



ACEHK Annual Seminar on Enhancing Project Cost Management

“Quality Public Housing - Creating Value with Rational Use of Resources”

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2. Lean & Green Design and Construction
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1. Introduction

The **Hong Kong Housing Authority (HA)** was established in 1973 under the Housing Ordinance.

OUR VISION

To provide affordable rental housing to low-income families with housing needs

OUR MISSION

- To provide affordable quality housing, management, maintenance and other housing related services to meet the needs of our customers in a proactive and caring manner.
- To ensure cost-effective and rational use of public resources in service delivery and allocation of housing assistance in an open and equitable manner.
- To maintain a competent, dedicated and performance-oriented team.

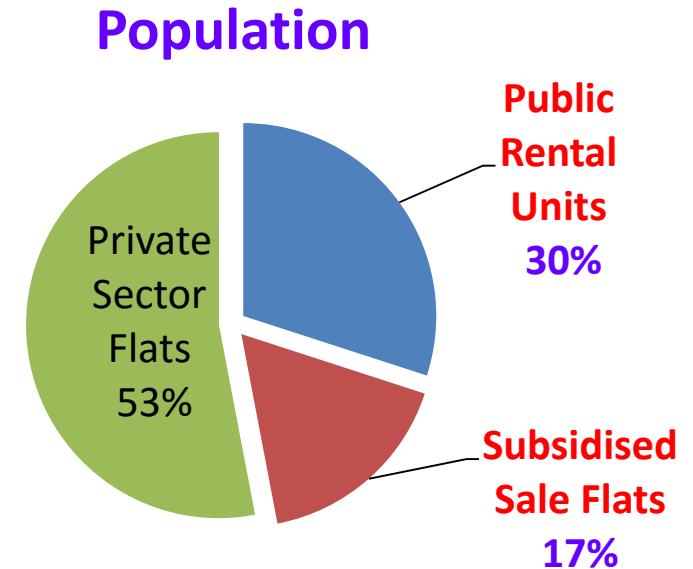


1. Introduction

As at end-December 2015, Hong Kong had about 2,700,000 flats :-
790,000 public rental units & **400,000** subsidised sale flats.



Housing Estates in Hong Kong



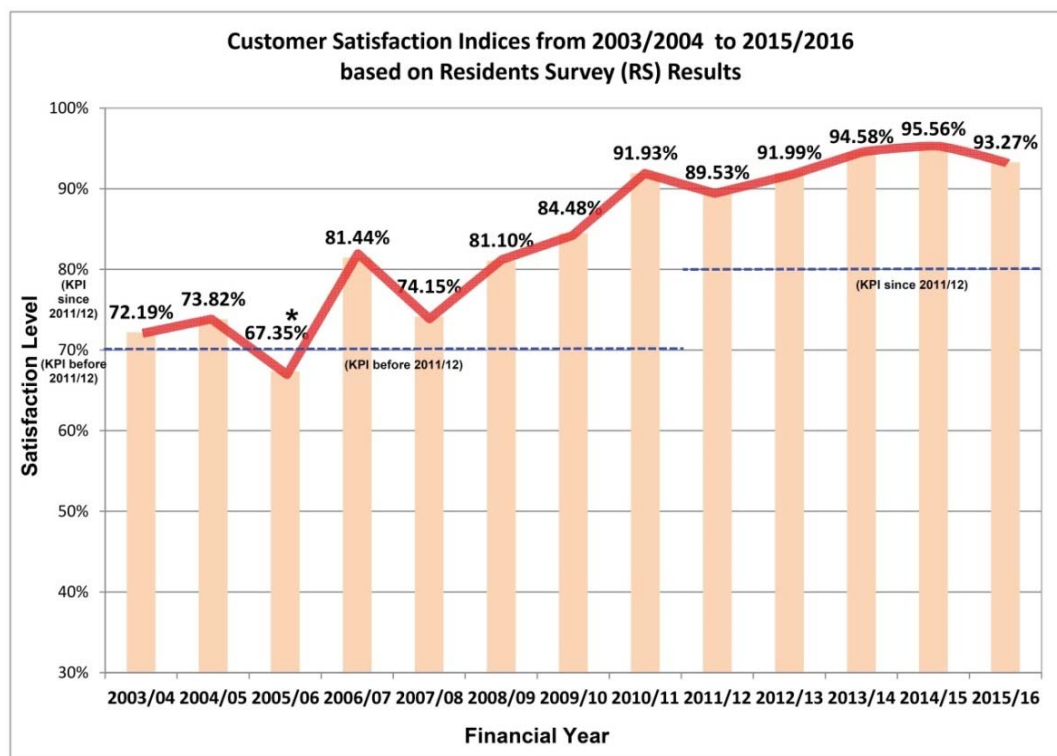
OUR TARGET is to develop

280,000 new rental & subsidised sale flats from 2017/18 to 2026/27

Quality = **Fitness for Purpose**
(Social, Economic and Environment)

Caring and Community Engagement

Every project begins with community engagement initiatives that are designed to gauge community needs and take on board local views. These initiatives include, for example, **community engagement workshops** during the early stages of planning and design of our projects and **surveys of residents in newly completed estates**, each of which is analysed and considered in our **Post Completion Review Workshops**, etc.

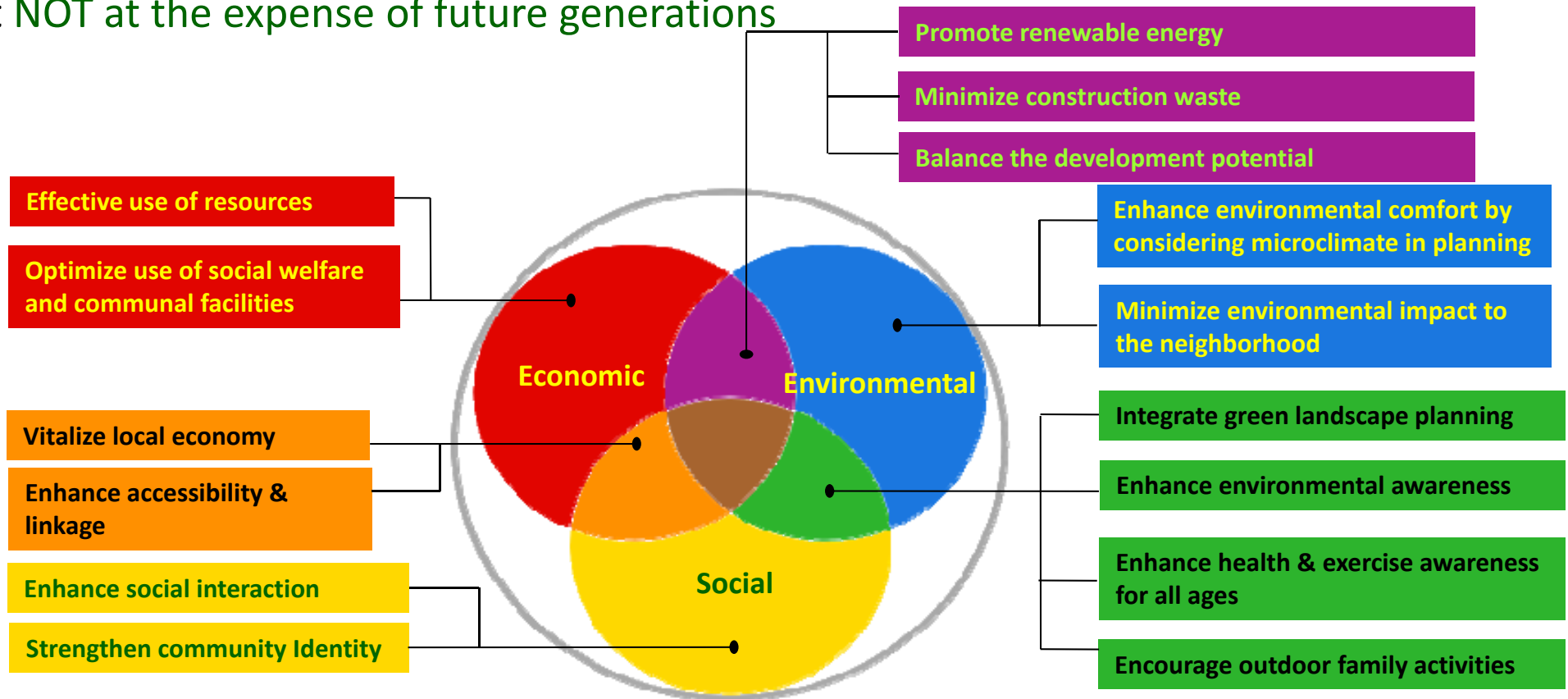


High Customer Satisfaction Index
>93%
 in last 3 years

The feedback is taken into account when we design new estates, alongside with other important criteria such as **safety and comfort, sustainability and environmental friendliness, and efficiency and cost-effectiveness.**

Building a Sustainable Community

To meet current **social**, **economic** and **environmental** needs but **NOT** at the expense of future generations



Design and selection of materials with due consideration of **life cycle cost** (including capital cost, operating cost, maintenance cost and disposal expenditure) for obtaining higher potential benefits over the life of the buildings.

