AFFORDABLE SOCIAL HOUSING: MODULAR FLAT DESIGN FOR MASS CUSTOMIZATION IN PUBLIC RENTAL HOUSING IN HONG KONG

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Summary

Since 2008, the Hong Kong Housing Authority has been developing a new design strategy: adopting modular flat design for mass customization in public rental housing in Hong Kong. The Modular Flat Design (2008 Version) has been optimized to strike a better balance amongst various factors including valuable land resources, buildability and cost effectiveness and user-friendliness including responses to the findings from Residents Survey. This is a product of cumulative experiences over years. By applying modular flats to the building design in affordable social housing developments, Hong Kong Housing Authority can assure quality and sustainability while at the same time achieving consistency in standards..

Keywords: Public Rental Housing, Modular Flat Design, Standardization & Modularization, Universal Design, Sustainability

1. Public Housing Design Development

The Hong Kong Housing Authority is a statutory body established in April 1973 under the Housing Ordinance. The Hong Kong Housing Authority plans, builds, manages and maintains public housing in Hong Kong. The Authority develops and implements public housing programme in meeting the housing need of those people who cannot afford private rental housing. This is one of the objectives of the Government policy. In past decades, the Hong Kong Housing Authority has been providing affordable public rental housing through mass production. Approximately 720,000 households, i.e. 30% of the Hong Kong population, is now living in public rental housing units. The Hong Kong Housing Authority targets to provide 15,000 new public rental housing units each year such that the average waiting time of the applicants on the Waiting List will be maintained at around three years.

The use of 41-storey high rise Standard Block has proved to be an optimum design solution in all the aspects of architectural, structural, and building services. Initial cost and running cost for (i) additional floors and subsequent requirement of refuge floor and fire safety provision, (ii) increase in structural requirement on gravity and wind loads and (iii) extra lift services and energy

consumption would all be saved. It has reaped the benefits of economy of scale.

During the turn of the millennium, site-specific non-standard design approach was explored as the development strategy since this would enable better response to site constraints and allows full optimization of site development potentials. This is especially proven to be effective in difficult site conditions.

2. Modular Flat Design

After implementing site-specific design for a few years with a proliferation of non-standard designs, the Authority rationalised its tool kits for mass customization. In 2008, in line with the principle of "Functional and Cost Effective" design, the Authority has further developed a new design strategy by adopting **a new library of Modular Flat Design (2008 Version)** for mass customization in public rental housing. This aims to achieve best value and best practice in sustainable housing design and construction. To strive for greater efficiency and productivity through wider use of mechanized building process promulgated under Quality Housing Initiatives, whilst at the same time maintaining a certain level of design control over provision standards of rental flats hence maintaining consistency across different projects. This new library covers a whole spectrum of small modular flats (1-Person / 2-Person and 2-Person / 3-Person flats) and family modular flats (1- Bedroom and 2- Bedroom flats). Individual project architects are to adopt these standard modular flats to make up their building blocks to suit individual site configurations.

The modular flat design has been optimized to strike a better balance amongst various factors including valuable land resources, buildability, cost effectiveness, user- friendliness and responses to the findings from Residents Survey on newly completed public rental housing estates. As we gained experience over the years, this modular flat design helps assure both quality and cost effectiveness.

We anticipate that there would be a number of advancements through the use of modular flat design, notably:-

2.1 Enhanced Buildability, Consistency and Economy of Scale

The following measures are introduced to enhance buildability, consistency and economy of scale.

2.1.1 We maintain the consistency in the flat size and provisions in terms of dimensions, habitable & services areas to address the allocation standard.

2.1.2 By adopting "coordinated dimensions" approach, different flat sizes share common denominator dimension. This enable easy pairing up of flats and rational combination of flat arrangement to suit different flat mix and site conditions for individual projects (Fig. 1).

