.
6.	(6) BIM Level 1 Single disciplinary use of object-based 3D modelling software within one discipline.
7.	(7) BIM Level 2 Sharing of object based models and data between two or more disciplines using IFC (Industry Foundation Class) or COBie (Construction Operations Building Information Exchange) file formats.
8.	(8) Modular gridlines are the major plan grids (x and y) that are in the increments of 300mm (3M).
9.	For structures using load bearing wall systems (without beams & columns), four (4) points each are provided automatically under the beams and columns sections.

4.4 IBS Score for Project with a Group of Buildings

i. In the case of a group of buildings in one project, the IBS Score of the project shall be calculated by multiplying the percentage of construction area of the respective building (out of total construction area of project); with the IBS Score of the individual building.

$$\sum \left[\text{IBS SCORE FOR BUILDING X} \frac{Q_{\text{ST (building)}}}{Q_{\text{ST (project)}}} \right]$$

Where :

$\sum$ - Sum of

$Q_{\text{ST (building)}}$ - Total construction area used in the IBS Score calculation of a building; including roof

$Q_{\text{ST (project)}}$ - Total construction area used in the IBS Score calculation of all buildings; including roof

ii. All major structures in the project, including car park building, surau, etc. are to be considered when computing the area covered by the respective systems.

iii. Minor structures, e.g. guardhouse, thrash bin and others should be excluded from the calculation provided that they are not structurally linked to the main buildings.

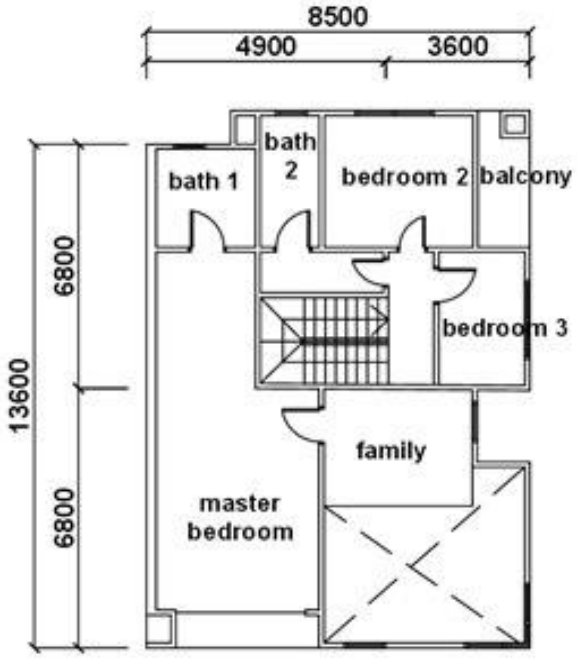
5.0 IBS Score Calculation Examples

In this section a number of examples are given to illustrate the calculation methods for determining the IBS score for various types of building.

5.1 Example 1

Double Storey Terrace House

Typical floor plan layout for one unit is as shown.



Say, from measurement taken from drawings:

1) Construction area

i)	Construction area for Ground Floor	=	117.0 m²
ii)	Construction area for 1st Floor	=	117.0 m²
iii)	Construction roof area	=	117.0 m²
	Total construction area	=	351.0 m²

2) Structural Systems

i)	Beams:	Precast concrete
ii)	Columns:	In-situ concrete using steel formwork
iii)	Floor slab:	Precast half slabs on 1st Floor
iv)	Roof trusses:	Prefab timber

3) Wall System

i) Internal wall:	Precast concrete panels (total 79.5 m length)
ii) External wall:	Precast blocks (total 87.8 m length)

4) Other simplified construction solutions

i) Beams: 60% comply with MS 1064 Part 10
Columns: 100% comply with MS 1064 Part 10
Walls and Slabs: Less than 50% comply with MS 1064 Part 10
Doors: 80% comply with MS 1064 Part 4
Windows: 0% comply with MS 1064 Part 5

