THE HONG KONG POLYTECHNIC UNIVERSITY
香港理工大學

J.C.DISI
賽馬會社會創新設計院

WEBINAR / CPD TRAINING

TRANSITIONAL SOCIAL HOUSING PLANNING WORKSHOP

Architectural Design for Transitional Social Housing by Modular Integrated Construction

26 May 2020

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SYMPOSIUM SERIES 研討會系列

10萬分1 One from Hundred Thousand

Season 1 TSH Pre-symposium **Co-design Workshops** & **Symposium** (9,10/2018)

- **Summary Report** (11/2018) - **Technical Advisory Panel** (2/2019)

Season 6 TSH Pre-symposium **Planning Workshops** & **Symposium** (5,7/2020)

- Action Projects **Consultancy Report** (7/2020)

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Chinese National Engineering Research Centre
For Steel Construction (Hong Kong Branch)

Research Project "Relocatable Housing by MiC" (9/2020)

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1. Introduction
    - Modular Integrated Construction for Transitional Social Housing
2. Key Design Strategies
    - Module design: size, types & configurations
    - Block planning: building clusters (wings)
    - Unit internal layout: kitchen, pantry, bathroom
3. Current Research – Design Prototype

1. Introduction - Modular Integrated Construction: Terminology and Basic Concept

Modular
integrated
Construction

"factory assembly followed by on-site installation"

Prefabricated
Prefinished
Volumetric
Construction

Design
for
Manufacture &
Assembly

"ease of manufacture and efficiency of assembly"

Panelized
+
Pod

Possible Hybrid?

Precedents

Low income social housing examples (low rise)


London Cooperative Housing UK


Monterrey Social Housing, Mexico


Morangis Retirement Home, France


Donnybrook Quarter, London


La Courneuve Social Housing, France

Mei Ho House Youth Hostel, Hong Kong

Maribor city, Slovenia

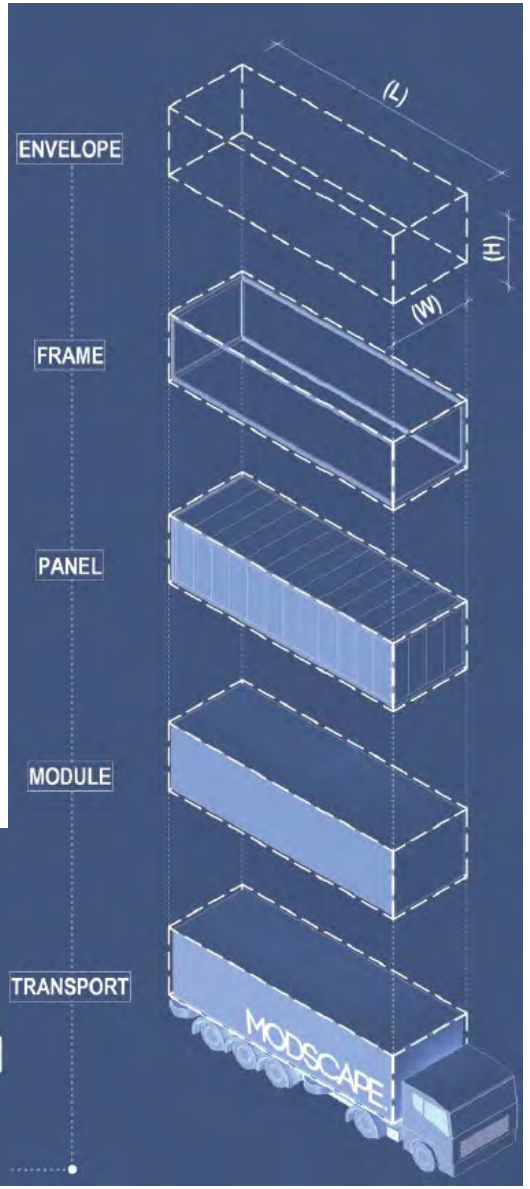
WHY Modular Housing System?

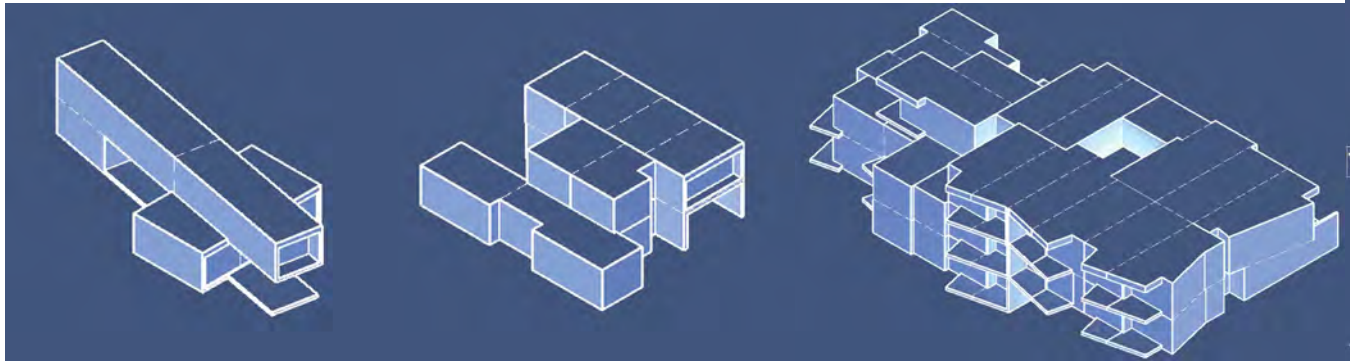
Benefits to building industry and society:

- QUICK DELIVERY - Shorten construction time on site
- **CONSTRUCTION SAFETY & HEALTH** - Enhance occupational safety on site
- **BIM** APPLICATION - improve integration of design, manufacture & installation
- ADAPTABLE - Modular system can respond to varying site, environmental conditions and operational needs
- ENVIRONMENTAL & ECONOMICAL– reduce building material consumption & wastage, modules are relocatable & reusable
- SOCIAL IMPACT - direct response to pressing social needs e.g. manpower decline
- MiC DEVELOPMENT – global trend to widen adoption to multiple sectors

For Transitional Social Housing

- **Relocatable & Reusable** – to suit land tenure, site availability & efficient life cycle costing
- **Optimum scale of economy** – unit types to modular units ratio (>1:50)
- **Adaptable** – flexible modular unit combinations to respond to changing society needs e.g. different demographic groups in different districts and future time

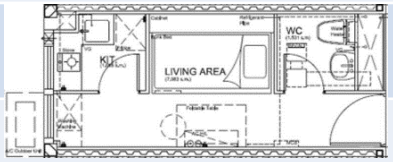


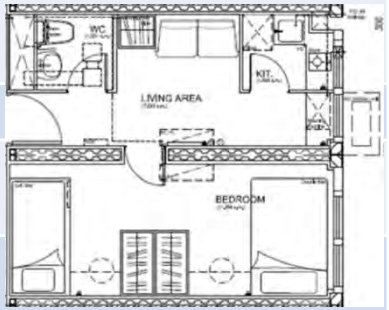


Comparable Examples

https://www.rsh-p.com/projects/place-ladywell/

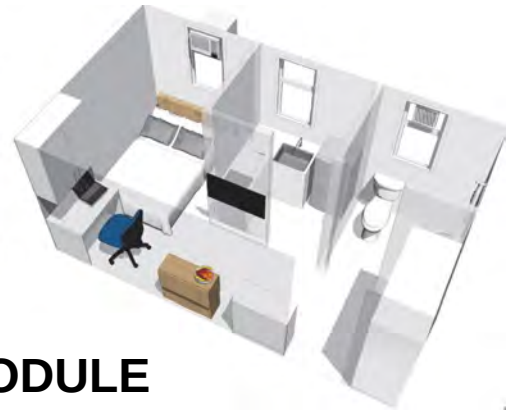
Project	Hong Kong Council of Social Services (Operator - Tung Wah Group)	"Ladywell" Pop Up Scheme for Homeless Families
Location	202-220 Nam Cheong Street, Shum Shui Po, Kowloon, Hong Kong	Lewisham Council, London UK
Time Program	"Design & Built" Contract 4/2019 – Q2/2020 (**365 days+**) Land tenure overall **5 years** (2017-2022)	Design, construction **2 years** (2014-2016) Land tenure **4 years** (2017-2020)
Structure	4 storey **steel** framed (2.5m wide modules)	4 storey **timber** framed
Unit type	**1 person, 2 persons, 3 persons** flat @13.36 – 20 - 26.73 sqm respectively (total **89 nos**.)	**4 person** (2 bedrooms) flat @80 sqm approx. (total **24 nos**.)
No. of occupants	150 approx. **@> 7.5 sqm** approx.	96 approx. **@ 20 sqm** approx.
Construction cost	**HKD$ 400,000/ unit** approx. (total project HKD$ 37.5mil)	**£ 1,200/sqm**. (total project £ 4.98 mil)
Redeployed	Not known, Design life to **20 years**	**5** more times, Design life **60 years**





MiC Building Components

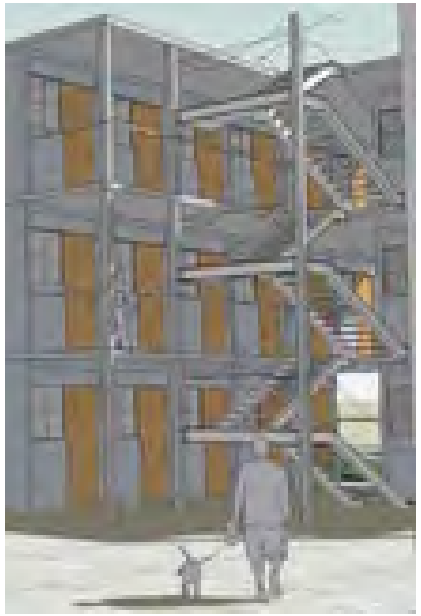
SINGLE MODULE



FAMILY (TWIN) MODULE

STAIRS – OPEN / VENTILATED

ACCESS CORRIDOR – SINGLE / DOUBLE LOADED



(ARCHTECTURAL FAÇADE – CUSTOM DESIGN)

(ROOF, PASSIVE SOLAR - CUSTOM DESIGN)

