GUIDELINE FOR INDUSTRIALISED BUILDING SYSTEM (IBS) ASSESSMENT
CONSTRUCTION PRODUCT APPROVAL (CPA)

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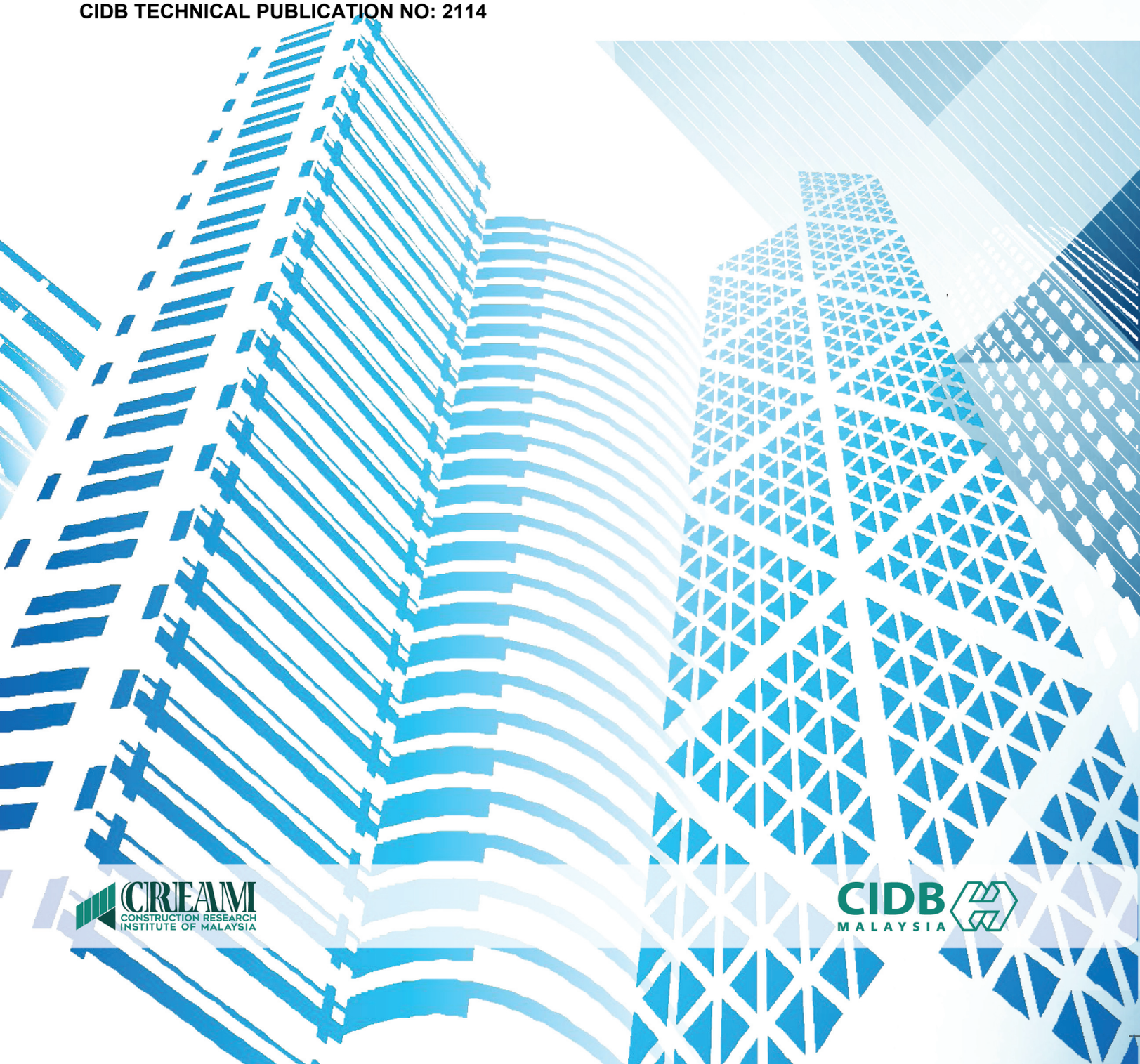

CREAM
CONSTRUCTION RESEARCH INSTITUTE OF MALAYSIA

CIDB
MALAYSIA

GUIDELINES

FOR

CONSTRUCTION PRODUCT APPROVAL (CPA)

Guidelines for Construction Product Approval (CPA)

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PREFACE

Construction Industry Development Board (CIDB) Malaysia is a statutory body enacted under the Act 520 in 1994. Its mission is to develop Malaysian Construction Industry towards global competitiveness. To support this mission, a number of functions were formulated and one of them is to encourage the improvement of construction techniques and materials. Construction Research Institute of Malaysia (CREAM) as a subsidiary of CIDB, carry out assessment and appraisal of any kind of product, technology, and innovation that are related to the construction industry.

