PPVC – EFFICIENCY IN PPVC DESIGN AND BUILDABILITY THROUGH MODULARISATION

BY ADDP architects

AR NG SIN YONG
AG PRINCIPAL ARCHITECT

- introduction
- the singapore condition
- factors affecting ppvc design
- case studies
- summary

ADDP architects










ADDP HAVE MORE THAN 20 PPVC PROJECTS (BOTH ONGOING/COMPLETED)

ADDP
architects

PPVC | Prefabricated Prefinished Volumetric Construction refers to a construction method whereby free-standing 3-dimensional modules are completed with internal finishes, fixtures and fittings in an off-site fabrication facility before it is delivered and installed on site.

ADDP
architects

HDB Steel Prefab Study Studio (2012-2014)
Study for construction of lifestyle lab @ Centre of Building Research (HDB BRI)
(Completed in 2014).

Brownstone EC (2013)
1st Concrete PPVC condominium in SG

Clement Canopy (2016)
Tallest PPVC in the world (40 Sty)

Avenue South (2019)
Tallest PPVC in the world (56 Sty)

ADDP architects

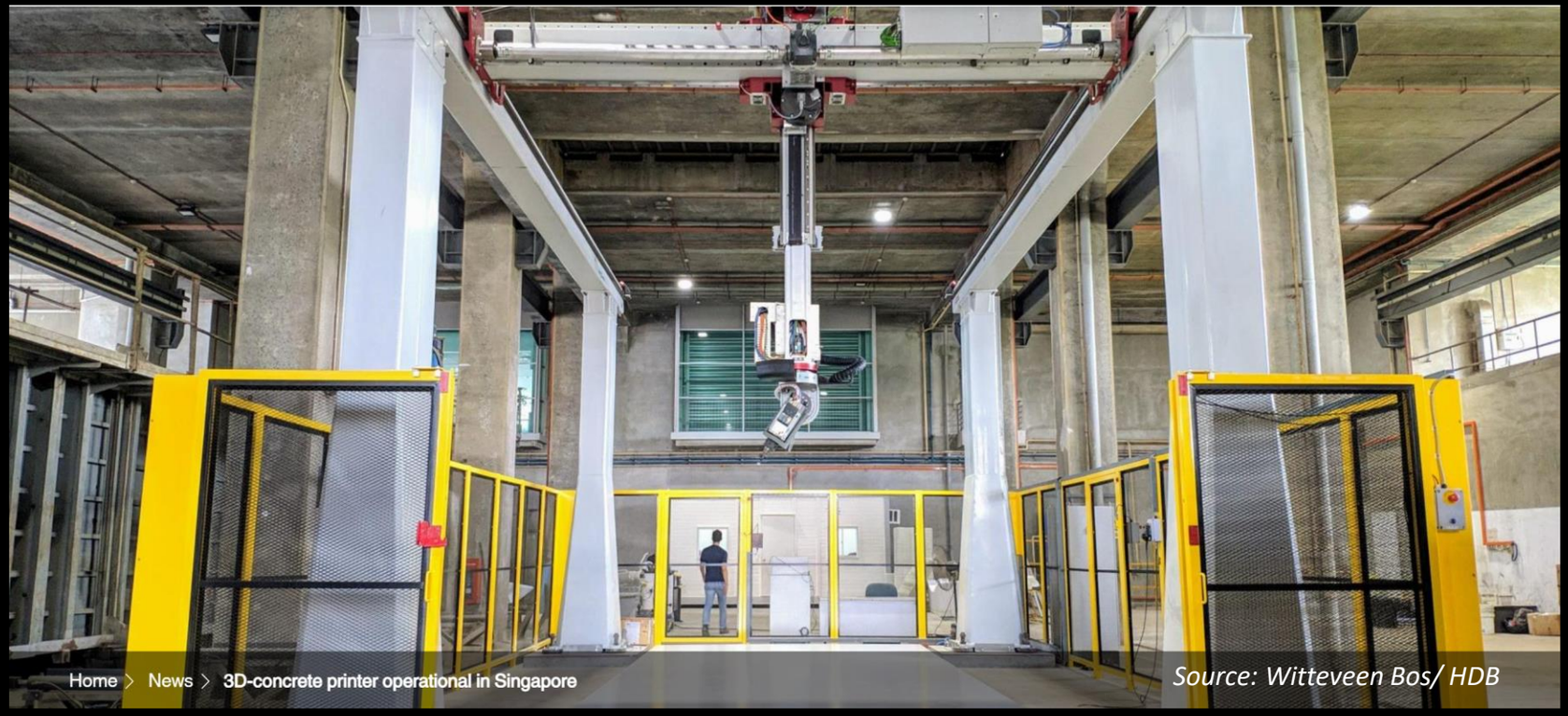
Singapore	Other Countries (Specifically with large land masses)
- Lack of sizeable land plots	- Abundance of land
- High plot ratio – Space maximisation – Less regular layout, site constraints	- High/ Low plot ratio – Flexible site planning – More repetition in layouts
- Predominantly urban sites – Marketability & USP – Productivity becomes secondary	- Both Urban and Rural Sites – Less competitive – Productivity can still be primary goal with flexible site planning
- Different Typology - Basement carparks/ MSCP/ Mechanical Parking	- Similar Typology - Generally MSCP/ Open air carpark
- High cost of labour	- Access to cheap labour
- Project Specific	- Possibility of mass usage

BESPOKE VS MASS PRODUCED

ADDP architects

- Majority in situ wet construction/ casting
- Precasting
- High % off site precasting
- ICPH (Advance precast/ Automated precast)/
- 3 Dimensional precast with finishes (PPVC)