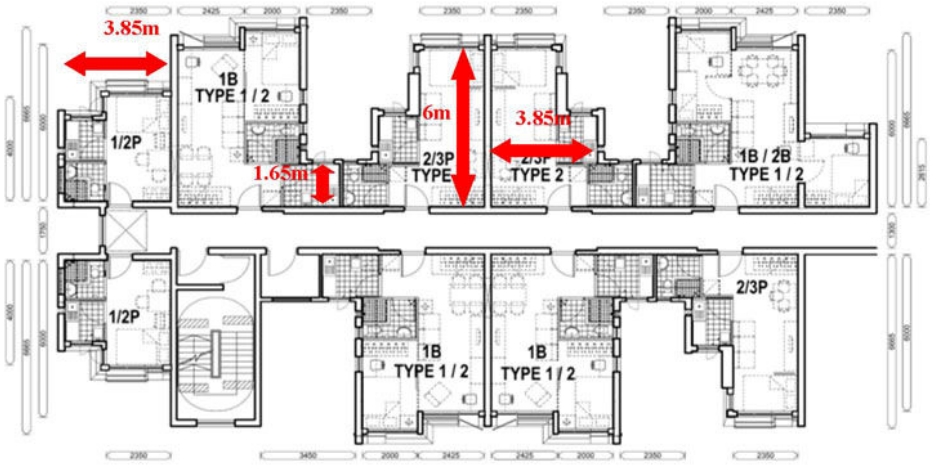

Fig. 1 Sample of Flat Arrangements

2.1.3 By allowing the optimization of structural design on the upper floors, we enable the reduction of the structural envelope and thus increasing internal flat size for user enjoyment within the permissible range.

2.1.4 By adopting standard precast façade (Fig. 2), we facilitate mechanization and prefabrication of structural elements and promote construction quality, efficiency and mass production while fine adjustment of the length of the reinforced concrete ledge is still permissible to regulate solar heat gain in different orientations.

Fig. 2 Precast Facade

2.1.5 By permitting wider use of volumetric precast components (Fig. 3), we advance the prefabrication technologies and promote greater benefits on cost, time and quality of construction as well as in the environmental and safety aspects.

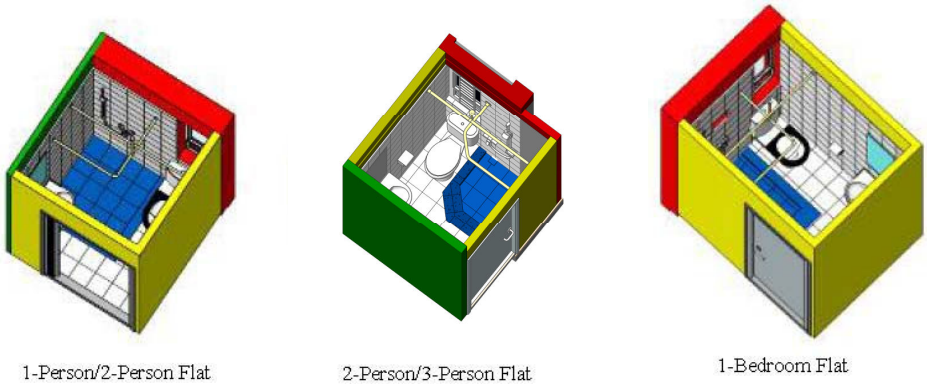

Fig. 3 Volumetric Precast Bathroom

2.1.6 By standardizing the flat configuration with co-ordinated dimensions repeatedly applied across various types of modular flats, we promote the wider use of precast fittings such as cooking bench / sink unit, metal gateset in Fig. 4.

Fig. 4 Prefabricated Cooking Bench / Sink Unit, Metal Gateset

2.2 Better Healthy Living, Safety and Easy Maintenance

To promote better healthy living, safety and easy maintenance, the following are taken into consideration.

2.2.1 We optimize the room dimensions and layout. The depth of re-entrant between flats is reduced below 1:3 minimizing stagnant effect and achieving better natural ventilation.

2.2.2 We optimize the service area to living area ratio to achieve a larger and better quality of living space.

2.2.3 We provide additional window(s) for better natural lighting and cross ventilation in living areas (Fig. 5).

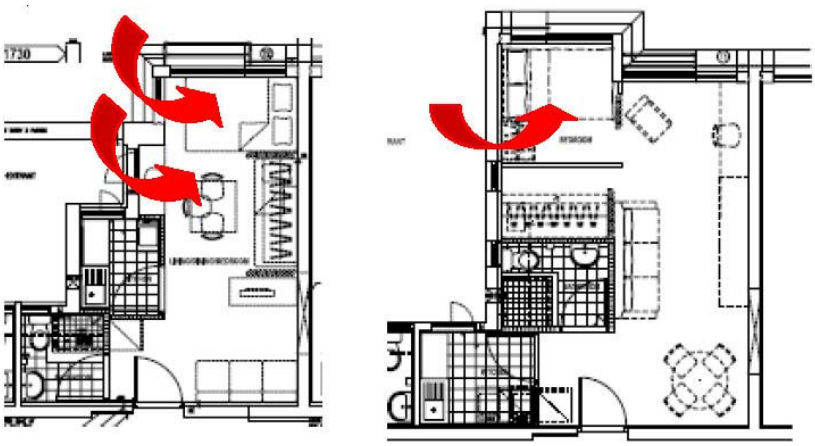

Fig. 5 Locations of additional windows in 2P/3P Flat and 1-bedroom Flat

2.2.4 We enlarge the bathroom and kitchen windows by lowering the window sills for better natural lighting (Fig. 6).

Fig. 6 Enlarged Bathroom & Kitchen Windows

2.2.5 To prevent transmission of disease through possible dried-up floor traps in the drainage stacks of high rise buildings, we enhance drainage design by introducing the self replenishing Common W- trap System (Fig. 7).