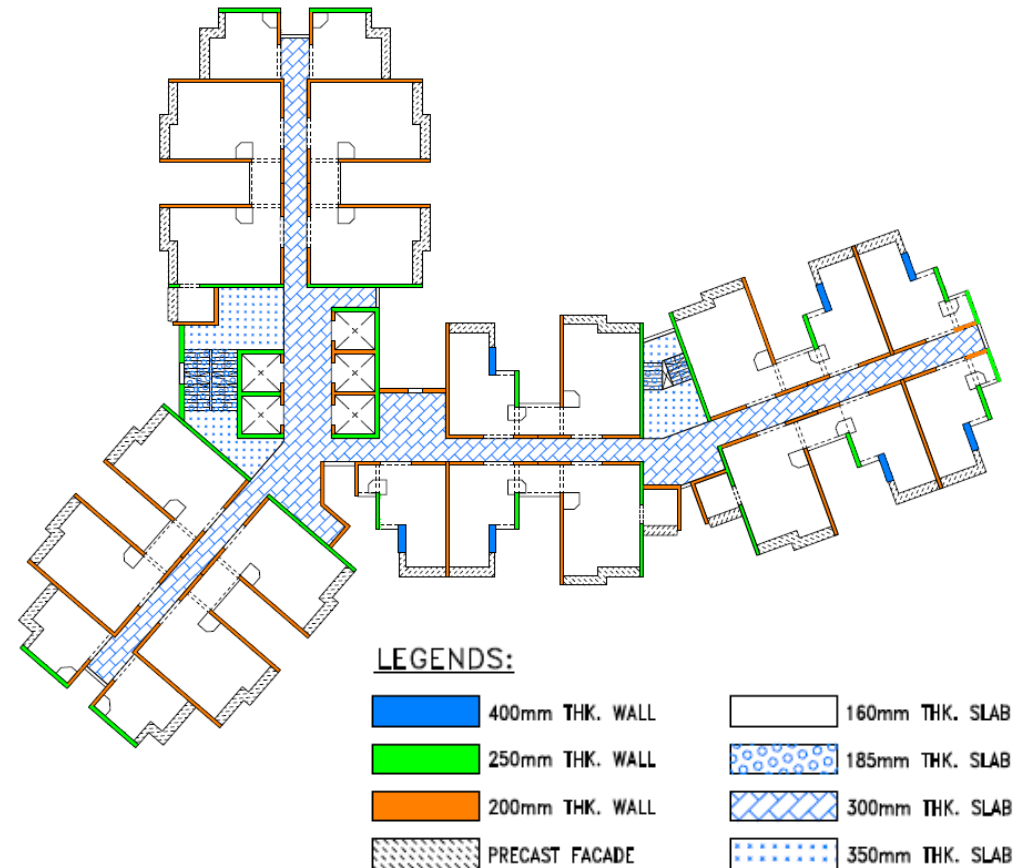
2. Lean & Green Design and Construction

2. Lean & Green Design and Construction

a. Lean Design to Meet Functional Requirements

Estimated Useful Life of HA Buildings ~ 100 Years

- ✓ Adopts **shear walls design** for the purpose of
(a) separating domestic flat units and
(b) withstanding wind load
- ✓ Adopts **flat slab design** for horizontal slab elements (i.e. without beams) between wall supports
- ✓ Since 2007, we have been adopting an in-house software called **“Cost Efficient Structural Design”** for carrying out structural optimization work for all our projects



2. Lean & Green Design and Construction

a. **Lean Design** to Meet Functional Requirements

- ✓ **Paint** on fair face concrete surfaces (both internally and externally) including typical floor lobbies and corridors
 - Faster construction & less capital and maintenance costs



Extensive use of multi-layer acrylic paint on fair-faced concrete instead of wall tiles

- ✓ **Homogeneous floor tiles and ceramic wall tiles for bathrooms and kitchens**
 - Durable but more economical materials



Homogeneous floor tiles to kitchens

2. Lean & Green Design and Construction

a. *Lean Design* to Meet Functional Requirements

- ✓ **Windows** with anodized aluminum frames with clear or tinted float glass
→ Providing sufficient daylight and ventilation
- ✓ **Internal design** enhancing natural lighting and cross ventilation

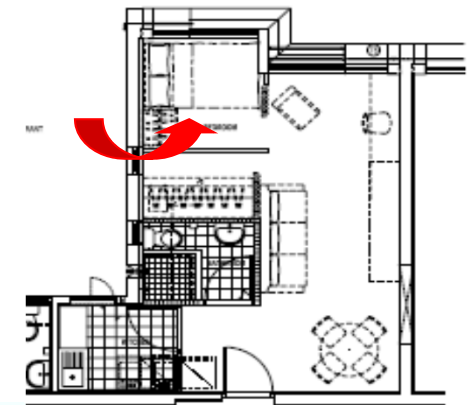
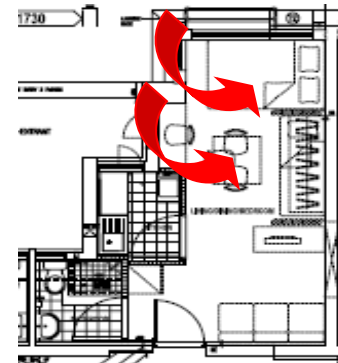
Corridors and Lobbies

Enhance natural lighting and cross ventilation



Domestic Flats

Additional and enlarged windows for better natural lightings and cross ventilation in living areas, bathroom and kitchen.



2. Lean & Green Design and Construction

a. Lean Design to Meet Functional Requirements

- ✓ Flats are self-contained with **basic fittings and provisions** including kitchen sinks, cooking benches, sanitary fittings and laundry racks → Meeting residents' essential needs



Basic fittings and provisions in toilets



"Low Level" suitable for Gas Cooker (595mm from F.F.L)



"Middle Level" suitable for Induction Cooker (755mm from F.F.L)



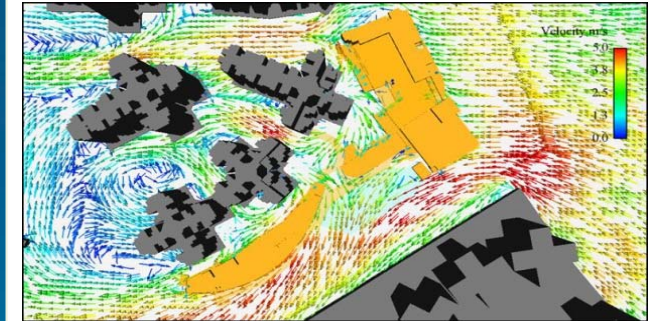
"High Level" suitable for built-in hob by cutting an opening to the polymer resin worktop (855mm from F.F.L)

Polymer resin cooking bench with three adjustable heights to suit different types and cookers and to better match with kitchen cabinets

2. Lean & Green Design and Construction

a. *Lean Design* to Meet Functional Requirements

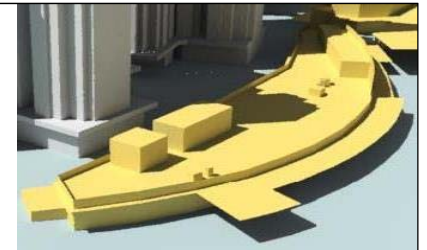
- **Comfortable Shopping under Verandah** with *Natural Light and Breeze*



Annual East wind

Gap between buildings and street helps to make the leeward side of the area **adequately ventilated** at ground level.

Shadowing
Pattern of
Shopping
Centre at
3:00pm in
summer



Large canopy along the street

- **No air-conditioning** required for public area
- **No direct sunlight** exposure to the shop fronts



2. Lean & Green Design and Construction

a. **Lean Design** to Meet Functional Requirements

- **Greening and Landscaping** for *better air quality and enhancing ecological and amenity value*



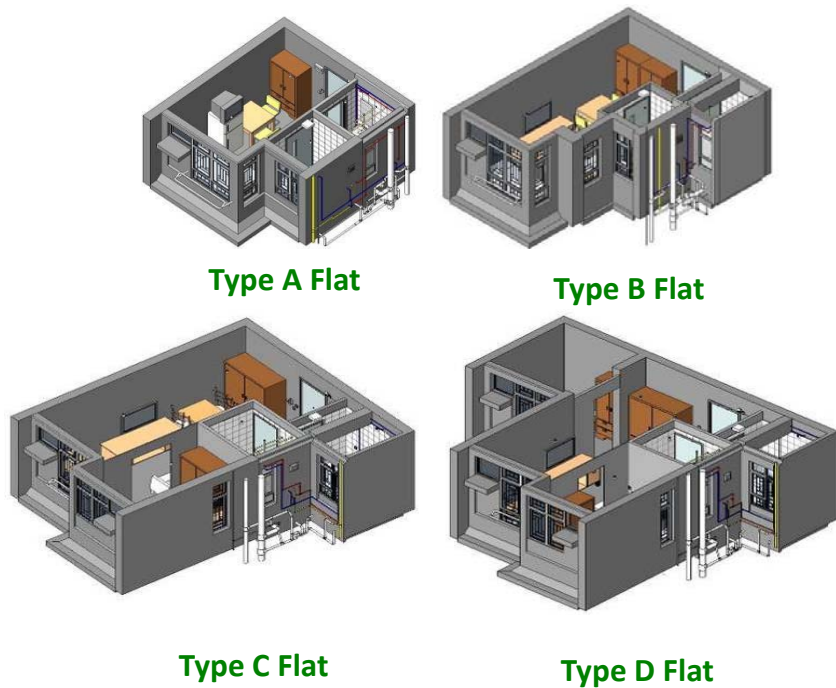
- Plant **at least one tree for every 15 flats**
- Implement initiatives **of roof greening, vertical greening and grass-paving system** for some vehicular areas, in addition to traditional **greening at grade and slopes**
- Provide **“Community Farm”** in new estates
- Achieve **greening coverage at least 20%** (target 30%)

2. Lean & Green Design and Construction

b. Modular flat design and high degree of repetition

- Allow effective adoption of **precast components**
- More precast components can save labour on site, reduce working platform and scaffolding required and enhance site safety

Modular Flat Design



Precast Building Technology

Higher quality, greater efficiency and productivity with wider use of mechanized building process and prefabrication of structural elements.



