Cool IDEAS FOR BETTER HDB LIVING Enterprise

CALL FOR PROPOSALS

ENHANCING CONSTRUCTION PRODUCTIVITY

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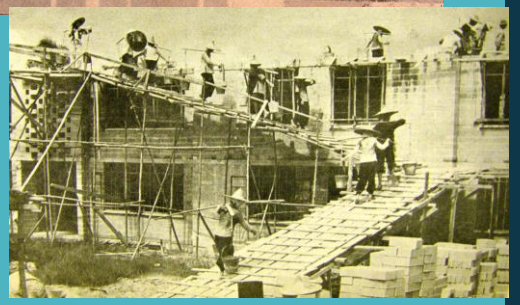
Housing & Development Board

OUR JOURNEY

1960s

- Labour intensive
- Cast-in-situ Method with Simple Machinery



1970s

- Promote Mechanization
- Explore Industrialized Building System

1980s

- Adoption of Prefabrication Technology

1990s

- Build the Industrial Capability & Capacity

OUR JOURNEY
FROM 2D TO 3D PREFABRICATION

2011
PBU
PREFABRICATED BATHROOM UNITS

100% of all HDB projects (2020)

Introduced in 2 Sengkang BTO projects

2014
PVC
PREFABRICATED VOLUMETRIC CONSTRUCTION

Piloted in West Terra, Bukit Batok under the Design & Build Scheme. 3 out of 9 residential blocks adopted the PVC construction method

2016
PPVC
PREFABRICATED, PREFINISHED VOLUMETRIC CONSTRUCTION

36.9% of all HDB projects (2020)

Piloted in Valley Spring, Yishun, where construction for 824 BTO units started in March 2017

OUR JOURNEY

CONVENTIONAL PRODUCTION METHOD

VERTICAL MOULD TECHNOLOGY

APPS
(AUTOMATED PRECAST PRODUCTION SYSTEM)

Implemented APPS in CBR to enhance our prefabrication productivity through automation

PLANT PRODUCTIVITY	▲	30%
PLANT CAPACITY	▲	45%
LAND USAGE	▼	40%

OUR JOURNEY
3D CONCRETE PRINTING

Largest 3D Concrete Printer in South East Asia

- Currently being deployed at HDB Centre of Building Research
- Collaborate with industry to explore 3D concrete printing application and build up capability

COOL IDEAS ENTERPRISE
FUNDING CRITERIA

- **Application Location:**
  - (a) Precast Plants or
  - (b) Construction Sites
- **Solution Maturity: R**eady or near-ready (max 2 years to deployment)
- **Solution Type:** Related to robotics, automation or digitalization
- **Solution Provider, funded amount:**
  - SMEs (up to 70%)
  - Non-SMEs (up to 50%)

Overview

Precast Challenge Statements

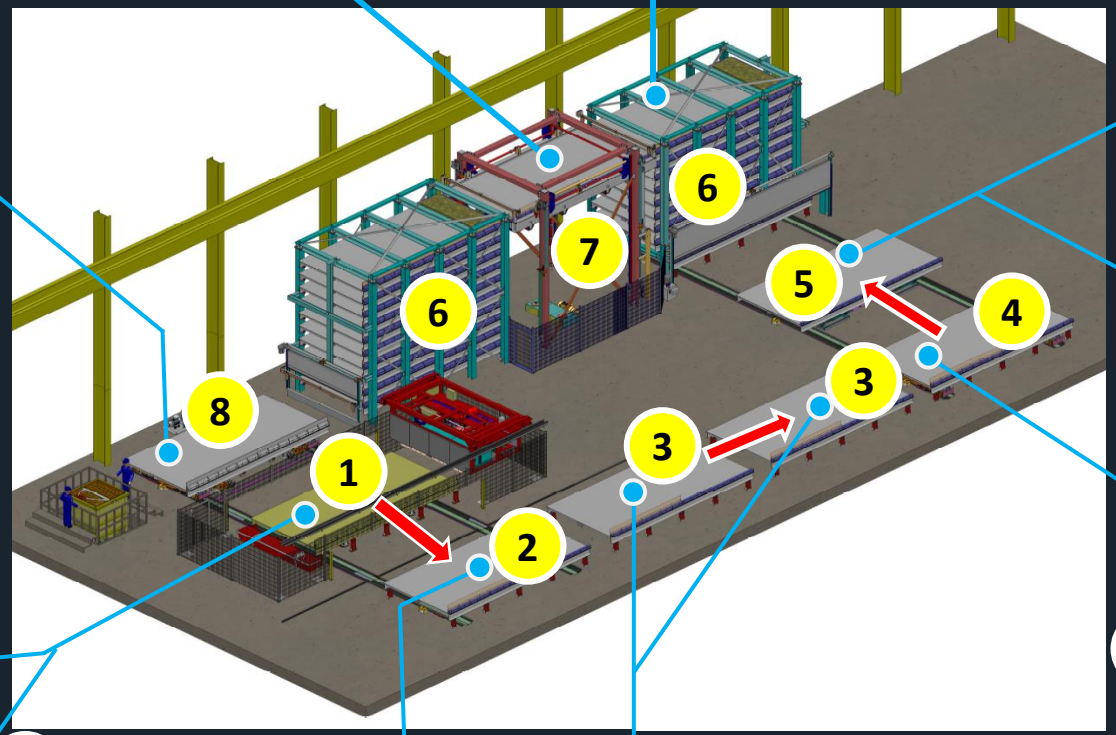
- A1: Robotising Precast Production Processes
- A2: Mechanized Flexible and Reusable Moulds for Volumetric Components
- A3: Automated Inspection of Precast / Volumetric Components
- A4: Any Other Precast Plant Solutions