ii) Horizontal repetition of structure = 100%

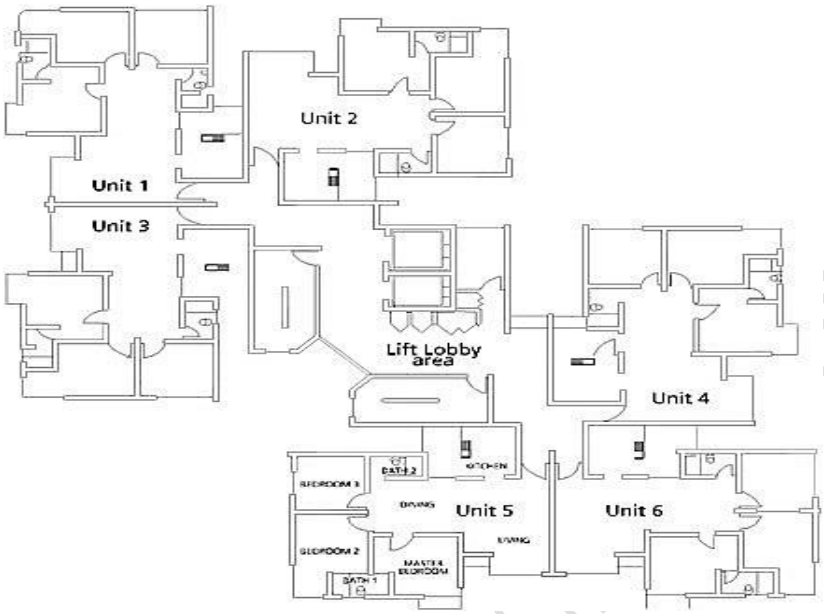
From the information given, the calculation can be tabulated as follows

	ELEMENTS	AREA (m²) or LENGTH (m)	IBS FACTOR	COVERAGE	IBS SCORE
1	Part 1: Structural Systems				
	Precast beams + in-situ columns with reusable formwork + precast concrete half slab. Ground Floor area = 117.0 m	117.0 m²	0.8	(117 / 351) = 0.33	0.33 × 0.8 × 50 = 13.2
	Precast beams + in-situ columns with reusable formwork (no slab) 1st Floor area = 117.0 m²"	117.0 m²	0.8	(117 / 351) = 0.33	0.33 × 0.8 × 50 = 13.2
	Roof truss using prefab timber Roof area = 117.0 m²"	117.0 m²	1.0	(117 / 351) = 0.33	0.33 × 1.0 × 50 = 16.5
	Total Part 1	**351.0 m²**		**1.00**	**42.9**
2	Part 2: Wall Systems				
	External wall using precast blocks	87.8 m	0.5	(87.8 / 167.3) = 0.52	0.52 x 0.5 x 20 = 5.2
	Internal wall using precast concrete panels	79.5 m	1	(79.5 / 167.3) = 0.48	0.48 x 1.0 x 20 = 9.6
	Total Part 2	**167.3 m**		**1.00**	**14.8**
3	Part 3: Other simplified construction solutions				
	i) 60% of beam sizes follow MS 1064 Part 10			60%	2
	ii) 100% of column sizes follow MS 1064 Part 10			100%	4
	iii) 80% of door sizes follow MS 1064 Part 4			80%	4
	iv) Horizontal repetition of structure = 100%			100%	6
	Total Part 3				**16**
	IBS SCORE = Part 1 + Part 2 + Part 3				**73.7**

5.2 Example 2

18-storey condominium

Typical floor plan layout for one floor is as shown.



Say, from measurement taken from drawings:

1) Construction area

i)	Area for one unit of condominium	=	94.4 m²
ii)	Lift lobby area	=	140.0 m²
iii)	Area for one floor		
	= (94.4 x 6 units) + 140	=	706.4 m²

2) Structural Systems

i)	Main structures:	Tunnel formwork system
ii)	Roof trusses:	Prefab steel

3) Wall Systems – per floor (6 units + lift lobby area)

i) Precast blocks wall	=	263m total length
ii) Tunnel formwork system	=	120m total length

4) Other simplifed construction solutions

i) Doors: 100% comply with MS 1064 Part 4
Windows: 100% comply with MS 1064 Part 5

ii) Repetition of floor to floor height = 90%
Vertical repetition of structure = 80%

iii) PBU 100% out of total bathrooms
Prefab staircases 50% out of total staircases
Submission of IBS Score calculation is using Level 2 BIM model
Modular gridlines 90% out of total major plan grids (x and y)