Volumetric Precast Bathroom



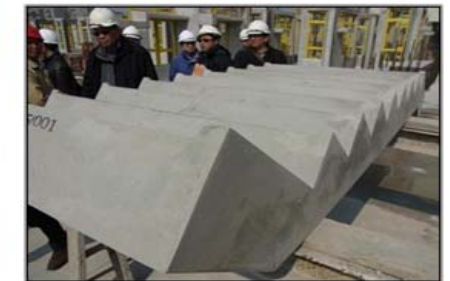
Fabric Reinforcement



Semi-precast Slab



Precast Façade



Precast Staircase

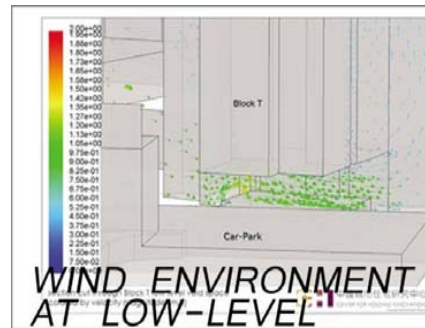
2. Lean & Green Design and Construction

c. Sustainability : Conducting Micro-climate Studies

- Apply micro-climate studies and air ventilation assessments at planning and design stages of all new projects
- To enhance **wind environment**, **natural ventilation**, **mitigate solar heat gain**, and **use of daylight** in housing blocks and external areas



Sun Shadowing Analysis



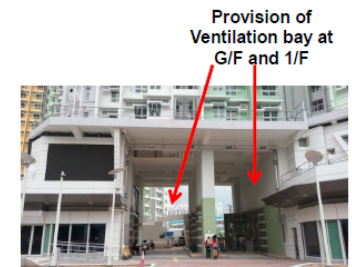
Wind Permeability



View corridors and ventilation ground floor bays to enhance wind environment



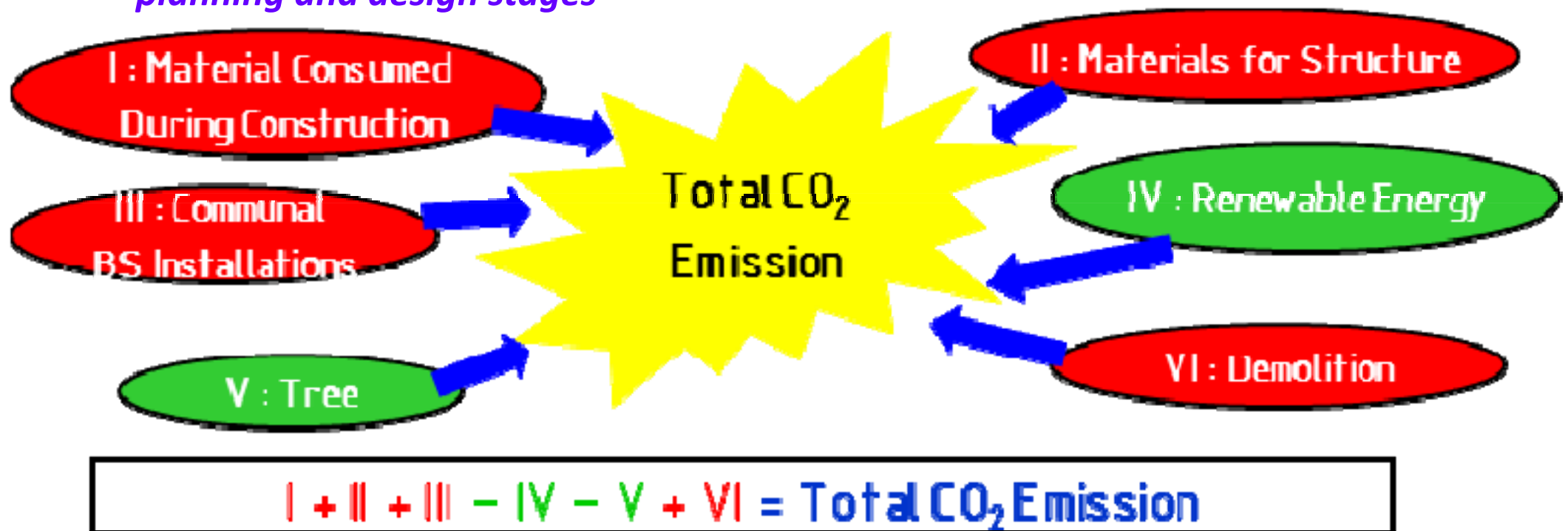
Ventilated corridors with natural daylight achieve energy saving up to 15%



2. Lean & Green Design and Construction

d. Sustainability : Adopting Low Carbon Building Design

- A life cycle **Carbon Emission Estimate (CEE)** method has been developed to estimate the carbon dioxide emission from building throughout their life cycle to **seek carbon emission reduction opportunities** for housing developments at the **planning and design stages**



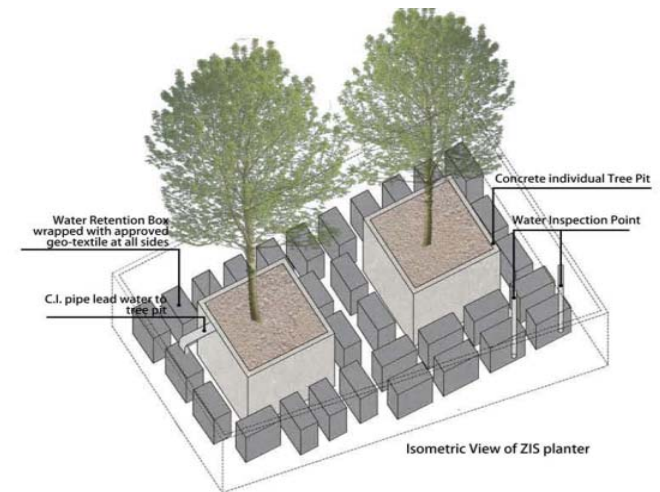
- Since **2011**, every new project would check its CEE against **benchmark** performance

2. Lean & Green Design and Construction

e. Sustainability : Green Design to save water

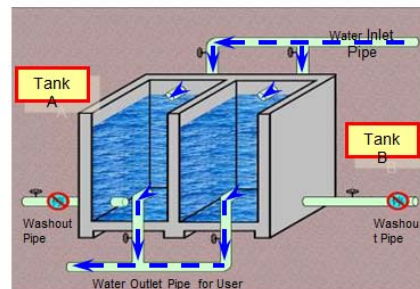
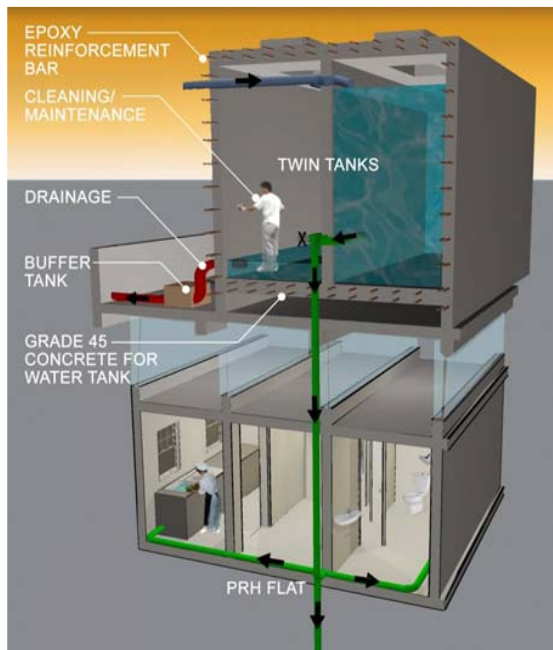


Use of water efficient *shower handsets and mixers* to comply with BEAM Plus and Water Supplies Department's **Water Efficiency Labelling Scheme** requirements to reduce the consumption of potable water



Zero Irrigation System (ZIS)

- Pioneered to apply sub-soil irrigation method to achieve 'zero irrigation' in residential projects
- **No manual watering operation and portable water required** for over 24 months of trial
- Self-sustained design to the vegetation and to minimize topsoil evaporation
- **100% saving of irrigation water**



Twin Tanks water supply installation provides an *uninterrupted fresh and flush water supply* to tenants. It **reduces water wastage** during maintenance or cleaning & **improves the durability of the building roof structures**

2. Lean & Green Design and Construction

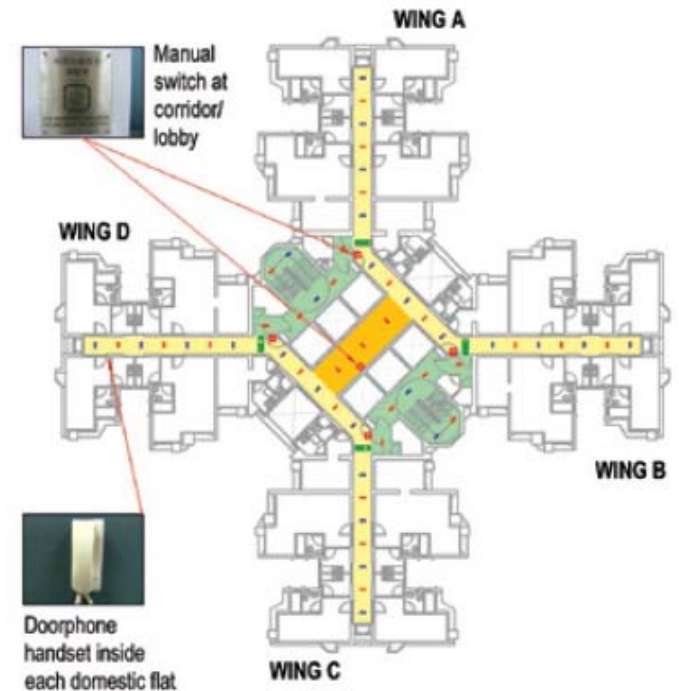
f. Sustainability : Green Design for Efficient Use of Electricity