Construction Site Challenge Statements

- B1: Automated Marking and Verification of On-Site Piling Location
- B2: On-site Autonomous Material Transporter
- B3: Mechanising precast joint preparation process (e.g. bedding mortar)
- B4: Automated On-Site Application of Architectural Finishes
- B5: Automated Crane Systems
- B6: Any Other Construction Site Solutions

A Precast Plants

Typical Precast Plant Processes



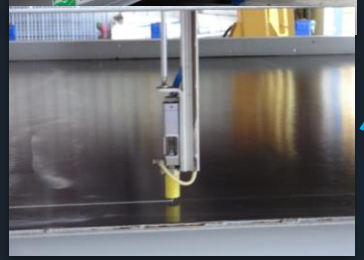
7 Moving and stacking of moulds into the shelves

6 Hardening chambers for concrete curing

5 Concreting
Compaction
Roughening

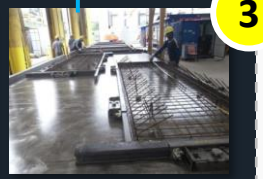
8 Removal of side forms and send to storage

1 Cleaning, Oiling and Plotting of the steel mould



4 Assembled moulds ready to receive concrete

2 Assembling of side forms and reinforcement on steel mould



3 Placing of spacers, cutting meshes to create openings for box-outs, tying of lifting hooks to reinforcement

Precast Plant Challenge Statements

Overview of Automated Precast Production System (APPS) at CBR

Automated

Manual

7 Mechanical lifter for moving and stacking of moulds into the shelves

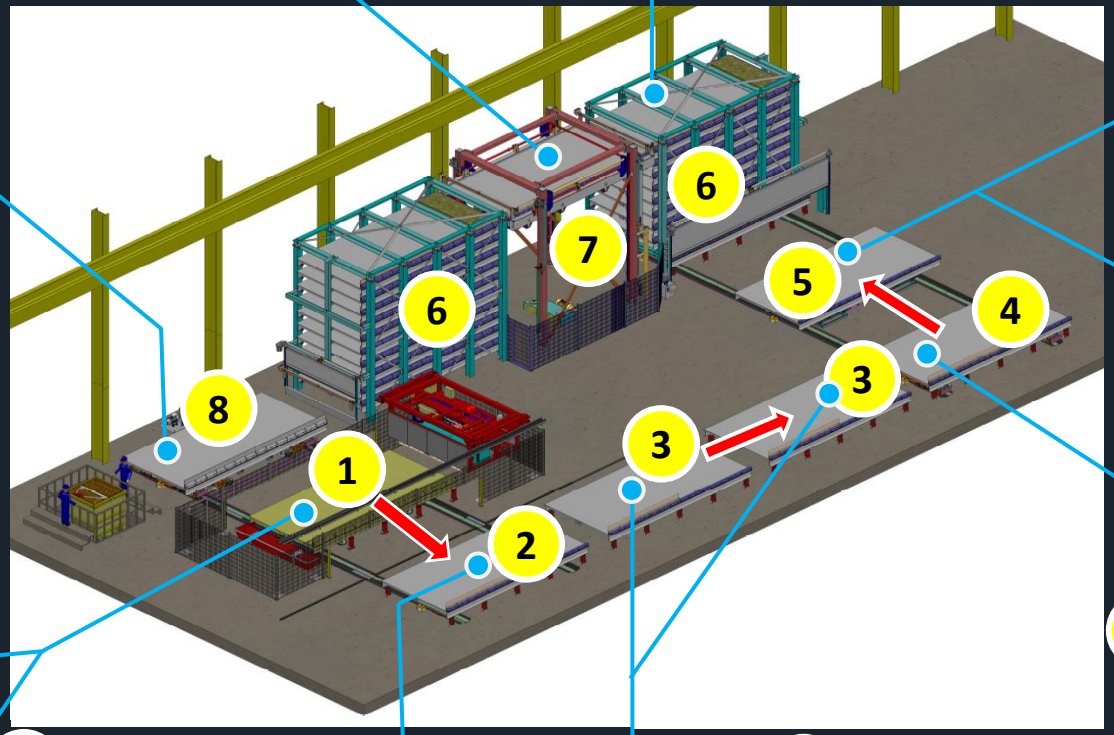
6 Hardening chambers with multi-level shelves for storage of moulds