Guidelines for Construction Product Approval (CPA) aims to provide reference to the relevant or interested parties in the construction industry mainly IBS Manufacturer for four IBS Categories i.e., metal framing system, timber framing system, reusable formwork system, and innovative system that do not have specific standards. It has been modelled based on international recommended practice, as an alternative certification scheme to assess and certify these products to enable each of the product in all categories apply for CIS 24:2018 - IBS Manufacturer and Product Assessment and Certification (IMPACT). It is developed by the Technical Expert Panel specialized in relevant construction products, materials, and technologies and in association with the Key Players from the Industry.

The assessment of construction products, materials, and technologies is done by CREAM's competent assessor. The assessment will be based on specific checklist which was developed together with this guideline. Industry players may use this CPA Guideline as a reference or supporting document for regulatory and approving authorities, architects, engineers etc. whenever dealing with new products and technologies in the construction industry.

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LIST OF ABBREVIATIONS

BS	:	British Standards
CB	:	Certification Body
CIDB	:	Construction Industry Development Board
CIDB Act 520	:	Lembaga Pembangunan Industri Pembinaan Malaysia Akta 520
CIS	:	Construction Industry Standard
CPA	:	Construction Product Approval
CREAM	:	Construction Research Institute of Malaysia
DSM	:	Department of Standards, Malaysia
EN	:	European Standards (Norms)
FTTR	:	Full Type Test Report
HIRARC	:	Hazard Identification, Risk Assessment and Risk Control
IBS	:	Industrialized Building System
IMPACT	:	IBS Manufacturer & Product Assessment & Certification
ISO	:	International Organization for Standardization
JBPM	:	Jabatan Bomba dan Penyelamat Malaysia
MS	:	Malaysian Standard
PC	:	Product Certificate
PE	:	Professional Engineer
PPS	:	Perakuan Pematuhan Standard
QMS	:	Quality Management System
SAMM	:	Skim Akreditasi Makmal Malaysia
UBBL	:	Uniform Building by Laws

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CONSTRUCTION PRODUCT APPROVAL (CPA)

1. INTRODUCTION

CIS 24:2018 – IBS Manufacturer and Product Assessment and Certification (IMPACT) was developed by CIDB to assess and certify IBS products meeting the specified standards listed in the referred CIS. Prior to the application for IMPACT certification, the products need to obtain Product Certificate (PC) as an evidence of conformity of product to the specified standard from any accredited Certification Body (CB). However, there are four categories of IBS, namely metal framing system, timber framing system, reusable formwork system, and innovative system that do not have specific standards. Hence these products faced difficulty in obtaining PC for IMPACT application. In order to address this issue, Construction Product Approval (CPA) certification was mooted as an alternative certification scheme to assess and certify these products to enable each of the product in all categories apply for IMPACT certification.

2. DEFINITION

Applicant
Company that submits CPA application which can be a manufacturer or a supplier.

Assessor
CREAM technical officer(s) appointed to inspect and verify documents, records, factory inspection, to collect samples (if applicable) and site verification (if required).

Certification Body
Agency that is accredited as product certification body by Department of Standards Malaysia or other certification bodies that are compliant with ISO/IEC 17065.

Factory Inspection

i. **CPA Factory Inspection**

First factory inspection upon receiving application for the purpose of certification.

ii. **Surveillance Factory Inspection**
Factory Inspection after one year of certification and renewal.

iii. **Renewal Factory Inspection**
Factory Inspection after receiving application of renewal.

Full Type Test Report
Full Type Test conducted in the laboratory in accordance with all test requirements in the relevant standards.
For products that do not have reference standards, the Full Type Test Report is a verification to the design which has been certified by PE.

Hazardous Material
Materials which can cause adverse effects to people, environment, and organism upon exposure as per listed in Occupational Safety and Health Act 1994.

Manufacturer
A licensed manufacturer capable of fabrication and producing the mentioned four categories of IBS systems.

Product
Refers to production or fabrication of material or system that have been categorized as IBS.

Product Certificate (PC)
Product Certificate is where a third party (Certification Body) gives a written assurance that a product, process, or service conforms to specified requirements. It provides an independent assurance that the product is manufactured under an effective system of testing, supervision, and control.

Product System

i. **Innovative System**
Innovative system is a form of construction which comprises IBS components or products manufactured using new materials or new technologies in constructing the building system.
In terms of material innovation, the innovative products could comprise non-concrete or combination of concrete and non-concrete materials.
In terms of technology innovation, the innovative products could comprise components manufactured using concrete, non-concrete or combination of concrete and non-concrete materials and manufactured or constructed in the form of innovative construction technology such as the combination of different structural components with different materials, partial volumetric or modular units to form complete building systems.