- Quality
- Safety
- Productivity
- Dust/ Noise
- Time



Source: Witteveen Bos/ HDB

Source: Witteveen Bos/ HDB

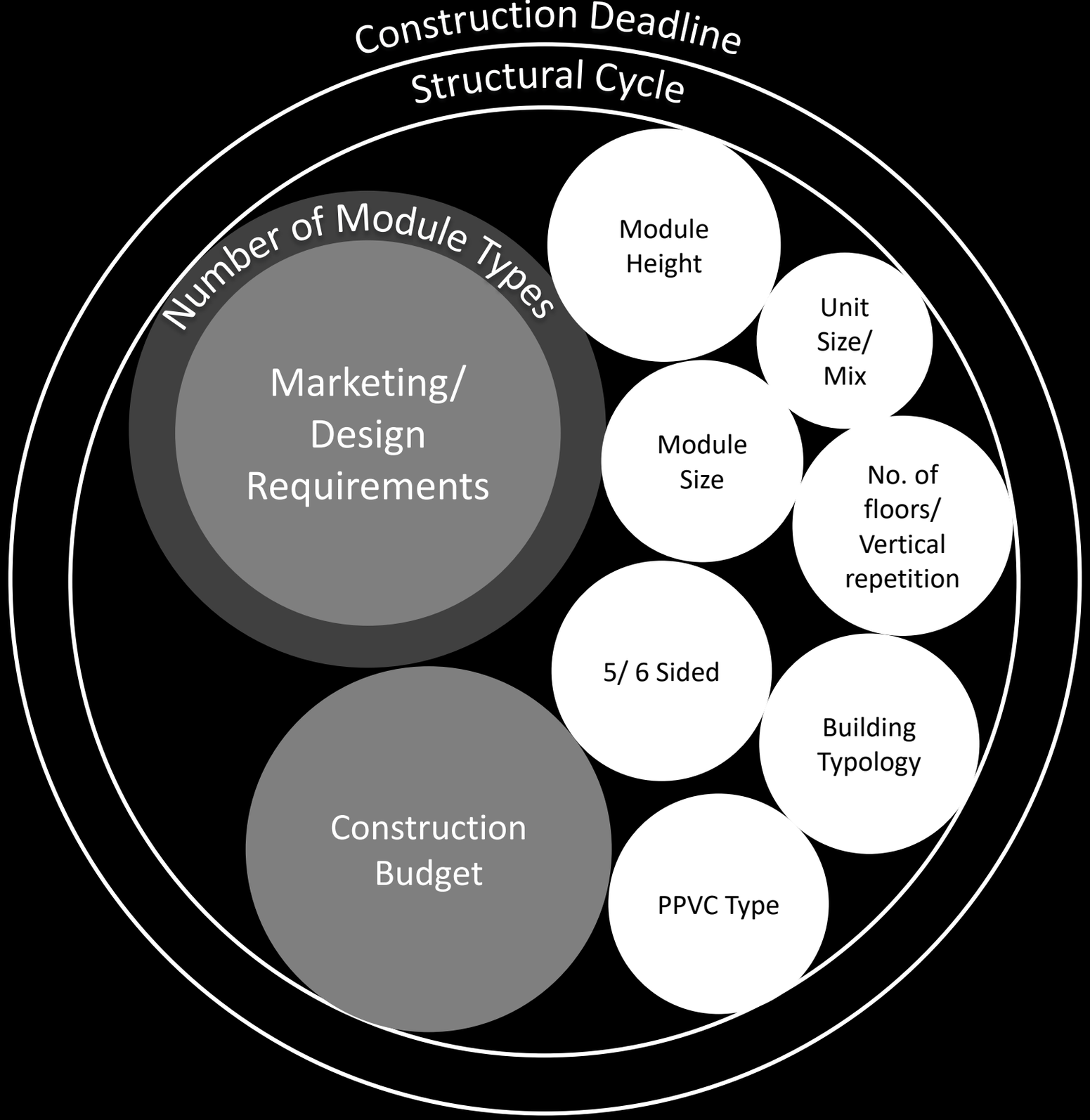
Automated 3 dimensional casting?
3D printing?

Will we have more of such architecture with PPVC method?

ADDP
architects

PPVC | efficiency in PPVC design

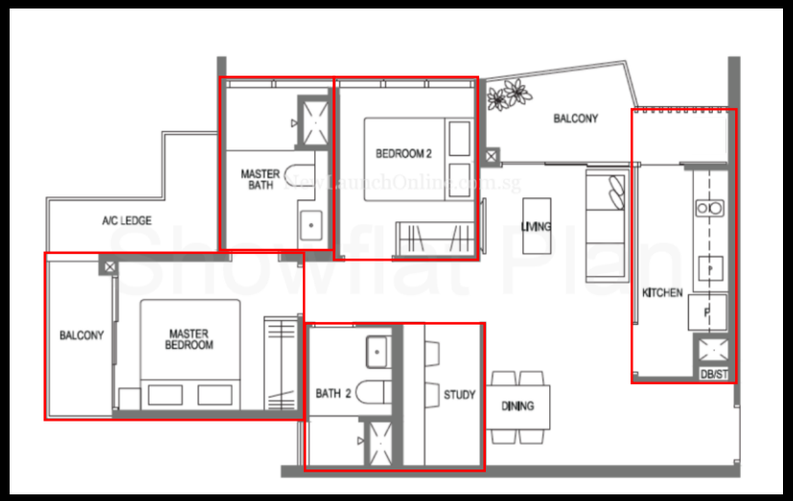
ADDP
architects


Construction Deadline
Structural Cycle
Number of Module Types
Marketing/ Design Requirements
Module Height
Unit Size/ Mix
Module Size
No. of floors/ Vertical repetition
5/ 6 Sided
Building Typology
Construction Budget
PPVC Type

case Study 1 | residential PPVC

<u>Marketing Design Driven Layout</u>

- High amount of module types
- Misaligned modules
- Small modules sizes, more joints
- Wider than 3.4m with AC ledge



