Adaptive Reuse of Industrial Buildings for Affordable Housing in Hong Kong

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In response to the urban shortage of affordable housing, this paper elaborates on research findings on potential solutions for alleviating the current housing crisis in Hong Kong. This research specifically investigates the opportunities and constraints inherent in transforming industrial warehouses into residential units, from urban planning and architectural perspectives. Hong Kong is one of the most densely populated cities in the world, and it is currently facing an urgent call to provide adequate housing for its citizens. Although the Housing Authority is expending great effort to expedite public housing construction, finding an immediate solution to alleviate the current housing crisis remains doubtful as tremendous time and resources would be needed. At the same time, rapid urbanization in some industrial districts, such as Kwun Tong and Tsuen Wan, has left many old industrial buildings vacant. This paper proposes revitalizing selected abandoned industrial spaces and converting them into habitable units. In a larger sense, it proposes a theoretical framework for a sustainable methodology for urban revitalization and adaptive reuse. While focusing on developing an integrated strategy for converting specific old industrial districts into public housing, the ultimate goal of this research is to become a model for other old industrial districts and provide a new affordable housing solution.

Keywords: *affordable housing, adaptive reuse, urban revitalization, urban design, built environment*

1. INTRODUCTION

1.1 BACKGROUND

As one of the most densely populated cities in the world, Hong Kong is constantly confronted with a shortage of land on which to develop housing. One of the most pressing urban issues for the HKSAR government is how to create more affordable homes for its population of seven million. Currently, the Housing Authority provides public housing for over two million people, accounting for about 30% of Hong Kong's total population. Yet, despite adding 15,000 new public rental housing (PRH) apartments each year, a serious shortage remains. Hong Kong's government is desperate to find more feasible schemes to increase the number of available, affordable units and improve current housing conditions for all citizens. One obvious solution is to expedite the construction of new housing blocks; however, this takes a tremendous amount of time and resources. The proposition of converting existing building blocks into mass housing establishes a dialogue between an old context and a new function, and is potentially a feasible architectural expression of new sustainable planning. However, there is currently no statutory zoning mechanism to allow industrial areas to be rezoned to residential use.

Many districts are looking into taking advantage of a unique opportunity in the rapidly transforming urban fabric of Hong Kong, where economic changes have left many industrial buildings vacant. This research examines adaptive reuse as a means of urban regeneration by investigating the challenges of reusing industrial buildings and the technical feasibility of converting vacant industrial premises (vips). This paper presents research findings from a dataset responding to research questions such as: What are the essential considerations when converting an industrial building into residential units? What institutional framework/administrative procedures might be required for implementation? What urban planning elements, such as green spaces, community facilities, school allocations, commercial distribution, and cultural centres should be provided? Building upon a theoretical framework of housing sustainability and adaptive reuse of existing factory buildings, the aim of this research is to propose a housing-related feasibility study for converting some of Hong Kong's existing industrial buildings to create an affordable and liveable urban environment.

1.2 SIGNIFICANCE OF STUDY

Kwun Tong was chosen as the study area for this research because it was one of the earliest satellite towns of Hong Kong (Figure 1). Kwun Tong witnessed the population boom and the heyday of Hong Kong's manufacturing industries since the 1950s. The area experienced phenomenal

economic growth as its factories produced massive amounts of garments, electronics, toys, and other products. After the 1990s, most of the factories moved north to China in search of cheaper labour, and the light industries in the district faced a major decline. Hong Kong's manufacturing industries have declined from accounting for 21.8% as the major contributor to local Gross Domestic Product (GDP) index in 1981 to 2.5% in 2008 (Table 1). As the result of high vacancy rates in these warehouses, the government announced new policy measures to promote the revitalization of older industrial buildings through redevelopment and the wholesale conversion of vacant or under-utilized industrial buildings.

Figure 1: The location of Kwun Tong District

In 2009, a revitalization scheme was implemented to permit the conversion of industrial buildings into "Other Specified Uses" annotated "Business" ("OU(B)"), or "Commercial" zones ("C"). The new "OU(B)" zone allows a mix of office, commercial and non-polluting industrial uses, resulting in about 500 hectares of industrial land rezoned for non-industrial uses including 200 hectares to "OU(B)" use. Despite a number of incentives introduced, such as nil premium benefits and special waivers, the current system has limited effectiveness because it does not allow wholesale conversion from industrial to residential use. The new function of industrial buildings after wholesale conversion is still restricted to only a few allowable uses for the relevant zones, and there is no formal mechanism in place to grant permission to change these vacant spaces into a means of solving Hong Kong's pressing housing problem. The research aims to fill a gap in knowledge by establishing a theoretical framework for the adaptive reuse of industrial warehouses into residential units, from urban planning and architectural perspectives.

While focusing on developing an integrated strategy to convert an old industrial district to create a quality housing solution, the study embraces a broader theoretical framework for urban revitalization. The concept of adaptive reuse has been widely used in architecture as one method of reusing old buildings for new purposes, instead of demolishing and rebuilding new buildings on the sites. Though the original functions of the buildings might change as a result of an adaptive reuse process, there are multiple economic and social benefits in retaining the original building envelopes. Other than saving major demolition and construction costs, adaptive reuse encourages the conservation of social, heritage, and community values. The research is most relevant in cities like Hong Kong as the practice can offer a possible solution to solving the current housing crisis while promoting heritage conservation by retaining existing building envelopes of the factory blocks.