Grid-connected photovoltaic system installed where appropriate to provide at least **1.5% of the communal electricity consumption**



LED bulkhead lighting as the standard luminaries **in public areas of domestic blocks** all new works project under design since early 2016 for **energy efficiency**



Two-level Lighting Control System

- For allowing **barrier free access** , **maintaining a minimum lighting level for safety and security** while enabling **high efficiency lighting**
- Lighting can be operated by environmental lighting control using motion sensors and on-demand switch with timer-controls

2. Lean & Green Design and Construction

g. Sustainability : Utilising Green Materials and Products



Use **Ground Granular Blast Furnace Slag (GGBS)** for precast facades and precast staircase in all new projects starting from 2016 to reduce concrete usage and enhance utilisation of recycled materials



Reuse granite blocks which were finishing materials of the older planter walls, fence walls and landscaping paving and help to reduce landfill burden



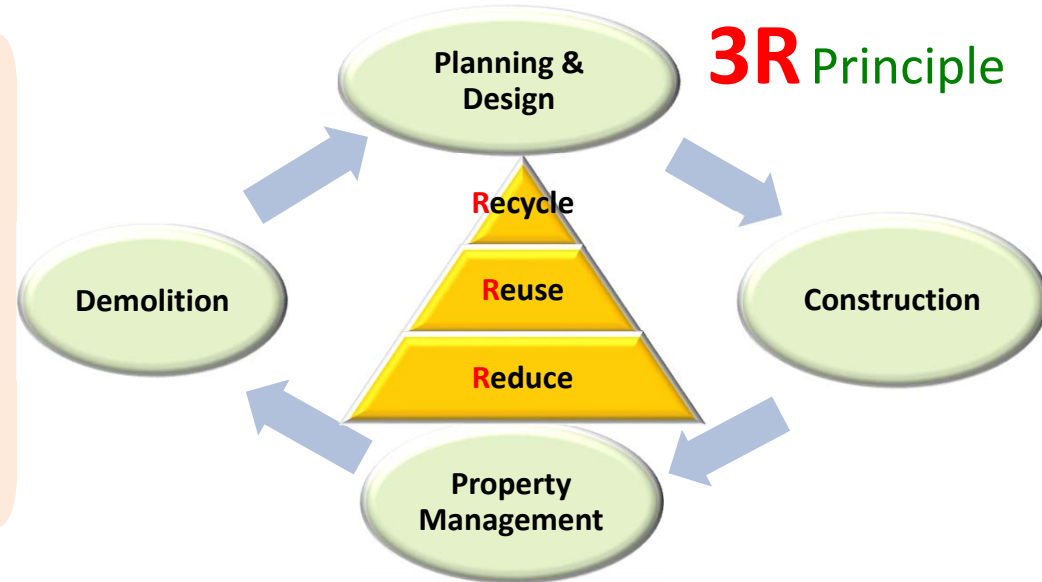
Use of **timber from certified sustainable source** for manufacturing of doors

h. Sustainability : Utilising Resources



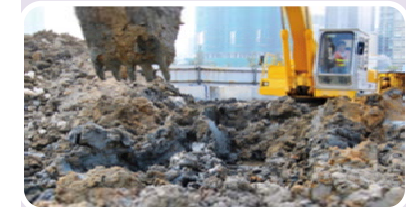
Transfer of C&D Waste Materials

- Established an inventory on quantities of C&D materials available from each site
- Facilitate bulk transfer between HA's contracts
- Over **80,000** tonnes of C&D waste have been reduced



Use of Recycle Materials

- Marine mud stabilised by cement as **useful backfill materials**
- Glass & aggregates recycled as **concrete paving blocks**
- Bore-logs for **landscape and associated external works**
- GGBS as **cement replacement material** in concrete for the manufacture of **precast façade**
- Excavated rock materials as **recycled rock-fill** in earthworks and **recycled sub-base materials** in roadworks
- **Reuse of the wood logs** from trees felled



2. Lean & Green Design and Construction

h. Sustainability : Utilising Resources

Selective Demolition



Selective Demolition

- Reversal of the construction sequence to **increase the recycling rate of reusable materials**
- Project Officer can help contact recognised social organisations for their collection of re-usable items, such as electrical appliances

Modular Hoarding



Modular hoarding

Facilitate the reuse in housing and other construction sites so as to **minimize wastage of construction materials**

Large Panel Formwork



Large Panel Formwork

Sustainable Construction

2. Lean & Green Design and Construction

Sustainability : BEAM Plus Ready

- Setting a **green building benchmark**
- Since 2011, **BEAM Plus Gold** ready (all new projects with standard at least Gold rating)
- **7 & 13 BEAM Plus Provisional Platinum** & **BEAM Plus Provisional Gold** new projects

PA PLATINUM (NB)



PA GOLD (NB)



1st EB Final Platinum



1st Neighborhood Platinum



Most Platinum



Green Leadership 2016



3. Challenges in Development

Ideal Development Parameters for Cost Effectiveness

- ***Flat site with normal site and ground condition***
 - ✓ *minimize the construction cost of foundation and external works*

- ***Site of reasonable size for 2 or more domestic blocks***
 - ✓ *achieve economies of scale*

- ***Domestic block of 40 storeys***
 - ✓ *refuge floor is not required*
 - ✓ *maximize repeated use of formwork moulds*
 - ✓ *sharing of fixed costs such as building services components, etc. by optimum number of typical floors*

Nowadays, majority of the sites available for public housing development are:-

- **Non “spade-ready” sites → longer development lead time**
- **Small, congested sites**
- **Sloping sites**
- **Sites with difficult ground conditions**
- **Sites affected by noise pollution**
- **Combination of the above**

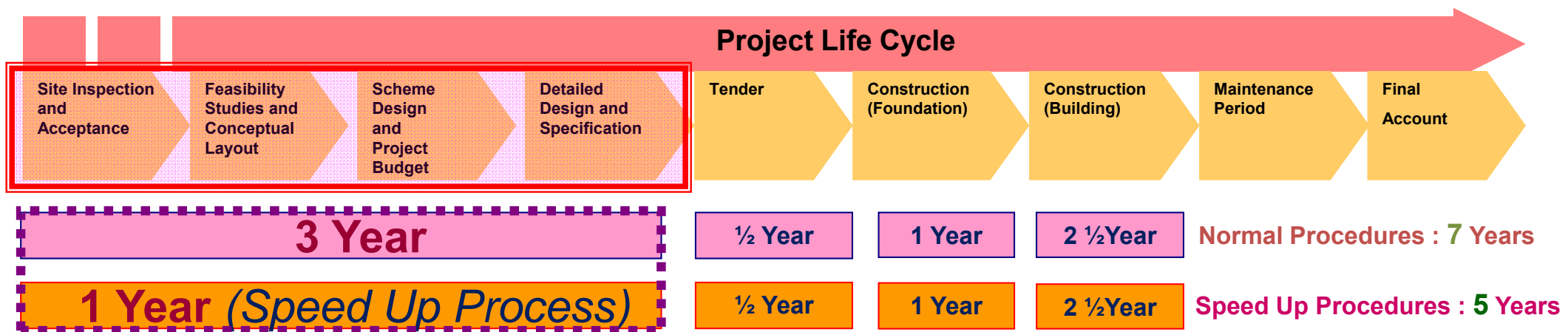


4. Overcoming Site Constraints

4. Overcoming Site Constraints

- HA has successfully pushing forward the **“spade-ready”** sites (20%), e.g. the first batch of six newly-built Home Ownership Scheme projects, Eastern Harbour Crossing Site Phase 7
- About **80%** of the projects for which HA have consulted District Councils (DCs) in the past six years are **non “spade-ready”**
- **Longer lead time** required for these non “spade-ready” sites to require proper Town Planning Board Procedures (e.g. *re-zoning, increasing plot ratio*), resumption, clearance, re-provisioning of existing facilities, site formation or provision of additional infrastructure.
- HA endeavoured to **fast-track** the development process with success in non “spade-ready” sites, e.g. *Queen’s Hill Site 1*.