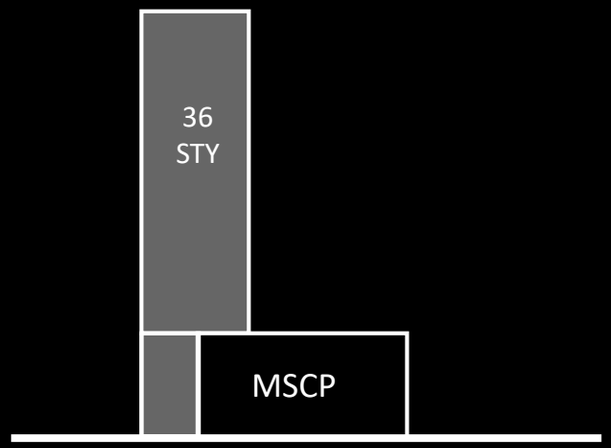
ADDP architects

case Study 2 | residential PPVC

<u>Balanced PPVC Design</u>

- Regular module layout
- Interchangable between unit types
- Front and rear layout align, easier for hoisting and joints
- Highly efficient PPVC design

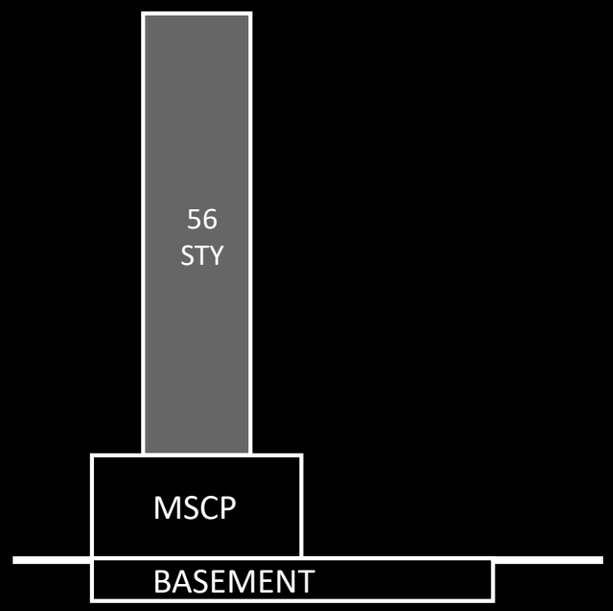
ADDP architects



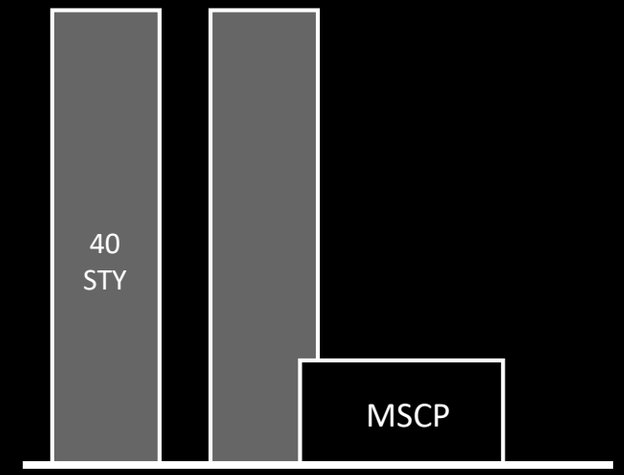
01 PARC RIVERIA

Good Typology for PPVC

- Highrise
- But require MSCP to complete first



02 AVENUE SOUTH RESIDENCES

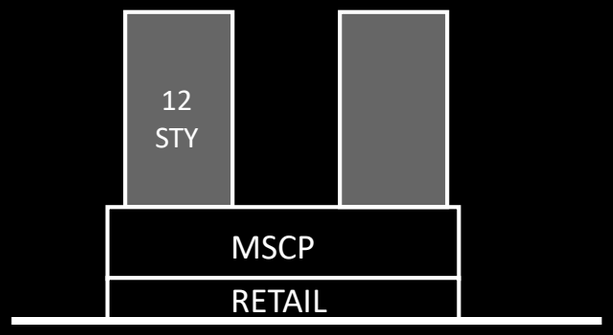


03 CLEMENT CANOPY

Ideal Typology for PPVC

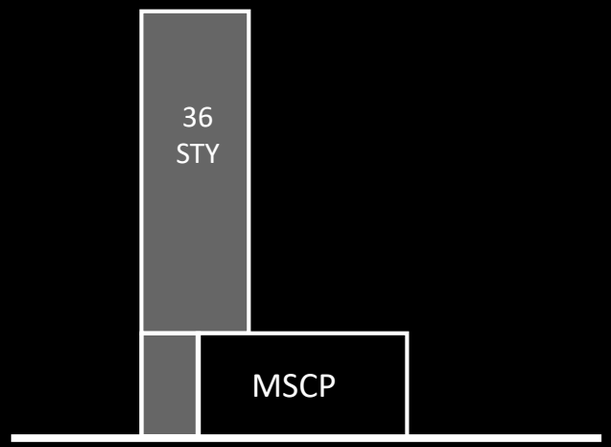
- Vertical repetition
- Min overlap with carpark
- Can start tower once foundation completes