Fig. 7 Common W-trap System.

2.2.6 We rationalize the alignment of water supply pipes by running them at high level and internally as far as practicable so as to enhance the space utilization and ease of future inspection and maintenance especially in high rise buildings.

2.3 Focus in addressing Customer Needs

The modular flat design is focused to address the needs of the customers for social sustainability.

2.3.1 By refining the flat layout and window provisions we allow more flexibility in furniture layout and partitioning by tenants after intake and enhance the livability of modular flats.

2.3.2 By locating bathroom windows away from shower areas, we ensure better privacy.

2.3.3 For better safety in using the stove, we locate the cooking bench away from the kitchen window (Fig. 8).

Fig. 8 Cooking bench located away from the window

2.3.4 To address the need for laundry facilities and to provide clothes drying in the open air, we relocate the plugged-on laundry racks to the front façade and add more racks for family flats (Fig. 9).

Fig. 9 Laundry Rack at Front Facade

2.3.5 We rationalize the location and setting out of light switches and electrical wiring accessories. We relocate them to the living areas and group single sockets into twin sockets. This enables flexible usage and simplifies conduit run of building services within flats.

2.4 Enhanced Universal Design

Universal Design is further enhanced in various aspects to excel social sustainability.

2.4.1 Sunken shower

We provide sunken shower to improve accessibility and maneuvering of elderly and disabled tenants (Fig. 10). To ensure safe access to the shower area, we also provide anti-slippery floor tiles with high coefficient of friction along the edges of sunken showers.

Figure 10 Sunken Shower with Installation of Grating by Tenants

2.4.2 By setting back the concrete support of cooking bench and sink unit (Figure 11), we improve maneuvering of the wheelchair bound.

Figure 11 Cooking bench / sink unit

2.4.2 Power Sockets and Light Switches

By raising the height of designated power socket(s) to 1000mm above finished floor level (Figure 12), we facilitate easy reach by elderly and wheelchair users or walking-frame users without the need to bend down.

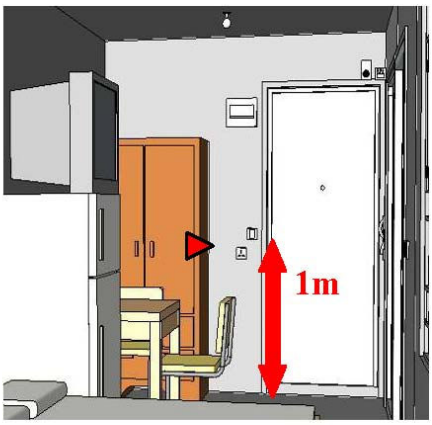

Figure 12 Universal Design Power Socket / Light Switch

3. Building Information Modeling

In the development of the Modular Flat Design (2008 Version), we pilot the use of Building Information Modeling, an advanced design and drafting software. Modules are created for use by project teams. A common Building Information Modeling platform has also been constructed for sharing of design practices amongst project teams in estate planning and tall building design. Furthermore, we are establishing a Building Information Modeling Design Library containing not only the modular flats but also the miscellaneous building components for common application across all design developments. These basic components can be used to create more complex standard modular flat models which assemble to form building wing(s), floor(s) and block(s) (Figure 13).