Hong Kong Housing Authority has been working hard to **fast-track** the development process where possible



4. Overcoming Site Constraints



Tai Wo Hau Road
(~800 Flats)



Chai Wan Road
(~800 Flats)

Small Sites



Eastern Harbour
Crossing Site Phase 7
(~500 Flats)

Large Sites



Queen's Hill
(~12,000
Flats)



Tung Chung Area 39
(~3,800 Flats)



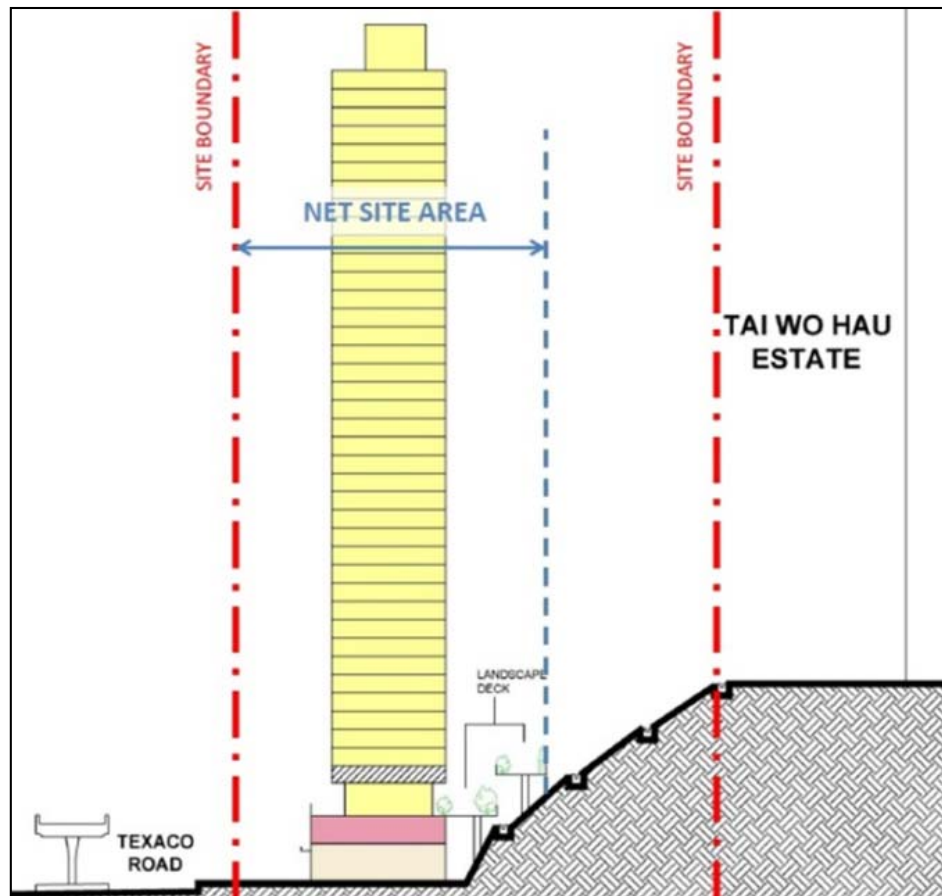
Shek Mun Phase 2
(~3,000 Flats)

HA has been working **on different sizes of LAND** for public housing development, striving to **MAXIMIZE SITE POTENTIAL** of every site

4. Overcoming Site Constraints

Site Constraints – Sloping Sites Texaco Road Site

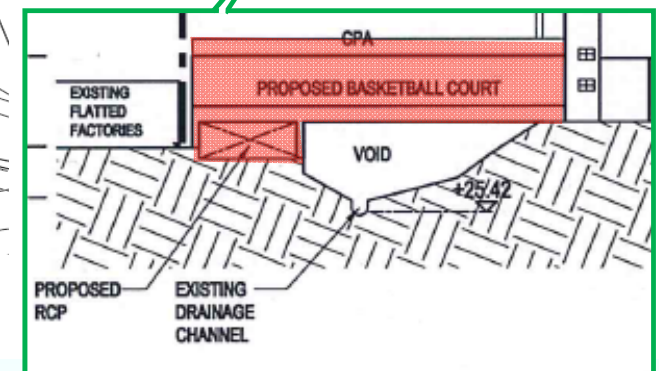
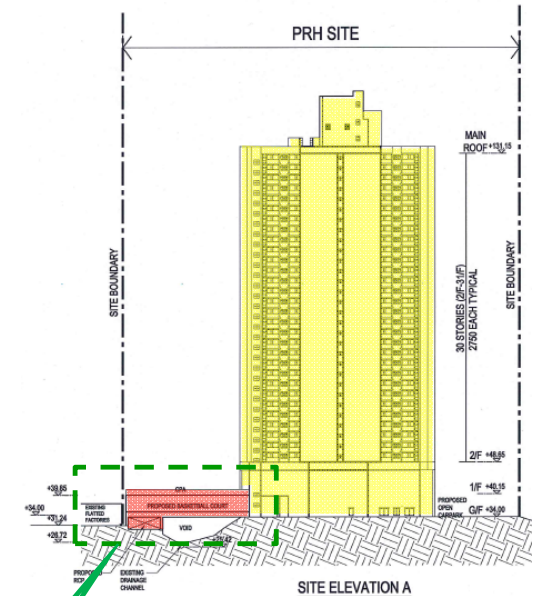
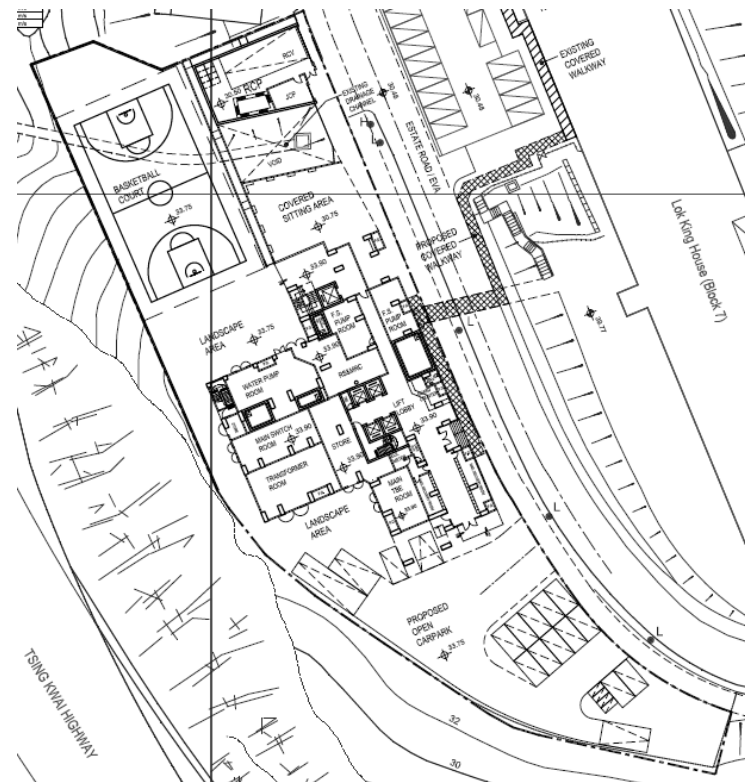
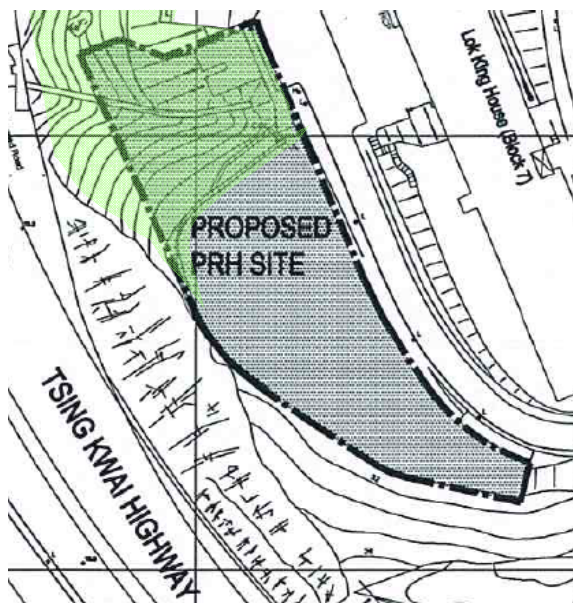
Double decks over slope to increase the
Net Site Area and hence Flat Production



Site Constraints – Sloping Sites

Near Lai King Hill Road Site

Deck over slope for re-provisioning of basketball court to **increase the Net Site Area** and hence **Flat Production**



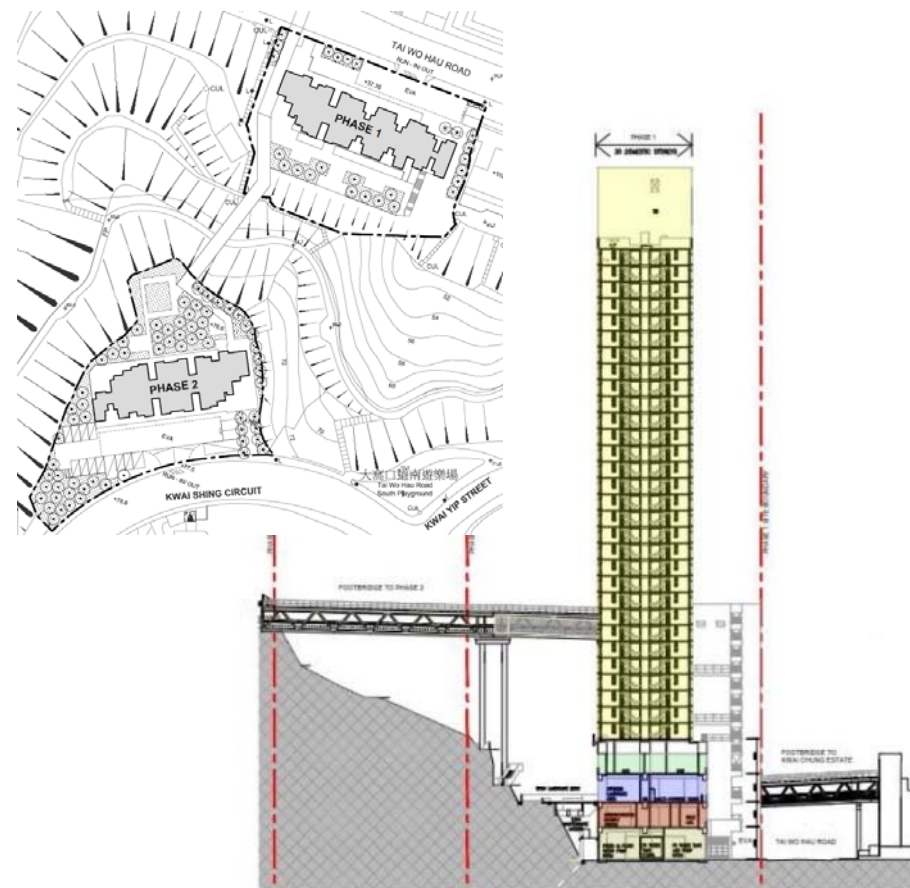
Site Constraints – Sloping Sites

Footbridges and lift towers to link up different platforms of the site or for better accessibility

