D3 AND DeLIGHT: INNOVATION IN PRECAST CONCRETE STRUCTURES FOR HOUSING

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The Government’s plan to build 1 Million units of affordable homes within 10 years (2018 – 2028). A total of 100,000 affordable homes are expected in a year by promoting greater engagement by the private sector. The National Affordable Housing Council will be set up to coordinate the management of affordable public property.

❖ Mid-Term Review 11th Malaysia Plan, Tun Dr. Mahathir (18 October 2018)
**Housing** is a vital issue in many countries, especially in a country like **Malaysia**, which is moving toward the status of a **high income country**.

Such challenge can be solved through the application of **Science, Technology**, and **Innovation**.

The Construction Industry Development Board Malaysia (CIDB) expects a **5% reduction in construction costs by 2020**, if the use of IBS is made mandatory by then.

*(CIDB, 2018)*

The need to revolutionise the construction sector to make it **more efficient, safe and less reliant on foreign labour**, are reasons why the **Industrialised Building System (IBS)** is being touted as the new way of building.

*Gamuda IBS*  
*(The Star, 12 Jun 2018)*
Construction costs are part of factors that affect the housing supply in Malaysia due to issues of fragmentation which typically relate to the construction industry.

Characterized by fragmentation and suffers from:

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<thead>
<tr>
<th>#</th>
<th>Description</th>
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<tbody>
<tr>
<td>01</td>
<td>Lack of collaboration between all parties</td>
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<td>02</td>
<td>Low takers in technology to produce quality, economy of scale, and fast delivery house</td>
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<td>03</td>
<td>The combination of low skills level and production technology</td>
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<td>04</td>
<td>Little improvement of design inputs to enhance buildability on-site (simply, standard, and system)</td>
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<td>05</td>
<td>No standard design as Pre Approved Plan (PAP) and Green Lane process to faster the approval process of development plan</td>
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HOUSING ISSUES IN MALAYSIA

Low Quality Design & Construction
Insufficient Ventilation & Day Lighting
Safety
Crammed Living Spaces
MaiNtenance
Overcrowding
Modern Methods of Construction (MMC) for Responsive Housing Supply

**MMC definition:**

“The range of processes + technologies which involve prefabrication, offsite assemble and various forms of supply chain specifications”

British Research Establishment (BRE)
DEGREE OF INDUSTRIALISATION

Continuum of Prefabrication

5. Site-based MMC
   Innovative methods of construction used on-site. They include thin joint blockwork and insulated formwork

4. Sub-assemblies and components
   Larger components incorporated into new homes. They include roof and floor cassettes, prefabricated chimneys, porches and dormers, and I-beams

3. Panelised systems
   Panels with timber or light steel framing, structural insulated panels (SIPS) or cross-laminated timber (CLT)

2. Pods
   Pods are used in conjunction with another construction method. Examples are bathroom or kitchen pods

1. Volumetric construction
   Three-dimensional units which are fully fitted out off-site

Source: NHBC Foundation (2016)
MALAYSIAN CONSTRUCTION INDUSTRY

Technology Complexity

Value Added to Customer

Current State

1. Conventional – Column Beam/Bricklaying
2. Reusable Formwork System
3. Precast System
4. Automated & Robotics
5. PPVC / Modular
6. 3D Printing

Conventional – Column Beam/Bricklaying
ISSUES IN PREFABRICATION/ OFFSITE CONSTRUCTION

- Uncertainties throughout architecture, engineering and construction industry (AEC) design project due to complications of multidisciplinary teamwork.
- Challenges associated with automation – Unstructured production of information exchange and integration of data processing.
- Low adoption of construction technology to support prefabrication/offsite construction processes (e.g.: technology support tools, risk analysis and product modelling flow).
- Unsystematic design and design management.
- Low degree of flexibility in addressing customer needs during the on-site assembly stages.
- Issues concerning on business models.
- Limited knowledge and skills about the manufactured-oriented approach.
- Collaboration issues with both design and implementation.
SOLUTION FOR PREFABRICATION/ OFFSITE CONSTRUCTION

Technology:
+ Digital construction
+ Automation and Robotic
+ New construction methods and materials

Process:
+ Lean construction principles
+ Agile Project Management
+ Construction supply chain management

People:
+ Up-skilling of personnel and enhance local workforce
Affordable Housing Exemplar Project
D3 stands for **Divergent Dwelling Design** which focuses on affordability, adaptability, quality and sustainability via a collaboration between **Sime Darby Property** and **CREAM** (research arm of CIDB).

**Objectives:**

- To meet the **affordable housing needs** of the nation with **quality homes**.
- An **innovative design and construction method** to improve the quality of affordable homes that creates **value** on a massive scale.
- To adopt **higher IBS content** in line with the National Construction Industry Road Map to enhance construction **time, quality and cost**.

**Benefits:**

- Improves standard of living without the penalty of high prices
- Improves livability with superior designs
- Improves construction speed with the use of Industrialized Building System (IBS)
- Improves site safety and lower labor dependency via off-site fabrication
- Reduces material wastage and preliminary cost through modularization
OBJECTIVES

01
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02
An innovative design and construction method to improve the quality of affordable homes that creates value on a massive scale.

03
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DIVERGENT DWELLING DESIGN

**DESIGN METHODOLOGY**

“Fragmentation of dwelling into independent design units that enable mass production and mass customisation”
**DIVERTED DWELLING DESIGN**

**ADVANTAGES**

**01 OCCUPANTS**
- Cooler internal temperature
- Flexible layout
- Leak-proof toilet pods
- Natural lighting and good ventilation

**02 DEVELOPERS**
- Shorter construction period
- Better product quality
- Cost saving—lower construction cost
- Reduce site and labour wastage

**03 INDUSTRY**
- Enables mass production
- Better quality housing
- Fulfill affordable housing need
- Sustainable
Common mass housing design (900sqft)

DIVERGENT DWELLING DESIGN

D3 mass housing design (900sqft)

DESIGN CONCEPT

MORE LIVEABLE, MORE BUILDABLE & MORE SUSTAINABLE

3 ‘HALAMAN’
3 internal 'halaman' space for natural lighting, ventilation and space for urban farming.

3 BIG BEDROOMS
Enable double bed with wardrobe space.

2 TOILET PODS
Ready made plug-in toilet pods.
**PASIVE DESIGN STRATEGY:**
Energy Efficiency

- Natural lighting
- Cross ventilation
- Indoor outdoor living
- Urban farming
- Recessed external wall

1. Reduce interior temperature
2. Maximize airflow rate
3. Provide protection from sunlight and rain
4. Encourage urban farming
THANK YOU

Prepared By:
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