Any IBS components or products that meet any criteria of either material or technology innovation are considered as innovative system.
In innovative system, the components can be manufactured and delivered to construction sites in the form of individual, partial volumetric or complete volumetric system.

ii. Metal Framing System

Metal used for component such as column, beam, slab, and roof trusses.

iii. Reusable Formwork System

Reusable formwork does not involve the production in factory. It is used in supporting in-situ conventional construction work. The main function is to enable temporary work to be reused for minimum count of 20 times. Type of reusable formwork known to be widely used are column formwork, beam, wall, and slab. Tunnel form is used for monolithic construction wall and slab. Application of reusable formwork ensure high quality finishing and shorten construction time compared to in-situ conventional method.

iv. Timber Framing System

A form of construction that is basically made up of a combination of timber structural elements such as beams, columns, tie rods and panels fitted together using timber connectors to support loads.

Supplier

A company constituted under the laws of Malaysia and carrying out business of supplying the related IBS systems in Malaysia. A supplier can be an importer, a local authorized representative or a distributor but does not include the retailer.

Testing Body

Test laboratories that have obtained the Malaysian Laboratory Accreditation Scheme (SAMM) or International Laboratory Accreditation Cooperation-Mutual Recognition Agreement (ILAC-MRA) or approved by CIDB according to the set criteria. The laboratory must be accredited by the Accreditation Body in accordance with ISO/IEC 17025.

3. SCOPE OF CPA CERTIFICATION

The scope of this certification is to certify conformity of metal framing system, timber framing system, reusable formwork system, and innovative system with any CIDB recognized standards. However, this does not cover products that fulfill criteria specified in Schedule 4 CIDB Act 520.

4. FACTORY QUALITY MANAGEMENT SYSTEM (QMS)

4.1 The manufacturer shall provide evidence that the factory has established and maintain an effective Quality Management System (QMS) at the factory to ensure the production of acceptable quality and consistency products.

4.2 For a manufacturer that has been certified to ISO 9001, it is deemed to have fulfilled this requirement and need to submit the copy of the valid certificate.

4.3 For any manufacturer that is not certified to ISO 9001, it shall establish and maintain the identified elements of QMS as follows:

a. Quality objective
b. Quality policy
c. General quality system and documentation
d. Management & resources
e. Production control procedure
f. Calibration certificates
g. Control of documents
h. Control of records
i. Internal audit
j. Management review
k. Corrective action
l. Preventive action
m. Customer complaint
n. Customer Satisfaction survey

4.4 Besides ISO 9001 certificate or QMS, the manufacturer is also encouraged to submit any other available ISO management certificates such as ISO 18001, ISO 14001, ISO 50001 etc.

5. DESIGN

5.1 For IBS products that are used as structural components, the manufacturer is required to submit engineering design, details which shall comprise of design criteria, calculations and drawings endorsed by a Professional Engineer (PE) registered with the Board of Engineers, Malaysia.

5.2 The design criteria shall include loadings, properties of material and shall be based on either as a stand-alone product or full system. The design shall include among other appliances such as, jointing, bracing, structural system where applicable. Meanwhile the design calculation shall include the loading capacity table and design limitation if applicable (i.e., limiting values for weight, member properties, or dimensions). Design drawings

shall consist of details based on design and other typical drawings which shall include other accessories if applicable.

5.3 All requirements for design shall comply to all regulatory requirements (e.g., UBBL, JBPM etc.).

5.4 All requirements for design shall adhere to acceptable relevant design code or standard if applicable.

5.5 All designs prepared by foreign engineers shall be endorsed by a PE registered with the Board of Engineers, Malaysia.

6. MATERIAL

6.1 All materials (local or imported) that are used in the IBS products as listed in Schedule 4 of CIDB Act 520 shall have valid PPS from CIDB.

6.2 The applicant shall furnish the valid PPS certificate and designated products specifications for materials listed in Schedule 4 Act 520.

6.3 Materials that are not listed in Schedule 4 of CIDB Act 520, the applicant shall declare the testing done at accredited laboratory recognized by CIDB and comply to any acceptable Standards.

6.4 Hazardous materials that might cause adverse effects to people, environment and organism are not allowed to be used in IBS products.

6.5 Materials used in the IBS products shall neither be highly combustible nor pose fire hazard to the occupants of the building / surroundings.

6.6 The applicant needs to specify the usage of the submitted IBS products i.e., structural, architectural, internal, external etc. In addition, the applicant needs to describe the limitation on the usage of the materials/products.

6.7 Apart from the product certificates, the applicant is encouraged to submit green related certificates that denotes the level of sustainability of the products. The applicant is also encouraged to submit the Life Cycle Analysis (LCA) and carbon footprint of the products.

7. TESTING

7.1 All test reports submitted by the applicant shall be full type test report (FTTR) performed by Testing Body.

7.2 For fire testing, the test must be conducted at fire testing laboratory certified by JBPM.

7.3 All testings using the services of foreign laboratories must be carried out by Testing Body.

7.4 Priority in product testings shall be conducted for conformity to Malaysian Standards (MS). In the event where MS is not available, the products can be tested to the relevant ISO standards or any standards recognised by CIDB. Therefore, for the latter, the applicant need to get approval from CIDB.

7.5 The validity period for test report is 4 years. The expiry date for the submitted test reports shall be not less than three months from the date of submission for application.