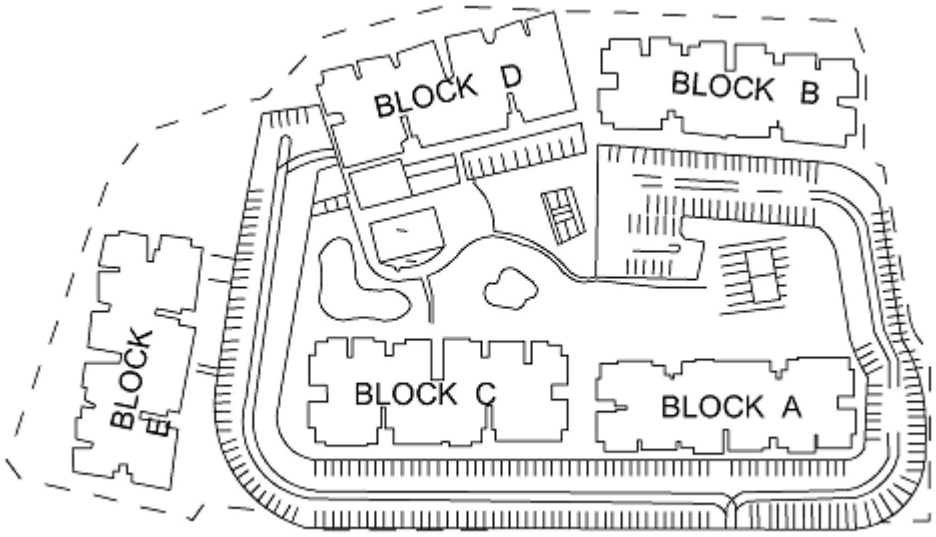
From the information given, the calculation can be tabulated as follows

	ELEMENTS	AREA (m²) or LENGTH (m)	IBS FACTOR	COVERAGE	IBS SCORE
1	Part 1: Structural Systems				
	Tunnel formwork system Total area = 706.4 m² x 18 storey = 12,715.2 m²	12,715.2 m²	0.5	(12,715.2 / 13,421.6) = 0.95	0.95 × 0.5 × 50 = 23.75
	Roof truss using prefab steel Roof area = 706.4.0 m²	706.4 m²	1.0	(706.4 / 13,421.6) = 0.05	0.05 × 1.0 × 50 = 2.5
	Total Part 1	**13,421.6 m²**		**1.00**	**26.25**
2	Part 2: Wall Systems				
	External wall using tunnel formwork = 120 m x 18 storey	2,160 m	0.5	(2,160 / 6,894) = 0.31	0.31 x 0.5 x 20 = 3.1
	Internal wall using precast blocks = 263 m x 18 storey	4,734 m	0.5	(4,734 / 6,894) = 0.69	0.69 x 0.5 x 20 = 6.9
	Total Part 2	**6,894 m**		**1.00**	**10**
3	Part 3: Other simplified construction solutions				
	i) 100% of door sizes follow MS 1064 Part 4			100%	4
	ii) 100% of window sizes follow MS 1064 Part 5			100%	4
	iii) Repetition of floor to floor height = 90%			90%	2
	iv) Vertical repetition of structure = 80%			80%	2
	v) Usage of PBU = 100%			100%	2
	vi) Usage of prefab staircases = 50%			50%	1
	vii) Submission using Level 2 BIM Model			Level 2	6
	viii) Usage of Modular gridlines = 90%			90%	4
	Total Part 3				**25**
	IBS SCORE = Part 1 + Part 2 + Part 3				**61.25**

5.3 Example 3

Group of buildings

The site plan for a housing development project is as shown.



i. Block A – 5-storey apartment

Construction area, Q_{ST} (Building A)	= 3,000m²
IBS Score (Building A)	= 83

ii. Block B – 5-storey apartment

Construction area, Q_{ST} (Building B)	= 3,000m²
IBS Score (Building B)	= 87

iii. Block C – 4-storey apartment

Construction area, Q_{ST} (Building C)	= 3,200 m²
IBS Score (Building C)	= 35

iv. Block D – 4-storey apartment

Construction area, Q_{ST} (Building D)	= 3,200 m²
IBS Score (Building D)	= 47

v. Block E – 3-storey office block

Construction area, Q_{ST} (Building E)	= 3,000m²
IBS Score (Building E)	= 75
Total construction area (Block A+ B + C + D + E)	= 15,400m²

IBS Content Score for the project can be calculated using the following formula:

IBS Score for project =

$$\sum \text{ IBS Score for building X} \frac{Q_{\text{ST (building)}}}{Q_{\text{ST (project)}}}\Bigg]$$

The calculation can be tabulated as in the table below:

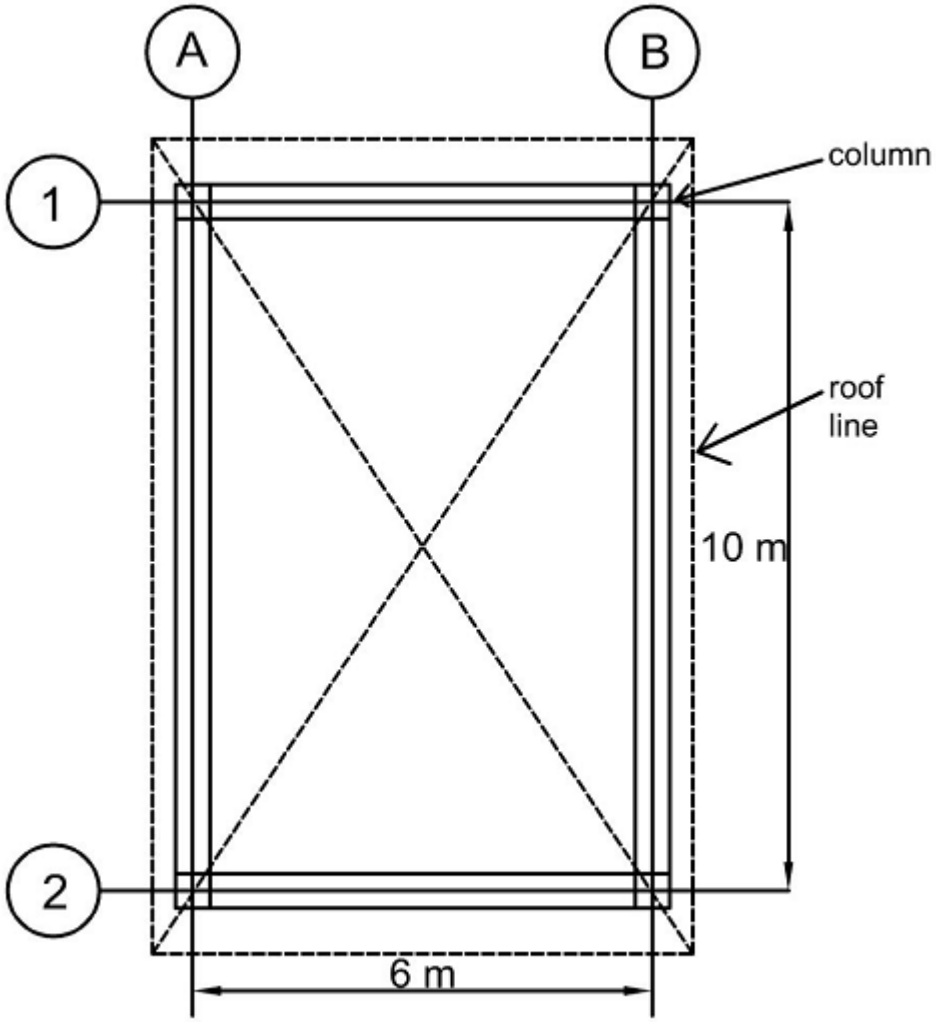
BLOCK	CONSTRUCTION AREA (m²)	COVERAGE	IBS SCORE (BUILDING)	IBS SCORE (PROJECT)
A	3,000	3,000 / 15,400 =0.195	83	0.195 x 83 = 16.2
B	3,000	3,000 / 15,400 =0.195	87	0.195 x 87 = 17.0
C	3,200	3,200 / 15,400 =0.21	35	0.21 x 35 = 7.4
D	3,200	3,200 / 15,400 =0.21	47	0.21 x 47 = 9.9
E	3,000	3,000 / 15,400 =0.195	75	0.195 x 75 = 14.6
Total	**15,400**	**1.0**		**65.1**

Therefore the IBS Score for the whole of project is 65.1

6.0 Calculation Guides

6.1 How to Calculate Construction Area

- Measure from grid to grid (ignore offsets of beams/walls to gridlines).
- The construction area for structural systems is taken as the plan area covered by the building line underneath it. As such, the construction area for roof is similar to construction area of beams and columns underneath it.
- For elements that are not horizontal, e.g. roof, staircases, and all other sloped surfaces, plan areas shall be used for the calculation.

