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Micro-MACRO Living in the Global High-Rise

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Abstract

What housing models should dense urban cities pursue to address population rise, housing shortages, and changes in demographics? As cities seek to address large discrepancies between their housing stock and their population, many developments opt for buildings with large footprints and massing bulk. While these multi-family housing developments offer large quantities of units, they diminish the street environment with their monumental bases – often occupied by a single use or a few large uses. This paper explores the viability of "micro-macro" living, in which one's private residential unit decreases in size, in favor of increased social interaction, sense of community, and density and diversity of neighborhood amenities. "Small" or "micro" need not connote a living experience that is diminished or isolated. By understanding the challenges and opportunities in the design and construction of micro-unit apartments, cities can address growth and density without undermining diversity and social interaction.

Keywords: Micro-Units, Affordable Housing, Density

Introduction

The challenge of micro-units lies not only in their small dimensions, but also in the larger opportunities to address how the needs of urban dwellers have changed. From demographics to modes of living and working in cities, these changes bear witness to a confluence of contributing factors. In cities globally, people are living greener, healthier lifestyles, and are therefore living longer. They are also marrying later, partly due to the fact that women are studying and working more, as well as divorcing more. The result is evidenced by a global rise in solo living by 30% in the last decade. In Manhattan, nearly half of the population lives alone and the nuclear family (traditionally characterized by two parents and children) has decreased to below 20% (Perine & Watson 2011) (see Figure 1). The paradox in the United States lies in the fact that, despite the shrinking family unit, the size of the average house has nearly tripled between 1950 and 2016 (Perry 2016). This is partly born out of turn-of-the-century housing reforms, when the journalist Jacob Riis exposed the horrific living conditions of New York City's immigrant population. His photographs of overcrowded tenement housing without proper ventilation and daylight brought about the city's current housing regulations, which set the new standard for life safety and apartment sizes (37 square meters with a 2.4-meter ceiling height minimum). Yet, the large apartments for nuclear families that the regulations encouraged no longer fit with the city's demographics. There are 1.8 million small households, with only one million suitable apartments to house them in New York City. As demand outpaces supply, the rental cost per unit of area in studio apartments outstrips that of larger apartments, contributing to informal and illegal sublets and subdivisions. How should the city respond if people cannot find appropriate housing due to cost or lack of availability?

> "Even with the extra dimensions allowed for modular construction, the Carmel Place project relied on a construction tolerance of 38 millimeters in certain areas, in order to retain a financially viable unit count."

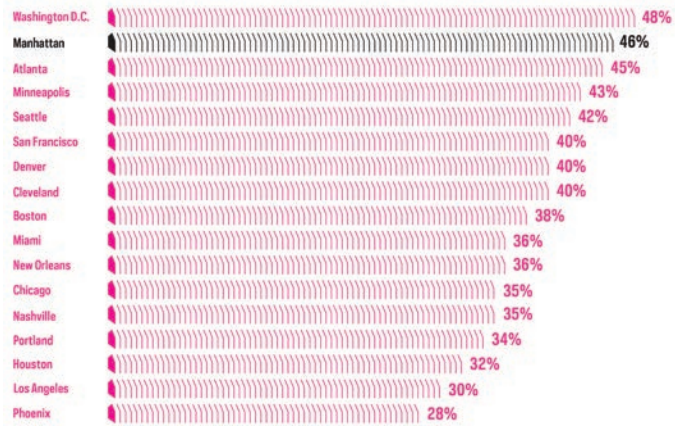


Figure 1. Percentage of single households in the United States.

Figure 2. Carmel Place, New York.

Running parallel to demographic change, one finds transformations in the relationship between work and workers. Thanks to technology, work has lost its temporal and physical boundaries. Work has stretched across longer hours, intermittently invading traditionally "off" hours and creeping into informal, casual settings outside of the workplace. On the other hand, the notion of "home" and its domestic armature have found physical expression in the work and public spheres. Amenities for living, recreation, and social interaction have been atomized and dispersed beyond the rigid delineation of "home." The very concept of micro-living is thus tied to macro-pressures of population change and its corresponding housing supply challenges, as well as changes in how and when we work. What are the numerous constraints that the planning, design, and construction of micro-units must synthesize, to make them a livable, humane, and essential typology within a city's diverse housing stock?