Shui Chuen O Site



Tai Wo Hau Road Site

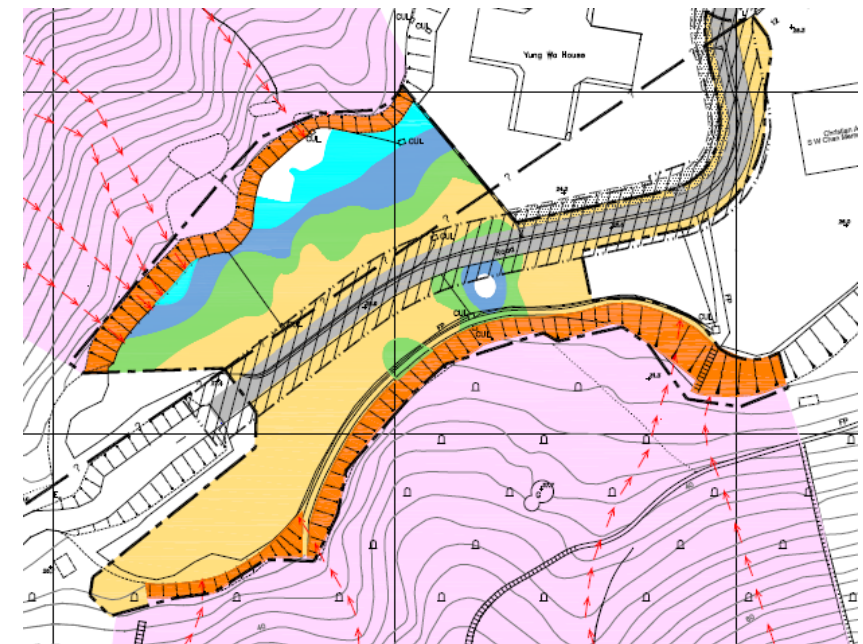
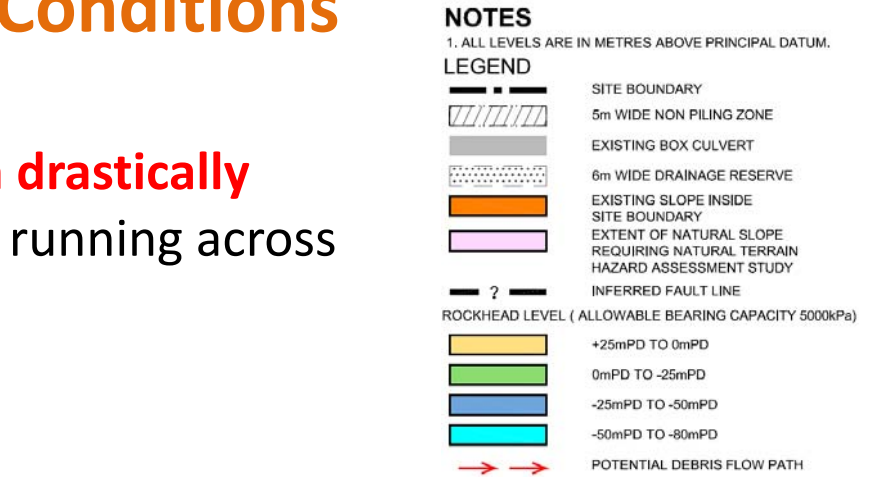


Site Constraints – Difficult Ground Conditions

Fanling Area 49 Site

Constraints: including geological conditions (with drastically varied rockhead levels) and underground culvert running across the central part of the site

Disposition: Two Linear Domestic Blocks



Site Constraints – Noise Noise Mitigation Measures

At Source



Low noise road surfacing

At Propagation Path

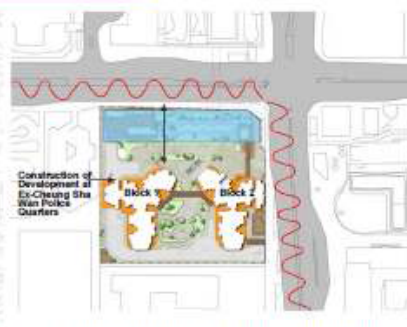


Noise Barrier

At Receiver End



Building setback



Flat configuration & Disposition



Noise Enclosure



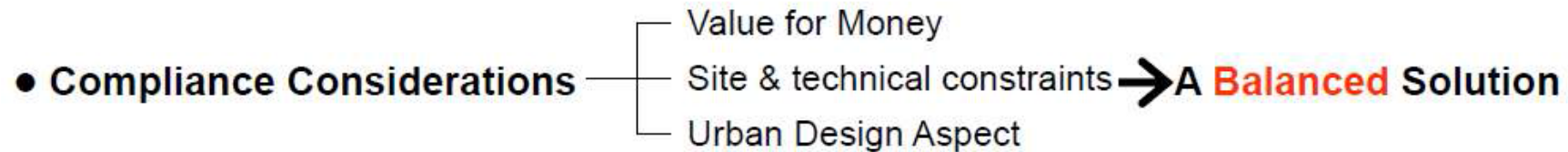
Non noise sensitive building



Acoustic Balcony



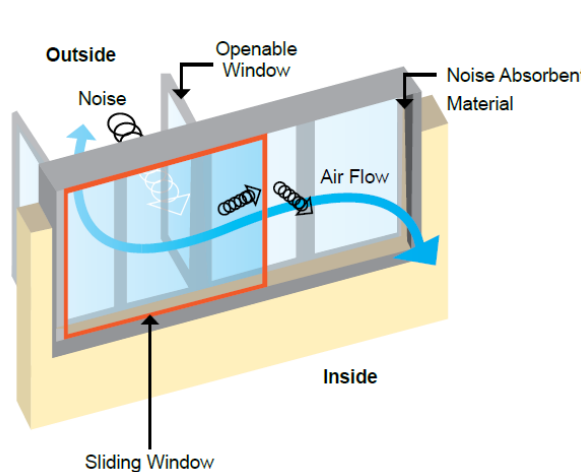
Acoustic Windows



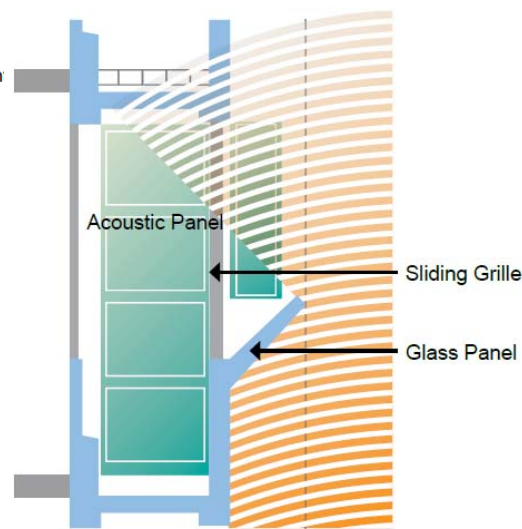
Site Constraints – Noise

Research and Development of Noise Mitigation Measures at Receiver End

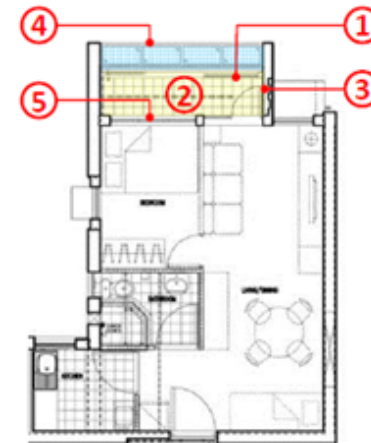
- Achieving maximum noise attenuation ranging from 6 to 10 dB(A)
- Securing comfortable environment, maintaining **valuable natural ventilation**



Acoustic Window (2009)
(- max. 8 dB(A))



1st Generation Acoustic Balcony (2013)
(- 2 to 6 dB(A))



Main Features –

1. **Sliding screen** in front of balcony door
2. **Plenum configuration** of balcony for better air flow (concept of acoustic window).