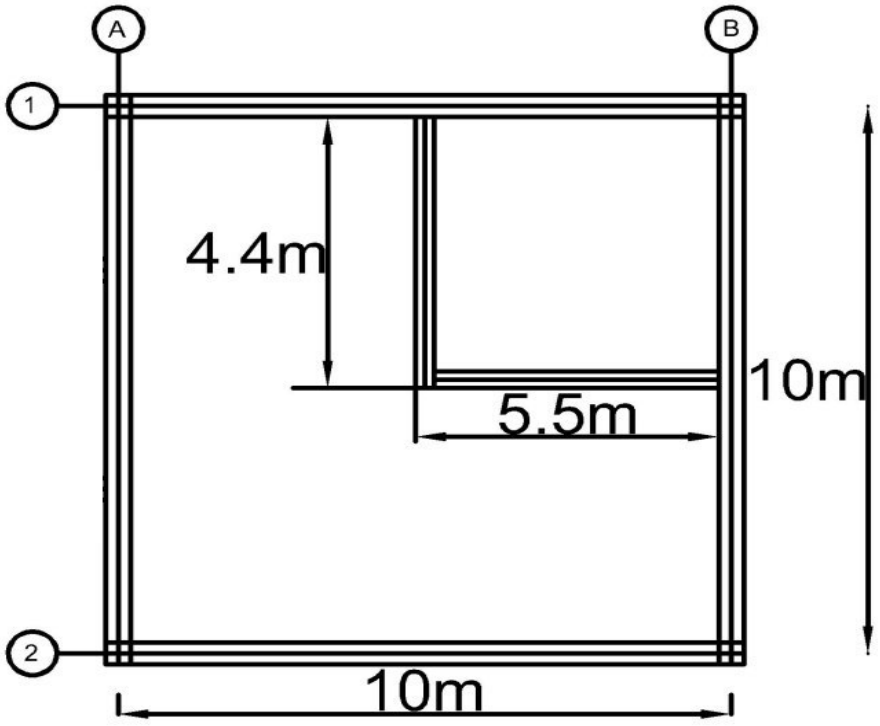


Construction Area

Construction Area for beams/columns/slab	=	6 m x 10 m
	=	60 m²
Construction Area for roof	=	6 m x 10 m
	=	60 m²

6.2 How to Calculate Wall Length

- For curved or diagonal wall (bay window etc.), assume straight wall.
- Measure wall length from grid to grid for external walls (ignore columns)
- For internal wall, measure actual wall length.

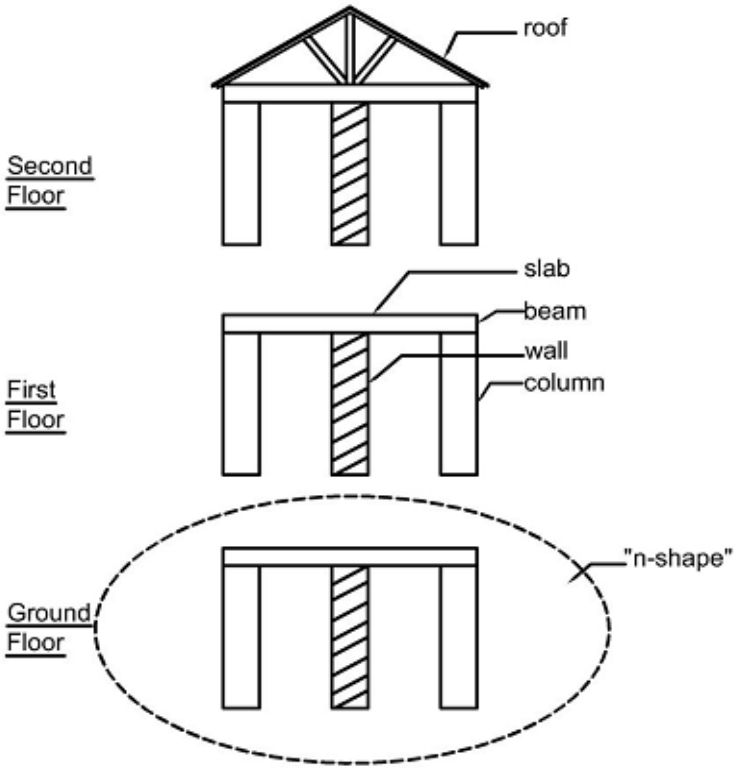


Wall Length

External wall	=	10 m + 10 m + 10 m + 10 m
	=	40 m
Internal wall	=	4.4 m + 5.5 m
	=	9.9 m

6.3 How to Calculate IBS Score for Part 1: Structural Systems and Part 2: Wall Systems

The approach is always to treat the components as performing in an “n-shape”structure.