7.6 During the CPA Factory Inspection, the assessor shall take samples if the applicant fail to present required test reports during submission of application. The samples will be taken based on the agreed sampling plan. Subsequently the test will be carried out according to the agreed test methods.

7.7 Generally the testings will be divided into two parts. First part is the general testing requirements (Appendix A) and the second part is the additional specific testing requirements (Appendix B) for each IBS systems.

8. FACTORY INSPECTION

8.1 Factory inspection for the purpose of verification on the process of production and product will be performed by the assessor appointed by CREAM at factory or fabrication yard. CREAM will issue written notice to the applicant for factory visit two weeks before the proposed date of visit. For an applicant that falls under definition of supplier need to make the necessary arrangement to the sourced factory either local or abroad.

8.2 For CPA, Surveillance and Renewal Factory Inspection, apart from verifying the related submitted supporting documents, the assessor shall inspect the items as in Table 1.

Table 1: Required Items for Inspection

No.	Items	CPA Factory Inspection	Surveillance Factory Inspection	Renewal Factory Inspectio
a.	Calibration records for test equipment	√	√	√
b.	Product marking	√	√	√
c.	Mock-up installation (if required)	√		
d.	Traceability report	√		√

8.3 Product marking must be visible either on the product or packaging shall at least entails as follows:

a. Manufacturer identification / Trademark
b. Standard reference
c. Date of manufacturing
d. Country of origin (for imported product)
e. CREAM CPA reference certification
f. Product name

8.4 The assessor(s) will use the prepared standard checklist for the inspection of respective IBS systems as follows:

Checklist for Innovative System
Checklist for Metal Framing System
Checklist for Reusable Formwork System
Checklist for Timber Framing System

8.5 Upon completion of factory inspection, the applicant may request a copy of the assessment report from CREAM. Under normal circumstances, the duration for factory inspection is one day.

8.6 The factory will take all the necessary measures to ensure the safety and health of CREAM assessor(s) during the visit.

9. PRODUCT INSTALLATION

9.1 The applicant shall provide site installation manual that provides a comprehensive and systematic description on proper installation work of the product at site. Alternatively, the applicant can submit method statement for installation work. Among the criteria that will be assessed are as follows:

a. Safety and health aspect
b. Quality control
c. Time efficiency as compared to conventional method (work rate)
d. Less manpower

e. Supporting machinery and equipment
f. Safety and health manual/record
g. Life cycle (for reusable formwork)
h. To inform on limitation and restriction
i. Method of handling and storage

9.2 The applicant shall provide fabrication method statement if the system is being fabricated on site.

9.3 The assessor may request the applicant to arrange for site verification as and when the assessor opines necessary. CREAM will issue written notice to the applicant two weeks before the proposed visit date.

9.4 The applicant will take all the necessary measures to ensure the safety and health of assessor(s) during the site visit.

10. CPA CERTIFICATION

10.1 Upon the approval from CPA committee, CREAM will issue the due certificate to the applicant. The certificate will be written in English.

10.2 The validity period for this certificate is 2 (two) years from the date of issuance.

10.3 CPA Factory Inspection will be conducted upon receiving the new application. First Factory Surveillance Inspection will be conducted after one (1) year of CPA certification. Renewal Factory Inspection will be conducted upon receiving renewal application from the applicant. If the Renewal Application meet the requirements, Second Surveillance Factory Inspection will be conducted at the end of the third year. This process is summarized as per Figure 1.

10.4 The applicant shall submit renewal application 3 (three) months prior to the expiry date. However, if there are any changes on the design or materials of the product at renewal application then it will be considered as new application.

10.5 If the application of renewal is submitted after the expiry date then it will be considered as new application and if necessary, the assessor(s) will make the factory visit for inspection.

10.6 CREAM reserves the right to suspend or revoke the certificate if the applicant is found to commit any of misconduct actions as follows:

a. The applicant has committed an offence against any of the relevant statutory and regulatory requirements
b. At any instances during the validity period, CREAM found that the applicant had submitted false or incomplete information at the point of submission of the application
c. The applicant was found to misuse the usage of the certificate
d. The applicant fails to comply with terms and conditions set by CREAM in issuing the certificate
e. The applicant has been adjudicated a bankrupt

10.7 The applicant shall not supply, distribute, and install the products during the suspension period or revocation.

10.8 The applicant is allowed to appeal not more than 21 days from the date of written notice from CREAM.

10.9 The applicant shall not be entitled to any form of compensation from CREAM for any loss caused to the applicant due to the suspension or revocation under this guideline.

10.10 The certificate issued is valid for the designated factory only. It does not cover for another similar factory at another site under the same company.