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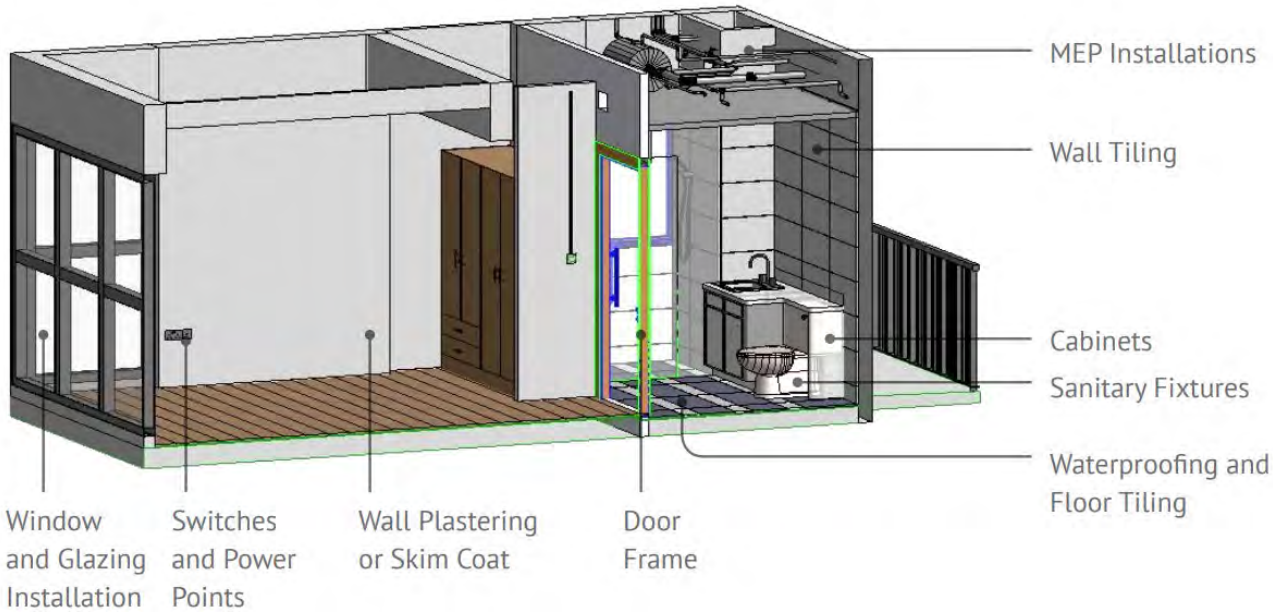
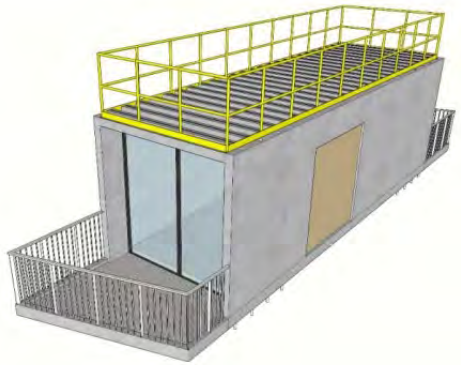
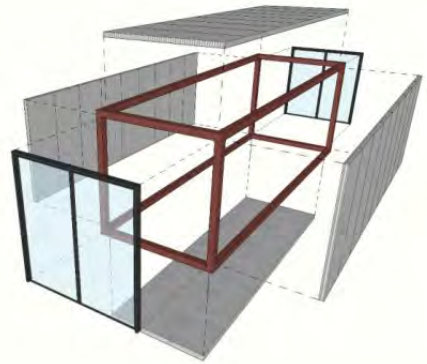




1

REINFORCED CONCRETE PPVC MODULE

Wall: Concrete
Floor: Concrete



2

STEEL PPVC MODULE

Wall: Steel frame with lightweight walls
Floor: Concrete or Lightweight Flooring System

Building and Construction Authority

2. Key Design Strategies- Module size & Configurations

Occupants needs

- **Privacy** – to be balanced with social interactions.
- **Daylight and ventilation** – adequate fresh air and sunshine
- **Social Interaction** – connection with the wider community
- **Noise, odors, crowdedness** – mitigate to reduce stress levels and negative perception of density.

Vulnerable demographic groups & priorities:

FOR WHO ?

- **Low income singles** – shared space for co-working and co-living
- **Single Families & Small Family with Children** – more space for play and activities.
- **Early career youth –** higher needs of autonomy personally & financially
- **Elderly** – access to natural environments, places to walk, exercise, rest and connect to society.
- **Persons with disabilities** – universal accessibility for independent & dignified living.

Traffic Requirement & Module width

Hong Kong

TD Requirement for Wide Load Delivery	
Width of load on Vehicle	Hour
Width <2.5m	Any time
2.5m< width <2.8m	Permissible from 10:00 am to 4:00 pm with Wide Load Permit
2.8m< width <3.5m	Permissible from 8:00 pm to 7:00 am with Wide Load Permit
>3.5m	Apply with Transport Department

EPD Requirement for Noise Control	
Barge Loading/Unloading	
Preferred Barge Loading Hours	8:00am to 9:00pm
Cease Barge Loading Activities	11:00pm to 7:00am
Assumed Sound Power Level	
Lorry	112 dB(A)
Tower Crane	95 dB(A)
Basic Noise Levels	
Evening Hours 7:00pm to 11:00pm	65 dB(A) for HKSTP Site
Night Hours 11:00pm to 7:00am	50 dB(A) for Site in Tai Po

*TD and EPD Requirement for reference only. And shall be assessed on case-by-case basis

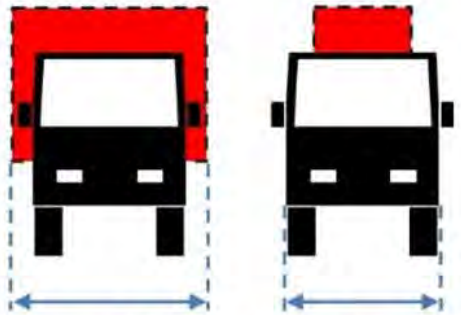
Singapore

*** Rear Overhang of Load ***

Excess length of load extending beyond rear of motor vehicle or trailer (including any load).

Permit is required when rear overhang is:

- more than 40% of length of motor vehicle or trailer carrying load; or
- 1.8 metres



*** Overall Width ***

From leftmost point to rightmost point of motor vehicle or trailer (including any load).

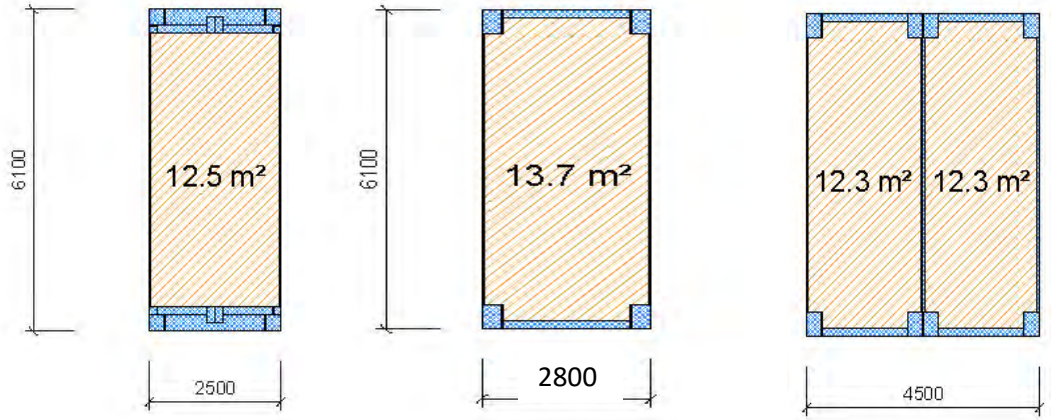
Permit is required when overall width is :

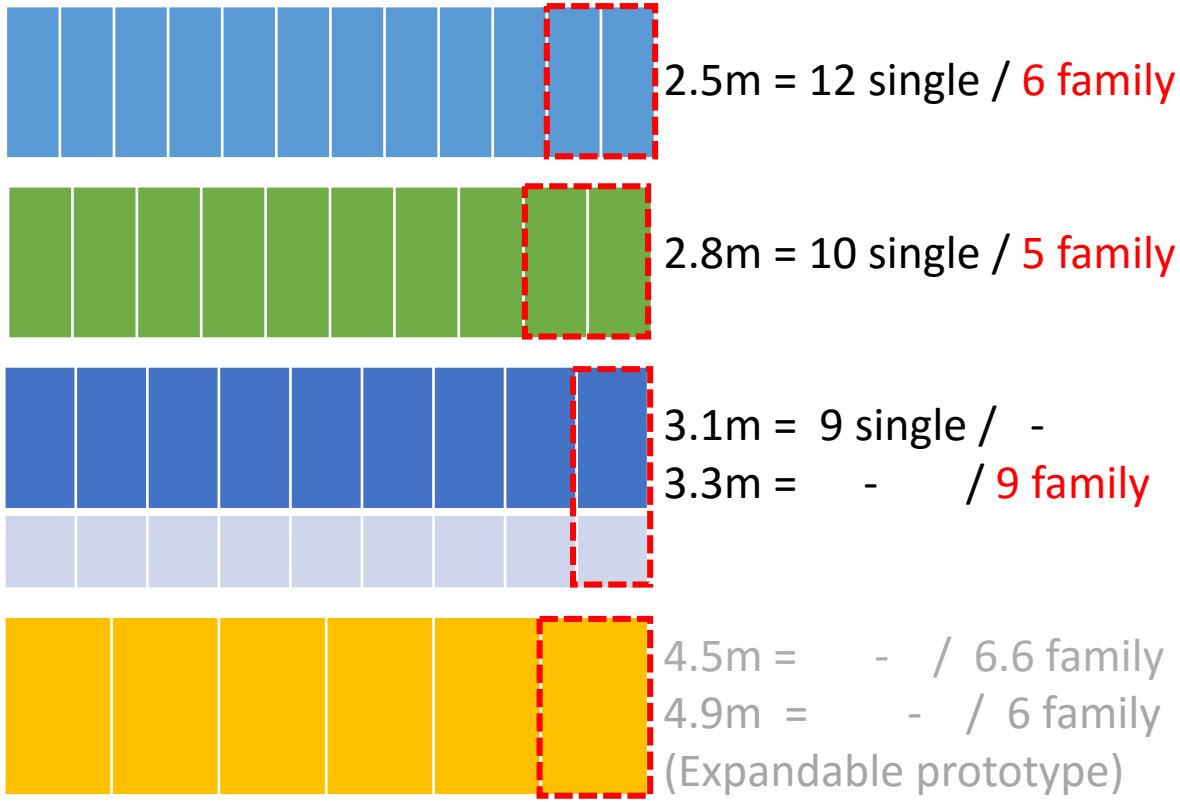
- more than 3.0 metres; or
- more than 2.6 metres when travelling on controlled roads

No single maximum limit for width, length, height, or weight for public roads. Limits would very much depend on proposed route

Spatial Configuration

MiC module internal floor area
(in accordance to PNAP APP-161)





- Spatial layout options and **smart furniture** placement based on respective needs of demographics
- Parametric **daylight** and **ventilation** to comply with BD regulations.
- Optimisation of **window to wall ratio** of MiC modules.

