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POLITEKNIK
Jabatan Pengajian Politeknik

EXAMINATION AND EVALUATION DIVISION
DEPARTMENT OF POLYTECHNIC EDUCATION
(MINISTRY OF HIGHER EDUCATION)

CIVIL ENGINEERING DEPARTMENT

FINAL EXAMINATION
JUNE 2012 SESSION

**CC206 : INDUSTRIALISED BUILDING SYSTEM**

**DATE : 18 NOVEMBER 2012**
**DURATION : 2 HOURS (8.30 AM – 10.30 AM)**

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This paper consists of **THIRTEEN** (~~13~~ 12) pages including the front page.

Section A: 30 Objectives Question
Section B : 10 True or False Question
3 Essay Question

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(The CLO stated is for reference only)

## SECTION A

## OBJECTIVES (30 marks)

Instruction: This section consists of 30 objective questions. Write your answer in the answer booklet.

1. What does IBS stand for? (CLO 1: C1)

   A . Industrialised Building Structure

   B. Industrialised Building System

   C. Industrialised Building Software

   D. Industrialised Building Symptom

2. Which of the following is not the component of IBS? (CLO 1: C1)

   A. Floors

   B. Walls

   C. Bricks

   D. Beams

3. What is the percentage compulsory to use the IBS components in government building project? (CLO 1:C1)

   A. 70%

   B. 60%

   C. 50%

   D. 80%

4. Which of the following is the main factor for using IBS in construction industry? (CLO1:C2)

   A. To boost the trade

B. To follow other nations

C. To change the history

D. To improve project efficiency and deliverables

5. The agency that responsible for the IBS development is (CLO1:C2)

A. Risda

B. Felcra

C. CIDB

D. Frim

6. Curve panel is built to portray that the building is ..... (CLO1:C1)

A. Modern

B. Stylish

C. High quality

D. More economic

7. The following are the advantages of Panel Construction, EXCEPT; (CLO 1:C1)

i. High impact on natural resources
ii. Simple way to install
iii. Combination of wood and other materials
iv. Less expensive

A. i and iv

B. i, ii and iii

C. i, ii, iii and iv

D. iv only

8. Panel system can be defined as a system which is..... (CLO 1:C2)

A. Fabricated at construction site

B. Consistent for quality products

C. Responsible for aesthetical expression of building

D. Accountable for the uppermost section of moldings

9. Which of the following does NOT describe the precast prestressed hollow core slab? (CLO1:C2)

A. Produced in lengths of about 120 meters

B. Cost of construction is lower

C. Fast production

D. The slab are typically 100cm wide with standard thickness between 15cm and 20cm

10. We need Modular Coordination in construction industry to ..... (CLO1:C1)
A. give more profit to contractors.
B. increase the price of housing in Malaysia
C. permit standardization
D. easily plan for material and equipment at site.

11. Modular reference system contains..... (CLO1: C2)
A. The dimension of grids and lines
B. The position of joints and component
C. Manufacturing and assembly
D. Dimensions and size

12. Reference System is a system of points, ....., and planes to which sizes and positions of building components or assembly may be related to or measure from. (CLO2:C1)
A. drawings
B. lines
C. space
D. zone

13. Benefits of using reference system in modular coordination are as below, **EXCEPT** (CLO2:C2)
A. Better coordination between contractor and sub-contractor
B. Reduction time in planning stage of construction

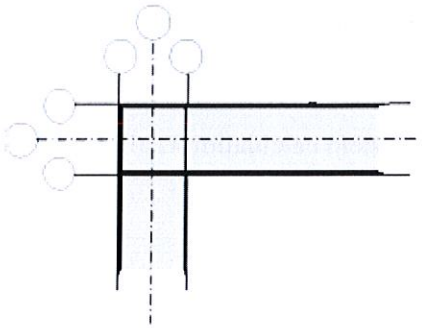
C. Reduction time in transporting and assembly materials at site
D. Reduction time in design stage

14. The principle calculation of Modular Coordination can be found in ……..(CLO2:C1)
A. MS 1063
B. MS 1064
C. BS 8110
D. BS 5650

15. Modular Coordination is essentially based on statements below **EXCEPT** (CLO2:C2)

A. A reference system to define the coordinating spaces and zones for building elements and components.
B. Rules for locating building element within the boundry system.
C. Rules for sizing building component in order to determine their work sizes.
D. Rules for defining preferred sizes for building components and coordinating dimensions for building.

16. All the following are main elements of Modular Reference System **EXCEPT**; (CLO2:C2)
A. Floor height
B. Building height
C. Room height
D. Column height



17. Which of the following explains the usage of the reference above? (CLO3:C1)

A. To coordinate the position of the building components and determines the nominal size of the building component

B. To coordinate the position of a particular component by placing the component so that the middle axis coincides with a modular coordinating grid/plane.

