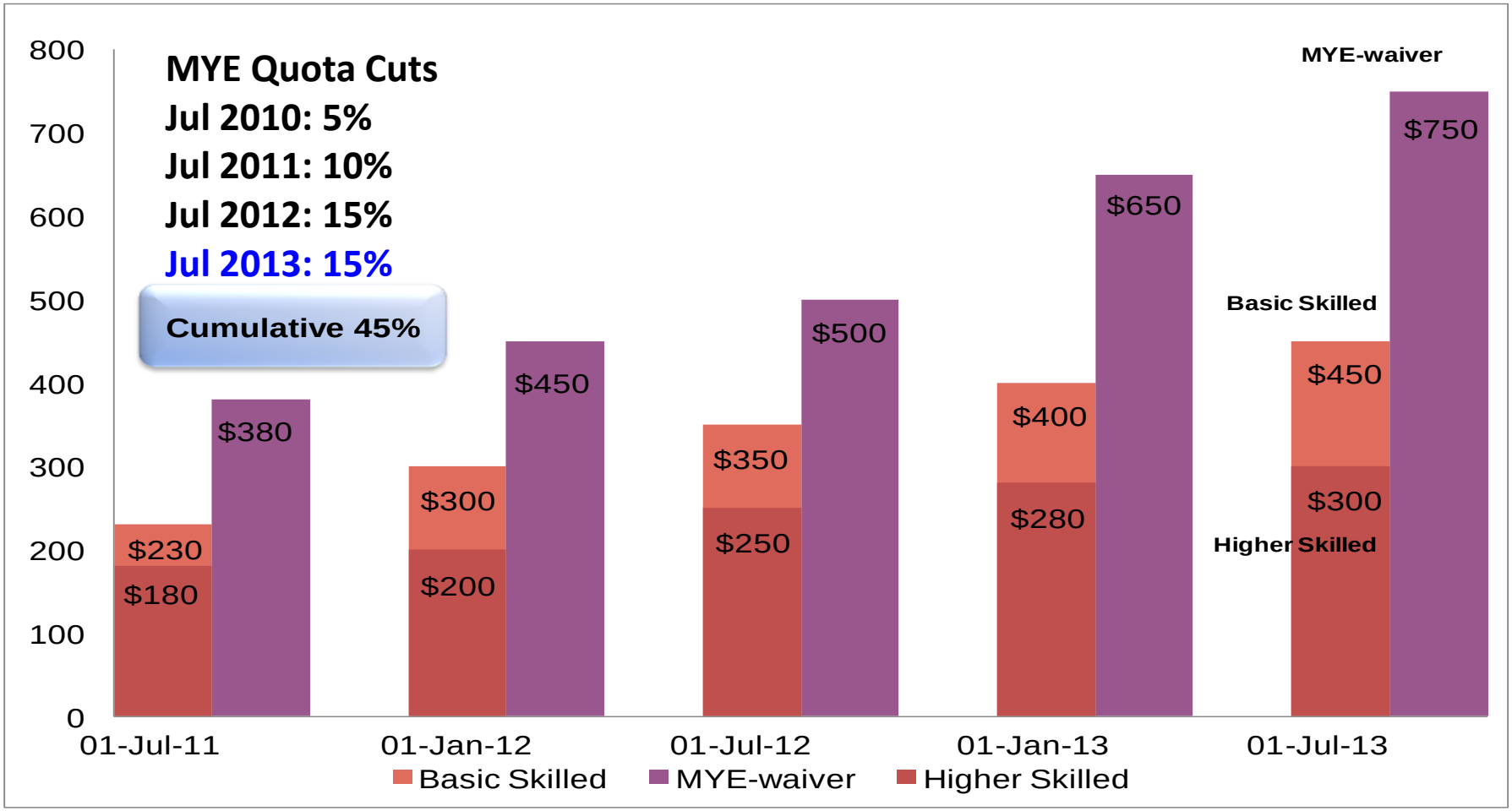
HDB
Productivity Framework

Mr Neo Poh Kok
Director, Building Construction Management
Housing & Development Board