Units types to Module types ratio – enhancing the cost efficiency of MiC

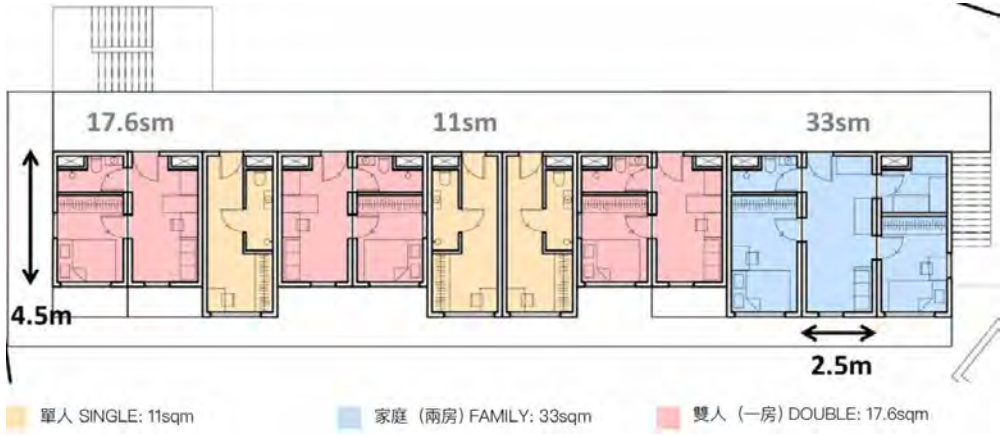
Site A - 213 units (4 unit types)

Total Number of MiC Modules	210-355*
Number of MiC Module Types	12
Number of MiC Modules per Unit Type	50-60*

* Depending on scheme

(Efficient)

Site B - 21 units (3 unit types)



Total Number of MiC Modules	36
Number of MiC Module Types	9
Number of MiC Modules per Unit Type	3-6

(Not efficient)

Tips: To further improve ratio / cost efficiency, avoid mirror layout of same unit type (note: pay-off in coordination of additional piping or deleting pipe ducts entirely)

Block Planning – Optimum building clusters/wings

- Linear or rectangular layout with open corridors for natural lighting & cross ventilation
- Communal space at the corner
- Communal Space : Unit area = range from 8% to 12.5%.

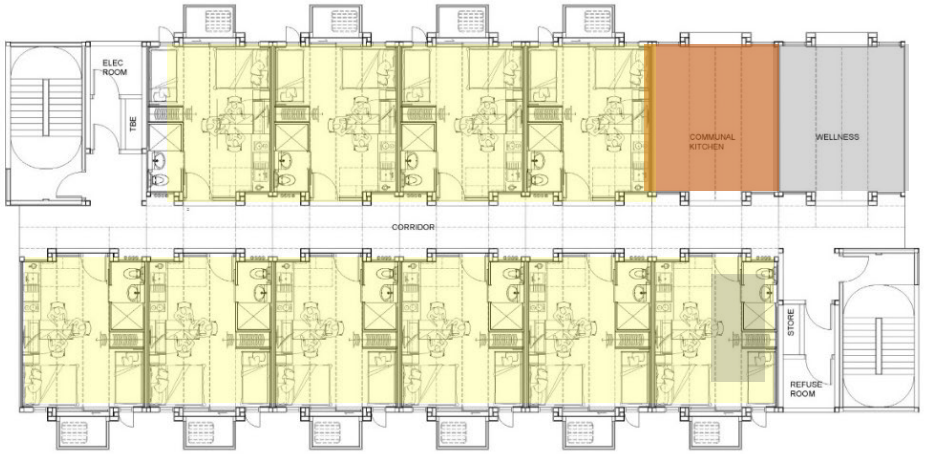
i.e. 1:8 to 1:12 (typical vs ground floor)

Project	Country/Region	Communal Space (m^2)	Communal Space per unit	Communal Space percentage
Mei Ho House Youth Hostel	**Hong Kong**	521	4.6	**8%**
Kaohsiung Social Housing	**Kaohsiung, Taiwan**	2440	9.96	**8%**
Plaza Apartments (Affordable housing)	San Francisco, US	63.1	5.26	12%
The Schemerhorn (Affordable housing)	New York, US	1109	5.87	14%
Commonspace (Co-living)	Syracuse, US	162.2	7.7	19%
Carmel Place (Co-living)	New York, US	443.1	8.05	14%
Average			**6.9**	**12.5%**

1:12
(Typical Floor)

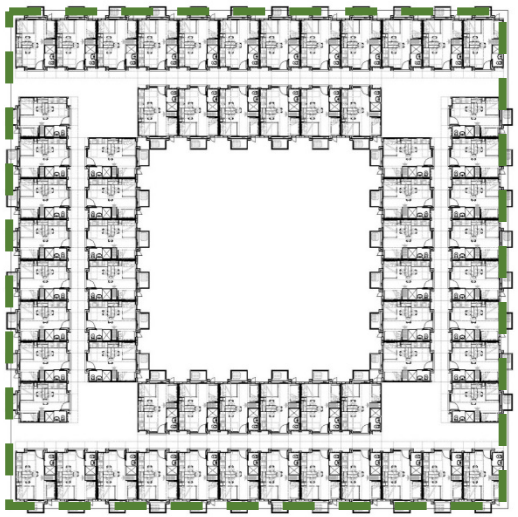
Affordable Housing by Paulett Taggart Architects
http://ptarc.com/work/housing/plaza-apartments/

1:10
(Ground Floor)



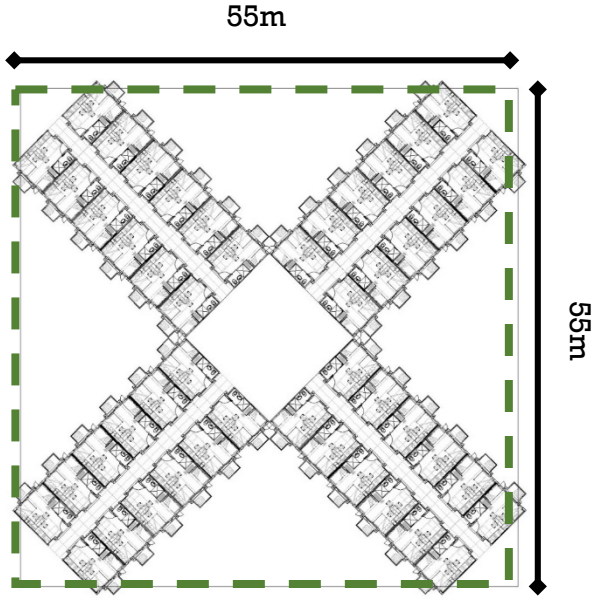
MLP Layout – Optimizing total no. of units

A few MLP configurations based on a 55m by 55m plot have been studied to maximize the number of modules to be placed on site. Further optimization of MLP configuration will be carried to suit specific site attribute and constraints.



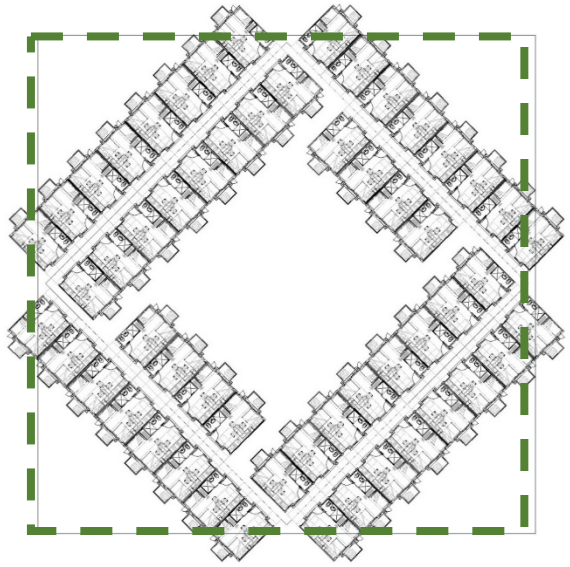
64 UNITS MAX

(MOST EFFICIENT)



48 UNITS MAX

(OPEN ASPECT)