Figure 3. Street view of completed Carmel Place project. © Iwan Baan

Micro-Constraints: Planning and Design

In response to research highlighting the mismatch of New York City's housing stock relative to its current population, the mayor's office, the Department of Housing Preservation and Development, and the City Planning Commission launched a public competition in 2012. Entitled ***adAPT NYC,*** the competition posed the question – should the city reduce the current 37 square-meter minimum for new apartments? Carmel Place, the winning proposal, was conceived as a pilot project to test exactly how small a livable, humane apartment could be (see Figure 2). Although the project received a mayoral override for the minimum apartment size under the Quality Housing Program, it still complied with all other building department rules regulating residential unit interiors. These include the Americans With Disabilities Act (ADA) – accessible kitchens and bathrooms, minimum habitable room dimensions (14 square meters, with 2.4-meter ceilings), and requirements for light, air, and separation of the kitchen from the living area.

In terms of zoning, Carmel Place received an override for residential density (the number of apartments in a building as a ratio of overall area). It is the first and only building in the city consisting of 100% micro-units or studios (see Figure 3). Other overrides acknowledge the challenges of modular construction. Structurally integrated modules that do not rely on a primary structural core produce double floor/ceiling and wall assemblies when stacked. The redundancy results from structural self-stacking requirements, connection details on site, and shipping constraints of individual modules, which are required to protect the module structurally and from the elements during staging and setting (see Figure 4). To encourage modular construction in the city, the project was

Figure 4. Modular assembly underway at Carmel Place.

Figure 5. Micro-units at Carmel Place reduce area by 25% over traditional studios, whereas volume is reduced only 10%.

Figure 6. Units feel surprisingly spacious due to ceiling heights and careful choices about diminishing less-noticeable dimensions.

granted a minimal height extension and lot coverage. Even with the extra dimension, the project relied on a construction tolerance of 38 millimeters in certain areas, in order to retain a financially viable unit count. Such a tight tolerance to ensure code compliance would not be possible with traditional in-situ construction methods.

Macro Strategies

The studio units in Carmel Place average 27.8 square meters in area. While reducing the previous minimum for new apartments, the architects considered ways in which to compensate for the loss of floor area. They determined that people perceive subtle differences in vertical dimensions more precisely than in the horizontal dimension. For example, most people perceive the difference between a 1.67-meter- vs. 1.75-meter-tall person, whereas most would not notice the difference between a 3-meter vs. a 3.12-meter-wide room. In comparison to the standard minimum of 2.4-meter ceiling heights, the micro-units measure 2.95 meters tall, which allows for extra storage space above the kitchens and bathrooms. Therefore, while the area decreased by 25%, the volume only diminished by 10%. Similarly, each apartment includes minimum 2.4-meter tall by 1.8-meter-wide sliding doors and Juliet balconies, exceeding the light and air requirement for habitable space by more than 50% (see Figure 5). Coupled with the ceiling height, these strategies maximize the perceived volume of space, resulting in surprisingly spacious-feeling units (see Figure 6).

To expand the tenant's perceived scale of their home, the architects placed emphasis on a larger-than-average ratio of shared amenities to leasable tenant space, on all levels of the building. By dispersing all the amenities of a typical house throughout the building, beyond the walls of the individual apartment units, these active spaces encourage casual daily social interactions and enhance connections within the building community (see Figure 7). Tenants have a choice of spaces where they could sit and work – in the spacious building lobby with defined seating areas, exterior seating areas with access to outlets, community

> "To date, Carmel Place is the tallest modular building built with self-supporting units in Manhattan. A total of 65 individual steel- and concrete-framed modules include 55 apartment units and 10 units that serve as the building's stair and elevator core."