Table 1: Hong Kong Gross Domestic Product (GDP) from 1981- 2008 – illustrating a decline in manufacturing sector

Year	1981	1991	2000	2008
Manufacturing as a Percentage of Hong Kong's GDP	21.8%	14.5%	5.4%	2.5%

(Source: Planning Department, the Government of the Hong Kong Special Administrative Region, 2009)

This paper will present findings from surveys with property owners of industrial buildings and district stakeholders that were conducted between June 2012 to March 2013 to help understand the challenges and aspirations of reusing industrial buildings in Hong Kong. The discussion focuses on both refurbishment and redevelopment of vips, and the outcome draws out some evidence of stakeholders' concerns regarding the district's reused vips. Main objectives of this research are to: 1) present the findings related to the challenges of adaptive reuse; 2) discuss technical considerations for converting industrial buildings into affordable residential housing; and 3) offer recommendations to various government departments, such as the Planning Department, on future housing and planning strategies, and on streamlining current administrative procedures within the existing institutional context. In addition, local building by-laws such as Buildings Ordinance Chapter 123 and relevant building regulations will be referred to as the basis of defining minimum requirements for health and safety concerns, such as lighting and ventilation provisions. Secondly, the latest Code of Practice

for Fire Safety in Buildings will be analyzed to determine appropriate means of escape, means of access, refuge floors, and fire service installations for modifying industrial premises into affordable housing units.

2. ADAPTIVE REUSE

2.1 LITERATURE REVIEW AND THEORETICAL FRAMEWORK OF ADAPTIVE REUSE OF INDUSTRIAL BUILDINGS

The urban planning and architectural term for restoring old and obsolete buildings into new uses is "adaptive reuse". Adaptation or adaptive reuse occurs when a building is no longer performing, or intending to perform, its designated function (Kincaid, 2002). The conversion of obsolete structures, originally intended for other uses, into other spaces has been manifested in multiple combinations of new uses such as hospital-to-living units and warehouse-to-offices or studios etc. Scholarly studies by Austin, Woodcock, Steward, and Forrester (1988) provide various aspects of adaptation options, while other literature covers public policies related to rehabilitation of buildings and sustainability issues in building adaptation (Berens, 2010; Douglas, 2006). It has been argued that reusing existing structures can save time and resources compared to building completely new spaces.

In the U.K., the practice of adaptive reuse entered the mainstream after it was included in the sustainability agenda and became firmly endorsed by the U.K. government. Aside from residential and historical revitalization, adaptation projects are also implemented in industrial buildings as a special form of refurbishment. It implies renovating old warehouse structures to fulfil contemporary building and planning standards. Some buildings are adapted to provide stimulating environments for uses unheard of at the original time of construction, or they can be stripped back to their historic facades to act as mere "faces" for new spaces. Austin et al. (1988) explains the rationales behind the endeavour, addressing issues related to preservation of a city's identity, conservation of built form and continuity of existing urban fabric. Although it is recognized that adaptive reuse has clear economic, environmental and social benefits for the built environment, developers would need certain incentives to consider this option as opposed to demolition and redevelopment of an obsolete industrial building.

Langston, Wong, Hui and Shen (2008) outlines successful international examples of conversion of disused industrial spaces. In cities such as London, Rotterdam and New York City, adaptive reuse has been widely applied as an active mode of urban revitalization. Many post-industrial sites in London have been refurbished from warehouse buildings into liveable units since the early 1980s. Former warehouses such as Butler's Wharf, Spice Wharf and Sesame Wharf near the Shad Thames area have been transformed from derelict sites into apartments, with restaurants and shops on the ground floor. In particular, the example of Shad Thames illustrates economic benefit brought forth from the revitalizing of industrial buildings. The development is able to provide an adequate supply of quality housing options while balancing heritage conservation as well as maintaining a financially viable model.

Gause et al. (1996) further highlights the advantages and challenges of warehouse conversion. It is identified that the timing, favourable zoning, market value of the existing building and financial support are all essential to the effectiveness of adaptive reuse. This model suggests that proactive private initiatives and public support are both critical to influence the real estate community to adapt obsolete buildings for economically viable new uses. Ball (1999; 2002) explores the sustainability issues related to vips extensively, pointing out the debates on the capital costs and related benefits and constrains of reuse versus new building. Through qualitative research and his multiple case studies in Stoke-on-Trent, U.K, it was suggested that the critical components, such as collaboration between private and public sectors, participation from specialist firms and local authorities, are essential to contribute to the success of adaptive reuse projects (Ball, 2002). Similar to Ball's research methodology, this research also used surveys and focus groups to determine the benefits of conversion to interim or temporary housing in Hong Kong, specifically for a demographic category of young professionals who cannot make a first down payment for home ownership in the current market. Although revitalizing industrial buildings for residential use is not a new approach in other countries, it has never been formally implemented in Hong Kong under the current planning and design regulations. The research sets itself apart from many other studies on this topic by assessing the suitability of transforming spatial form in terms of structural, architectural and urban planning requirements. In the end, this study proposes possible future new uses of industrial buildings by utilizing the existing statutory framework.