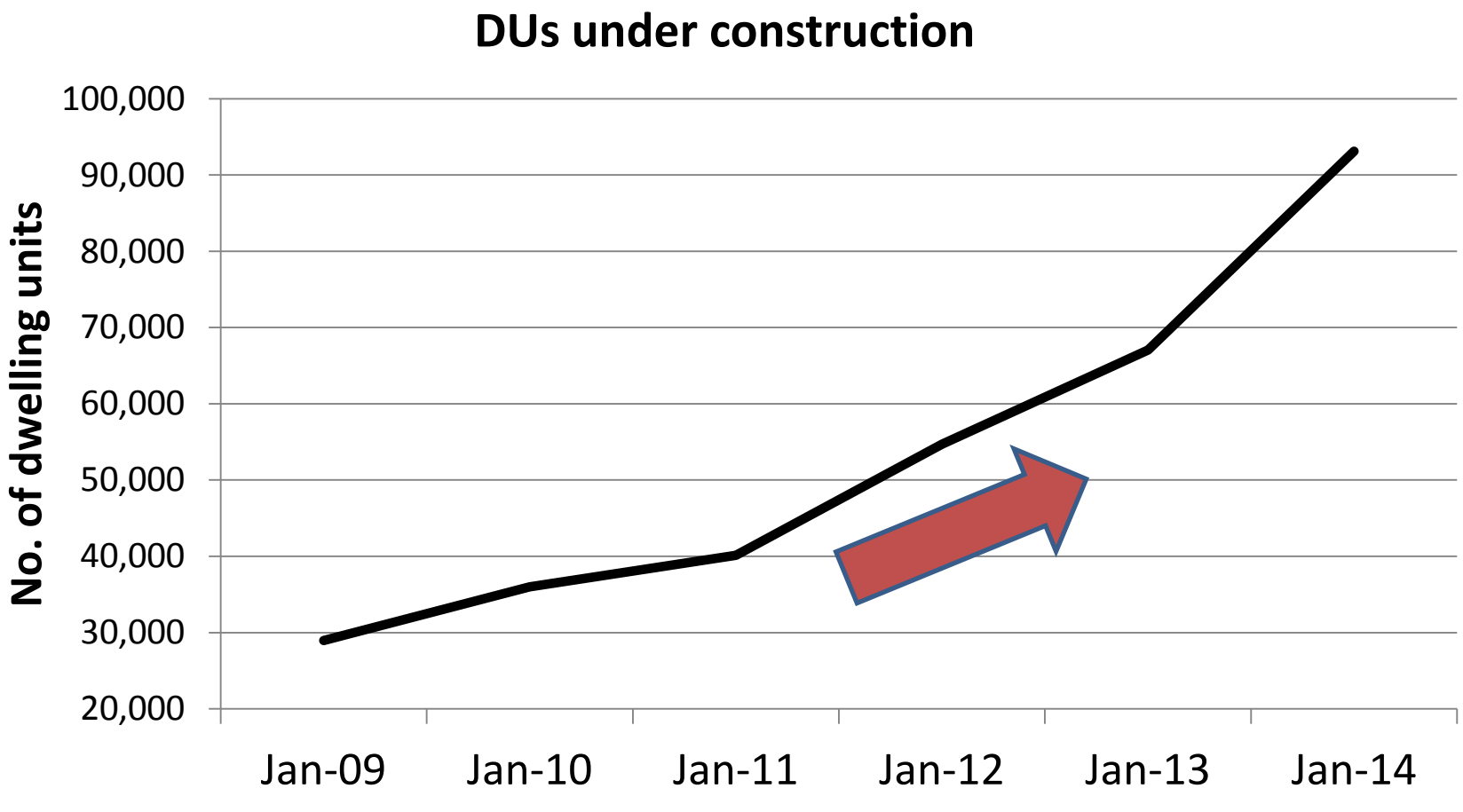
Introduction

i. Hike in workers' levy and reduction in MYE



Introduction

ii. Substantial ramp-up in HDB's Building Programme



HDB Productivity Framework



<u>A continual process</u> to raise productivity

Target to raise construction productivity of at least 20% by 2020

HDB Productivity Framework

Pre-Construction Stage:

i. **Manage design process**
   - Achieve high buildability through standardisation

ii. **Build capability**
   - Build up a pool of consultants familiar with HDB requirements

iii. **Explore new technology & research**



HDB Productivity Framework

Construction Stage:

i. **Implement new initiatives**

ii. **Build capability**
- Regular sharing, encourage innovation

iii. **Review work methods**
- Ensure constructability



HDB Productivity Framework

Post - Construction Stage:

Conduct customer survey and post construction reviews for :

- Design guidelines
- Materials
- Methods and details



HDB Productivity Framework



Key Thrusts

1. Strive for standardisation
2. Explore alternative design, method and material
3. Adopt BIM for more efficient & integrated design process
4. Promote mechanisation
5. Build capability
6. Research for new products, equipment and technology

(1) Strive for Standardisation

a. Precast standardisation

b. Standardisation for unit plans

c. Good practices guide for block key layout

d. Standardisation of linkway designs

e. Early involvement of precasters

(a) Precast Standardisation

	Standardisation	% based on concrete volume
Cat 1	Fully standardised across projects	5%
Cat 2	Partially standardised across projects	80%
Cat 3	Standardised within a project	15%

(a) Cat 1 – Precast Components





- Staircase
- Refuse chute
- Duct
- Water tank
- Segmented ring tank
- Suction tank
- Secondary roofing slab





(a) Cat 2 - Precast Components









- Planks
- Walls
- Columns
- End wall
- Beams
- Household shelter

(a) Cat 3 - Precast Components





Mainly precast façades

- **Allow creative aesthetic expression**
- **Strive for standardisation within project**

(a) Punggol West C20



Original design of sunshade element



Revised design of sunshade element

- Curved sunshade elements
- Inconsistent leave pattern on the sun shade element
- 14 types of sunshade element

- Only curved sun shading element at balcony area
- Reduced leave patterns to improve consistency
- Reduced to 8 types of sunshade element

(a) Precast Pictorial Guide

HOUSING & DEVELOPMENT BOARD

PRECAST PICTORIAL GUIDE
2012

BUILDING & INFRASTRUCTURE GROUP
ENGINEERING SERVICES SECTION

5.2 Canopies shall not pull around columns along access corridors, as it will give rise to potential alignment issues. Canopy shall terminate at the edge of the column.