As an example, for this 3-storey building:

For Ground Floor IBS Score calculation:

Consider types of structure for 1st Floor Beams, Ground to 1st Floor Columns, 1st Floor Slab and Ground Floor Walls.

For First (1st) Floor IBS Score calculation:

Consider types of structure for 2nd Floor Beams, 1st to 2nd Floor Columns, 2nd Floor Slab and 1st Floor Walls.

For Second (2nd) Floor IBS Score calculation:

Consider types of structure for Roof Floor Beams, 2nd to Roof Floor Columns, Roof Floor Slab and 2nd Floor Walls.

If the top has roof trusses instead of the roof slabs (no slab), calculations for roof system need to be done.

Example of a Part 1 and Part 2 IBS Score calculations for a 1-storey building without roof slab:

Identify beams:	in-situ roof beam using timber formwork
Identify columns:	in-situ column using timber formwork
Identify slab:	no slab

Therefore, from Table 1, the IBS Factor is 0.5

Identify roof system: prefab timber

From Table 1A, the IBS Factor is 1.0

Calculated area covered by the beams/columns	= 50 m²
Calculated area covered by the roof	= 50 m²
Total area	= 100 m²
IBS Score (Ground Floor)	= 50 / 100 x 0.5 x 50 = 12.5
IBS Score (Roof)	= 50 / 100 x 1.0 x 50 = 25
Total IBS Score for Part 1 : Structural Systems	= 12.5 + 25 = 37.5

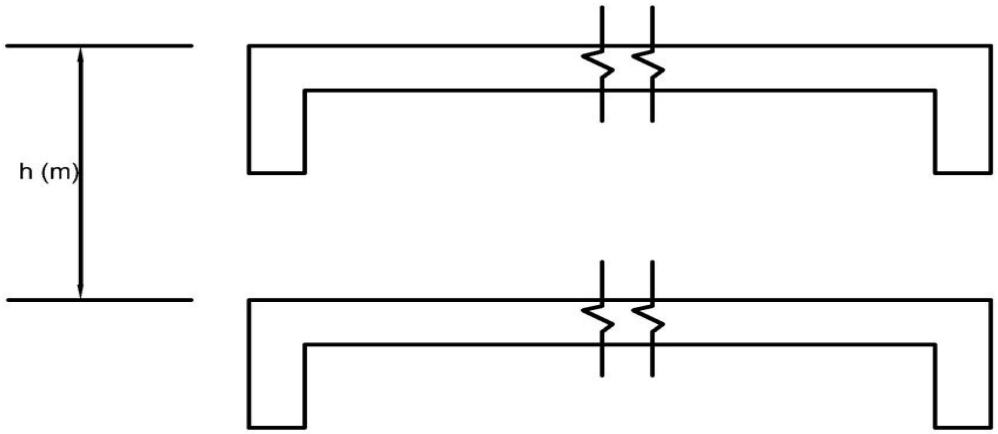
Identify wall system: common brickwall

From Table 2, the IBS Factor is 0

Calculated length covered by the walls	= 50m
IBS Score (Walls)	= 50 / 50 x 0 x 20
Total IBS Score for Part 2 : Wall Systems	= 0

6.4 How to Calculate IBS Score for Part 3 : Other Simplified Construction Solutions - Calculating Floor Heights / Beams and Columns

- Floor height is measured from finished level to finished level



h = floor height

- A beam in between two supports is counted as one beam.
- A column in between two floors is considered as one column

6.5 How to Calculate IBS Score for Part 3 : Other Simplified Construction Solutions - Standardised Components (Based on MS 1064)

Points are awarded based on the percentage of components (beams,columns,walls,slabs doors and windows) as defined in MS 1064.