04 DAINTREE RESIDENCES

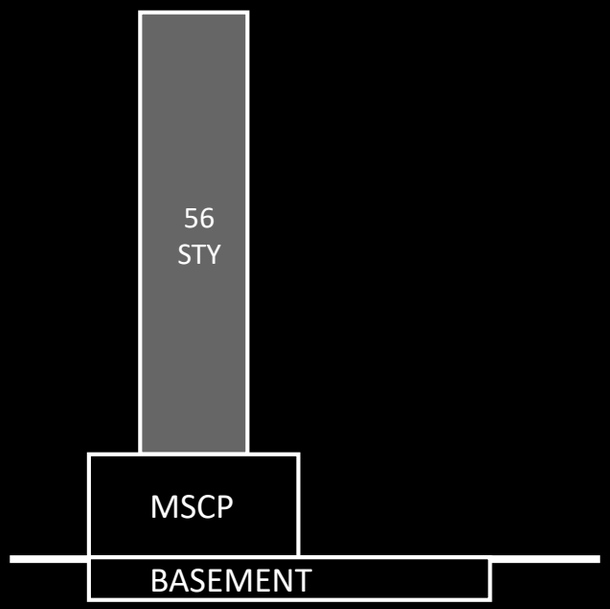


05 LE QUEST

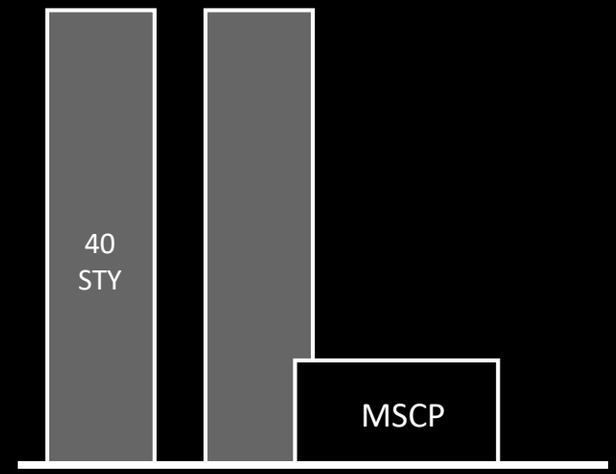
06 BROWNSTONE EC



01 PARC RIVERIA



02 AVENUE SOUTH RESIDENCES

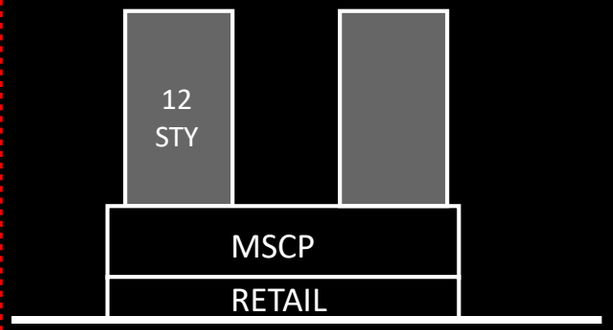


03 CLEMENT CANOPY

04 DAINTREE RESIDENCES

Not effective Typology for PPVC

- Low rise – 5 sty



05 LE QUEST

Average Typology for PPVC

- Mid rise
- Require podium to be completed

06 BROWNSTONE EC

Good Typology for PPVC

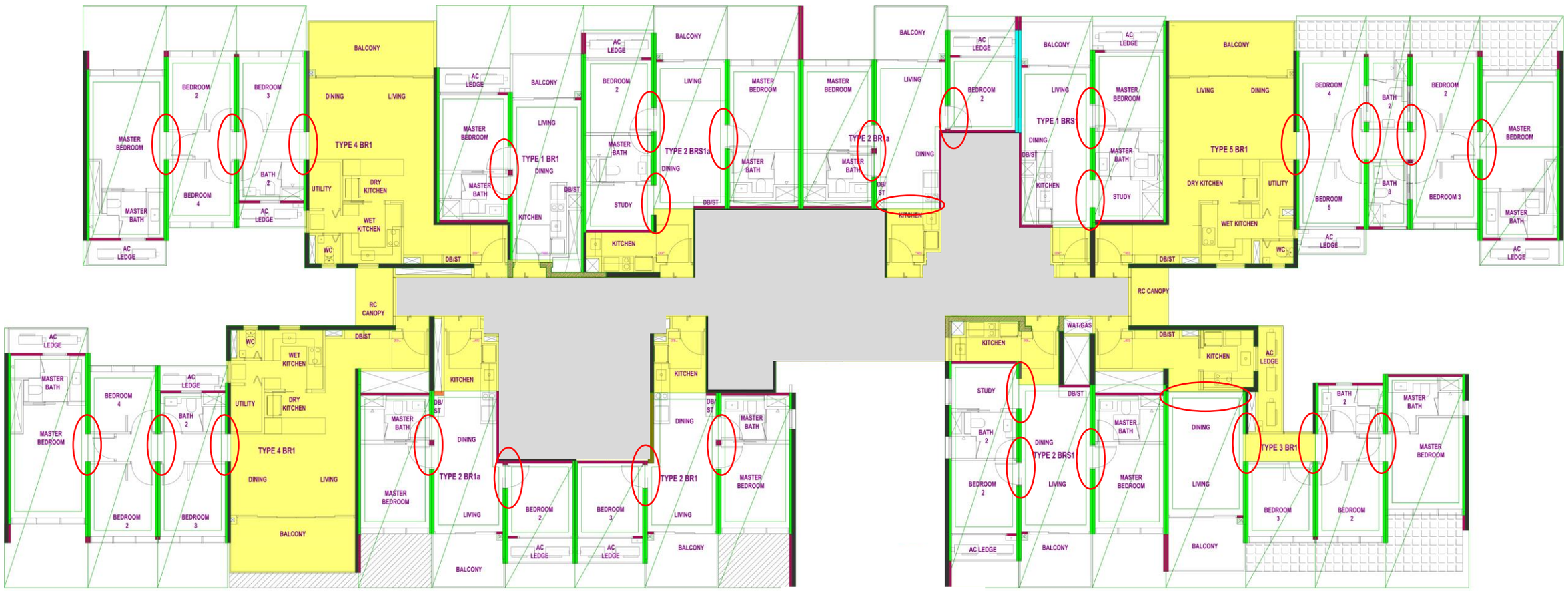
- No overlap with carpark
- Can start tower once foundation completes
- Not tall enough – 12 sty