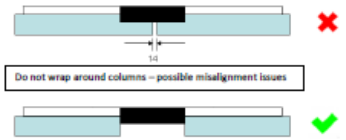


Figure 5B – *Termination of canopy at edge of column*

5.3 Canopies over windows shall have a 100mm overhang. Canopies shall not be continuous across windows for separate components.

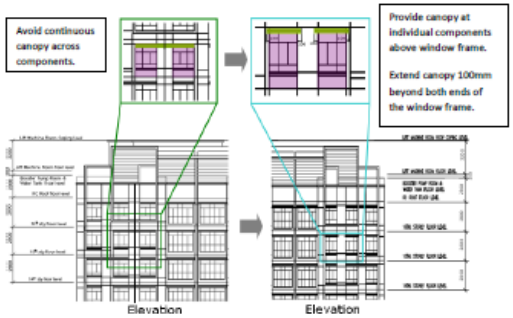


Figure 5C – *100mm overhang and non-continuous canopies*

CHAPTER 9

ARCHITECTURAL DESIGN & REPETITION

9.1 Consultants are to use at least 100 repetitions as the guideline for component repetition to ensure cost-effectiveness of the project (Refer to Annex E – The rationale behind 100 repetitions and the right way to approach this number).

9.2 Precast component repetition schedule shall be submitted as early as possible to the precast review team and consultants shall justify for any deviation and seek waiver from the precast review team (See Clause 9.7 of C&S guide).

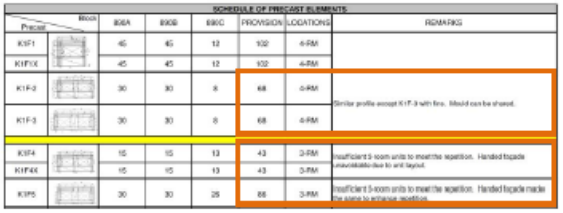


Figure 9A – *Component without 100 repetitions must be justified*

9.3 Consultants shall always consider painting of the façade as architectural treatment before resorting to treatments like groove lines, nibs or fins.

Strive for standardisation

(a) Engineering Reviews

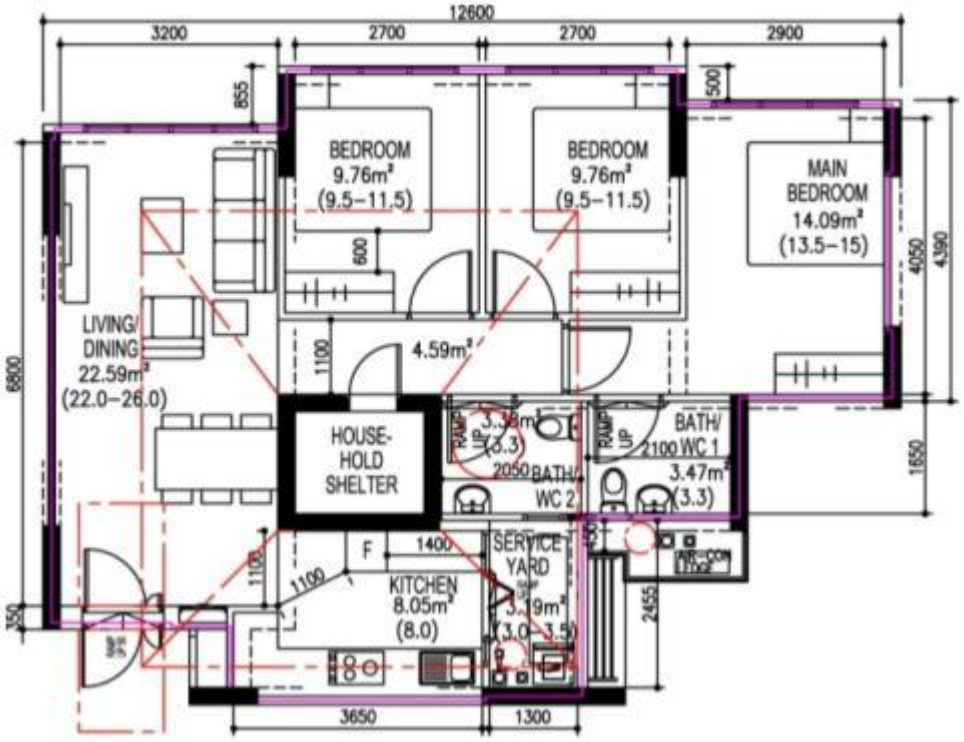
i. Comply with standardisation guidelines
ii. Optimise precast construction