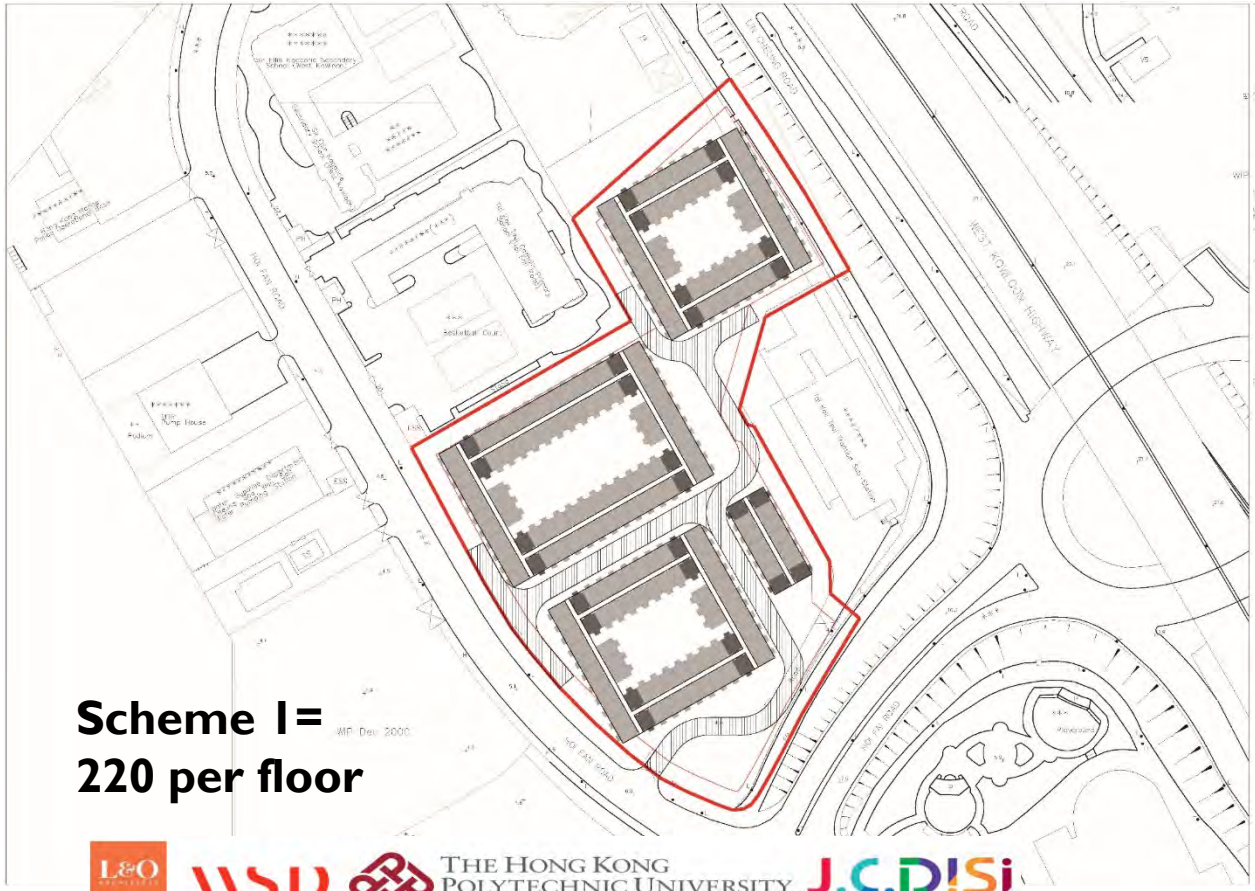


56 UNITS MAX

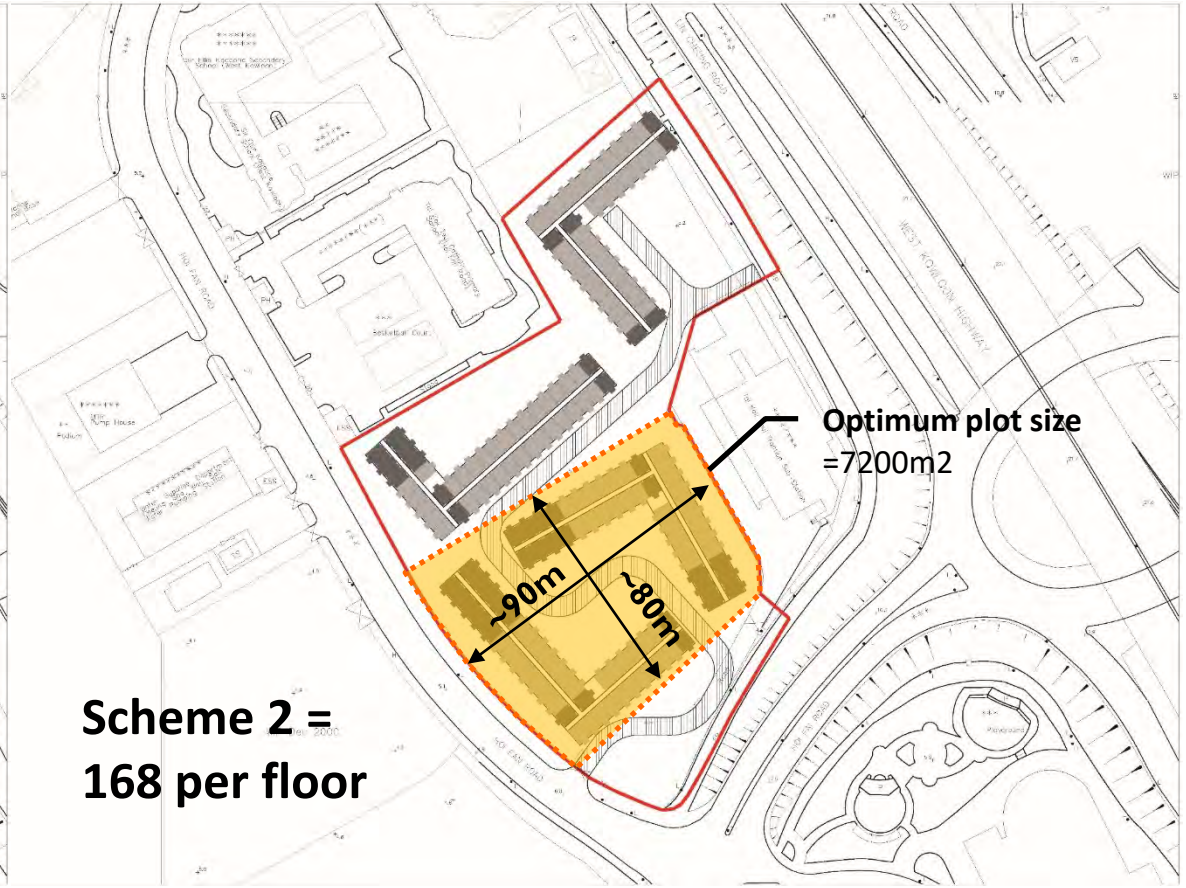
(OPTIMUM?)

Block Planning - Master Layout Plan

The number of units were determined by basic statutory required e.g. EVA and prescribed window, as well as taking wellbeing into consideration. Optimised plot size was determined by maximising the number of unit to be placed within the sit. However, this will subject to actual site attribute and site constraints applicable.

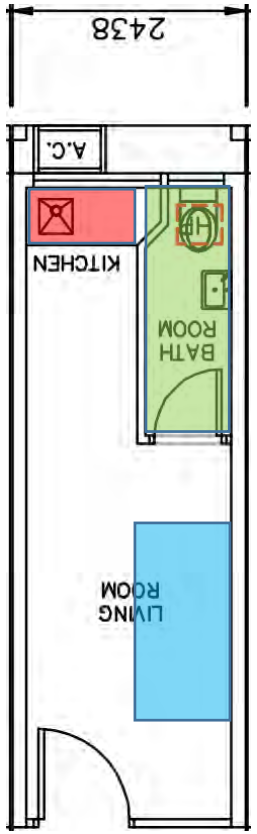


Scheme 1=
220 per floor

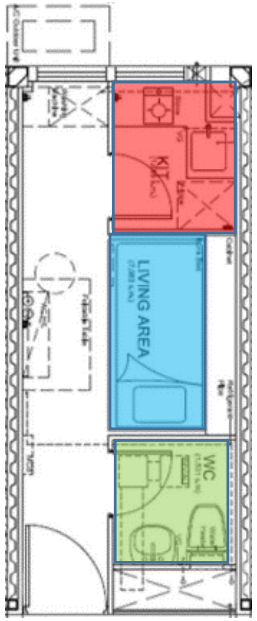


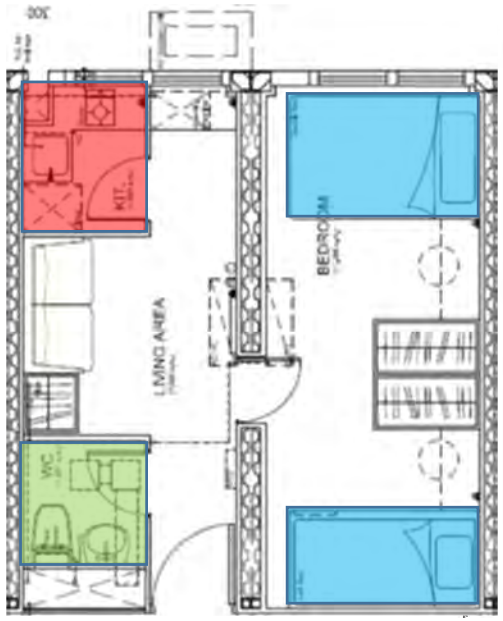
Scheme 2 =
168 per floor

Unit layout – Kitchen, open pantry, bathroom



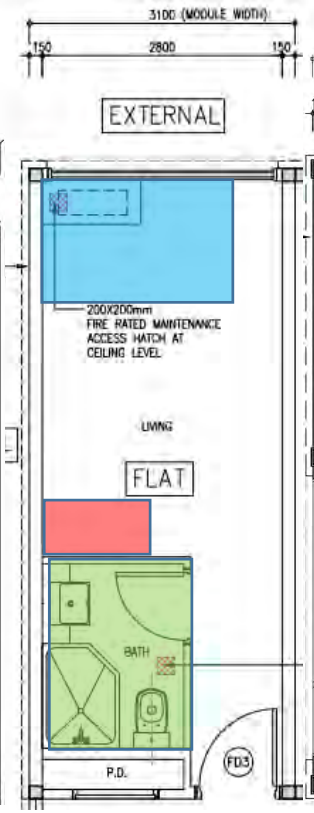
2.5m
Single



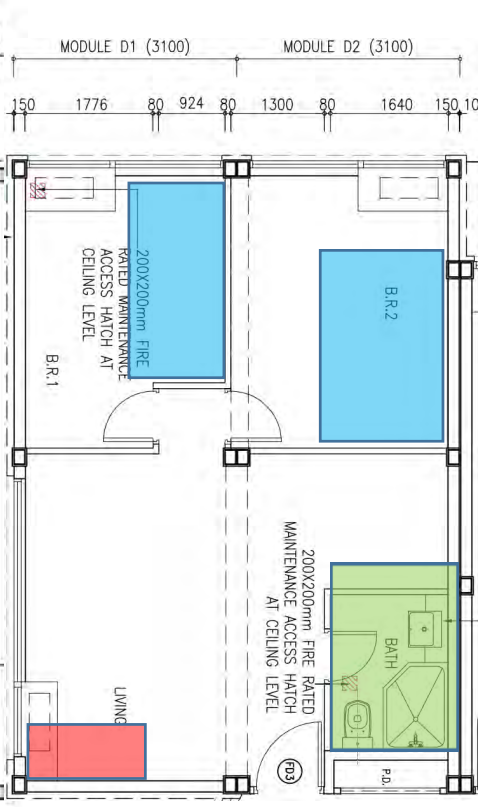


2.5m x 2
Family (3 -4 p)

2.5m x 3
Family (3-4 p)



3.1m
Double(2p)



3.1m x 2
Family (4p)/Accessible

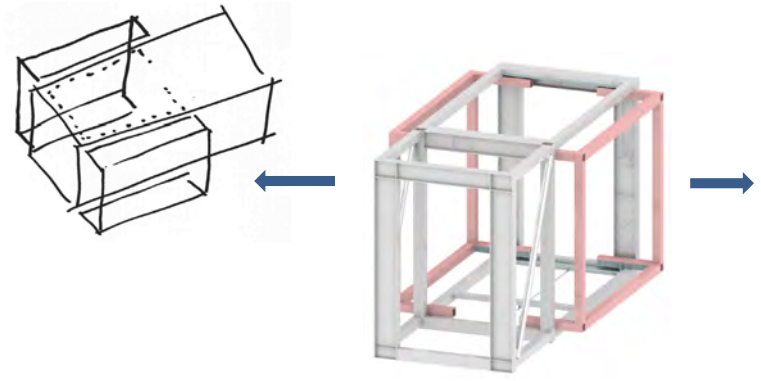
Priority? Unit living space vs kitchen vs bathroom ……. & communal space

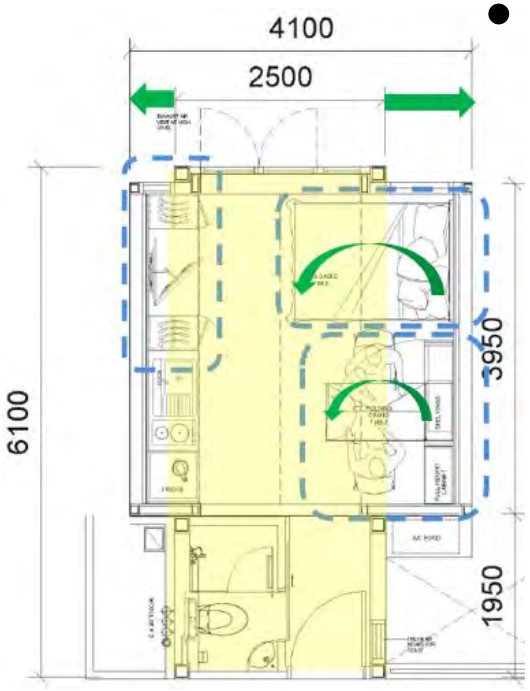
3. Research - “Relocatable social housing by Modular Integrated Construction”

Objective : To develop an adaptable prototype design (1) to meet different site conditions and occupancy needs, (2) also fully relocatable, reusable and self-sustainable.