5 Concreting

Compacting

Roughening

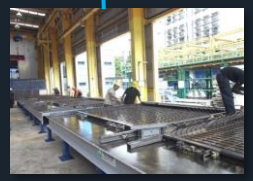
8 Removing side forms & sending to storage



1 3 In 1 Machine performing cleaning, oiling & plotting operations automatically

4 Assembled moulds ready to receive concrete

2 Assembling side forms & reinforcement on steel mould



3 Securing spacers, cutting meshes to create openings for box-outs, tying lifting hooks to reinforcement

Precast Challenge Statement A1:
Robotising Precast Production Processes

A) To automate reinforcement assembly processes

1. Place & secure side forms

2. Retrieve main & side meshes from storage to place in mould pallet

3. Secure side meshes to main mesh, place & secure spacers, lifting hooks, cut mesh & place box-outs

4. Remove side forms (demould)

Precast Challenge Statement A1:
Robotising Precast Production Processes

B) To automate concreting processes

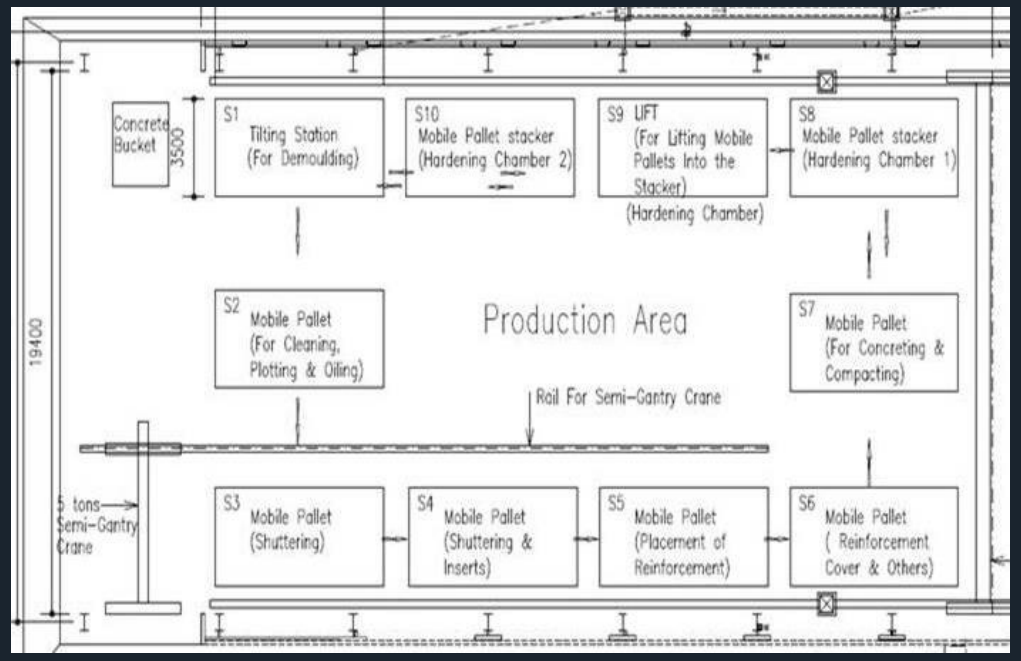
5. Spread wet concrete

6. Roughen concrete surface

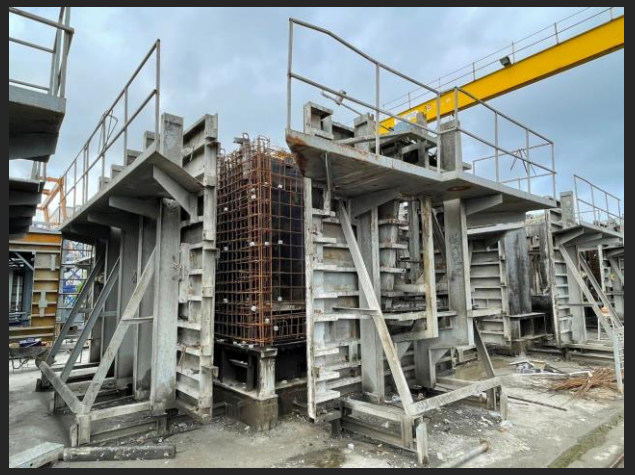
Precast Challenge Statement A1:
Robotising Precast Production Processes

GENERAL REQUIREMENTS

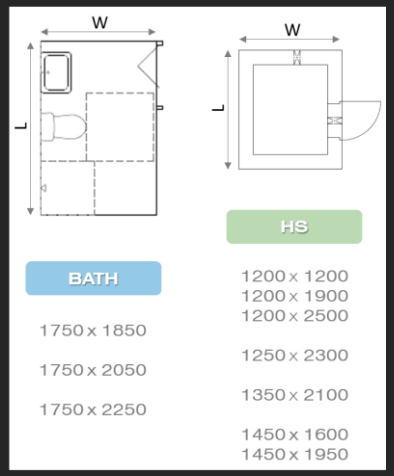
- Solutions developed shall be customized to implement in APPS at CBR