C. To coordinate the position and dimensions of the building component by a combination of axial and boundary reference.

D. To coordinate the position of building component by placing one surface of the component flush on to a modular coordinating grid / plane.

18. ..... is a reference system to define coordinating spaces and zones for building elements and assemblies to accommodate certain elements non-modular interrupted zone. (CLO3:C1)

A. Interrupted grid
B. Displacement grid
C. Superimposed grid
D. Basic modular grid

19. Which of the following is **NOT** the dimensions of preferred sizes for modular reinforced concrete wall (CLO3:C2)

| Width | Length |
|---|---|
| A. 100 | 600 |
| B. 200 | 1200 |
| C. 255 | 1850 |

| | |
|---|---|
| D. 400 | 3000 |

20. IBS score point in wall system calculation is allocated based on (CLO1:C1)

A. Types and material

B. Width of wall system used

C. Quantity of block wall used

D. Percentage of the length in wall system used

21. The lowest percentage in IBS Score calculation is contributed by (CLO1:C2)

A. Wall System

B. Structural System

C. Repetition

D. Other Simplified Solution

22. False column is a simple column provided at the ..... (CLO1:C2)

A. Cast in window system panel

B. Over a door or window

C. Support of pre-cast staircase

D. Opening side of the door and simply bind at grade beam or roof rods

23. The objectives of Buildability Design are listed below EXCEPT : (CLO2:C1)

A. To have lesser site labour

B. To improve the quality

C. To increase in standards

D. To promote prefabrication

24. The following systems are taken into structural system score point **EXCEPT**: (CLO2:C2)

A. Slab system

B. Roof system

C. Load bearing wall

D. Sub-structure system

25. The percentage of IBS usage to be achieved according to the new IBS Roadmap (2011-2015) is ..... (CLO2:C1)

A. 70%

B. 60%

C. 50%

D. 40%

26. The following are the IBS Score principle **EXCEPT**: (CLO2:C2)

A. Repeating section

B. Application of Prefabricated Components

C. The reduction of construction cost and wastage

D. Application of standard component as clarified in MS1064

27. Which of the following is the maximum IBS factor for structural systems? (CLO3:C1)

A. 6

B. 1.5

C. 1

D. 0.5

28. "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"

The statement above refers to : (CLO3:C2)

A. Repetition of floor to floor height

B. Horizontal repetition of structural floor layout

C. Other Simplified Solution

D. Pre-assemble brickwall

29. Which of the following is excluded from Wall System Calculation? (CLO3:C1)

A. Wall Cladding

B. Blockwork System

C. Toilet Cubicle Partition

D. Full Height Glass Panel

30. The implementation of cast-in window system requires coordination between ..... (CLO 3:C2)

A. the fabricator and house owner

B. the fabricator and the precaster

C. the contractor and workers

D. the contractor and interior designer

**SECTION B**

**TRUE OR FALSE QUESTION (10 marks)**

Instruction: This section consists of 10 true or false questions. Answer **all** questions.

| | | | |
|---|---|---|---|
| 1 | The implementation of IBS can increase the employment of unskilled workers, wastage of construction materials and construction period. | True / false | CLO 1 |
| 2 | The precast bathroom unit is furnished with conceal conduits, pipe sleeves, waterproofing and tiling. | True / false | CLO 1 |
| 3 | The concrete topping for half slab and hollow core slab is 65mm thick. | True / False | CLO 1 |

| | | | |
|---|---|---|---|
| 4 | Modular Coordination is a concept of coordinating the dimension and space where buildings and components are dimensioned and positioned in a basic unit or module known as 1M which is equivalent to 100 mm, as stipulated in MS 1064. | True / false | CLO 1 |
| 5 | Facades are flushes placed on the outside of a modular reference plane. | True / false | CLO 2 |
| 6 | Cross walls and structural frames such as beam and column are placed according to interaxial planning and boundary planning. | True / false | CLO3 |
| 7 | Repeatability and standardised component are the principles of IBS Score. | True / false | CLO 1 |
| 8 | The employment of modular coordination in dimensions is the key feature of buildability design. | True / false | CLO 1 |
| 9 | Sub-structure system is taken into structural system score point. | True / False | CLO 2 |
| 10 | The assessment of IBS Score is made based on three main components which are 50% for structural system, 30% for wall system and 20% for other modular application. | True / False | CLO 3 |

**STRUCTURED/ESSAY (60 marks)**

Instruction: This section consists of **THREE** (3) structured questions. Answer **TWO** (2) questions.