Main challenges 主要挑戰

- Multiple land use (Open car parking) 一地多用 (地面泊車)
- Road transport restriction 路運限制
- Scale of economy 經濟規模
- Technical burden on NGOs 建築設計支援





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Chinese National Engineering Research Centre For Steel Construction (Hong Kong Branch)

Expected results 預期成效

- Adaptable/expandable on site 高適應度
- Bulk purchase w/customization 批購+定制
- Supply chain install-maintain-relocate service 供應鏈串聯服務
- Tripartite PPP 三方「公商社」合營

Fund for social housing operators
Fund for construction and maintenance
Technical support & design customization for social housing operators

Research Project

Relocatable Housing by MiC

(Modular Integrated Construction)

in Hong Kong

Interim Design Report

Dec 2019

DESIGN TEAM

L&O ARCHITECTS

wsp

THE HONG KONG POLYTECHNIC UNIVERSITY 香港理工大學

J.C.D!Si 賽馬會社會創新設計院

RESEARCH FUND

國家鋼結構工程技術研究中心香港分中心
Chinese National Engineering Research Centre For Steel Construction (Hong Kong Branch)

Objectives

Propose a versatile **MiC building system prototype** for Hong Kong context:

1. **Fully relocatable, reusable and environmentally self-sustainable**
2. **Time and cost efficient** low-rise structural and **building system**
3. **Built-in flexiblity** to meet different occupants' needs

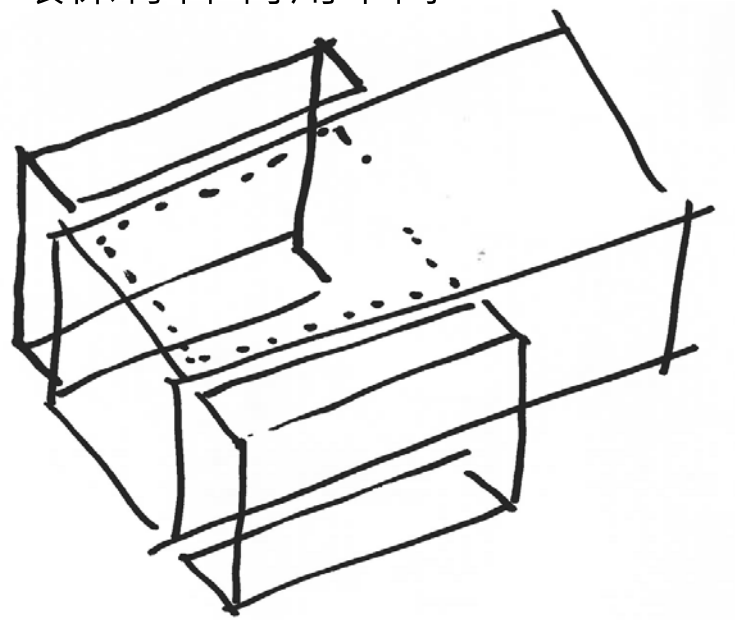
Concept

Expandable MiC prototype module

- Overcome **road transportation limitation** - packaged to 2.5m wide & transported during daytime.
- **Expand on-site** to 4.5m to 4.9m wide – create efficient unit layout optimized for living to meet different occupants' needs.
- **Volumetric** construction - minimize in-situ works
- Allow maximum potential for **future reuse**

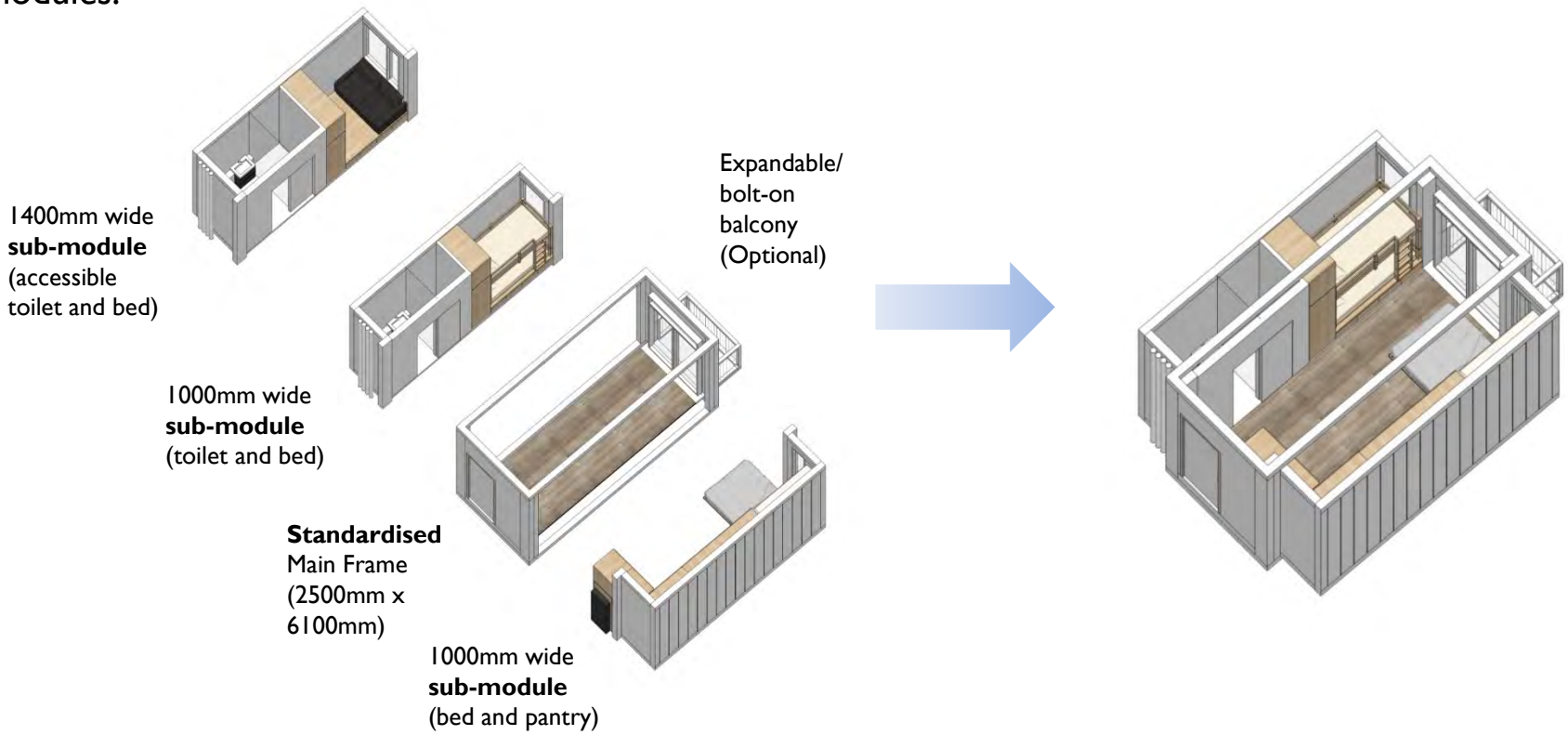
鋼結構

- 運輸吊放-輕巧易搬
- 安裝拆卸-简單
- 環保材料-再用率高

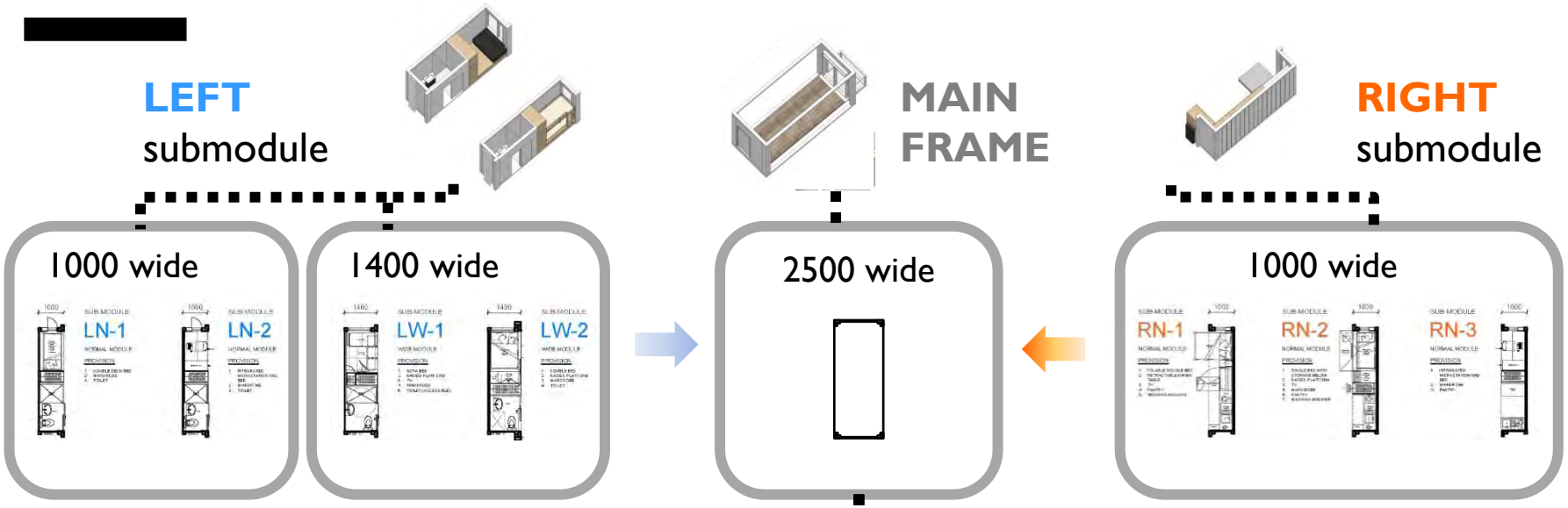


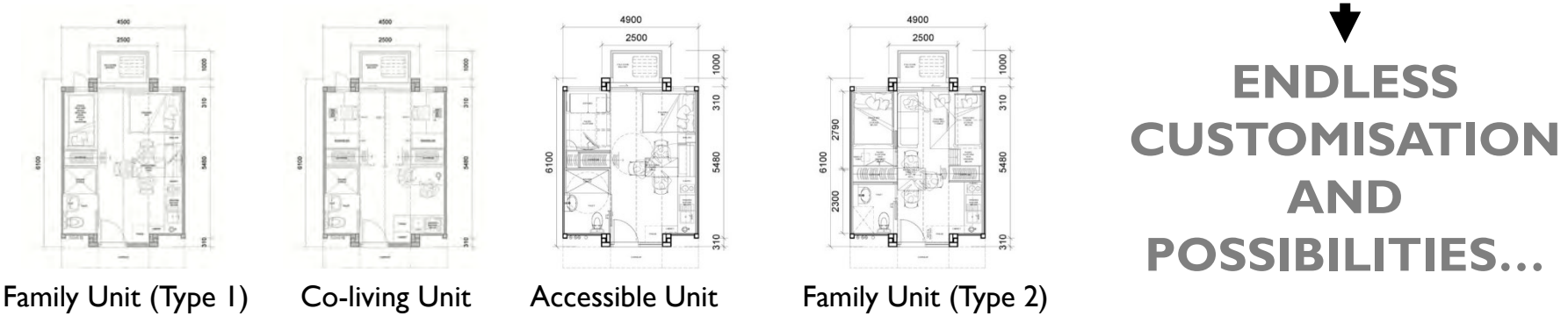
Module Standardisation

In order to achieve cost effectiveness, all modules are fabricated in the concept of fitting **purpose-built submodules** on two sides of **a standardised main frame modules**. The cost effectiveness can be further increased by eliminating the need of mirrored units in order to reduce the variation of submodules.