- Redesign existing processes & fixtures (e.g. spacers, lifting hooks) suitable for automation production
- Solutions must be cost-efficient, scalable (e.g. to produce wall & column), increase construction productivity & safety



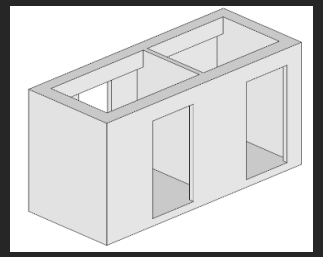
Precast Challenge Statement A2:
Mechanized Flexible and Reusable Moulds for Volumetric Components



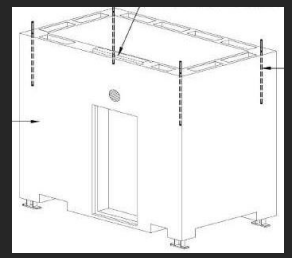
Unique Fixed Moulds for different modules



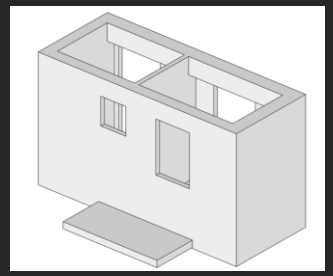
PBU, Households Shelter Dimensions



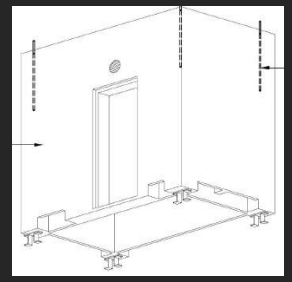
PBU Front View



HS Top View^



PBU Back View



HS Bottom View^

CURRENT PROCESS

Moulds are customised according to dimensions required to cast volumetric components such as Prefabricated Bathroom Units (PBU) and Household Shelters (HS).

As a result, many types of moulds would have to be fabricated to produce each different type of PBU and HS. These moulds are costly, take time to fabricate and are usually not reused.

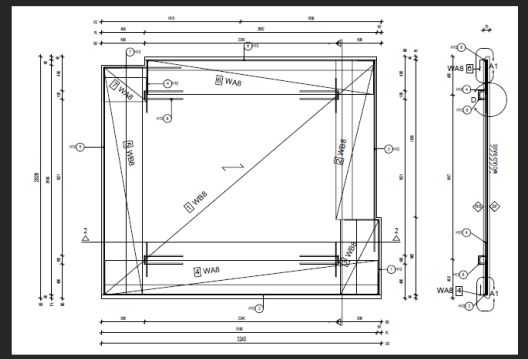
GENERAL REQUIREMENTS

- Mould design that can be automatically and mechanically configured in 50mm increments to produce different dimensions of PBUs and HS
- Mould should be able to accommodate standard detailing requirements such as openings for windows and doors.