PPVC | block/ unit case study

PPVC Design

- Rotate instead of Mirror
- Number of modules – depending on structural cycle
- Target for interchangability between diff units
- 20% non PPVC for areas wider than 3.4m
- Smaller units might not achieve 20% finishing due to floor joints

Element	Minimum level of completion off-site
Floor finishes	80%

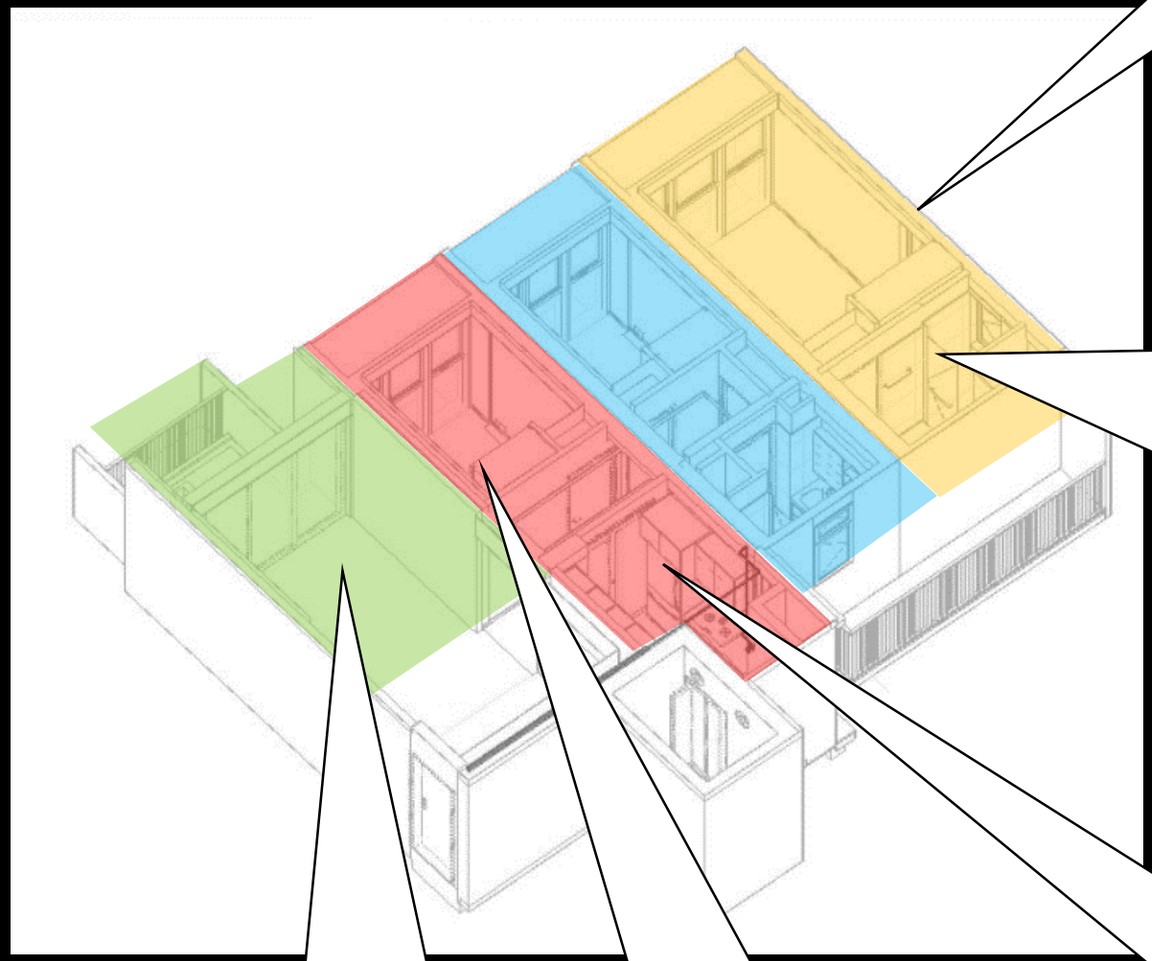


Pour Strip/ Floor Joint

Non PPVC

PPVC Modules