Adaptive reuse can pose major challenges for designers. Changing the design and built form or functional classification of a building often requires lengthy zoning consent and these new regulatory conditions are often difficult to fulfil. Austin et al. (1988) explains the significance of meeting the demands of statutory constraints. In cases where the basic fabric of the building was created to meet a completely different set of requirements, the challenges faced by the design teams, contractors, developers and the regulatory agencies are even greater as there is a high demand for creativity and compromise in order to comply with the intent of the law. Contemporary expectations with regards to upgrading heating, cooling, lighting, life safety, universal accessibility and new functional demands become essential requirements to be integrated into the legal regulatory framework within which the designers must operate. However, some studies suggest that older buildings are generally more energy efficient than the newly built buildings. The literature demonstrates how legislators at the national levels and local authorities have responded to society's demand to retain and adapt the best of the old by establishing financial incentives for such development. Some cases demonstrate that if a community can encourage reinvestment in the fabric of the inner city, this opportunity could potentially create more jobs in construction and revitalized businesses, greater stability and lower taxes.

While Ball and others use U.K.-based studies to emphasise the influence of planning structures and redevelopment on urban regeneration, other works reflect a deeper study of housing regulations, using institutionalism as the basis for analysis. In the review of institutional models, for example, Hamzah (2013) critically reviews current housing regulations that can be broadly sub-divided into redevelopment controls, planning obligations and housing standards. Housing development controls on planning, land and environment aim to provide minimum guidelines on health and safety. Additional clauses aim to provide improvement standards for energy consumption, universal accessibility and sustainability. Policies alone do not create the regulatory environment that governs the activities of market actors, and it is argued that the implementation of housing regulations is determined by the composition and characteristics of the housing market and policy implementers (Hamzah, 2013). Lizieri (1994) explains that transactions between occupational, investment and development markets formulate the key role of funding institutions. While the landlord-tenant relationship is most pronounced in the commercial (office and retail) sector, institutional investors and property companies have significant holdings in industrial properties (Lizieri, 1994). Therefore, the shift in the nature of industrial production, in the location of activity and in patterns of ownership, will influence the occupational markets (Lizieri, 1994). The literature review is relevant to the Hong Kong situation as it broadly offers a critique on the existing institutional framework, while recognizing that housing regulations are instrumental in the realization of adaptive reuse.

3. POLITICAL AND URBAN STRUCTURE

Industrialization in Hong Kong began in the 1950s with manufacturing sectors serving as a main source of income for Hong Kong's economic growth. Hong Kong remained one of the top three largest goods and services contributors throughout the 1980s. As Hong Kong's manufacturing industries rapidly developed, the colonial government at that time decided to develop industrial estates and establish industrial buildings in some districts, which were supported by nearby commercial and residential zones to assist in the industrial expansion. Kwun Tong, along with other districts like Cheung Sha Wan and Chai Wan, were typical industrial districts in early Hong Kong. Schenk (2001) claims that the new population from China transformed the economy by creating a substantial labour-intensive manufacturing base, as a large proportion of the immigrants were unskilled workers. One example of this was household workshops producing toys and plastic tools, which formed the early model of regional manufacturing industries in the centre of Hong Kong and further became the catalyst that expanded Hong Kong economy.

Hong Kong gradually transformed from a trading port into an industrial colony after an embargo policy was imposed on China's products (Chiu & Lui, 2009). Plastic toys, textile and clothing, electronic devices, and printing industries then became Hong Kong's core businesses. In effect, most of the city's industrial buildings were built from the early 1950s to 1980s in a response to industrial growth. They were constructed as flatted factory estates with minimum provisions for ancillary facilities; tenants needed to share sanitary rooms on each floor. The appearance of these industrial buildings gradually improved and became more spacious in the late 20th century. Figure 2 and Figure 3 illustrates some typical flatted factory estates and industrial buildings from various eras.

Figure 2: An obsolete flatted factory in Hong Kong

Figure 3: An existing typical industrial building in Kwun Tong District, Hong Kong

During the early 1980s to the late 1990s, manufacturing industries in Hong Kong underwent a process of restructuring that not only resulted in the local upgrading of production processes, but also the relocation of factories to Mainland China (Chiu & Lui, 2009; Hong Kong Special Administrative Region Government, 1997). The relocation of Hong Kong's manufacturing industry to China transformed its economic pattern, resulting in a large amount of factories and industrial buildings being abandoned. This phenomenon became more serious around 2010, when Hong Kong faced a severe shortage of land for offices and housing. According to a report conducted by the Development Bureau (2009), there were more spaces in Hong Kong's industrial premises than required by the manufacturing industries since 1992 (Figure 4). The 2009 Planning Department's *Report on Area Assessments of Industrial Land in the Territory* states that only about 40% of industrial premises in "OU(B)" zone is still engaged in industrial and related uses. The rest of the floor area is either occupied by non-industrial uses or has been left vacant.

Due to the restructuring and relocation of traditional manufacturing businesses to Mainland China, many private flatted industrial buildings in Hong Kong are under-utilized. The report by the Development Bureau (2009) implies that the total stock of private flatted factories was about 17.2 million m² at the end of 2011, resulting in a vacancy rate of 6%. Moreover, it was found that some vacancies have attracted non-compliant uses of the buildings other than industrial, such as restaurants and food factories, showrooms, and art and music studios. These uses are not permitted uses under the current land use zoning, meaning that either no planning permission has been granted for these uses or the identified uses do not comply with the current lease conditions. Non-compliant uses of industrial buildings are creating hazards for both tenants and visitors.