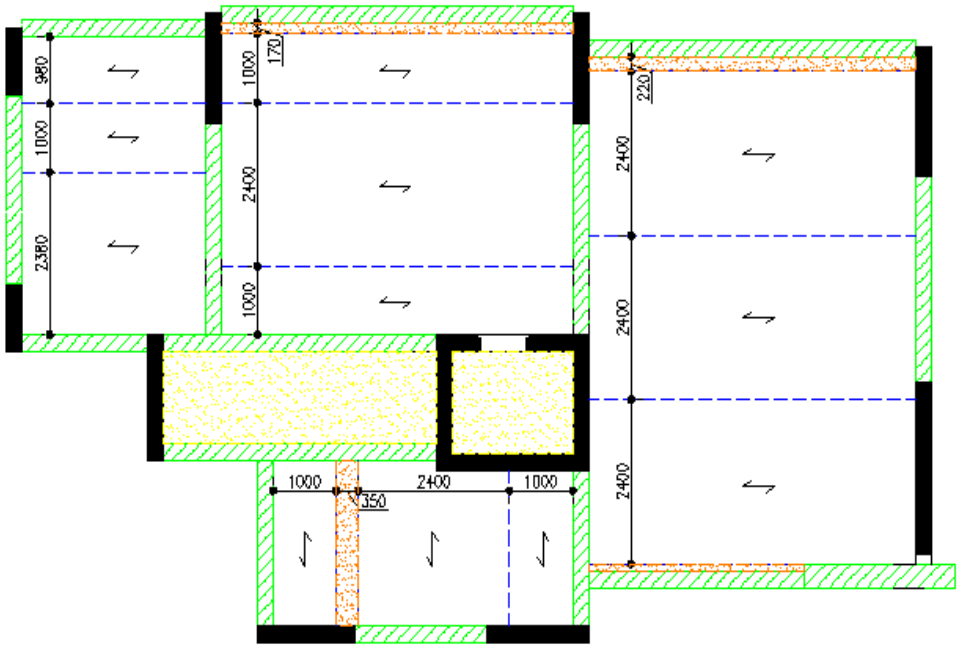
(b) Standardisation for Unit Plans

- **Developing prototype unit plans**
- **Less time spent to adjust plans to meet HDB standard requirements**

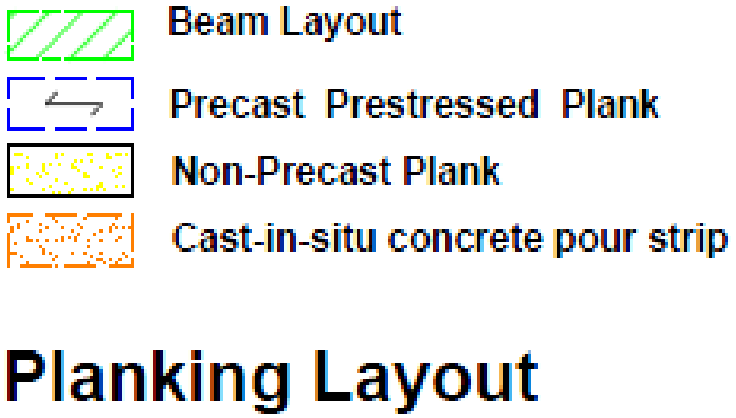


(b) Modular Precast Planning

- More efficient structural layout
- Planking optimisation i.e. 1000mm & 2400mm (fixed width) to reduce amount of wet pour



Planking Layout for standardisation



(c) Good Practices Guide
- Block Key Layout

Factors to consider :

- **Centralised lift lobby & refuse chute**
- **Adequacy in lift provision**
- **Cross-ventilation & natural lighting**
- **High floor efficiency**
- **Well-placed unit entrances**
- **Safety and security**

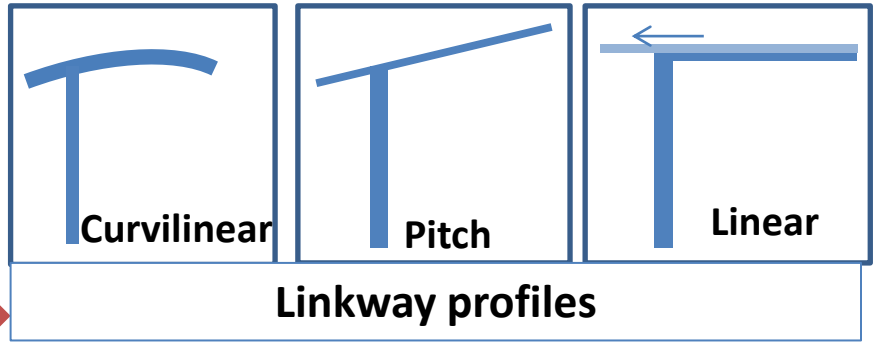


Strive for standardisation

(d) Standardisation of Linkway Designs



Current linkway designs



Linkway profiles



- No standardisation due to variety in designs
- Designs may not meet functional needs of weather protection

- Optimise member sizes & spacing
- Standardise connection details
- Combine related components into a single prefabricated element