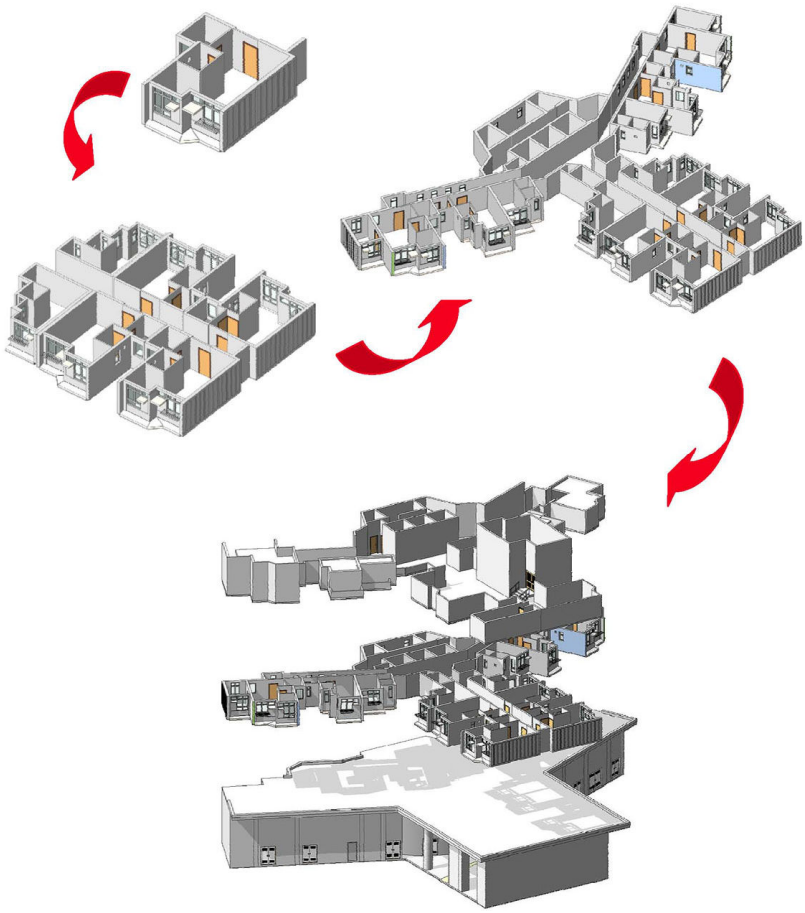

Fig. 13 Assemble Standard Modular Flats to form Building Wing(s) / Floor(s)

With environmental studies such as lighting, ventilation, energy, carbon emission, green design etc., Building Information Modeling models can create a better living environment for the public (Figure 14). All these with visualization would indeed make our Modular Flat Design (2008 Version) more user-friendly. Our next step is to link to Master Details, specification, statutory submission, environmental studies.

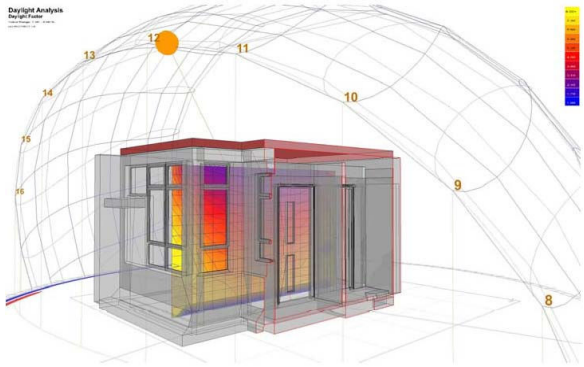

Fig. 14 Daylight Analysis

4. Conclusion and Way Forward

From October 2008 onwards, the new Modular Flat Design (2008 Version) has been adopted in all public rental housing projects at scheme design stage. The first project adopting the new modular flats will be due for completion in 2012. Hong Kong Housing Authority is exploring the use of another line of modular flats to address different site constraint such as severe noise abatement. Based on feedbacks from face-to-face customers' surveys and post completion reviews, we are continuing to improve the modular flat design in our annual revisions or updated editions.

The construction industry welcomes standardization, modularization and advance review on the critical spatial arrangement such as reinforcement and building services through Building Information Modeling (Figure 15) in achieving better buildability and easier construction management. We envisage with the use of BIM technology to gain more insight for enhancement in smart living, safety and sustainability in our works.

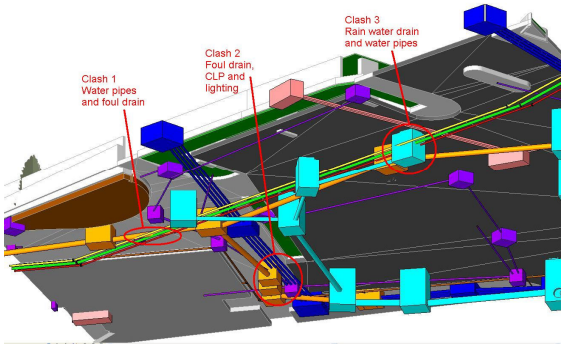

Fig. 15 BIM snapshot showing complicated pipe run for underground services

The Hong Kong Housing Authority is committed to build a sustainable community through a balance among social, economical and environmental dimensions. Benchmarking our sustainability targets, Hong Kong Housing Authority is (a) building 34% less costly in comparison with similar building in private sector of Hong Kong; (b) generating 30% less construction waste in our construction process; and (c) having 75% less accident rates than the norm in Hong Kong. Additionally, our yearly customer satisfaction index has continued to far exceeding 70% benchmark since 2006/07. All these truly confirm Hong Kong Housing Authority's sustainable development philosophy in practice. By applying modular flats to the tall building design in public rental housing developments, Hong Kong Housing Authority can assure even better quality, best value and best practice, and user-friendliness to address tenants' concerns while at the same time achieving consistency in standards to a certain extent. On the other hand, individual estates could still be designed with its own identity and responsive to micro-climate and other environmental considerations without creating monotony out of standardization.