**QUESTION 1**

The local construction industry in Malaysia is changing rapidly to abandon the conventional practices in favor of the modern IBS approach.

a. Define IBS (3m) (CLO1:C1)

b. Elaborate **TWO** (2) types of IBS system. (6m) (CLO 1:C2)

c. Describe **THREE (3)** aspects on how IBS can contribute to sustainable and green construction in the future. (12m) (CLO 1:C2)

d. Elaborate **THREE (3)** characteristics of façade. (9m) (CLO 1:C2)

**QUESTION 2**

(a) MS1064 was introduced as a standard to Modular Coordination in building. (CLO 1:C1)

i. Define the Modular Coordination. (4m)

ii. The use of Modular Coordination (MC) as an important factor in IBS effective application. State and explain the **THREE (3)** benefits of Modular Coordination. (12m)

(b) The modular reference system enables designers to relate sensible elements of construction.
List and sketch the **FOUR (4)** types of references in locating building elements. (CLO 3:C2)
(12m)

(c) Basic modular grid is one of the reference systems in modular coordination.
Give a simple explanation using a simple diagram. (CLO3:C2)
(2m)

**QUESTION 3**

(a) What are the principles to be followed in order to calculate the IBS Score? (CLO 1:C2) (8 m)

(b) Using the IBS Score, calculate the IBS contents score of a Bungalow House based on the data given below. (CLO 3:C2) (22 m)

**1) Construction area**

i) Construction floor area = 135 $m^2$

iii) Construction roof area = 135 $m^2$

**2) Structural Systems**

i) Beams : Precast concrete beams

ii) Columns : In-situ concrete using steel formworks

iii) Floor slab : Precast concrete slabs

iv) Roof truss : Prefabricated timber roof truss

**3) Wall System**

i) Internal wall : Precast concrete panel = 120 m length

ii) External wall : Precast block works = 270 m length

**4) Other simplified construction solutions**

i) Beams : 60% complies to MS 1064 Part 10 : 2001

Columns : 100% complies to MS 1064 Part 10 : 2001

Walls and slabs : Less than 50% complies to MS 1064 Part 10

Doors : 80% complies to MS 1064 Part 4 : 2001

Windows : 0% complies to MS 1064 Part 5 : 2001

ii) Horizontal repetition of structure = 100%

iii) Other prefab components / construction solutions = none

# MANUAL FOR IBS CONTENT SCORING SYSTEM (IBS SCORE)

## Table 1. IBS Score For Structural Systems

| SYSTEM | FLOOR / COLUMN / BEAM [6] | Precast concrete slab [1] | In-situ concrete on permanent metal formwork | In-situ concrete using reusable [3] system formwork | In-situ concrete using timber [4] formwork | Steel flooring system | Timber frame flooring system | No Floor [8] |
|---|---|---|---|---|---|---|---|---|
| CONCRETE | Precast column and beam | 1.0 | 0.9 | 0.7 | 0.6 | 1.0 | 1.0 | 1.0 |
| | Precast column and in-situ beams using reusable [3] system formwork | 0.9 | 0.8 | 0.6 | 0.5 | 0.9 | 0.9 | 0.8 |
| | Precast column and in-situ beams using timber [4] formwork | 0.8 | 0.7 | 0.5 | 0.4 | 0.8 | 0.8 | 0.7 |
| | Precast beams and in-situ columns with reusable [3] system formwork | 0.9 | 0.8 | 0.6 | 0.5 | 0.9 | 0.9 | 0.8 |
| | Precast beams and in-situ columns using timber [4] formwork | 0.8 | 0.7 | 0.5 | 0.4 | 0.8 | 0.8 | 0.7 |
| | In-situ column and beams using reusable [3] system formwork | 0.7 | 0.6 | 0.5 | 0.3 | 0.7 | 0.7 | 0.6 |
| | In-situ column and beams using timber [4] formwork | 0.6 | 0.5 | 0.3 | 0.0 | 0.6 | 0.6 | 0.0 |
| LOAD BEARING BLOCKWORK [5] | Vertical and horizontal member systems / structure | 0.8 | 0.7 | 0.6 | 0.5 | 0.8 | 0.8 | 0.7 |
| STEEL | Steel columns and beams | 1.0 | 0.9 | 0.7 | 0.6 | 1.0 | 1.0 | 1.0 |

Notes :

1. Precast concrete slab include half slab, hollow core slab, and precast prestressed planks.
2. Precast concrete include products of factory precasting, site precasting or the useof tilt-up systems.
3. Reusable formworks include plastic, fibreglass, steel, aluminium and other metal formworks that can be used not less than 20 cycles.
4. Timber formwork means the timber components are sized, cut and fabricated in-situ to form the formworks and the required temporary works.
5. For structural system using Load Bearing Wall, whether precast or in-situ, the factor can be determined from the table by treating the wall as a wide column.
6. The IBS factor for tunnel formwork system is 0.6.
7. Load-bearing blockwork include interlocking block, concrete masonry unit, hollow block and lightweight block.
8. This is for structures without floor. Refer examples in Section 6
9. For other structural systems not mentioned in the table please refer to IBS Centre, CIDB for the IBS Factor.