Strive for standardisation

(e) Early Involvement of Precaster

i. **To optimise precast construction, precast requirements must be considered from the beginning of the design process**

ii. **HDB will experiment with early involvement of precaster in a D&B project in 2013**

iii. **A precaster must be included in a D&B team**

(2) Alternative Design, Method & Material

a. Hybrid construction

b. Prefabricated bathroom units

c. Accelerated lift shaft construction

d. Improvement to ferrolite wall system

e. Dry internal partition walls

f. Self compacting concrete

g. Engineered wood

h. Statnamic pile load test or O-cell system

(a) Hybrid Construction

i. **Reduce the use of precast components and allow selected internal members to be cast-in-situ with system formwork**

ii. **Allow concurrent activities and reduce reliance on tower cranes**

iii. **Piloted in a project at Sengkang N1 C27 (Rivervale Arc)**

(a) Hybrid Construction



Metalform





Aluminium Form

Use of aluminium formwork raised productivity by 33% compared to conventional metalform

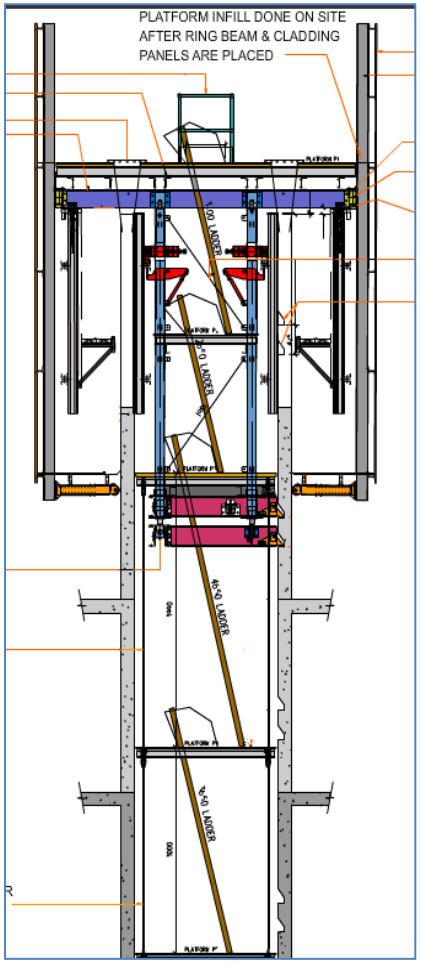
(a) Hybrid Construction



Precast panel system



Self climbing system form



Use of self climbing system for lift shaft is more productive and allows lift shaft to be completed earlier for lift installation

(a) Hybrid Construction

Outcomes of study:

a. A shorter RC Cycle time of 8.8 days for typical floors

b. Cost savings of $1 million

c. Productivity gain:

	RC Cycle	Structural Manpower	Mandays
Hybrid	9 days	272 man	2448
Conventional	12 days	236 man	2832
Productivity Gain			15%

d. HDB will adopt hybrid construction for 16 projects to be awarded in 2013. Some of them will be tendered in Nov/Dec 12

(b) Prefabricated Bathroom Units

HDB experimented with prefab bathroom since 1990s to raise productivity and quality







Need to address issues with maintenance, renovation and public perception

(b) Prefabricated Bathroom Units

i. Design considerations in the recent pilot project at Sengkang N4C24
   a. Concrete wall and floor as a volumetric unit
   b. Single floor system
   c. Minimise double wall with cavity