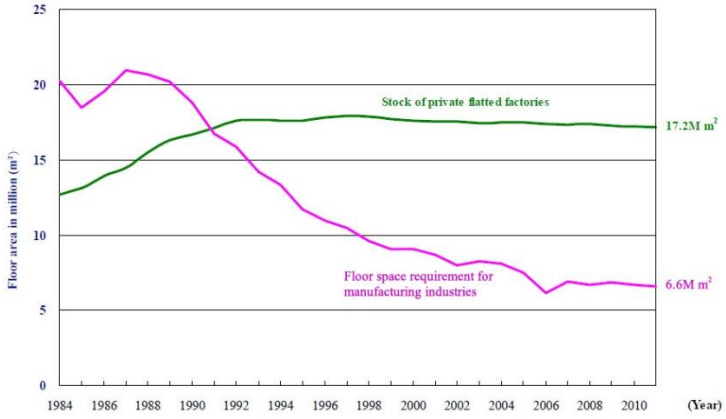

Figure 4: Demand for manufacturing floor spaces and stock of industrial premises
(Source: The Development Bureau, The Government of the Hong Kong Special Administrative Region, 2009)

Understanding and planning future development is essential for Hong Kong's built environment, so the HKSAR government launched the "Hong Kong 2030 Planning Vision and Strategy" study in 2007 for the development of Hong Kong over the next 20-30 years. The government intends to relax planning controls on the use of industrial buildings and to optimize the use of any surplus industrial land or obsolete industrial buildings, by adaptive reuse, to loft apartments or other special uses. The relaxation of planning policies includes permitted new usage within industrial buildings to encourage adaptive reuse for other purposes. Nevertheless, despite the pressing need for housing units, there are no policy incentives from the government to restructure or reuse these industrial buildings for residential use or interim housing. The need for affordable dwellings has remained unmet.

4. RESEARCH METHODOLOGY

The research sets itself apart from many other studies on this topic by assessing the suitability of transforming spatial form in terms of three main criteria, which are structural integrity, architectural layout feasibility and urban planning considerations. The objective is to offer recommendations for potential new uses of industrial buildings utilizing existing statutory framework. The research was divided into two stages.

Stage 1 – Background desktop research

The first stage of this research involved understanding the urban morphology, the context of Kwun Tong and its potential and the constraints of adaptive reuse practices. Site visits to the area and visual surveys were carried out to 256 existing factory buildings to provide an analysis of building age (Table 2), structural conditions, access, parking, available services and ownership distributions (Table 3). A content analysis observed that over 40% of industrial buildings in Hong Kong are younger than 30 years of age and some of them are located in prime districts, including Kowloon Bay and Kwun Tong. These buildings are generally in good structural condition, and have high accessibility and versatile design. There is great potential and opportunity for changing the uses inside these industrial buildings from industrial/manufacturing to other potential uses. Based on visual inspections by structural engineers to testify the structural feasibility of this batch of factory buildings, physical attributes such as gross floor areas, interior plans and fire escape locations were compared with typical housing layout as surveyed in selected housing studies (Ma & Chow, 2005).

Table 2: Building age distribution in Kwun Tong

Building age	Number of buildings	Percentage of total
1-20 years	64	25
21-30 years	46	18
31-40 years	67	26
41 years and above	79	31
All	256	100

(Source: Kee, 2013)

Table 3: Ownership distribution in Kwun Tong

Ownership type		Building type: Flatted factories	Industrial/offices	Storage	Vacant	Total
Single	No.	70	9	1	4	84
	%	27.3	3.5	0.4	1.6	32.8
Multiple	No.	165	6	1	0	172
	%	64.5	2.3	0.4	0	67.2
All	No.	235	15	2	4	256
	%	91.8	5.8	0.8	1.6	100

(Source: Kee, 2013)

A factory re-use potential analysis revealed that most of the existing floor plates can accommodate typical housing units generously. Other urban design elements such as auxiliary amenities and services, such as health services, sports facilities, and other community support, in the Kwun Tong neighbourhood are critical to determine whether the urban ecology can support future increase in population capacity. Initial carrying capacity assessments testify that existing infrastructure load, employment opportunities and auxiliary amenities are adequate. These elements of urban and built environment are important for a sustainable urban regeneration model as the implementation of affordable housing into a revitalized district is not only dependent on the physical attributes and the economy of housing market, but also on the auxiliary amenities and services available in the neighbourhood (Flynn, 1978).

Stage 2 – Data collection and analysis

Based on the assessment on the structural and technical feasibility of industrial premise conversion, stage 2 of the research was divided into two parts. The first part included the methodology of primary data collection from 511 sets of questionnaire surveys. The survey was based on a sampling frame built up from local housing authority's lists and a total sample size of 511 in the district of Kwun Tong was collected from June 2012 to March 2013. The survey collected information from respondents on housing needs and aspirations, which would be applied to the overall projected demand for understanding housing needs and demands. The second part of this stage was a series of focus group discussions. Five separate focus groups were conducted with invitees including district council representatives, private factory owners, architects and planners, owners committees and real estate developers to deepen the understanding of potential and constraints in adaptive reuse.

From the completed 511 sets of questionnaire surveys from respondents, majority of the respondents (62%) strongly supported the adaptive reuse of industrial buildings to temporary or interim housing solutions; 58% agreed to maintain their current industrial use; 56% suggested to support office or other commercial activities; 51% advocated creative industries and 50% supported shopping mall facilities (Table 4). These questionnaire surveys presented a high interest in industrial conversion in the area. The general attitude to adaptive reuse is apparent and can be an obvious influence on the regeneration policy towards reoccupations and redevelopment of vacant industrial floor spaces. The support of industrial reoccupation, however, was subject to further findings from the focus group results.