Say, a building has a total 100 columns: with the following sizes:

200mm x 200mm:	60 numbers
250mm x 250mm:	10 numbers
375mm x 375mm:	30 numbers

Among these three types, the preferred sizes that are in MS 1064 are 200mm x 200mm and 250mm x 250mm. Therefore, percentage of columns that comply to MS 1064 is

= (60 + 10) / 100 x 100%

= 70%; and based on Table 3, the IBS Score for columns is 2.

Another example: say a building has a total 100m run of walls with the following width (thickness) :

100mm:	60 m run
130mm:	40 m run

Between these two types, the preferred size that is specified in MS 1064 is 100mm. Therefore, percentage of walls that comply to MS is

=60 / 100 x 100%

=60%; and based on Table 3, the IBS Score for walls is 2.

6.6 How to Calculate IBS Score for Part 3 : Other Simplified Construction Solutions – Repetition of Structural Layouts

6.6.1 Repetition of floor to floor height (Typical floor height)

Say, a building has 5 levels (ignore basement, if any):

Ground Floor to 1st Floor	= 32M	= 3200mm
1st Floor to 2nd Floor	= 30.5M	= 3050mm
2nd floor to 3rd Floor	= 30.5M	= 3050mm
3rd floor to 4th Floor	= 30M	= 3000mm
4th Floor to Roof	= 30M	= 3000mm

Therefore, take the height with the most repetition: 30M and 30.5M (repeated two times each). As we have two sets of typical height, consider a set only.

Percentage of coverage
= 2 / 5 x 100%
= 40%; and based on Table 3, the IBS Score for floor to floor height repetition is 0.

6.6.2. Vertical repetition of structural floor layout (Typical floor plan)

Structural (load-bearing) layout of the unit below must be identical to the unit above.

Say, a building has 5 levels (ignore basement or flat roof slab, if any)

Ground and 1st Floor	Same layout but not identical to 3rd and 4th Floor
2nd Floor	
3rd and 4th Floor	Same layout

Therefore, the building has two repetitions of structural floor plan vertically.

Percentage of coverage = 2 / 5 x 100%
= 40%; and based on Table 3, the IBS Score for vertical repetition of structural floor layout is 0.

6.6.3 Horizontal repetition of structural floor layout

Mirror image of the structural layout is also considered as being repetitive.

Say, a block comprises of 6 units of one-storey dwellings.

Unit 1	
Unit 2 and 3	Mirror to each other and identical as Unit 5 and 6
Unit 4	
Unit 5 and 6	Same layout

Therefore,the building has four repetitions of structural floor layout horizontally

Percentage of coverage = 4 / 6 x 100%
= 67%; and based on Table 3, the IBS Score for horizontal repetition of structural floor layout is 3.

6.7 How to Calculate IBS Score for Part 3 : Other Simplified Construction Solutions – Other Productivity Enhancing Solutions

6.7.1 Usage of prefab bathroom units (PBU) and staircases

Say, a building has a total of 100 bathrooms; and 75 of the bathrooms are PBU.

Percentage of coverage = 75 / 100 x 100%
= 75%; and based on Table 3, the IBS Score for usage of PBU is 2.

The same approach will be used to calculate the IBS Score for the usage of prefab staircases.

6.7.2 Usage of BIM models for IBS Score submission

Points are given based on the usage of BIM models for IBS Score submission. Markings of the structural, wall and other simplified construction solutions used in the calculation need to be made in the BIM model.

Say, a Level 2 BIM model (either IFC (Industry Foundation Class) or COBie (Construction Operations Building Information Exchange file format) is being used in the submission.

Based on Table 3, the IBS Score for usage of BIM models is 6.

6.7.3 Usage of Modular gridlines in drawings

Points are given based on the usage of Modular gridlines for the major plan grids (x and y); based on dimensions with the increments of 300mm (3M).

Examples of Modular dimensions are 3000mm, 6000mm, 6600mm, 9300mm etc.

Say, a building has a total of these major plan grids:

x direction = 10 gridlines; and 8 are in Modular dimensions
y direction = 12 gridlines; and 10 are in Modular dimensions

Percentage of coverage = ((8 + 10) / (10 + 12)) x 100%
= 18 / 22 x 100%
= 82%; and based on Table 3, the IBS Score for usage of Modular gridlines is 4.