1. Concrete Structure

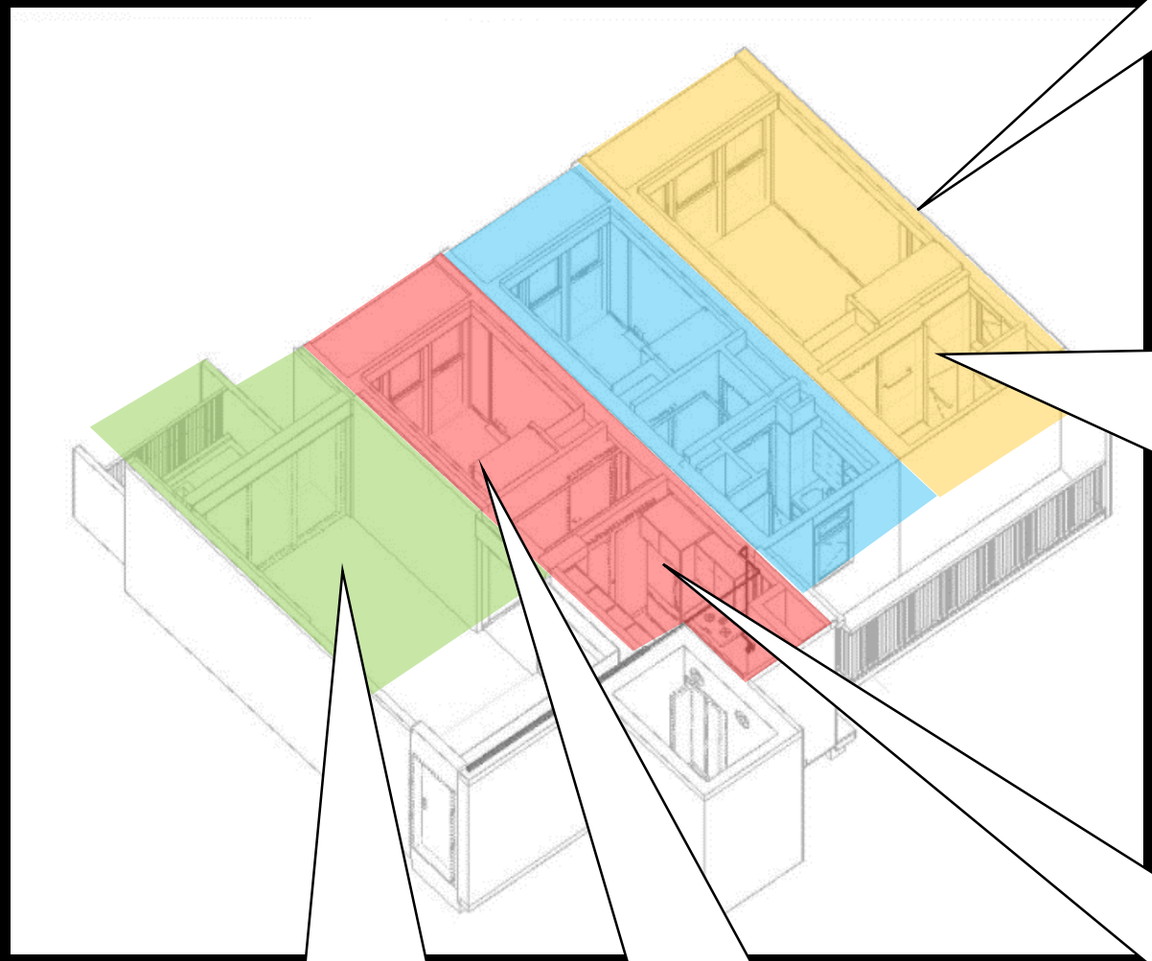


2. PBU/ IBB
- Waterproofing
- Tiles
- Carpentry
- Fixtures
- Glass
- Ceiling

3. Kitchen
- Waterproofing
- Tiles
- Carpentry
- Appliances
- Ceiling

4. Living/ Dining
- Tiling/ Stone
- Fixtures (A/C)

5. Bedroom
- Wardrobe
- Timber/ Vinyl Flooring



1. Concrete Structure

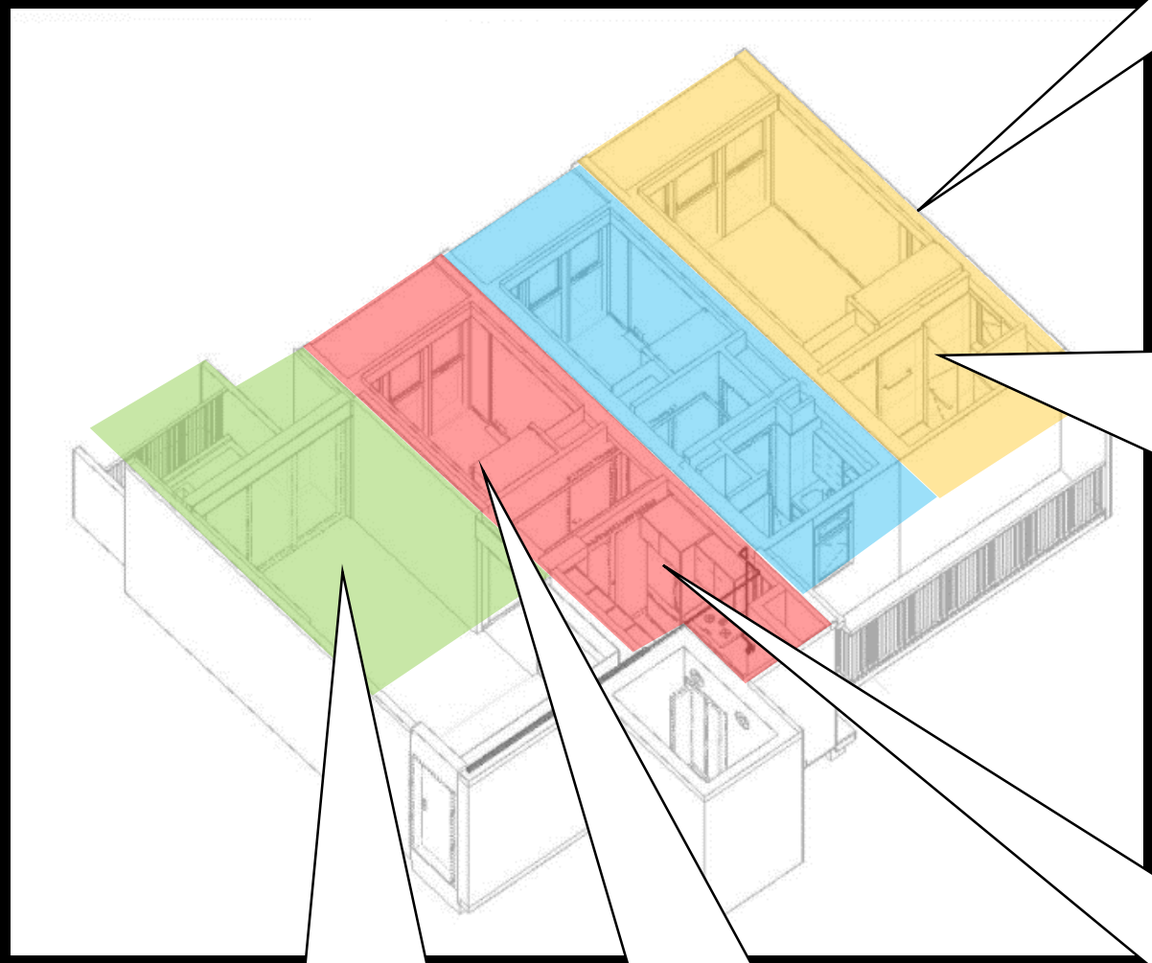
2. PBU/ IBB
- Waterproofing
- Tiles
- Carpentry
- Fixtures
- Glass
- Ceiling