Table 4: Interviewer's perspective on the future use of the industrial buildings in Kwun Tong (question allowed multiple selections)

Building type	Number of responses	Percentage of total for type
Public house	315	62
Retain industrial use	294	58
Office	288	56
Shopping mall	257	50
Creative industry	260	51
Residential house	164	32
Tourism facility	119	23
Private building	77	15
Hotel	59	12
Luxury house	14	3

(Source: Kee, 2013)

The focus groups identified major challenges on private owners who were interested in adaptive reuse. Findings revealed that some industrial building owners and tenants expressed that they were reluctant or unable to carry out redevelopments, wholesale conversion or even temporary change of use for these buildings because of physical and financial challenges. Nearly 21.8% of owners expressed major difficulties due to the multiple ownerships in flatted industrial buildings which rendered difficulty in reaching a consensus to convert or redevelop the buildings. About 32.9% of private owners were deterred by the requirements to pay full market premium for lease modification for redevelopment to other uses. 18.4% of building owners were reluctant to be the "first movers" to convert or redevelop their buildings for non-industrial uses before similar uses emerge in the neighborhood. 26.9% of building owners found it difficult to justify the initial capital required to support adaptive reuse as opposed to demolition of the building for redevelopment. Many expressed that if there was more government incentive or tax relief for small entrepreneurs who have an interest in the adaptive reuse process but lack financial backups, it would increase business interests.

5. CONSIDERATIONS FOR CONVERTING INDUSTRIAL BUILDINGS INTO AFFORDABLE RESIDENTIAL HOUSING

5.1 PLANNING REGULATION AND GOVERNMENT INCENTIVES

The results from the research provided a useful basis for assessing attitudes across district stakeholders and revealed an apparent demand on industrial reoccupation. The current building and planning structure, however, would need to be enhanced to provide an impetus for owners to revitalize the buildings to increase its competitiveness and conform with surrounding uses. The current statutory control in Hong Kong includes the Outline Zoning Plan stipulated by the Planning Department and the Building Ordinance under the Buildings Department. Since 2001, the Town Planning Board rezoned most of the suitable industrial areas from "Industrial" use to "Other Specified (Business)" use and has launched the following measures to encourage new uses for industrial buildings by offering more financial incentives.

The Hong Kong Legislative Council Paper LC Paper No. CB(1)1909/10-11(07) states that the lowering of application threshold for compulsory sale orders under the Land (Compulsory Sale for Redevelopment) Ordinance from 90% to 80% of ownership for industrial buildings aged 30 years or older situated in non-industrial zones can address fragmented ownership in flatted industrial buildings. The subsidiary legislation required for implementing this measure came into effect on 1 April 2010, after being vetted by the Legislative Council. If the government is aspired to relax the current planning control, buildings owners expressed from the focus groups that a tailor-made lease modifications at a "pay for what you build" premium (i.e., assess premium based on the optimal use and proposed gross floor area of the redevelopment) would promote business interests. This relaxation would allow more financial incentive and release the burden on those who would promote industrial adaptive reuse.

To encourage more investment opportunity and increase the economic benefits, another measure is to allow owners who modify the lease for redevelopment to opt for payment of 80% of the land premium through annual installments over five years at a fixed rate of interest (at 2% above the average best lending rate of the three note-issuing banks prevailing at the time), if the total premium exceeds $20 million. The most effective motivation, as the focus group identified, could be to allow owners to apply for an exemption for fee for change of use of the existing industrial building for the lifetime of the building or the current lease period. The lack of sufficient incentives for the industrial reoccupation constituted the major hurdle to adaptive reuse practices. It is recognized that once the current planning mechanism is relaxed, more private owners would opt for adaptive reuse considering the economic and community benefits.

5.2 HOUSING AFFORDABILITY

Since there is an urgent need to increase housing supply in Hong Kong, the research aimed to demonstrate the possibility of converting industrial buildings to public housing or interim housing could be a potential solution to current housing shortage. Despite the current statutory constraints, there are mechanisms by which the technical aspects of upgrading a building can be overcome and achieved. The continually rising property sale and rental prices have led to an increase in the number of applications for public housing (Table 5), reaching over 189,000 in 2012 (Hong Kong Housing Authority, 2012). This figure has risen to 200,000 in the first quarter of 2013. There are some extreme housing conditions in Hong Kong whereby people live in illegally sub-divided apartments or 'cage houses'. A recent survey commissioned by the Long Term Housing Strategy Steering Committee between January to April 2013 reflected that over 171,300 people live in

Table 5: Number of people waiting for Housing Authority Public Rental Housing in 2012

Waiting List			
As at end of the period	2001/02	2006/07	2011/12
No. of live applicants	86,000	107,000	189,000

The average waiting time for the general waiting list applicants to be allocated with HA PRH flats in the year 2011/12 was 2.6 years. The monthly income limit and asset limit for a 4-person household were HK$20,710 and HK$418,000 for 2012/13 respectively.

(Source: Hong Kong Housing Authority, 2012)

subdivided units. Most of these units are in poor hygiene condition and at a high fire risk. This housing crisis in Hong Kong is becoming an alarming issue and the Government has announced its priority to search for more land that can be used for housing purposes in the Government Policy Address 2013.