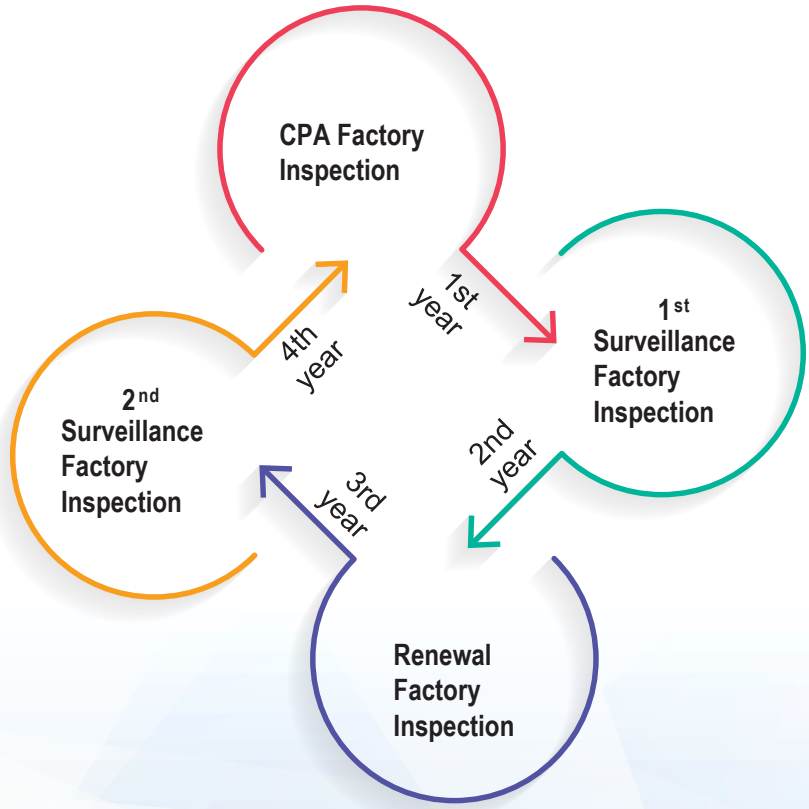

Figure 1: Factory Inspection Cycle

11. APPLICATION FOR CERTIFICATION

11.1 Application form for this certification can be downloaded from CREAM website.

11.2 The supporting documents (can be in either softcopy or hardcopy) that need to be attached during submission of application are as shown in Table 2:

Table 2: List of Supporting Documents

No.	Document Title	New Application	Surveillance Assessment	Renewal Application
1.	Company Declaration Ownership	√		
2.	PPS Certificate	√		√
3.	Traceability report	√		√
	Laboratory full test reports (if any)	√		√
4.	Product catalogue / specification	√		
5.	Relevant ISO or green product certificates (if any)	√		
6.	Design calculation	√	√	
7.	Design drawing	√	√	
8.	Materials list	√	√	
9.	Product standards	√		
10.	Letter of appointment from Manufacturer to Supplier	√		
11.	Factory organization structure	√	√	√
12.	Factory layout plan	√	√	
13.	Production plan / drawing	√	√	
14.	QA / QC plan	√	√	√
15.	Sampling plan	√		
16.	Inspection and test plan	√		
17.	Mill certificate	√		√
18.	Receipt of payment	√		√

Note: The validity date must not be less than three months from the date of submission.