Optional Features to further reduce noise–

3. **Sound absorptive lining** at walls and ceiling
4. **Projected RC panel** outside the parapet
5. **Acoustic windows** at living areas



2nd Generation Acoustic Balcony (2016)
(- 6 to 10 dB(A))
Better Noise Attenuation
Better Ventilation

Site Constraints – Noise

San Po Kong Site

Traffic Noise from Prince Edward Road East
Acoustic Windows Adopted

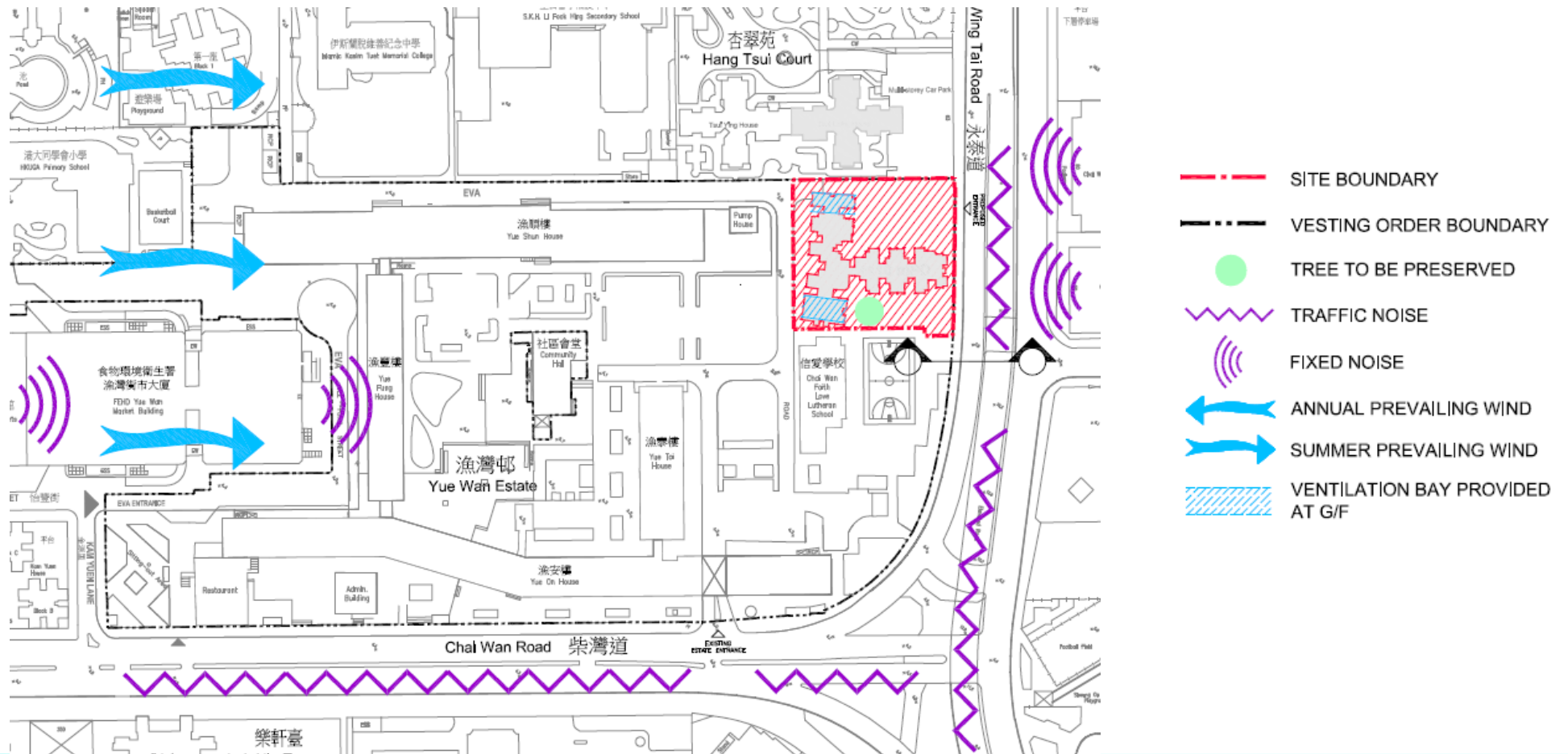


Site Constraints – Noise

Wing Tai Road Site

Subject to Fixed Noise and Traffic Noise

Acoustic Balconies Adopted



5. Overview on Construction Costs

Key Performance Indicators (KPIs)

To gauge our input and performance, KPIs are set annually for **average superstructure construction cost:-**

	Targets for 2016/17	Target Met
PRH	$\leq \$13,320/m^2$	↓ 17%
SSF	$\leq \$14,780/m^2$	↓ 19%



Target Met!

Current Performance of HA Construction Cost

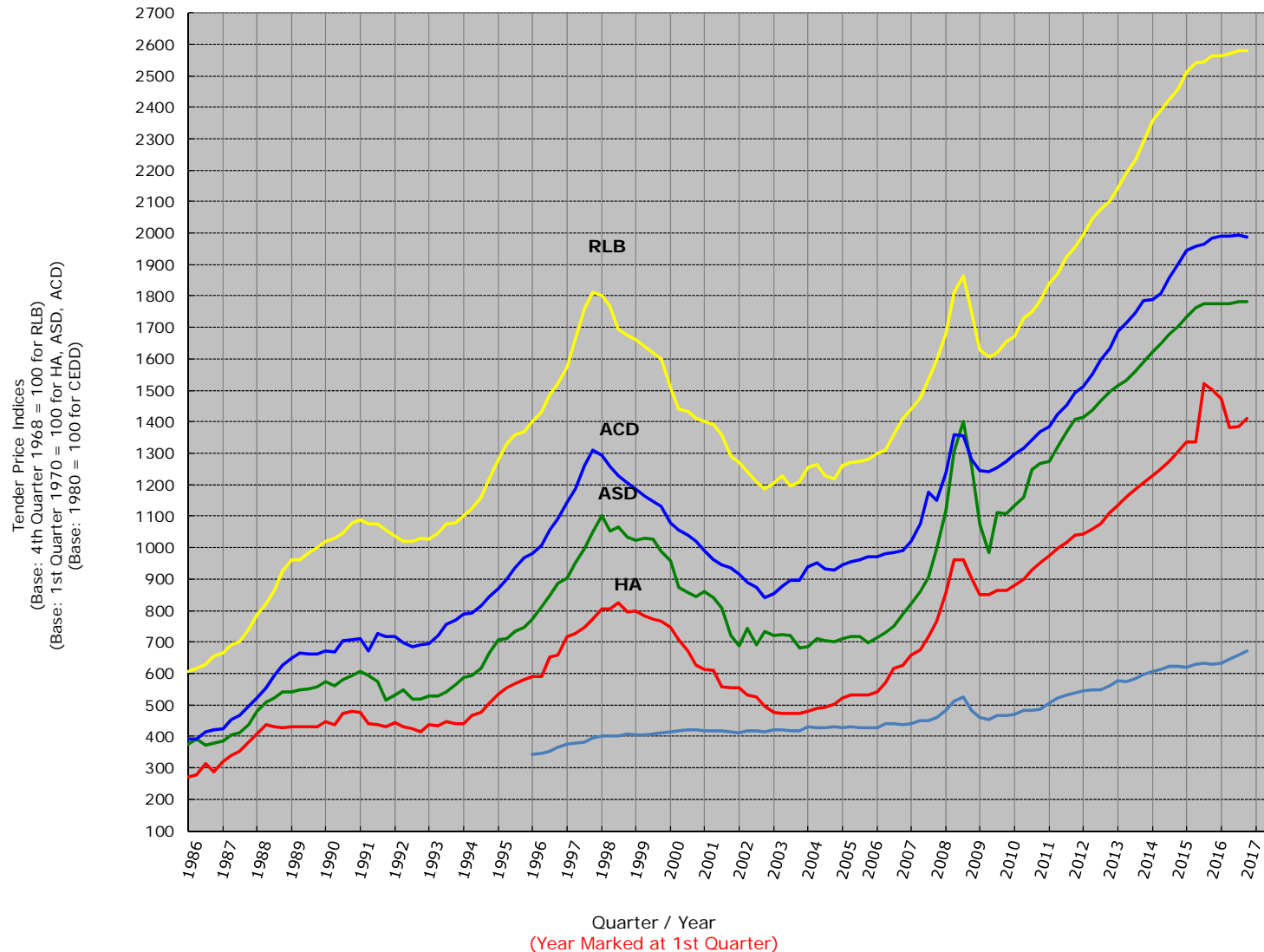
Benchmarking HA Construction Cost against Residential Building in Private Sector

- *HA's projects have achieved better cost effectiveness*
- *HA **PRH** projects & **SSF** projects are **42%** & **38%** less costly in comparison with the projects with residential buildings of average standard in the private sector of Hong Kong*



Market Trend

Rising Trends of Tender Price Indices



5. Overview on Construction Costs

Average Daily Wages of Construction Workers in Recent Years

Trades	2014	2015		2016	
Concretor	\$2,000 / day	\$2,300 / day	+15%	\$2,500 / day	+9%
Bar Bender and Fixer	\$1,710 / day	\$1,930 / day	+13%	\$2,150 / day	+11%
Formwork Erector	\$1,750 / day	\$2,050 / day	+17%	\$2,250 / day	+10%
Metal Worker	\$980 / day	\$1,080 / day		\$1,150 / day	
Joiner	\$1,050 / day	\$1,130 / day		\$1,230 / day	
Bamboo Scaffolder	\$1,600 / day	\$1,700 / day		\$1,800 / day	
Plumber	\$1,120 / day	\$1,250 / day		\$1,350 / day	
Plasterer	\$1,200 / day	\$1,350 / day		\$1,450 / day	
Painter	\$1,050 / day	\$1,120 / day		\$1,170 / day	
Electrical Fitter	\$1,070 / day	\$1,150 / day		\$1,210 / day	



Source: Hong Kong Construction Industry Employees General Union

Projected Average Construction Costs per Flat

Public Rental Housing (PRH) projects and **Home Ownership Scheme (HOS) projects** completed or to be completed during the period from **2016-17 to 2019-20**



	Public Rental Housing (PRH)	Home Ownership Scheme (HOS)
Financial Year	Estimated Average Construction Cost (\$) per flat	Estimated Average Construction Cost (\$) per flat
2016-2017	589,100	1,076,100
2017-2018	712,500	1,878,200 [#]
2018-2019	837,500	1,178,600
2019-2020	942,200	1,139,700

Based on HA's Public Housing Construction Programme as at December 2016.