However, searching for appropriate plots of land is a time-intensive process, and detailed feasibility studies and careful planning have to be undertaken. Hulchanski (1995) explains that the concept of affordability as the difficulties faced by each household in obtaining adequate housing and accommodation. Hancock (1993) further notes that the term affordability is concerned with gaining a certain housing standard for accommodation at a price or rent that is reasonable and payable based on household income. To achieve this, the Housing Authority of the Hong Kong SAR Government started to provide low-cost housing and public rental housing in the 1950s and 1970s, respectively, for residents who could not afford the price of private apartments. In order to provide a better living environment for people who can afford higher apartment prices, the Housing Authority launched subsidized housing, which has more provisions for facilities and a larger apartment size (Royal Institution of Chartered Surveyors, 2011). Both public rental housing and subsidized housing in Hong Kong have gained a good reputation for their design, unit size, living environment, building quality, and management. To meet the demand for more housing, many professionals, district councilors, and NGOs urged the government to increase and expedite the provision of public rental housing and to resume the sale of subsidized housing.

In 2002, the Planning Department conducted a study on transforming industrial towers into lofts for living. It is generally accepted that deserted industrial buildings have the potential to change into new uses and relieve the urgent need for housing (Planning Department, 2002b). While the government is encouraging building owners and developers to revitalize and restore abandoned industrial buildings for domestic purposes, this will not be an easy task, and there are some fundamental feasibility issues identified in this research that need to be addressed prior to any conversion:

- *the compatibility and interfaces between the proposed use and the arising environmental impacts;*
- *the differences in plot ratio and development parameters control;*
- *impact on the future traffic arrangements and capacity;*
- *the adequacy of the provision of public facilities; and*
- *the fulfilment of Buildings Ordinance and Regulations and relevant Code of Practices*

5.3 Design and Built Environment Considerations

The institutional development controls on domestic buildings are more stringent than those imposed on industrial buildings in Hong Kong. The Building (Planning) Regulations Cap 123F [B(P)R], a subsidiary legislation under the Buildings Ordinance, has regulated that the maximum plot ratio (PR) of domestic development ranges from 8 to 10 PR, while that to industrial development is up to 15 in some cases. Therefore, if an industrial building with a PR of 15 is going to be converted into interim housing or residential units with a maximum PR of 10, the excessive gross floor area (GFA) has to be reduced by a minimum of 33% in order to comply with the B(P)R. According to Schedule 1 of the B(P)R, non-domestic buildings can achieve higher site coverage than domestic buildings (Table 6). When converting industrial buildings into domestic usage in the current built environment, the building bulk has to be reduced to ensure compliance with B(P)R.

Aside from institutional restrictions, conversion of industrial buildings into domestic uses may also create problems in complying with the other clauses in the B(P)R regarding the requirements for prescribed windows, lighting and

ventilation, since the requirements for residential buildings are more stringent than industrial uses. According to the B(P)R, every room should have direct access to natural ventilation and lighting; the requirements have been listed in Table 7. In most cases, however, studies show that most local industrial buildings can possibly satisfy these requirements of the B(P)R with slight adjustments to the interior layout. Nevertheless, the physical fulfillment will be subject to the decision of the Buildings Department regarding the degree of relaxation of regulations.

Table 6: Percentage Site Coverage and Plot Ratio

Height of Building In Metres	Domestic Buildings						Non-domestic buildings					
	Percentage site coverage			Plot ratio			Percentage site coverage			Plot ratio		
	Class A site	Class B site	Class C site	Class A site	Class B site	Class C site	Class A site	Class B site	Class C site	Class A site	Class B site	Class C site
Not exceeding 15 m	66.6	75	80	3.3	3.75	4.0	100	100	100	5	5	5
Over 15 m but not exceeding 18 m	60	67	72	3.6	4.0	4.3	97.5	97.5	97.5	5.8	5.8	5.8
Over 18 m but not exceeding 21 m	56	62	67	3.9	4.3	4.7	95	95	95	6.7	6.7	6.7
Over 21 m but not exceeding 24 m	52	58	63	4.2	4.6	5.0	92	92	92	7.4	7.4	7.4
Over 24 m but not exceeding 27 m	49	55	59	4.4	4.9	5.3	89	90	90	8.0	8.1	8.1
Over 27 m but not exceeding 30 m	46	52	55	4.6	5.2	5.5	85	87	88	8.5	8.7	8.8
Over 30 m but not exceeding 36 m	42	47.5	50	5.0	5.7	6.0	80	82.5	82	9.5	9.9	10.2
Over 36 m but not exceeding 43 m	39	44	47	5.4	6.1	6.5	75	77.5	80	10.5	10.8	11.2
Over 43 m but not exceeding 49 m	37	41	44	5.9	6.5	7.0	69	72.5	75	11.0	11.6	12.0
Over 49 m but not exceeding 55 m	35	39	42	6.3	7.0	7.5	64	67.5	70	11.5	12.1	12.6
Over 55 m but not exceeding 61 m	34	38	41	6.8	7.6	8.0	60	62.5	65	12.2	12.5	13.0
Over 61 m	33.33	37.5	40	8.0	9.0	10.0	60	62.5	65	15	15	15

(Source: The Planning Department, The Government of the Hong Kong Special Administrative Region, 2009)

Table 7: Lighting and Ventilation – Standard Requirements

Items	Standard	Design
Distance from a Prescribed Window	1/10 of floor area of room	1/15 of floor area of room
Aggregate Superficial Area of Glass	1/10 of floor area of room	1/15 of floor area of room
Openable Window	1/16 of floor area of room	1/24 of floor area of room