^Reference: SCDF CD Shelter Technical Requirements

Precast Challenge Statement A3:
Automated Inspection of Precast / Volumetric Components

Manual visual inspection by RTO



Checking precast components with precast shopdrawings

CURRENT PROCESS

Inspection of precast components (2D and volumetric) during pre-concreting and post concreting are carried out manually through visual inspection by the Resident Technical Officers (RTOs).

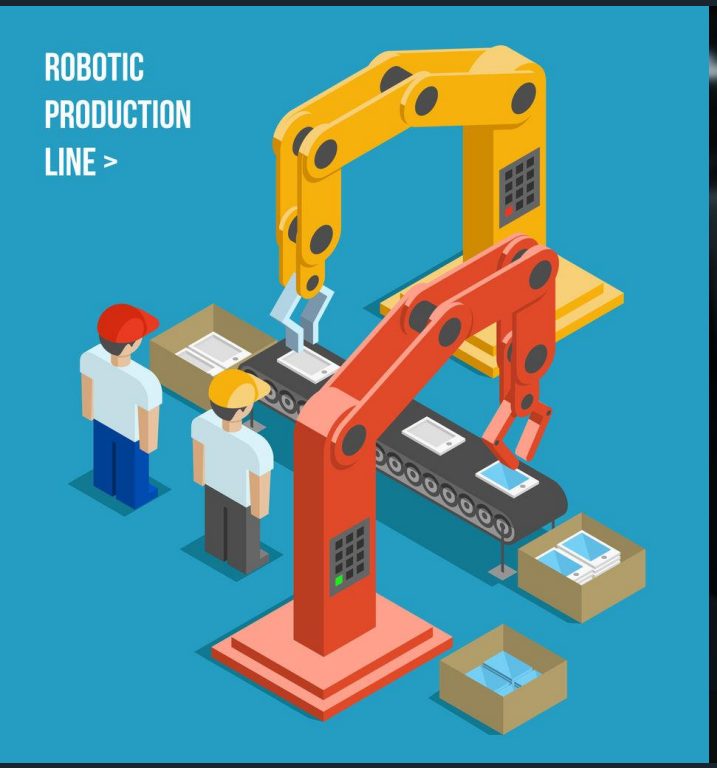
The inspection process is time consuming and additional manpower and time is required to rectify mistakes identified by the RTOs.

GENERAL REQUIREMENTS

Innovative solution for precast inspection to improve the productivity of the inspection processes by the RTOs, improve accuracy and quality of precast production works and reduce manpower and time loss due to rectification works.