Table 1A provides the IBS factor, Fs for various types of roof system.

**Table 1A. IBS Factor for Roof Structural Systems – Fs**

| NO | ROOF SYSTEM | IBS FACTOR |
|---|---|---|
| a. | Prefab timber roof truss | 1.0 |
| b. | Prefab metal roof truss | 1.0 |
| c. | Precut[1] metal roof truss | 0.5 |
| d. | Timber roof trusses[2] | 0.0 |

Notes :

1. Precut means the metal section are cut and sized in factory but assembled in-situ.
2. Timber roof trusses means the timber components are cut, sized and fabricated in-situ to form the formworks and the required temporary works

**Table 2. IBS Factor for Wall Systems**

| NO | WALL SYSTEM | IBS FACTOR |
|---|---|---|
| 1 | Precast concrete panel [1] | 1.0 |
| 2 | Wall cladding [2] | 1.0 |
| 3 | Prefabricated timber panel | 1.0 |
| 4 | Full height glass panel [3] | 1.0 |
| 5 | Dry wall system [4] | 1.0 |
| 6 | In-situ concrete with reusable [5] system formwork | 0.5 |
| 7 | In-situ concrete with timber [6] formwork | 0.0 |
| 8 | Blockwork system [7] | 0.5 |
| 9 | Pre-assemble brickwall / blockwall [8] | 1.0 |
| 10 | Common brickwall | 0.0 |

Notes :

1. Precast concrete panels include sandwich panel, solid panel and bay-window. Precast concrete includes products of factory precasting, site precasting or the use of tilt-up systems.
2. Wall cladding consists of panel actings as wall or facade and not as a skim to brickwall.
3. For full height windows, use the IBS Factor for panel glass. For wall with non-full height windows, take the higest or widest material e.g. brickwall, precast wall, glass, etc.
4. Precast dry wall include cementitious panels and composite gypsum boards.
5. Reusable formworks include plastic, breglass, steel, aluminium and other metal formworks that can be used repeatedly.
6. Timber formwork means the timber components are sized, cut and fabricated in-situ to form the formworks and the required temporary works. This is commonly referred to as stickbuilt formwork. Timber includes plywood.
7. Blockwork System either (loadbearing or non-loadbearing) includes hollow block, interlocking blocks, lightweight concrete blocks that can be laid on adhesive mortar.
8. Pre-assemble brickwall/blockwall means brick that being laid in form of a panel and transported to site.
9. Wall constructed using tunnel formworks, use Factor of 0.6.
10. For other wall system not mentioned in the table please refer to IBS Centre, CIDB for IBS Factor.

**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 LAYOUT** | | | |
| | **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 storeys** | | | |
| | Horizontal repetition of structural floor layout | Nos | 3 | 6 |

Notes :

1. Refer to MS 1064 : Pt 10 : 2001 Coordinating sizes and preferred sizes for reinforced concrete components. Values to use from the tables : beams and columns - width & depth, walls - width(thickness), slab-thickness.
2. Refer to MS 1064 : Pt 4 : 2001 Coordinating sizes and preferred sizes for door sets.
3. Refer to MS 1064 : Pt 5 : 2001 Coordinating sizes and preferred sizes for window sets.
4. Precast finished component/product means component that does not needs any finishes after installation on site such as plaster, skim coating and painting.
5. For structure using load bearing wall system, (without beams & columns) 8 marks is given automatically.
6. For non-concrete beams, columns, and slabs, 4 marks is given automatically for each component.
7. Other labour reducing products. Please provide details in the submission.

CALCULATION OF IBS SCORE FORM

| Elements | Area (m2) or Length (m) | IBS FACTOR | Coverage | IBS SCORE |
|---|---|---|---|---|
| **Part 1: Structural elements** | | | | |
| | | | | |
| | | | | |
| **Total Part 1** | | | | |
| **Part 2: Wall system** | | | | |
| | | | | |
| **Total Part 2** | | | | |
| **Part 3: Other Simplified Construction Solution** | | | | |
| | | | | |
| **Total Part 3** | | | | |
| **IBS CONTENT SCORE OF PROJECT (PART 1 + PART 2 + PART 3)** | | | | |