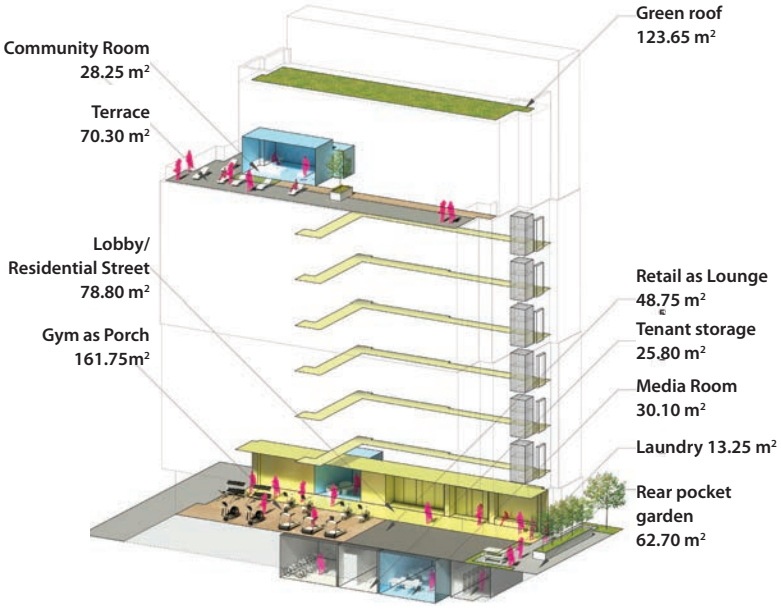


Figure 7. Carmel Place axonometric diagram showing allocation of common spaces.

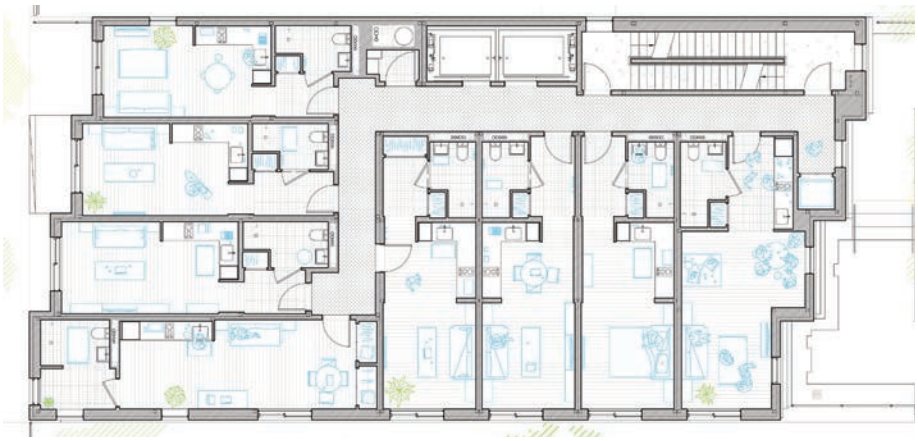


Figure 8. Typical floor plan, Carmel Place. There are five variations in size and orientation across eight units per floor.

rooms at the 8th floor level, and in the cellar. A gym, large relative to the size of the building, highlights the changing trend toward healthier lifestyles among single young people. The community rooms and terraces also provide additional amenities, such as a BBQ station, pool table, games, and a large-screen TV to facilitate social engagement. The building management also promotes regular social events for the building tenants hosted within these communal spaces. Corresponding strategies for the building's massing counter the perception that micro-living constitutes a diminished living experience. Conceived as a microcosm of the city skyline, Carmel Place's exterior resembles four slender "mini towers," connecting the concept of micro-living to the form and identity of the building (see Figure 2).

Micro-Constraints and Macro Benefits: Modular Construction

To date, Carmel Place is the tallest modular building built with self-supporting units in Manhattan. A total of 65 individual steel- and concrete-framed modules include 55 apartment units and 10 units that serve as the building's stair and elevator core. In footprint, each module delineates the boundary of an apartment unit, plus a portion of the corridor. The modules are interconnected vertically at each column, and at the floor level within the corridor. Building systems connections were made within the corridor. This "rawest" space of the building allows on-site work for system connections, including plumbing, mechanical, electrical, and fire safety. The stair core was fabricated without the steps, which were hoisted into place as the stacking of the building proceeded. Eight residential micro-units, with five variations in size and orientation, make up a typical floor (see Figures 8 and 9). The system allows the architect to balance efficiency through repetition with variation in apartment layout, thereby broadening the spectrum of choice for small family households.