PBU – Japanese type - “airplane toilet”
Large Panel wall cladding

3. Kitchen
- Waterproofing
- Tiles
- Carpentry
- Appliances
- Ceiling

4. Living/ Dining
- Tiling/ Stone
- Fixtures (A/C)

5. Bedroom
- Wardrobe
- Timber/ Vinyl Flooring



1. Concrete Structure

2. PBU/ IBB
- Waterproofing
- Tiles
- Carpentry
- Fixtures
- Glass
- Ceiling

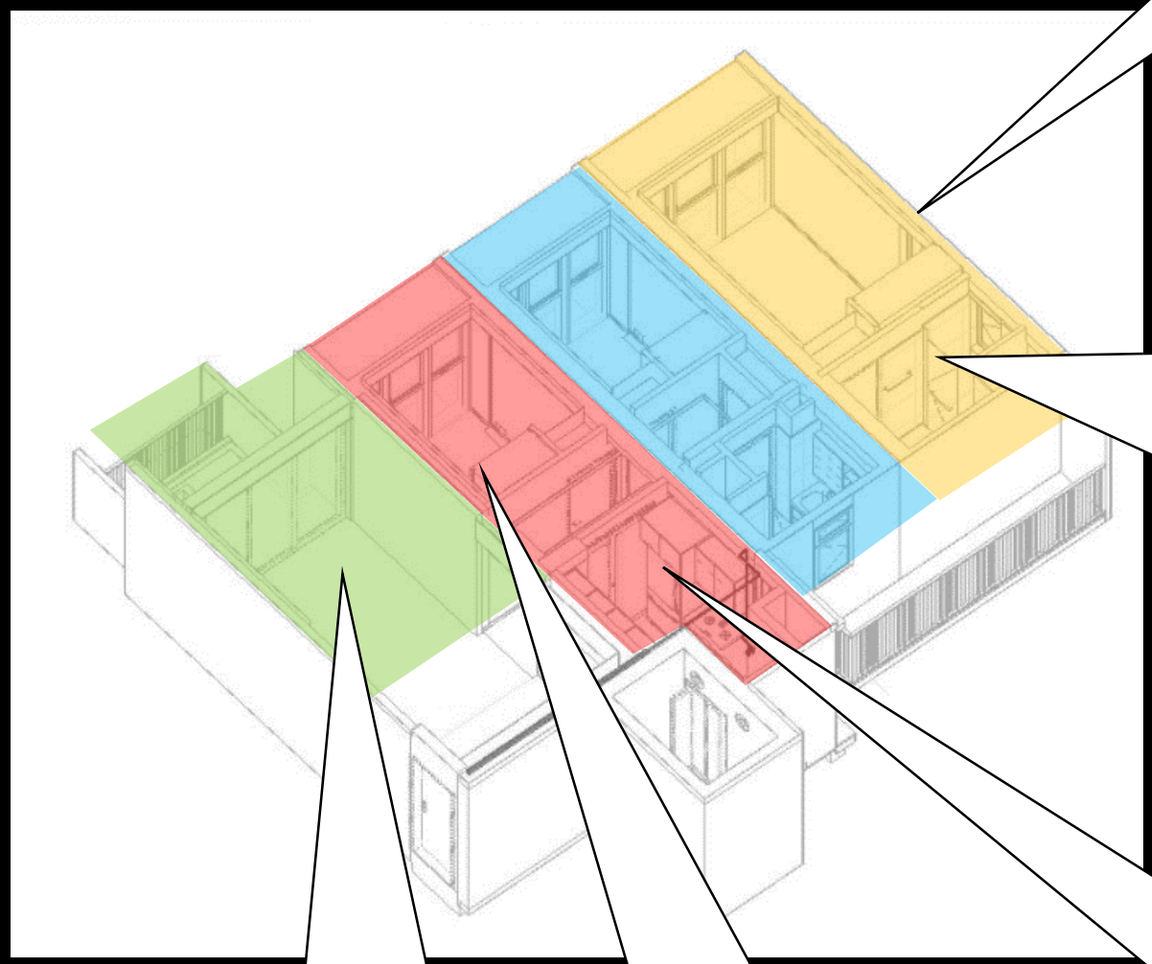
PBU – Japanese type
"airplane toilet"
Large Panel wall cladding