ii. Estimated 20% productivity improvement



Mould for PBUs

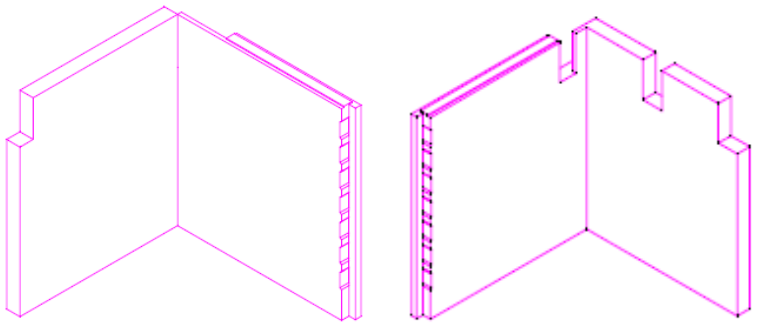


Completed PBUs



Completed PBUs with finishes

(c) Accelerated Lift Shaft Construction



Lift shaft construction by panels



Volumetric lift shaft

i. Current construction of lift shaft by individual precast panels

ii. Speed up construction by using volumetric components for topmost two floors

- Advance completion of lift shaft by 15 days

(d) Improvement to Ferrolite Wall System





Block laying for odd corners or non-standard width

Introduced T, L and smaller panels to replace in-fill block laying

(d) Improvement to Ferrolite Wall System





Manual forming of recess on blockwall for electrical services

Ferrolite panel with pre-form recess

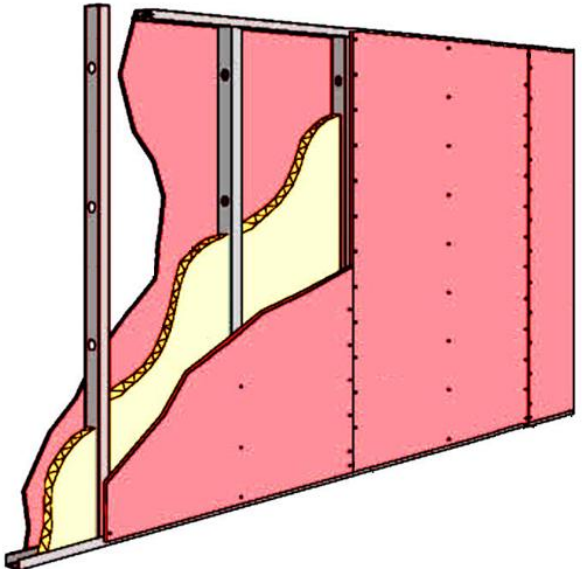
Implemented since Jan 12

(e) Dry Internal Partition Walls

i. Alternative method to ferrolite partition walls

ii. Benefits:

- More productive
- Better surface finish
- Better airborne sound insulation
- Flexibility in room configuration



iii. Concerns:

- Damage during renovation
- Mounting objects on drywall
- Hollow sound upon knocking

iv. HDB will adopt drywall in a demonstration project

(f) Self Compacting Concrete



Normal concrete



Self compacting concrete

Self compacting concrete – no vibration is required for compaction of concrete

(f) Self Compacting Concrete

i. Productivity Improvement

	Columns		Slabs	
	Normal Concrete	Self compacting concrete	Normal Concrete	Self compacting concrete
No of workers	8	4	15	4
Volume (m^3)	17	17	162	162
No of hours	3.0	2.6	5.7	5.5
Productivity (m^3/manhr)	0.7	1.6	1.9	7.3

(f) Self Compacting Concrete

ii. **Noise Reduction**

Noise (Leq 5mins)	Normal Concrete	Self compacting concrete	% Reduction
Column	74 dB	65 dB	12%
Slab	76 dB	68 dB	11%

iii. **Since Sep 12, contractors are allowed to use self compacting concrete as an alternative**

iv. **Contractors can apply for funding under BCA Productivity Improvement Project (PIP) Scheme**

- **Subsidy of up to 80% of the additional material costs, capped at $100,000**

(g) Engineered Wood



Timber strips



Engineered wood

i. Evolved from using single timber strips (70mm x 450mm) to timber panels (190mm x 1200mm)

ii. Pre-finished hardwood flooring

- No sanding and varnishing required after installation

iii. Improve productivity by 30%

iv. Implemented in two pilot projects

(h) Alternative Pile Load Test



Conventional kentledge test



Statnamic pile load test



O Cell load test

	Kentledge System	Statnamic Load Test	O Cell System
Duration of test (days)	18	5	3

Alternative load tests - Faster and safer

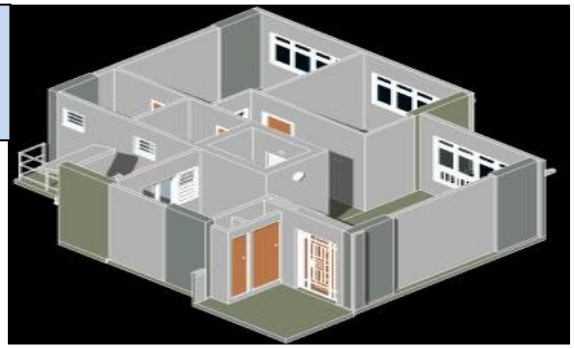
(3) Building Information Model

i. All disciplines can communicate via a common platform

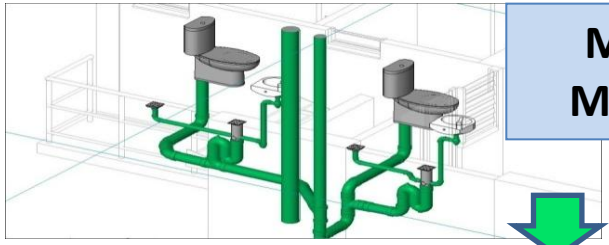
ii. Reduce construction conflicts upstream during design stage

iii. BIM guide for HDB housing projects to be rolled out in Oct 12

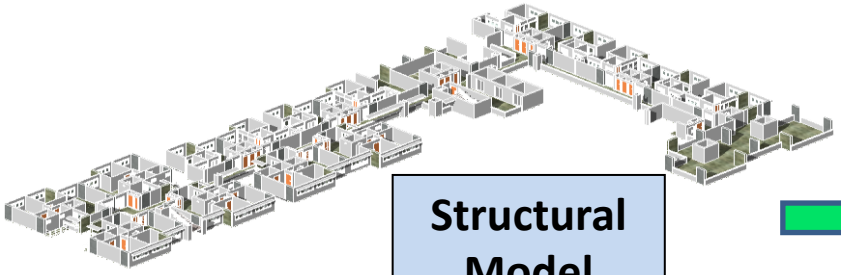
Arch Model



M&E Model







Structural Model

(3) Adoption of BIM in Building Projects

Timeline:

2013	**Mandatory Architectural BIM e-Submission for all new building projects >20,000 m^2**
2014	**Mandatory Architectural & Engineering BIM e-Submission for all new building projects >20,000 m^2**
2015	**Mandatory Architectural & Engineering BIM e-Submission for all new building projects >5,000 m^2**

(4) Promote Mechanisation

6 equipment specified as requirement in HDB projects tendered since May 12

- **Improve productivity by 5%**



Ride – on power trowel



Boom lift



Scissors Lift



Mast climbing work platform



Telescopic handler

(4) Automatic Wheel Washer



Conventional method of wheel washing





Automated wheel washer

	Conventional system	Automated wheel washer
No. of workers	2	0

(5) Build Capability

a. Comprehensive set of HDB guide drawings

b. Supervision guides for all disciplines

c. Regular dialogues & sharing of good practices

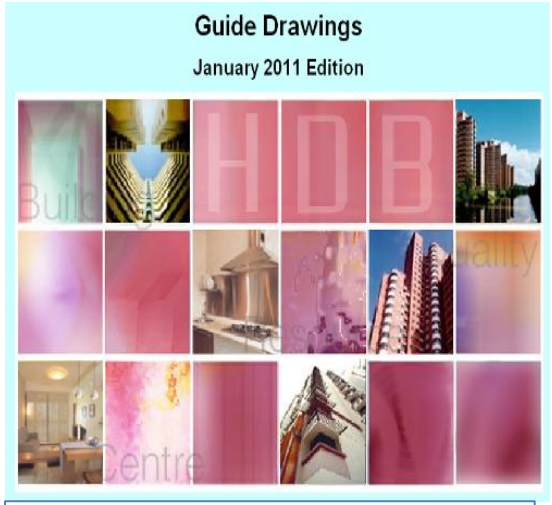
d. Enhance project management planning & execution

e. Project Management Portal

(a) HDB's Guide Drawings

i. Illustrate detailing and best practices from past projects

ii. Facilitate consultants in design development



HDB guide drawings



(b) Supervision Guides



(c) Dialogue & Sharing Sessions

Conduct regular dialogues with consultants, contractors and suppliers to discuss issues and share HDB requirements and practices





(d) Enhance Project Management Planning

i. **Detailed manpower planning & control**

ii. **Planning of work activities – "Do things right the first time"**

- **Ascertain quality standards prior to mass production**

iii. **Protection of architectural finishes**





Protection of architectural finishes



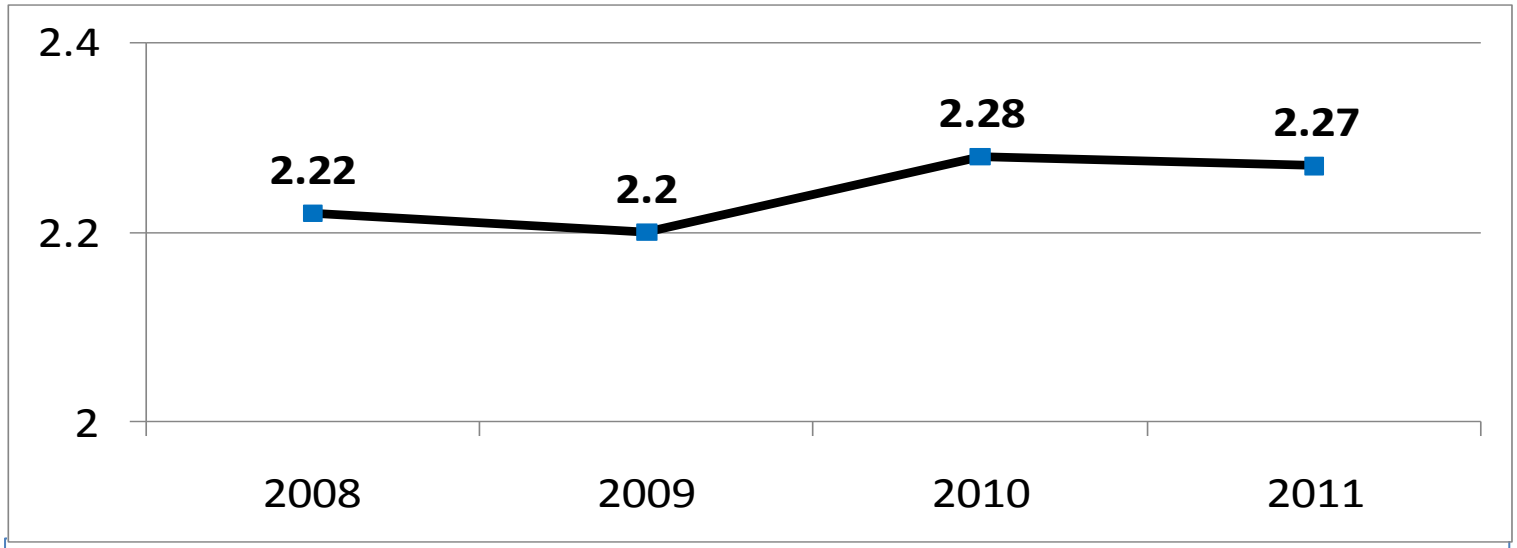
Conduct trade demo

Build capability

(e) Project Management Portal

Launched Productivity Management Portal (PMP) to capture

- **Project status and critical milestones**
- **Manpower data to measure productivity**