The modules were built in the Brooklyn Navy Yard and transported over the bridge to Manhattan, resulting in a greatly reduced carbon footprint in terms of material waste, transport resources, and use of local suppliers. The building is targeting a LEED Silver certification. Modular fabrication allowed for a more controlled and transparent construction process, facilitating documentation requirements for certification. The process also allowed for the fabrication of a complete mock-up unit prior to full production line fabrication, to resolve potential construction issues, space or layout adjustments, and to test the feasibility of extremely tight tolerances. Upon the modules' departure from the factory, most finishes, utilities, fixtures, and windows were in place, leaving only the appliances, finish flooring, and brick work to be completed in-situ. Stacking of the units lasted three-and-one-half weeks, bringing the benefits of greatly reduced neighborhood disturbance and construction time to a dense residential site.

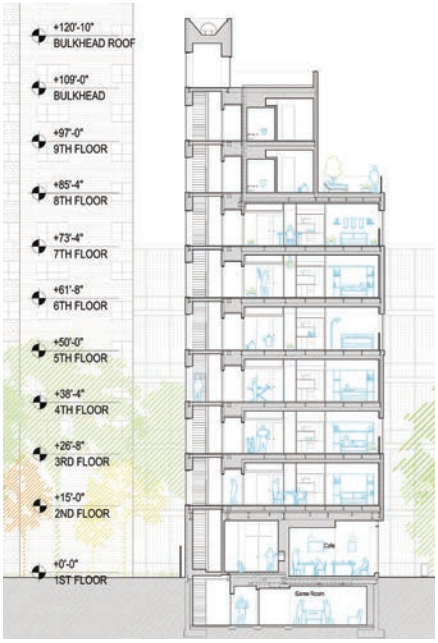


Figure 9. Section drawing of Carmel Place.

The very term "micro" triggers assumptions of impermanent, low-quality construction that will invite transient tenants and pose maintenance and durability issues in the long run. On the contrary, modular construction offers inherent redundancies that counter these negative associations. Double-wall and floor/ceiling assemblies provide excellent structural rigidity and acoustic isolation within dense unit configurations, as steel posts are embedded within the thickness of the mate-line wall assembly. The apartments are designed to allow for individual retreat, while the building provides options for social interaction in as many as seven different amenity spaces or zones. Contrary to the fearful perception of a "dormitory" environment, it is possible to achieve density without sacrificing privacy.

Comparison Point: Hong Kong, City of Micro-Units

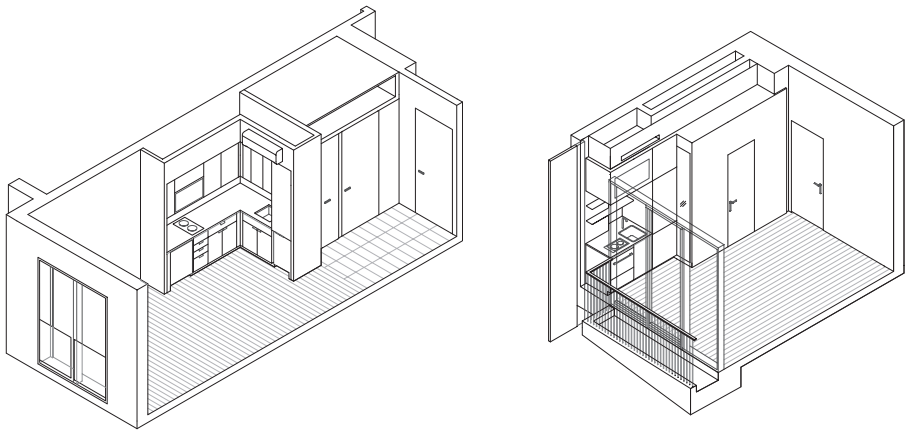
As a concurrent example of housing supply challenges, Hong Kong Island is 1.5 times the density of New York City (when calculated in relation to the actual buildable land area) (Hong Kong Census, NYC Planning, 2017). Just 2% of the buildable land area is dedicated to public space. Recognizing this shortage, city planning officials recently

revealed the ***2030 Plus*** vision for more public space (Hong Kong 2030+, 2017), including transforming roads and areas under bypasses into pedestrian and performance zones. Yet, the ***2030 Plus*** blueprint falls short of development area needed for housing (Zhao 2016). The macro-pressures of high land cost – usually two-thirds the cost of the entire project (including construction cost and soft costs) – drive the density and efficiency of housing developments. At the typical 90% efficiency (calculated as a ratio of leasable/sellable private space to shared circulation and amenity space), designers are not left with much room for social or public space.