Module Combination Matrix





Family Unit (Type 1) | Co-living Unit | Accessible Unit | Family Unit (Type 2)

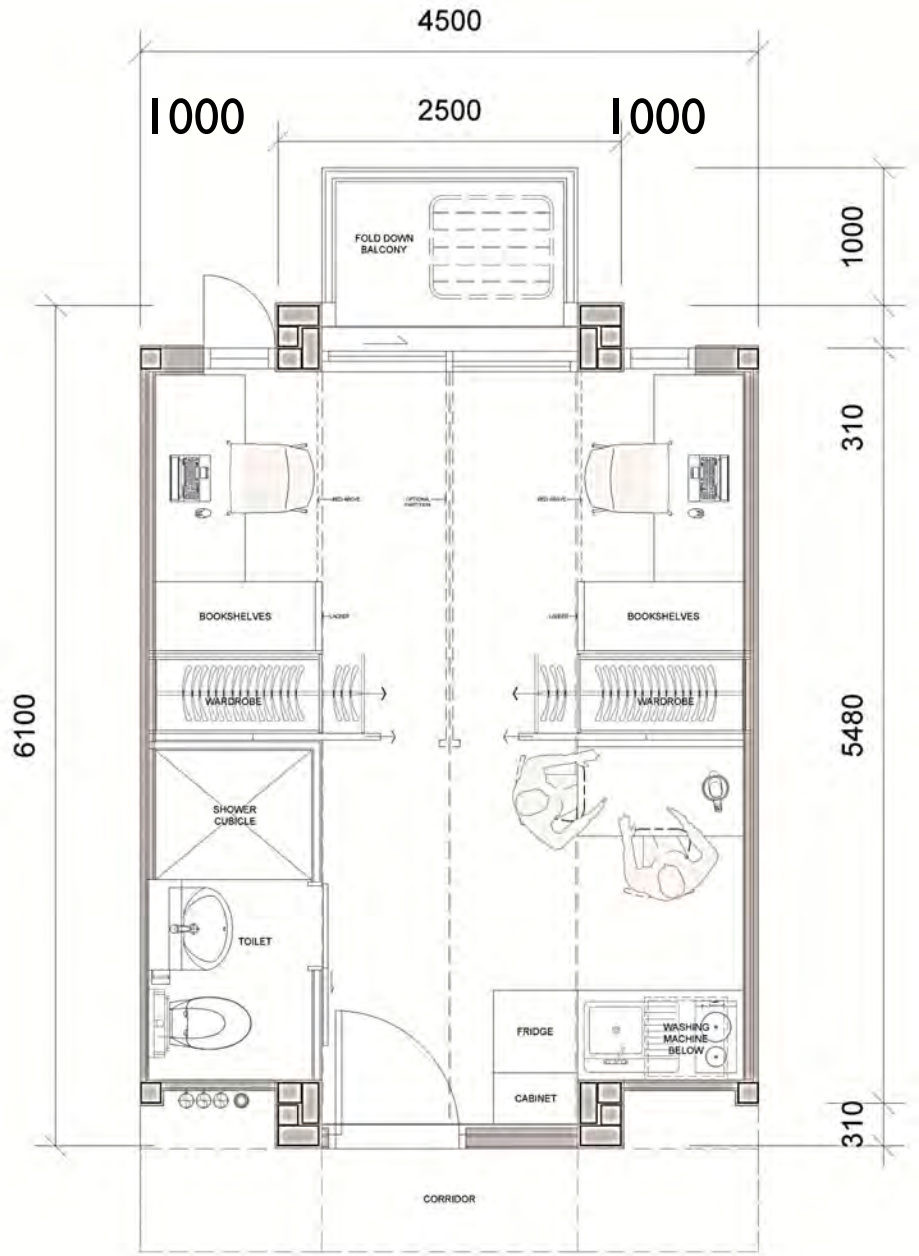
ENDLESS CUSTOMISATION AND POSSIBILITIES...

L&O ARCHITECTS wsp THE HONG KONG POLYTECHNIC UNIVERSITY 香港理工大學 J.C.DISi 賽馬會社會創新設計院

Co-living Unit (2P) Layout

HIGHLIGHTS

- shared unit for **2 people**
- Bedrooms can be separated for **private living space.**
- **Share bathroom, living room & open kitchen.**



CO-LIVING 2P – TYPE 1
(LOWER PART)

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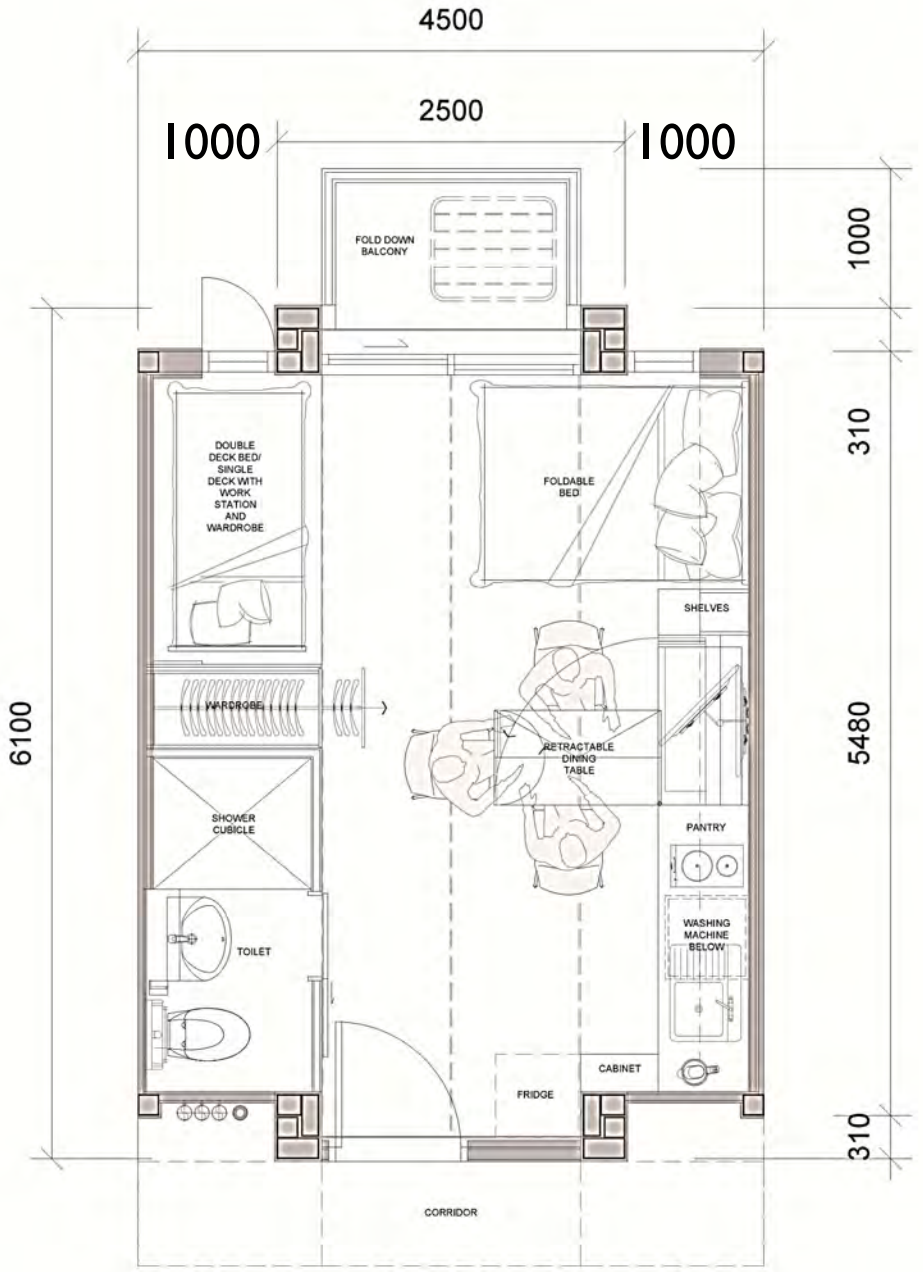
Family Unit – Type 1 (3-4P) Layout

HIGHLIGHTS

- Versatile unit for **young couple with 1-2 kids**
- **Fold-up furniture**: Couch/Double bed and TV Shelf/Single bed – create more clear space to be **both a bedroom and a living room.**