There is only one HOS project to be completed in 2017-2018. As this project comprises only one domestic block with 31 domestic storeys, providing about 250 flats, the estimated average construction cost is comparatively high.

6. Further Measures to Stabilize Construction Costs

Further Measures to stabilize cost:-

A. Design

- Continuously adopt **lean design** to reduce the use of materials
- Continuously adopt **modular design** and **standard components** to gain **economies of scale** and facilitate **mass customization** (e.g. modular flat designs, standard precast concrete façade designs and dimensions)
- Tap **contractors' expertise and views** at design stage to enhance buildability and lean construction
- Reduce rework through **Building Information Modeling technology**



Steel Mould



Precast Façade - Rebar and window fixing



Precast Staircase

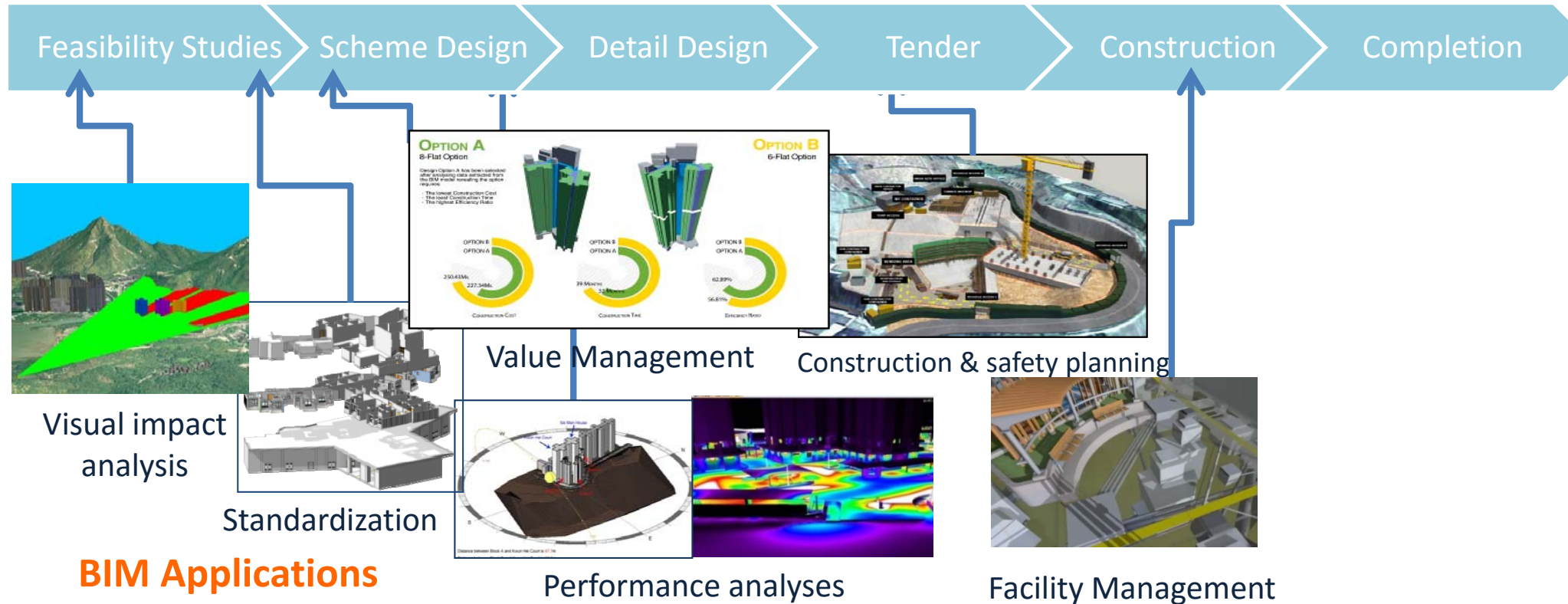
6. Further Measures to Stabilize Construction Costs

Measures to stabilize cost:-

Building Information Modeling (BIM) - Saving Resources ; Achieving optimization

5D BIM

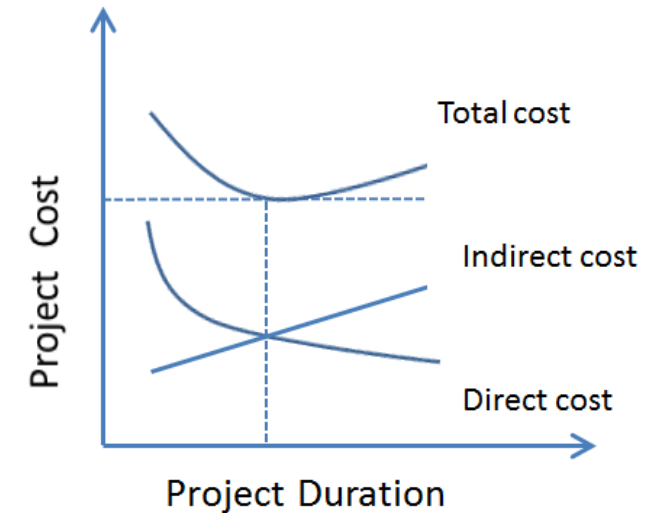
- adding **time** and **cost** in traditional BIM to strengthen project management and to **reduce clash** and **enhance buildability**



Measures to stabilize cost:-

B. Procurement

- Adopt **realistic contract period**; collaborate with **contractors to review the work sequence** to increase efficiency and optimize construction programme



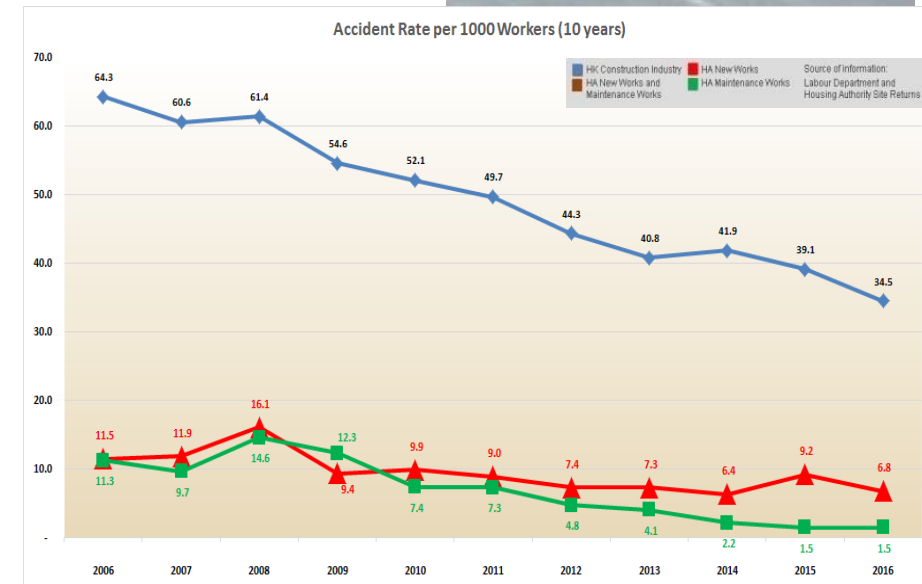
- Apply **suitable procurement strategies**, including bundling of contracts for small sites and ancillary works to enhance economies of scale, and using the Integrated Procurement Approach for large / complex projects

6. Further Measures to Stabilize Construction Costs

Measures to stabilize cost:-

C. Capacity Building

- ▶ Enable **system construction and centralized fabrication in workshop environment** (to alleviate the problem on shortage of skilled workers that lead to escalation of construction costs indirectly)
- ▶ Provide more **extensive training for new entrants** to the construction industry in a systematic manner (e.g. on-site training such as Contractor Co-operative Training Scheme)
- ▶ Provide **safe and healthy workplace** on site to attract new entrants to the construction industry



7. Conclusion & Way Forward

We are committed to **boost flat production** and **provide quality and environmental-friendly housing estates** for the public by making full use of **LAND** and make rational use of **PUBLIC FUNDING & NATURAL RESOURCES**:

- a. Maximize site potential to *meet housing supply target*
- b. Adopt *functional and cost-effective design*
- c. Apply *green, lean, safe & sustainable planning, design and construction.*
- d. Assure *better quality, the best practice and user friendliness* to address tenants' / owners' concern
- e. Continue to monitor the *effectiveness* of our planning and design **FOR THE BEST VALUE**



Planning, Design & Construction of Quality Public Housing

Benchmarking our sustainability targets

Public housing projects are **40% less costly** in comparison with the projects with residential buildings of average standard in the private sector of Hong Kong

HA projects generate **30% less construction waste** in our construction process

Average **Accident rate in HA new works contracts** is **80% lower** than the norm in Hong Kong construction industry

Electricity consumption in public areas of PRH blocks per flat per month is dropping consecutively in the last 8 years (**average - 3.4% a year**)

Customer Satisfaction Index >93% in the last 3 years



用心關懷 力求改進

Caring for People Committed to Progress

We are **Creative** and **Committed** to plan, design and construct home for people we **Care** for the **BEST VALUE** of resources