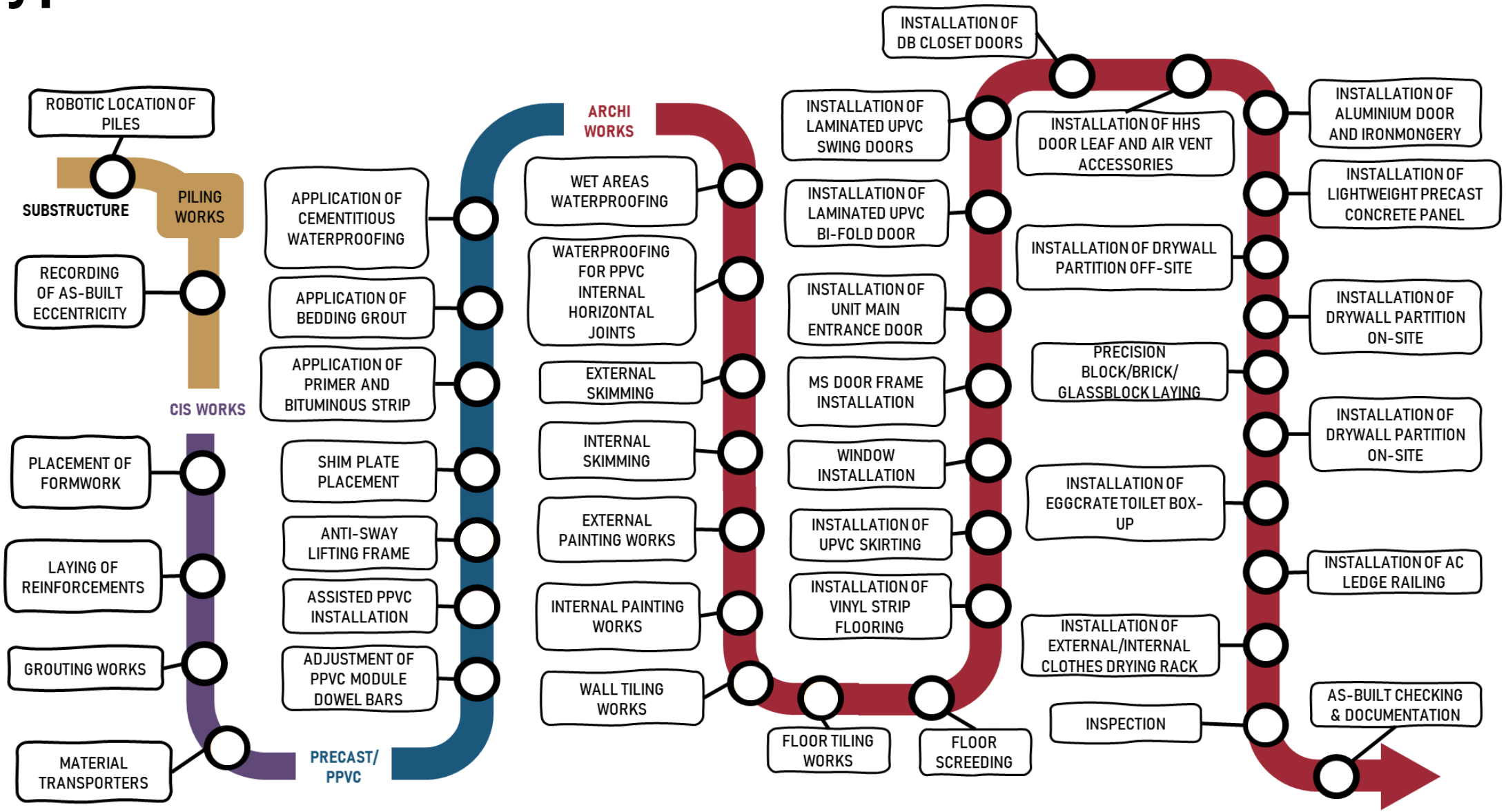
Precast Challenge Statement A4:
Any Other Precast Plant Solutions