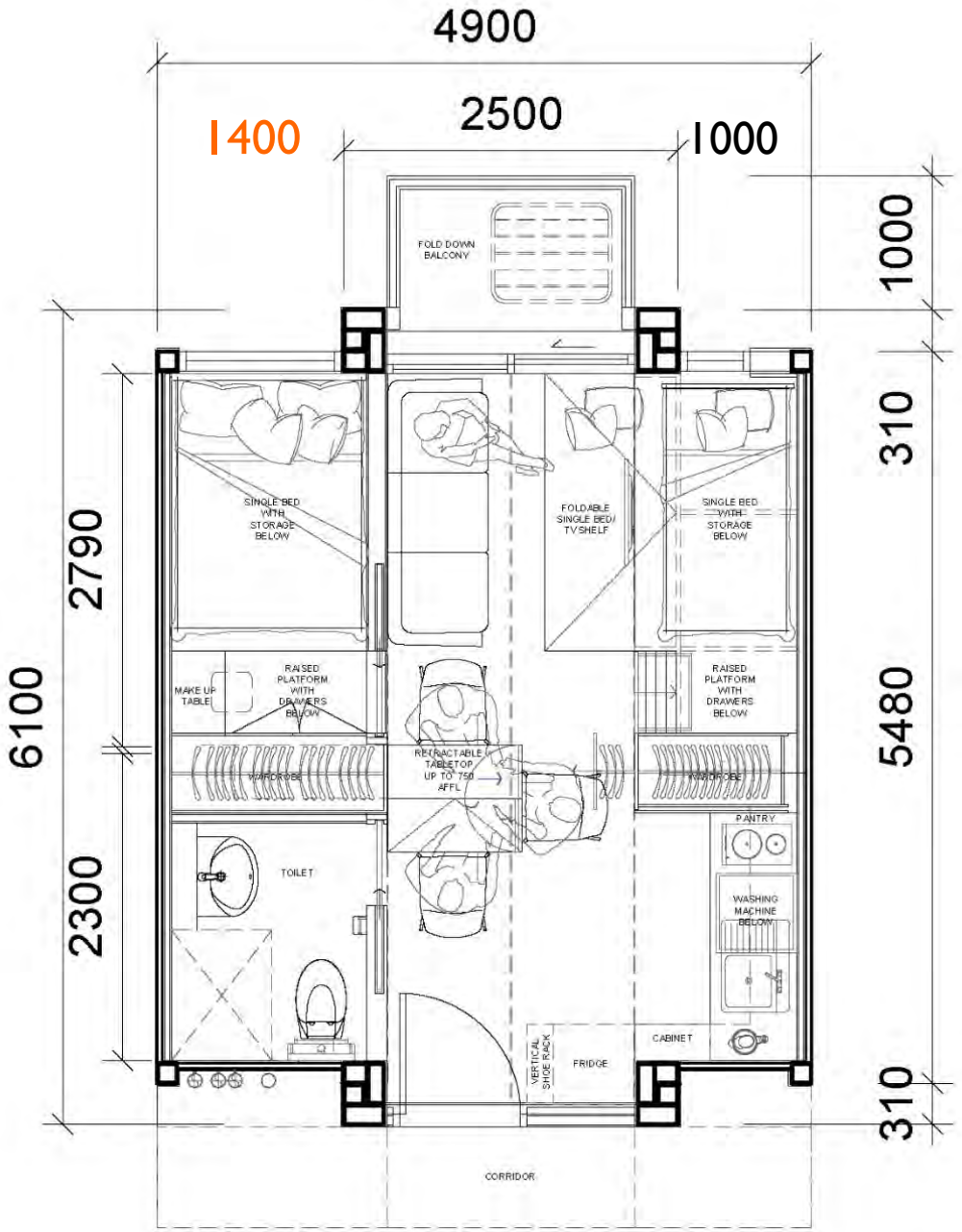


FAMILY
3–4P

Family Unit – Type 2 (3-4P) Layout

HIGHLIGHTS

- Also designed for **young couple with 1-2 kids**.
- Slightly larger to allow **partitioning of rooms** for increase privacy.
- **Fold-up furniture**: Couch/Double bed and TV Shelf/Single bed – create more clear space to be **both a bedroom and a living room**



FAMILY (TYPE 2) 3-4P SCALE 1:50 (A4) 20190918

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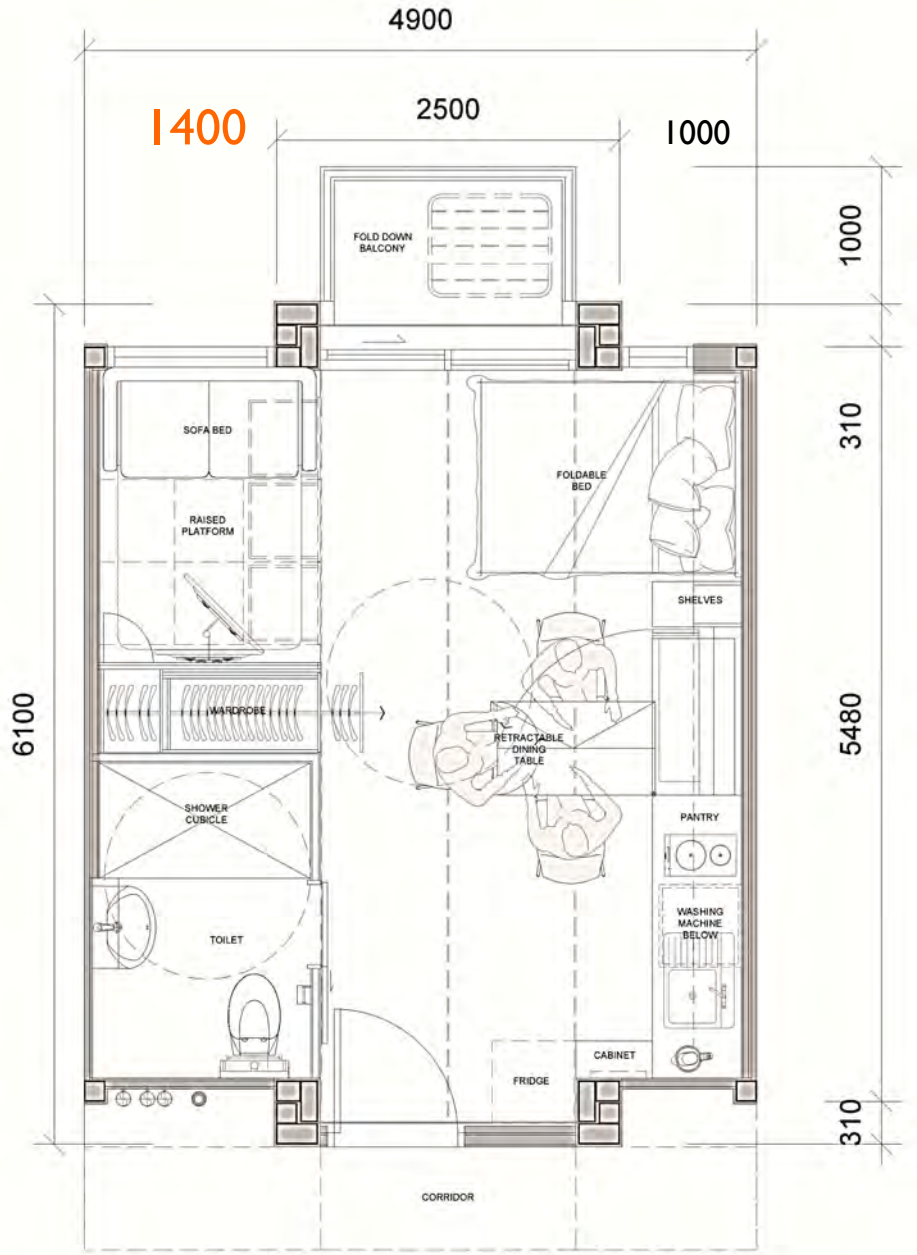
Accessible Unit (2-3P) Layout

HIGHLIGHTS

- Designed for assisted living of **older couples with one care giver**.
- Fully **wheelchair accessible** (bed space, kitchen, shower, cabinets) + **elderly friendly/Universal Design** features
- **Fold-up Furniture** - Couch/Double bed and TV Shelf/Single bed enables more clear space to be both a bedroom and a living room



ACCESSIBLE
2-3P

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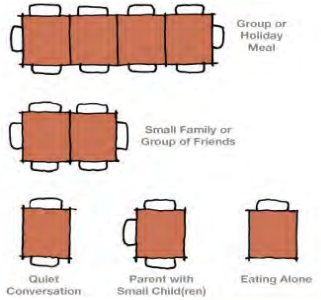
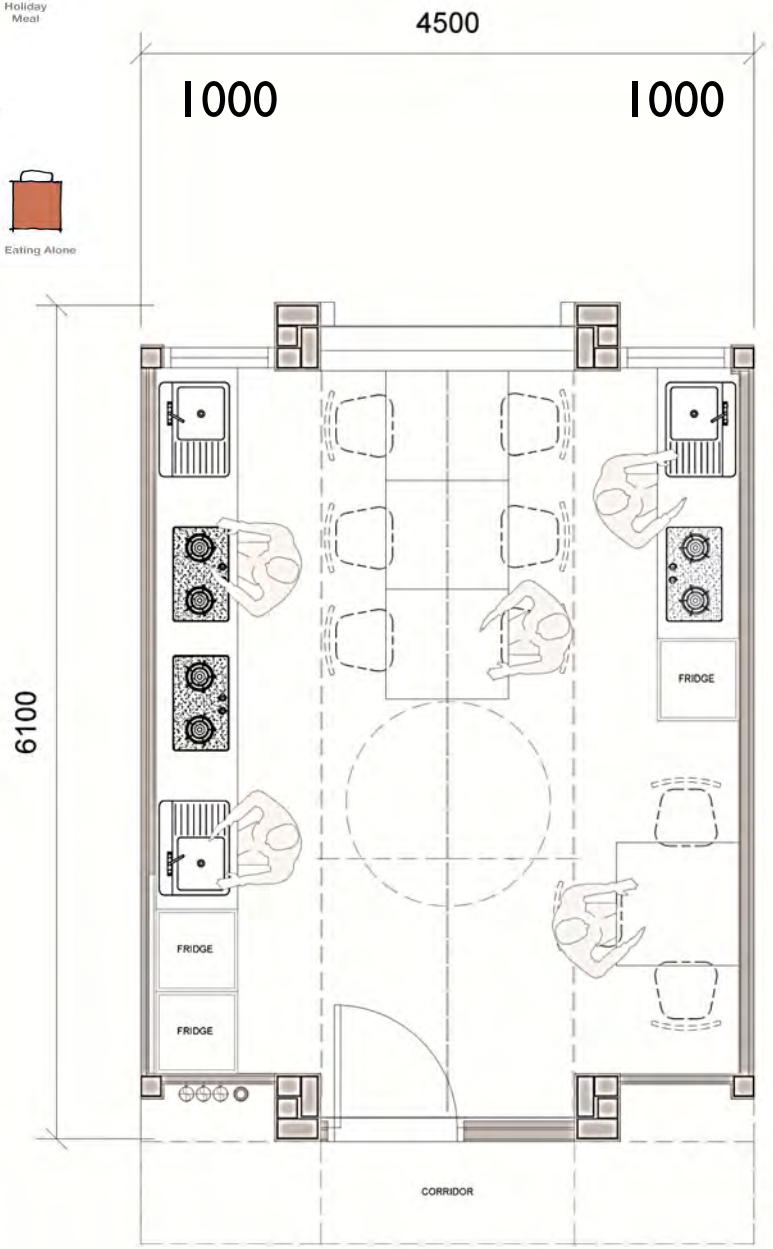
Communal Kitchen Layout

HIGHLIGHTS

- As all living modules only provide small pantry with portable electric cooktops, it is required under BO that a communal kitchen shall be provided due to non-provision of kitchen within unit. Similarly a smaller Laundromat module will also be provided.
- Features **multiple electric worktops** to allow **spontaneous use,** with **shared appliances** incl. fridge, microwave, oven, etc.
- **Flexible table arrangement** (1-8 pax) encourage social interactions among residents.