(Source: Department of Justice Bilingual Laws Information System, The Government of the Hong Kong Special Administrative Region, 1997)

Table 8: Fire and building safety

Items		Standard Domestic	General Industrial
Fire Resistance Period		1 hr.	2 hr.
Floor Loading		2.0 kPa	5.0 kPa
Fireman's Lift		1 no. within 60m of any part of floor	Nil
Means of Escape	*Capacity per floor*	156	464
	No. of stairs	2 (1,050mm)	5 (1,676mm)

(Source: Department of Justice Bilingual Laws Information System, The Government of the Hong Kong Special Administrative Region, 1997)

Another critical requirement for fire safety are means of escape for domestic buildings (Table 8). Compared to a common industrial building, except the provision of firemen's lift within 60m of any part of a floor, industrial uses have more stringent requirements than domestic buildings under the Buildings Ordinance. Currently, there is no specific provision for a firemen's lift in factories or industrial buildings; the existing facilities will need to be upgraded to fulfill the requirements of the fire regulations in a conversion scheme. For example, additional fire alarms, fire detectors, emergency lights, and refuge floors will need to be provided to suit the additional kitchen facilities that might be implemented in the building conversion to residential use. According to B(P)R Clause No.45, kitchen areas should have a properly constructed oven or cooking slab, and be equipped with a gas supply pipe or duct, oil, and electricity.

Furthermore, a habitable place should also be equipped with a sink and water supply for cleaning purposes. In general, the intended use of industrial buildings is for manufacturing has to be upgraded to provide minimum cooking facilities; therefore, provisions such as gas/oil/drainage pipe installation will need to be installed for most industrial buildings. Future alterations and installations should be required to fulfill the basic requirements of operation, as well as the administrative aspects of the B(P)R. Other additional means of escape, access routes, and fire installations will have to be improved to accommodate the increase in capacity and value of any particular enclosed area. The minimum provision of fire safety is one critical safety consideration in determining the feasibility of a particular building's adaptive reuse. On the other hand, there are accessibility issues to be considered. According to the Barrier Free Access Code of Practice, residential buildings must be equipped with the minimal provision for universal accessibility.

It is also important to prove that the building has not been contaminated because of manufacturing processes or the storage of toxic materials. Since most of the industries in Hong Kong were mostly light industry, heavy contamination is not a major concern. In order to provide a sound living environment, the urban design master plan needs to consider other community facilities, such as public libraries, swimming pools, schools, town halls, and religious institutions, which are necessities for a healthy and balanced urban neighborhood. This study identified that both urban amenities and technical provisions are essential when considering a conversion. Langston et al. (2008) imply that, within a contemporary city, it is necessary to balance social, cultural, and environmental provisions. Therefore, to promote the sustainability of the community, more technical feasibility studies and detailed urban planning guidelines are needed to outline the fundamental elements that make a neighborhood sustainable. Social amenities, such as schools, hospitals, public parks, and public parking will all need to be carefully planned

5.4 OUTLINE ZONING PLAN CONSIDERATIONS

Another challenging statutory structure is the Outline Zoning Plan that governs the urban environment. There is currently no residential zoning in some of the districts with industrial activities. Therefore, even though the feasibility of building conversion is technically viable in the individual building scale, this study identifies factors affecting the urban scale. While the integration of both social and environmental sustainability into urban planning is critical, further assessment criteria are necessary to constitute an affordable residential community. One of the major concerns about transforming factories or industrial buildings into other uses is the interface problems with the surrounding environment and potential hazards to future tenants. When an industrial building is converted to domestic use, industrial noise and air pollution problems generated from the adjacent industrial activities can affect the tenants of the housing units.

according to the demographics and needs of each district in the urban transformation. An assessment of the carrying capacity on urban infrastructure, transportation systems and other urban ecosystem would be valuable to best evaluate the effectiveness of the adaptive reuse transformation.

The Hong Kong Planning Standards and Guidelines (HKPSG) provides a source for reference, recommending one car parking space per 6-9 apartment units in subsidized housing estates; the suggested standard for industrial buildings is one car parking space to 1200m² GFA. It is obvious that more provision for parking spaces is required for residential zones than industrial zones. Existing zoning law also requires a minimum of one loading/unloading area. However, in terms of interim housing, residents plan to live in the units for only a short period and will eventually move to permanent public or private housing. As a result, the provision of car parking spaces can be reduced, subject to the decision of the Department of Transportation. A holistic approach that embraces both the building design and urban built environment context would be a prime requirement in future adaptive reuse strategy.

6. POLICY RECOMMENDATIONS

The research first outlines various technical considerations for converting some of the existing industrial buildings for new housing function under the existing statutory framework. It also explores major planning-related concerns such as green spaces, community facilities, school allocations, commercial distribution and cultural centres associated with adaptive reuse. This part of the study interprets evidence and recommends considerations to achieve a livable urban environment via the adaptive reuse of vips. Research findings show that 64% respondents viewed air pollution as the main urban problem that needs to be alleviated, while other respondents suggested traffic connectivity (62%) and pedestrian access (60%) were important. 53% respondents critiqued the lack of green spaces in the area (Table 9).