Site productivity for HDB projects (manday/m^2)

(6) Research

New products, equipment & technology

a. R&D in precast production

b. Re-engineering of processes

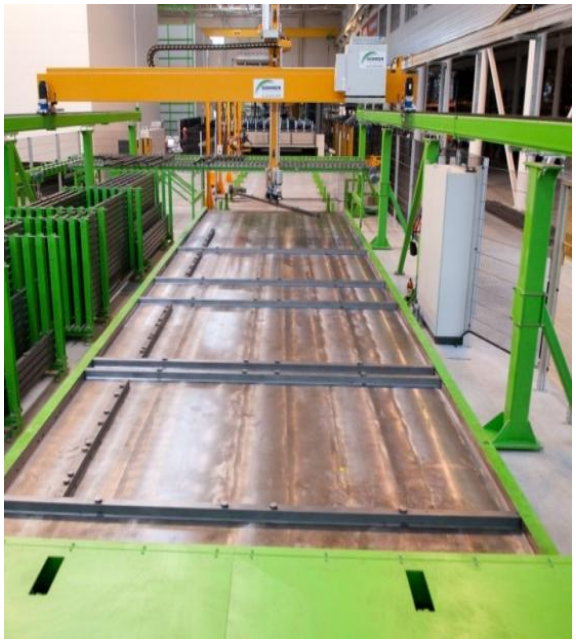
- **Customised forklift for HDB projects**

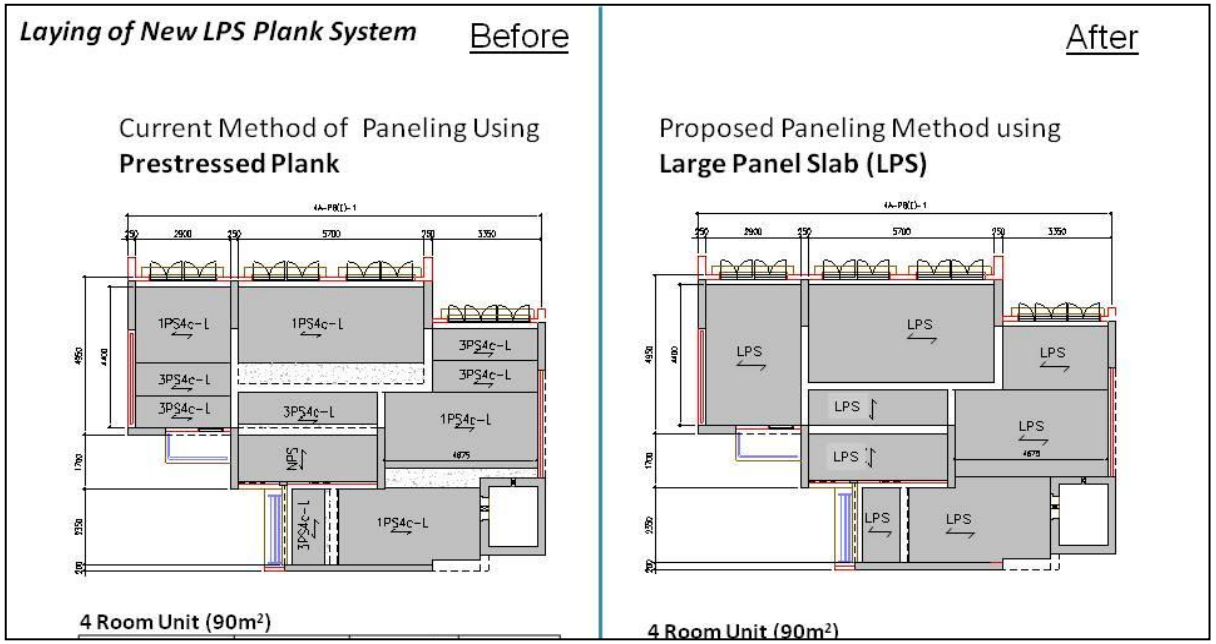
(a) R&D in Precast Production

HDB's continual efforts to invest in R&D in precast technology

- **Improve precast design to enhance constructability**

- **Develop new precast system to facilitate automation of production processes**





(b) Re-Engineering of Processes

Construction Materials Handling

- **Worked with equipment supplier to customise forklift suitable for use in HDB construction for material handling**



Transportation of materials using wheel barrows



Customised forklift to improve productivity in materials handling

Feedback Channel

We welcome your suggestion and feedback on our latest initiatives, eg

1. **Prototype Unit Plan**
2. **Hybrid Construction**
3. **Dry Internal Partition Walls**
4. **Self Compacting Concrete**
5. **Simplification of details for precast automation**
6. **Early involvement of contractor and precaster**

You can send your feedback or suggestions to our website at : http://www.hdbpeakforum2012.com/contactus.php

Conclusion

HDB is committed to take the lead in raising construction productivity and to forge a strong partnership in this journey to transform our industry



Thank You