Robotics, Automation or Digitalization Solutions



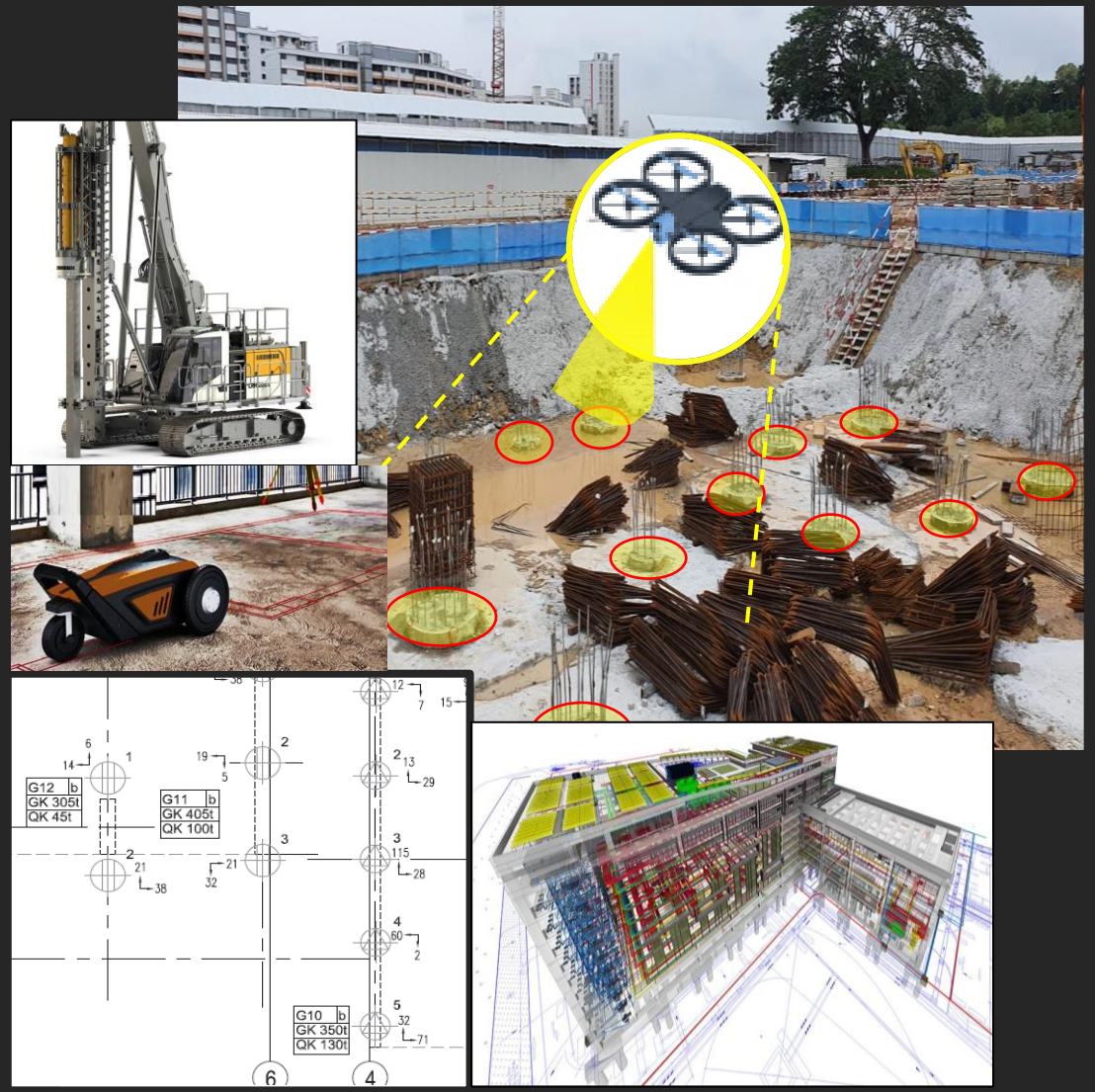
B Construction Sites

Typical Construction Site Processes



Construction Site Challenge Statements

Construction Challenge Statement B1:
Automated Marking and Verification of On-Site Piling Location



CURRENT PROCESS

Piling work, regardless of concrete or steel, requires surveyors to mark out the location for the piling. It is time consuming and manual, therefore looking for digital solutions to mark out location of the piles to reduce manpower and time spent on the process. For automated marking, ground-marker robots or smart piling rigs, with preloaded maps of piling locations from As-Built Drawings, could be deployed. For precise automated verification of pile locations, drones with preloaded maps of pile coordinates could be used.

GENERAL REQUIREMENTS

- Solution must be able to read pile layout drawings & automatically lay pile markers at the correct coordinates for riggers to bore
- Accuracy of +- 10 mm
- Solution should be able to **scan** the site and **digitally record** as-built locations of piles and display eccentricities in stipulated drawing presentation format
- Users should be **alerted** to installed piles that deviate from their respective designed coordinates by more than the allowable range listed in the stipulated requirements *(to be provided)*

Construction Challenge Statement B2:
On-site Autonomous Material Transporter

Construction Materials

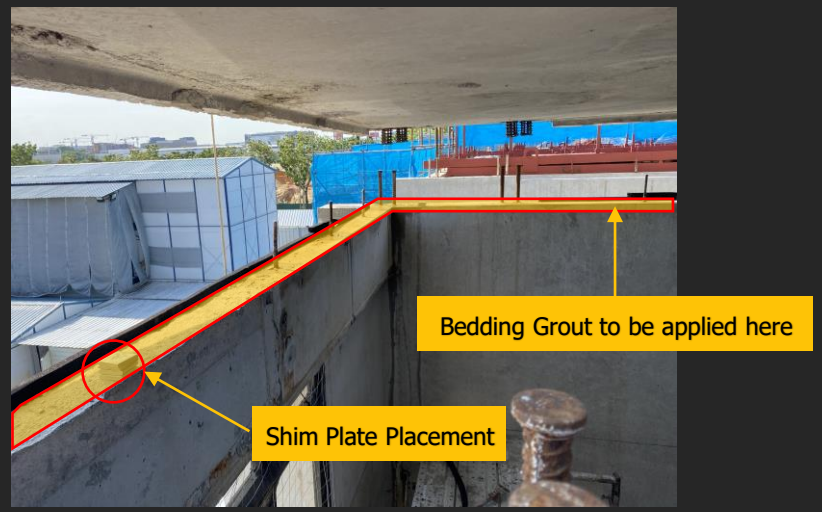
CURRENT PROCESS

Manpower is required to transport materials around the construction site, and up floors to unit locations where materials are needed. The task is mundane and repetitive, which makes it unproductive for manpower to do this.