11.3 The general process for CPA and renewal are shown in Figure 2.

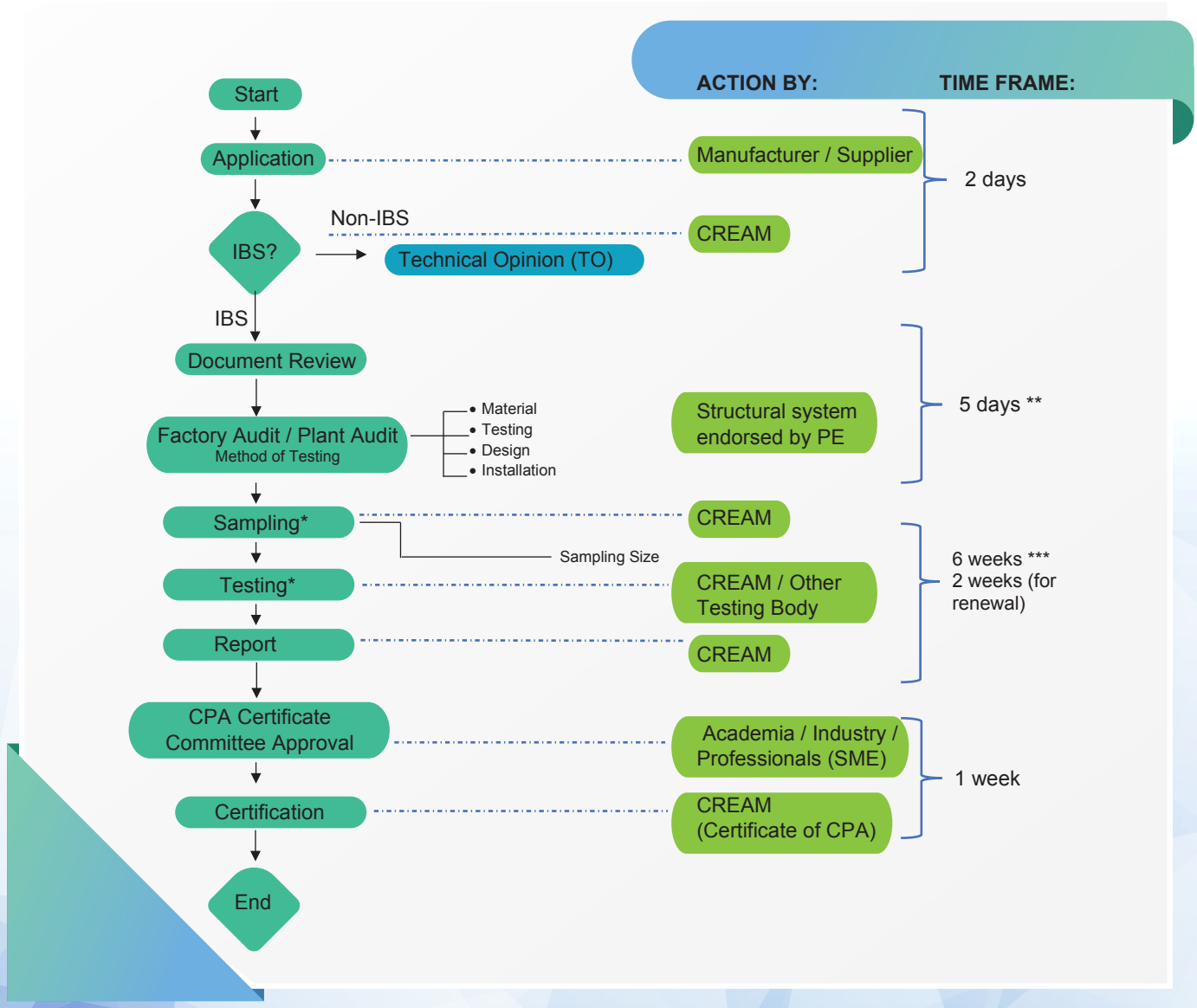

Figure 2: General Process for Construction Product Approval (CPA) and Renewal

Note:

* subject to the submission of valid FTTR

** 5 days, subject to the completeness of documents submitted

***6 weeks, subject to the accredited laboratory testing schedule and complexity of the test

ENQUIRIES

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REFERENCES

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2. CIS 21: 2016 – READY MIXED CONCRETE: PRODUCTION, CONFORMITY, TRANSPORTATION AND DELIVERY CRITERIA FOR PRODUCERS
3. CIS 24: 2018 – IBS MANUFACTURER & PRODUCT ASSESSMENT & CERTIFICATION (IMPACT)
4. INSPECTION GUIDELINE FOR INDUSTRIALISED BUILDING SYSTEM (IBS) – ROOF TRUSS, STEEL FRAMING, WALL PANEL & FORMWORK SYSTEM – SIRIM QAS
5. GUIDELINES FOR LISTING AND REGISTRATION OF PRODUCTS AND SUPPLIERS – SPAN, 2017
6. MS ISO 9001: 2015 – QUALITY MANAGEMENT SYSTEM - REQUIREMENT
7. MS ISO/IEC 17025: 2017 LABORATORY QUALITY MANAGEMENT SYSTEMS
8. MS ISO/IEC 17065: 2012 CONFORMITY ASSESSMENT — REQUIREMENTS FOR BODIES CERTIFYING PRODUCTS, PROCESSES AND SERVICES

Appendix A – General Testing Requirements

A. Innovative System

I. Individual Component

Table 3.1: General Testing Requirements for Innovative System – Individual Component

INDIVIDUAL COMPONENT	
Type of Product	Required Test for Each Product
STRUCTURAL WALL FOR VERTICAL BUILDING COMPONENT Innovative structural wall is defined as any wall, manufactured using non-concrete or combination of concrete and non-concrete materials. The wall functions as either load bearing wall for carrying vertical loads or shear wall for carrying lateral loads. Also, the innovative structural wall could be used as partition or party wall. Innovative structural wall products with different generic terms or identifications could be any of the following: • Lightweight Wall Panel • Interlocking Panel • AAC Wall Panel • Wool Composite Panel • Any other wall products that fall under the category of structural.	<u>MATERIAL TEST</u> Compressive strength test of material based on cube samples or equivalent. 1. BS EN 12390-3:2019 for concrete related. 2. BS EN 1015-11: 2019 for mortar. 3. Approved equivalent testing standards. <u>STRENGTH TEST</u> If the structural performance of innovative wall could not be established using any existing design standards, then the manufacturer or supplier should provide proposed structural design calculations which then be verified against the following experimental tests: 1. Compression test of full-scale wall panel if the wall is used as load bearing wall, or 2. Shear test of full-scale wall panel if the wall is used as shear wall.