Compared to the US, the interiors of Hong Kong apartments are not as heavily regulated, with no minimum area requirements and only a minimum ceiling height requirement of 2.5 meters. Given the economic pressures in the horizontal plane, achieving height is more feasible than width. Living vertically within one's unit constitutes the norm, whether that is via overhead storage or sleeping loft spaces. The Hong Kong building department also permits a higher density within domestic buildings, at a little over twice what is permitted in New York. Daylight requirements are comparable between the cities, but the requirements for ventilation in Hong Kong exceed those of New York by 25%. The most significant difference between Hong Kong and New York building requirements resides in the fact that Hong Kong interior domestic spaces do not need to offer "barrier-free design." Thus, bathrooms and kitchens that need only to comply with engineering and maintenance requirements result in much smaller, more efficient layouts (see Figure 10).

Other factors shaping the form of urban development include the local practice of selling land at auction to generate government revenue. This market-driven approach, alongside amendments to the buildings ordinance, has transformed Hong Kong's urban fabric, such that it increasingly consists of large towers on plinths (Cookson Smith 2011). Older, small lots are often purchased in series by developers, consolidated, and developed as single-use complexes at a monumental scale. What strategies should architects employ to reconcile the alienating scale of point towers with the informal, dynamic patterns of street activity that is characteristic of Hong Kong?

The architects' residential tower, Artisan House, rises 30 floors and 130 meters, and is being built in an old residential area in Sai Ying Pun that includes three-story shophouses, bulky six- to-eight-story blocks, and point towers. The development site consists of seven previously individual lots that had been combined into one, surrounded by small shops and businesses. To celebrate the history of the old neighborhood, with its narrow, low buildings and small shops, the architects mitigated the large scale of the podium and tower in a few



CARMEL PLACE UNIT AXON HONG KONG UNIT AXON

Figure 10. The size of the New York units at Carmel Place (left) differs from those at Artisan House, Hong Kong (right) due to differences in regulations concerning disabled access, ceiling heights and ventilation.

Figure 11. Traditional shophouses of Hong Kong provide a scale reference for the micro-unit tower.

Figure 12. Traditional shophouses of Hong Kong provide a scale reference for the micro-unit tower.

Figure 13. Communal space at height, Artisan House, Hong Kong.

ways. The podium is broken down into vertical bays, reminiscent in scale to that of historic shophouses (see Figures 11 and 12). Extensive green walls and planters at top of the podium help to counter the effect of extreme density and improve the street environment and air quality (see Figure 13). While Hong Kong's humid climate is desirable for plant growth, it practically mandates concrete, rather than steel (which presents water infiltration and rust issues) as the typical construction method. With a slenderness ratio of 1:11, the concrete structural piers range from 500 to 700 millimeters thick. To maximize interior space, a thin layer of plaster on concrete – the thinnest possible finish – is used in lieu of other wall assemblies. Lastly, the balcony soffits at each unit are clad in reflective aluminum, to reflect the street environment below. In this way, the building connects high-rise living with the social spaces and dynamic activities of the street.

The Beauty of Smallness

Parallel to developments in micro-living, designers and businesses have expressed a renewed interest in the collective and the benefits of sharing. Technology has enabled and promoted the "sharing economy," where the value of owning less and sharing tools, services, and experiences has increased.

Micro-living then, should be understood not only as a compact-sized residential unit, but also through the lens of the benefits of the collective experience. Using strategies of maximizing interior space while privileging connections to shared spaces, developments can balance density with heterogeneity of activities and amenities in buildings and their neighborhoods. Micro-macro living thus is one way in which cities can retain their essential diversity – of their demographics, housing stock, and modes of living. ■

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"Hong Kong interior domestic spaces do not need to offer 'barrier-free design.' Thus, bathrooms and kitchens need only to comply with engineering and maintenance requirements, resulting in much smaller, more efficient layouts than is possible in New York."