3. Kitchen
- Waterproofing
- Tiles
- Carpentry
- Appliances
- Ceiling

Modular/ flat pack
Kitchen

4. Living/ Dining
- Tiling/ Stone
- Fixtures (A/C)

5. Bedroom
- Wardrobe
- Timber/ Vinyl Flooring



1. Concrete Structure

2. PBU/ IBB
- Waterproofing
- Tiles
- Carpentry
- Fixtures
- Glass
- Ceiling

PBU – Japanese type
"airplane toilet"
Large Panel wall cladding

3. Kitchen
- Waterproofing
- Tiles
- Carpentry
- Appliances
- Ceiling

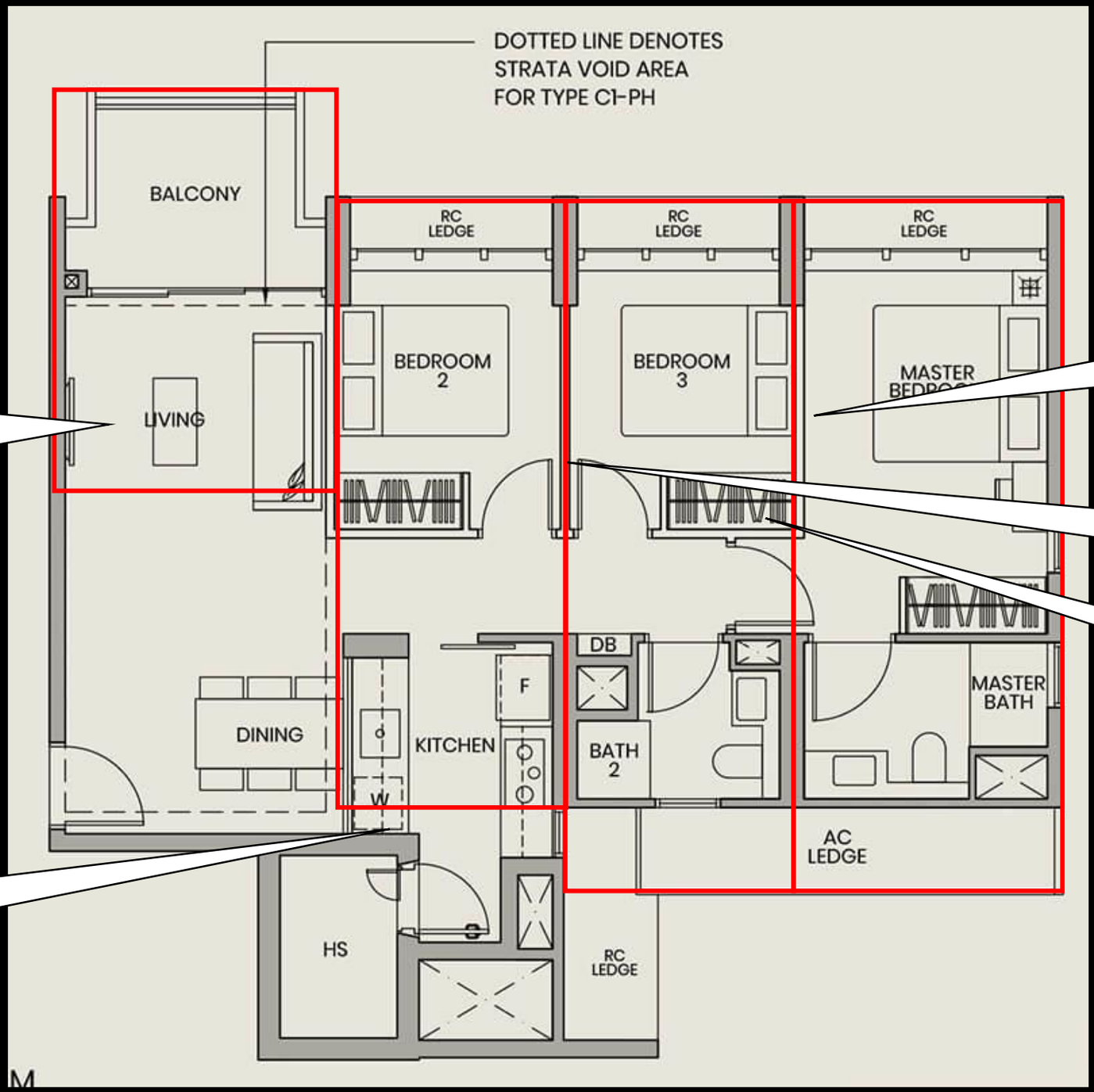
Modular/ flat pack
Kitchen

4. Living/ Dining
- Tiling/ Stone
- Fixtures (A/C)

Whole unit Vinyl Flooring

5. Bedroom
- Wardrobe
- Timber/ Vinyl Flooring

PPVC | column free plan?



Oddly shaped 3 sided modules

Large span for module, beam above

Floor joints/ pour strip

Finishing issues for wardrobe/ floor finishes

Precast HS not ideal for joints to PPVC modules

Currently working on our “Gen 2” of column and beam free PPVC.

SUMMARY

+ Current situation of DfMA/ PPVC

+ Further improvement into carcass production
  - 3D printing
  - Automated casting as possible next frontiers
  - Allow the ‘Box’ to be reimagined (ie more irregular form)

+ Further improvement of productivity on micro level

  Most labour intensive works can be further streamlined (subject to market acceptance)
  - Floor Tiling -> Vinyl
  - Plastering -> Machine
  - Bathroom -> Integrated WC/Basin/ Mirror Unit
  - Wall tiles -> Big wall panelling

+ To further push for productivity and flexible open plan space design

THANK YOU
Q&A

NG SIN YONG
ADDP ARCHITECTS LLP
SYNG@ADDP.SG

ADDP
architects