	3. Both compression test and shear test if the wall is used as load bearing and shear wall. CONNECTION TEST Full scale load test on actual connections between panel and end supports. FIRE RESISTANCE TEST 1. Fire Test (BS 476 Part 22) 2. Hose Stream Test (ASTM - E2226 - 15B) SERVICEABILITY TEST 1. Stiffness Test, Robustness Test (BS5234-2) 2. Water Absorption Test (if the product is used for external wall)
NON-STRUCTURAL WALL FOR VERTICAL BUILDING COMPONENT Innovative non-structural wall is defined as any wall, manufactured using non-concrete or combination of concrete and non-concrete materials, that is not capable of carrying vertical or lateral loads. The wall is used as infill or partition only. Innovative non-structural wall products with different generic terms or identifications could be any of the following: • Lightweight Wall Panel • Dry Wall Panel • Interlocking Panel • AAC Wall Panel • Wool Composite Panel • Any other wall products that fall under the category of non-structural.	MATERIAL TEST Compressive strength test of material based on cube samples or equivalent. 1. BS EN 12390-3 for concrete related 2. BS EN 1015-11 for mortar 3. Approved equivalent testing standards CONNECTION TEST Load test on full-scale connections between panel and end supports. FIRE RESISTANCE TESTS 1. Fire Test (BS 476 Part 22) 2. Hose Stream Test (ASTM - E2226 - 15B)

	SERVICEABILITY TESTS 1. Stiffness Test, Robustness Test (BS5234-2) 2. Water Absorption Test (if the product is used for external wall) TESTS FOR PRODUCTS USING SPECIFIC MATERIALS BS EN 520 (Test Methods for Gypsum Board)
STRUCTURAL PERMANENT FORMWORK FOR HORIZONTAL BUILDING COMPONENT Structural permanent formwork is an IBS innovative product used as a formwork for slab construction and subsequently becomes permanent and acts compositely with concrete of the slab to provide bending resistance. The formwork could be any of the following: • Steel floor deck • Fiber glass	MATERIAL TEST • Tensile Coupon Test • Material Composition Test • Corrosion Test STRENGTH TEST If the structural performance of the formwork could not be established using any existing design standards, then the manufacturer or supplier should provide proposed structural design calculations which then need to be verified against the following experimental test: • Bending Load Test SERVICEABILITY TESTS • Hazardous Material Test – for fiber glass formwork • Durability Test

NON-STRUCTURAL PERMANENT FORMWORK FOR HORIZONTAL BUILDING COMPONENT Non-structural permanent formwork is an IBS innovative product used as a formwork for slab construction only but subsequently becomes permanent and does not provide any bending resistance to the floor slab. The formwork must be able to carry the floor load during construction. The formwork could be any of the following: • Steel floor deck • Fiber glass	<u>STRENGTH TEST</u> If the structural performance of the formwork during construction could not be established using any existing design standards, then the manufacturer or supplier should provide proposed structural design calculations which then be verified against the following experimental test: • Bending Load Test <u>SERVICEABILITY TESTS</u> • Hazardous Material Test – for fiber glass formwork • Durability Test

II. Volumetric Modular Building System

Table 3.2: General Testing Requirements for Innovative System – Volumetric Modular Building System

VOLUMETRIC MODULAR BUILDING SYSTEM	
Type of Product	Required Test for Each Product
PARTIAL VOLUMETRIC MODULAR UNIT Products under this category are more related to technology innovation where components are delivered in partial modular forms. Any product that is prefabricated in partial 3-dimensional volumetric form and represents a module or part of a complete building system. Innovative partial volumetric product that is fabricated using either precast concrete, cold formed steel or hot rolled steel components could be any of the following: • Prefabricated volumetric modular unit	<u>STRENGTH TEST</u> Not required, if the partial volumetric product is fabricated using precast concrete structural components, cold-formed or hot-rolled steel sections in which these components are designed according to specified design standards given Table 1- CIS 24: 2018 or approved equivalent design codes. <u>DESIGN REQUIREMENT</u> Structural design requirements

• Prefabricated Bathroom Unit (PBU) • Prefabricated room unit • Any other products that fall under this partial volumetric category	are based on the materials used for the structural frame that provides stability to the building system. • For structural frame comprises precast concrete components, component and overall stability design should be based on Eurocode 2 or equivalent design codes. • For structural frame comprises steel components, component and overall stability design should be based on Eurocode 3 or equivalent design codes. The design of the structural frame should be carried out in accordance with Section 5 of this publication. <u>SERVICEABILITY TESTS</u> • Waterproofing test (ponding test) in wet areas. • Water tightness test for doors and windows • Water Absorption Test (if product is used for external wall)
Innovative partial volumetric steel product using steel shipping container	<u>STRENGTH TEST</u> Not required, if the container is manufactured in accordance with shipping container specifications complying with stiffness and strength requirements. <u>DESIGN REQUIREMENT</u> The building system constructed using steel shipping containers, however, should be designed for