The survey showed that the growing demand for industrial premise conversion was sufficient to bring many former vips back into new function in adaptive reuse practice. The previous stigma associated with deterioration, environmental problem and negative images of vips can be given new potential to solve current housing situation. With this as the conceptual framework, adaptive reuse of vips can be seen as a great urban resource. There is no doubt that such implementation needs to be supported by sound governance, financial support, technical feasibility and planning policy relaxation. There are a range of possible policy scenarios that are essential for the redevelopment actions. With regards to building and planning design, which include plot ratio, site coverage, lighting, ventilation requirements, and kitchen and sanitary fitments, stringent requirements are stipulated in the current building regulations. Minor relaxation of regulations in special conversion cases must be derived as an essential component to encourage reuse of obsolete warehouses and factories.

A second built environment related considerations for building adaptation concerns an adaptation plan of work to improve fire safety, car parking, lift provision, universal accessibility and environmental improvement (Douglas, 2006). Since the fire installation requirements of industrial buildings are generally higher than those of residential units, it can be manageable to upgrade fire installation by alterations or by fire engineering approach. In Hong Kong, the Planning Standards and Guidelines highlight technical standards on aspects such as car parking facilities and loading/unloading areas. In this paper, car parking facilities may not be a major factor affecting the conversion process in the context of changing industrial buildings into housing use. More relevant in the discourse of vips conversion might be the issue of environment pollutions, e.g., air and noise, as the quality of the built environment affects future tenants directly. Mitigation measures should be considered to reduce the adverse impacts imposed on residents should be considered. For example, the planting of greenery to reduce air pollution and noise barriers to minimize noise transmission from the industrial area to the living area are expected. Hong Kong can also adopt strategies on promoting leadership in energy and environmental design - recognized as the LEED programme (Henehan et al. 2003). The establishment of green design practices would be a prime urban sustainability development strategy for building adaptation (Douglas, 2006).

Table 9: Identified urban issues to be alleviated in Kwun Tong Industrial District (questions allow multiple options)

Problem type	Number of responses	Percentage* of total for type
Air pollution	326	64
Traffic jam	318	62
Narrow pedestrian road	305	60
Insufficient green area	272	53
Insufficient Food & Beverage	78	15
Insufficient recreational area	150	10
Insufficient shop	42	8
Insufficient parking	15	3

*Percentages are rounded to the nearest integer

(Source: Kee, 2013)

Contamination assessments of the vips should also be carried out to make sure that the premises have not been contaminated from previous undertaking and are safe for people to use. Although most Kwun Tong industrial buildings are situated in "Industrial" zones and the provision of public facilities may not be entirely adequate to support the population growth for future housing use, this proposed housing conversion is for temporary housing needs of people who are living in extreme poor conditions, either in private dilapidated flats or illegal sub-divided apartments. Therefore, it is recommended that tenants could stay for two to three years in adaptive reused vips while waiting to be allocated a public rental housing unit. The conceptualization of this research establishes an argument for an action plan under the current planning framework. However, more cases will be needed to verify the long-term sustainability of the adaptive reuse practices in industrial vips. To summarize, there are four significant potential impacts that is associated with findings of this research:

Firstly, the research can provide a potential solution for the current HKSAR government to create sound and affordable housing solutions due to the growing population in recent decades. The fundamental mission of the government intervention is to improve the distribution of land resources by unleashing the potential of vips. The lack of land for new development coupled with the rise in construction costs make the conversion from industrial buildings to residential units a viable alternative compared to constructing new development complexes.

Secondly, the continual rise in property prices and uneven distribution of wealth in the city make housing less affordable for average citizens. Through good urban planning strategies that utilize existing infrastructure, communities can be better integrated within the urban fabric, drawing upon existing strengths in economic, social, and cultural sustainability. Therefore, the adaptive reuse solution is one that is socially and environmentally sustainable.

Thirdly, the efficient conversion of vacant factory buildings into affordable housing will generate substantial income for the government in terms of rental revenue and taxation. Leaving these buildings vacant represents not only a missed opportunity for rental income, it also contributes to the loss of property and land values over time as the buildings fall into disrepair. The overall economic gain indicated by this research will benefit both the land price market and quality of life in the district.

Finally, the method of adaptive reuse can promote local heritage conservation. Many of Hong Kong's old buildings have been demolished as a result of urban redevelopment; this process continues despite the limited new measures implemented by the government in recent years. The principle of adaptive reuse can benefit our society by preserving sites with heritage significance, promoting environmental consciousness, and revitalizing the old districts of our city.

7. CONCLUSION

The scope of understanding for vips conversion has been identified in the review of technical feasibility in this paper. This proposal recognizes the unique urban context of Hong Kong and the research provides a comprehensive view of a viable alternative to the pressing housing problem. Aside from the method of adaptive reuse, purpose and urban environment spectrum have been examined. Further investigation on demographic growth, housing need forecast, economic benefits and upgrade feasibility within the legitimate administrative framework would be necessary to act as a catalyst in altering government's current reluctance to implement an industrial building-to-housing conversion scheme. Vips represent a great opportunity in solving current housing shortage problem but also a difficult challenge for local planners and administrators in view of the strict planning framework. Practical suggestions on answering "how to convert" as presented can inspire politicians, property owners and tenants who are aspired to see more economic, social, and cultural benefits of adaptive reuse. Research findings from Kwun Tong, though geographically limited, can enlighten similar planning strategies which are adaptable to other built environments undergoing similar urban revitalization and in desperate need of housing policy models. The ultimate goal of the research is to offer a potential inspiration for recommending vips for new affordable housing solution. In essence, the study opens up new way for a whole range of analyses and responses.

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