GENERAL REQUIREMENTS

- Built for construction terrain navigation
- Payload: At least 300 kg
- Semi-autonomous and Follow-Me modes
- Automated loading and unloading
- Able to transport materials from ground floor pick-up to desired floor unit drop-off

Construction Challenge Statement B3:
Mechanising precast joint preparation process (e.g. bedding mortar)



CURRENT PROCESS

Manpower is required to prepare the area and mortar mixture for application at precast joints. Workers are to ensure that the bedding meets the requirement and ready to receive the upper component.

GENERAL REQUIREMENTS

- Able to place shim plate to the right level before application of bedding mortar
- Prepare grout mixture as specified in technical specification
- Apply bedding mortar to desired location

Construction Challenge Statement B4:
Automated On-Site Application of Architectural Finishes

Screeding

Painting

Skim Coat Application

CURRENT PROCESS

Depending on the location, different surfaces will undergo various multiple surface finishes such skimming, painting, tiling, patch-up recesses and screeding. Labor performing surface applications like screeding, painting and skimming could have varying surface consistency. Labor working prolong on below the waist trades, like screeding, recess patch up and floor tiling, are prone to back musculoskeletal injuries.

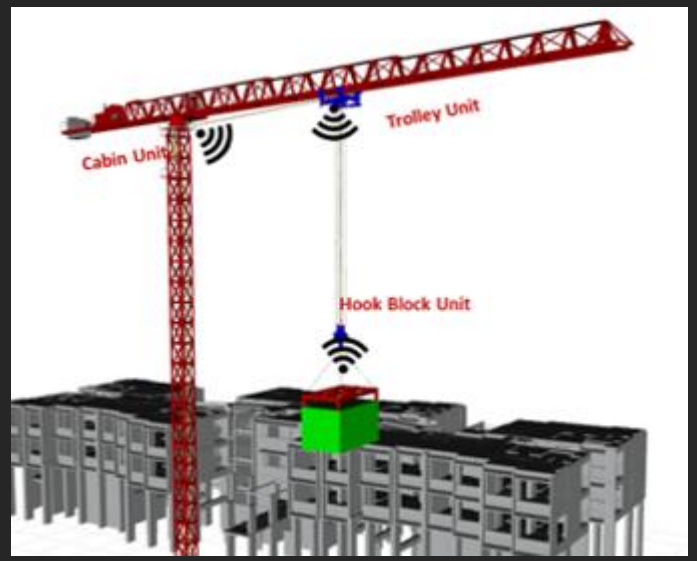
Recess patch-up

Floor Tiling

GENERAL REQUIREMENTS

- Thickness and spread consistency in surface application of screeding, painting, skimming and patch-up finishes.
- Precise sequential placement of tiles onto surface finish, followed by uniform compacting.
- Automate work on majority surfaces, with labor performing corner finishes and refinements.

Construction Challenge Statement B5: Automated Crane Systems



CURRENT PROCESS and CHALLENGES

- Too much hoisting activities on site with limited cranes resources
- Crane hoisting speed varies and dependent on:
  - Operator's judgement
  - Ground guidance
  - Environmental conditions
- Limited skilled operators
- Long operation hours & fatigue issues

GENERAL REQUIREMENTS

- To develop a smart autonomous control system for tower crane, to speed up hoisting efficiency and improve the working environment of the operator
- The autonomous control system shall be able to directly manipulate existing tower crane system without operator in cabin
- To work with HDB's research partners/team to conduct trials and testbed the current developed autonomous smart crane solution in HDB Centre of Building Research
- To further develop the current smart crane system and enhance the system robustness to be deployed for commercial application in actual construction site

Construction Challenge Statement B6:
Any Other Construction Site Solutions

Robotics, Automation or Digitalization Solutions

Site Visit/Recce

If you would like to attend a site visit to HDB Centre of Building Research's precast plant, please contact us.

LOOKING FORWARD TO YOUR PARTICIPATION

To submit your proposals or **enquiries**

Please contact us at:

HDB_CoolideasENT@hdb.gov.sg

Submission period : 27 Sep **2022 to 2 Jan 2023**

For more information and to download the application form:

Scan QR Code or go to

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