	overall stability as specified in Section 5 of this publication.
FULL VOLUMETRIC MODULAR UNIT Products under this category are more related to technology innovation where building systems are delivered in complete forms. Full volumetric product is fabricated in complete 3-dimensional volumetric form and represents a complete building system. Innovative full volumetric product that is fabricated using either precast concrete, cold formed or hot rolled components could be any of the following: • Modular house • Any other products that fall in this category	<u>STRENGTH TEST</u> Not required, if the full volumetric product is fabricated using precast concrete, cold-formed or hot-rolled steel components in which these components are designed according to specified design standards given Table 1-CIS 24: 2018 or approved equivalent design codes. <u>DESIGN REQUIREMENT</u> Structural design requirements are based on the materials used for the structural frame that provides stability to the building system. • For structural frame comprises precast concrete components, component and overall stability design should be based on Eurocode 2 or equivalent design codes. • For structural frame comprises steel components, component and overall stability design should be based on Eurocode 3 or equivalent design codes. The design of the structural frame should be carried out in accordance with Section 5 of this publication.

B. Metal Framing System

Table 4: General Testing Requirements for Metal Framing System

Type of Test	Component / Material
3-point or 4-point Load Test (Bending)	Metal section based on design
Full type material test (e.g., chemical, corrosion, adhesion, coating mass, etc)	Steel material (PC/TR) or for any other metal

C. Reusable Formwork System

Table 5: General Testing Requirements for Reusable Formwork System

Type of Test	Cold-Formed		Hot-Rolled	
	Component / Material	Structure	Component / Material	Structure
Tensile Test	• Steel material (PC / TR)		• Steel material (PC / TR)	
Load Test				
Full Type Material Test (e.g., chemical, corrosion, adhesion, coating mass, etc)	• Steel material (PC / TR)		• Steel material (PC / TR)	

*other materials (refer standards)

D. Timber Framing System

Table 6.1: General Testing Requirements for Timber Roof Truss System

Item	Component Materials	Fabrication Requirements	Design	Testing
Timber Roof Truss System	Solid and/or engineered timber, nail gusset, bolt, and split ring connector	MS 544	MS 544 {Approved by PE}	Not required if design is available otherwise Full Load Test

Note: Prefabricated (toothed metal plate connector) timber roof truss system is covered in CIS 5

Table 6.2: General Testing Requirements for Timber Frame Wall System

Item	Component Materials	Fabrication Requirements	Design	Testing
Timber Wall Frame	Solid and/or engineered timber.	MS 544	MS 544 {Approved by PE}	Not required if design is available otherwise Full Load Test
Shear Wall trusses or panels	Solid and/or engineered timber and steel if applicable.	MS 544	MS 544, EC3 {Approved by PE}	Not required if design is available otherwise Full Load Test

Table 6.3: General Testing Requirements for Timber Floor Joist System

Item	Component Materials	Fabrication Requirements	Design	Testing
Timber floor joist system	Solid and/or engineered timber joists and floor panel.	MS 544	MS 544 {Approved by PE}	Not required if design is available otherwise Full Load Test
Composite Timber floor joist system	Solid and/or engineered timber flanges and engineered timber web or diagonal steel truss members with engineered timber or concrete floor panel.	MS 544, EC2 and EC3	MS 544, EC2 and EC3 {Approved by PE}	Not required if design is available otherwise Full Load Test

Appendix B – Specific Testing Requirements

A. Metal Framing System

Table 7: Specific Testing Requirements for Metal Framing System

Hot-Rolled / Cold-Formed Check List		
1	Coatings Test (Mass and Adhesion)	MS 2657 MS 2543 MS 1196 MS 2660 MS 2385 AS 1397 MS 145 MS 146 MS ISO 5002 AS4600
2	Re-bend Test	
3	Deviations Test	
4	Dimension Properties	
5	Bonding Test	
6	Fatigue Test	
7	Yield Strength	MS 1490 MS 1491 MS ISO 14590 MS EN 10025 AS4600 MS 1196 MS ISO 6892
8	Tensile Strength	
9	Elongation Test	
10	Chemical Composition Test	
11	Impact Test	
12	Shape, dimension, mass & appearance	

B. Reusable Formwork System

Table 8: Specific Testing Requirements for Reusable Formwork System

	Material Specification
1	*General*
1.1	Product certificate or any other certificate (e.g.: PPS for Raw Material / Product under Schedule 4 CIDB)
2	Aluminium
	Compliance to MS 2040/MS 2289/BS EN 485-2
3	Steel
	Compliance to MS EN 10025
	Compliance to MS EN 10210/MS EN 10219/MS 1462-2-1
4	Composite
	Manufacturer specification
5	Timber
	Compliance to BS EN 13377 (timber beam)
	Compliance to MS 544

	Testing / Inspection
1	Material
	Mechanical properties
	Chemical composition
2	Component
	Main panel
3	Support/accessories
	i. Steel props (MS EN 1065)
	Load test
	Pin test
	Prevention on unintentional disengagement
	Tie rod
4	ii. Aluminium props (BS EN 16031)
	Load test
	Pin test
	Prevention on unintentional disengagement
5	Structure system

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