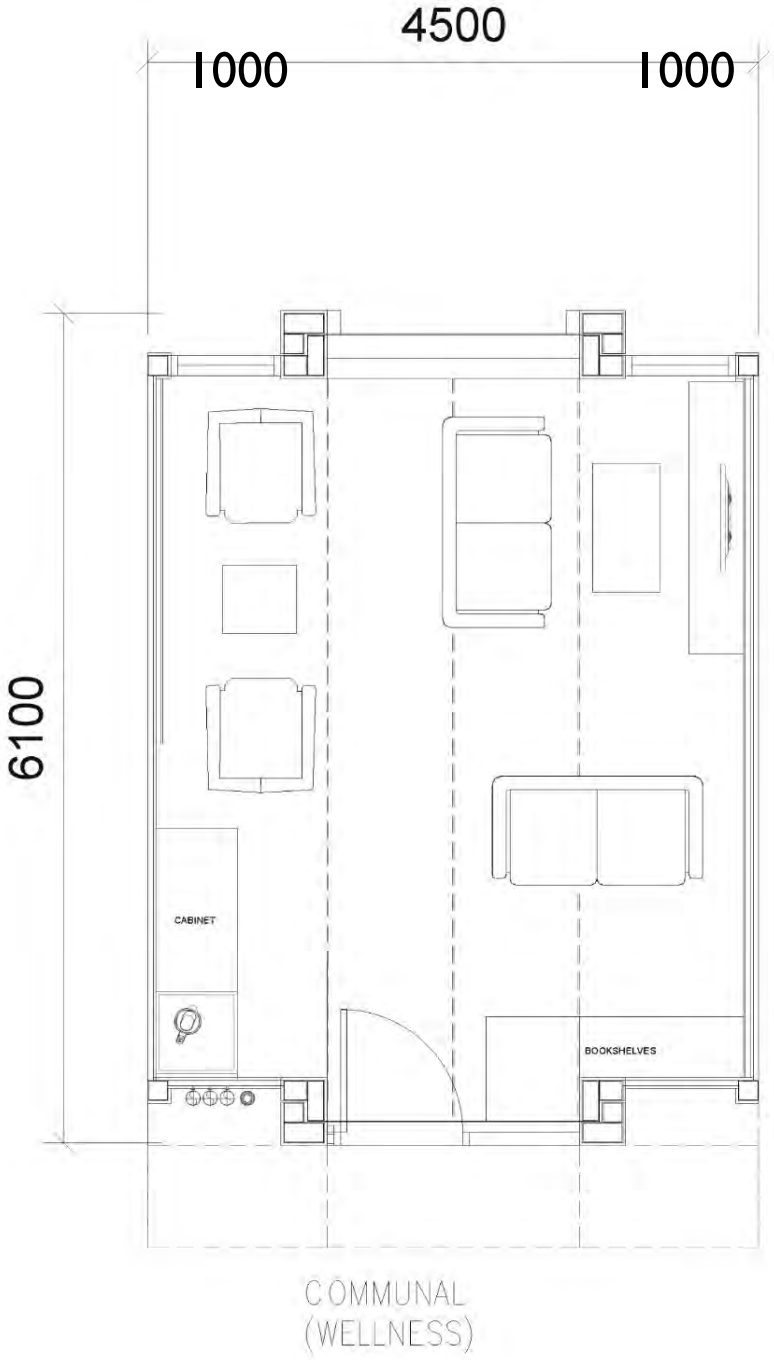


COMMUNAL KITCHEN

Wellness Unit Layout

HIGHLIGHTS

- The Wellness Unit is designed to provide **communal space** for leisure that fosters **interactions within neighborhood**.
- **Flexible seating arrangement** to encourage a variety of uses/spaces for different groups - up to 7-8 people also accessible to all residents including wheelchair-bound users.
- **Furniture:** Bookshelves, newspaper racks, board games, water pitchers/snacks, plants



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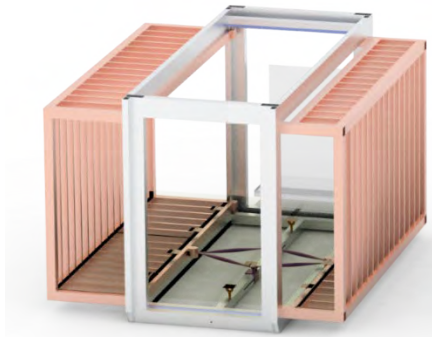
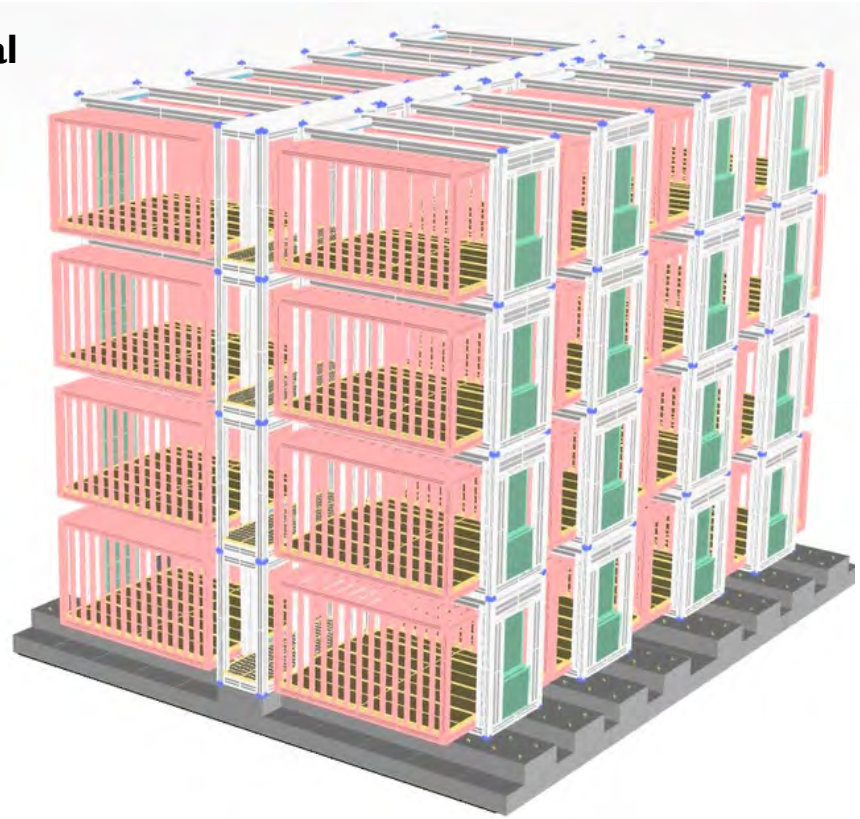
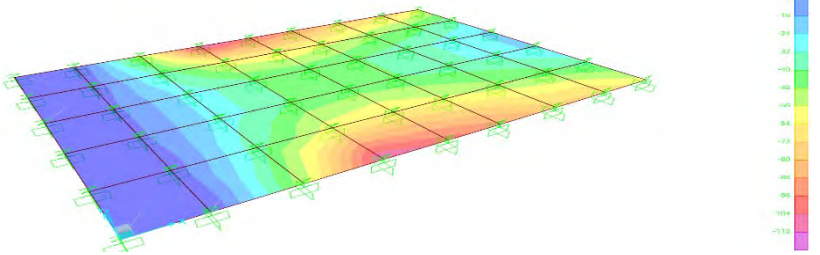
Structural Configuration

Expandable MiC Superstructure

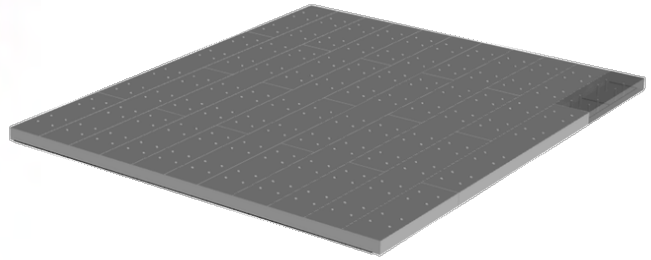
- **Freestanding 4 storey** building (or taller subject to ground bearing capacity and integration w/lateral resisting structural elements such as staircase and lift core)
- Volumetric module of **Structural Steel Portal Frame w/slide-out sub-module & fold-out balcony** (optional), galvanised for outstanding corrosion protection
- **Fully demountable module connection**
- **Relocatable precast concrete foundation** (spreader mat & base slab with maximum bearing pressure 100 kPa for 4 storey bldg)



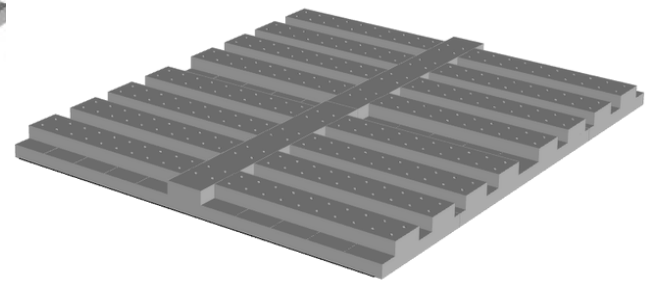




Max bearing pressure under Dead Load + Wind X = 110kPa

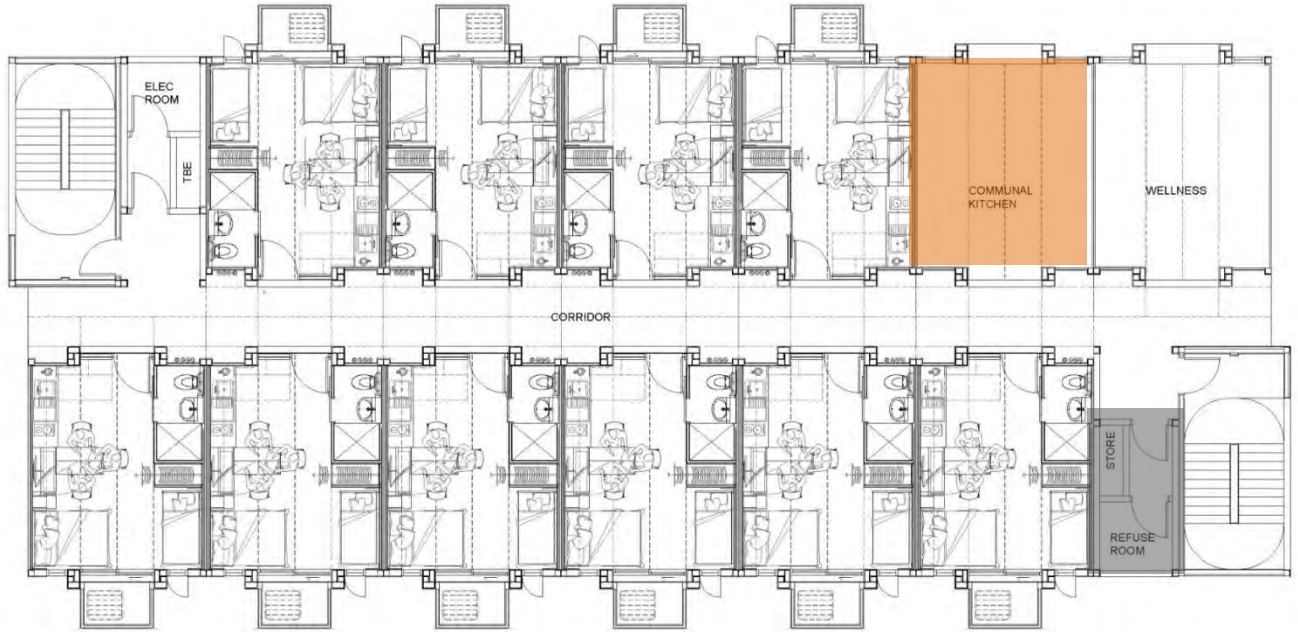


Upper layer - precast concrete spreaders with couplers and dowel bar connecting to the bottom layer



Bottom layer - precast concrete spreaders forming the **base mat** (footing)

Block & MLP Layout – Possible Configuration



Thank you !

Contact:

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