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CASE STUDY

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The negotiated public realm in the contemporary city: hybrid walkable urban networks of Hong Kong

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Abstract

This paper focuses on the character of multi-level pedestrian accessibility and walkability within the public and quasi-public realm in Hong Kong, using the particular case of the redevelopment of Taikoo Place in Quarry Bay. In an era when the value of public space as a space for public activity and debate is coming under increasing scrutiny, both in Hong Kong and internationally, this paper explores multi-level interior and exterior public and quasi-public realm, as a *hybrid* form of interior open and transit space in a commercial setting that has becomes a central part of the city's planning, designed to both serve and profit from the high level of pedestrian traffic. This paper draws on empirical research of pedestrian behaviour patterns to interrogate the value and significance of linked-spaces within commercial districts, both to the users and the real estate travelled through, using the city of Hong Kong as a reference and the specific case of Taikoo Place.

Keywords Walkability, Interior and exterior public realm, Public space, Hybrid space, Spatial network

Introduction

The built environment of Hong Kong is compact, intensively built up and extremely dense. One consequence of this, together with its hilly terrain and humid tropical climate, has been the emergence of a layered, multi-level public and quasi-public realm of interior spaces, serviced by covered walkways. In this context, much of Hong Kong's public spaces can be seen as a hybrid type of public realm—hybrid in terms of being spaces that combine exterior and open interior space, places of movement and places of commerce that link the public with the quasi-public, as a product of both formal and informal negotiation between the state and private owners. This hybridized environment has becomes part of the distinctive identity of the city, which both serves a functional need for movement and allows commerce to thrive. This is an unusually extensive, and highly connected realm, which traverses from underground, to street level, to elevated walkways and lobby spaces in a way that can be disorientating, particularly for visitors. A number of commentators have discussed the urban qualities of Hong Kong, focusing on its intense distinctiveness in relation to pedestrian access and walkability, and its complex transportation network (see Chiaradia and Zhang 2019; Sun et al. 2019; Transport Department on Public Engagement 2019; Zheng and Charlie 2016; ADMC 2016; Frampton et al. 2012; Audi et al. 2010; Ho 2009).

At a planning and policy level, the planning department of the Government of Hong Kong (2018) stipulates that '*pedestrian planning should not be confined just to streets and footpaths, but rather to all types of public space, making them accessible on foot and attractive for the enjoyment of people*' (https://www.pland.gov.

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hk). Hong Kong's planning regulations set out specific guidelines and alongside these mechanisms to establish and control the extent and nature of public space in Hong Kong. Bruyns et al. (2021) argue that in Hong Kong's case, a form of volumetric urbanism informs the character of public space, and differs from vertical urbanism in that it does not require verticality, rather verticality is considered a consequence of spatial compression. This compression, Lin (2018) suggests, also results in an interweaving of both spaces and social interaction. not just of vertical urbanism is multi-layered and multi-dimensional urban landscape that both physically and socially interweaving organism, with a vibrant and unique urban character emerging. Internal corridors and levels connecting buildings take on a street like character where temporally dynamic and diverse activities and interactions take place.

As a means to increase or maintain vertical public space in built up areas, *how in practice does the city of Hong Kong operate and make use of this multi-level public and hybrid public spaces*?

In Hong Kong, as with many other cities, public space is an *assemblage*, to use Dovey's term (2010); the outcome of intentional design, historical accretions, combined with a social and economic structure. This assemblage may be viewed as a continually negotiated construct, informed by the social and commercial institutions of the city, overlaid on a dense urban form, which in turn is the consequence of the morphological development of the city over a long period, constrained by the topographical condition of the landscape on which it has been built.

However, there has been little academic focus on the spatial qualities and character of this hybrid realm as a type of third space (Oldenberg 1986), and whether and in what ways the informally negotiated result might be considered a 'win–win' for the city and its different stakeholders. Considering that, this paper aims to evaluate the form and usage of *multi-level hybrid public realm*, using the particular case of Taikoo Place in the eastern Hong Kong district of Quarry Bay.

Methodology

In order to evaluate the vertical public realm in both its physical and functional qualities, the paper applies a multi-method research approach to measure and analyse both the physical character and usage of the multi-level hybrid space in Hong Kong, including the definition of a series of key elements for this hybrid spatial layout. In the second part of the paper this definition is tested using the three dimensional, multi-leveled hybrid public realm of Taikoo Place in Hong Kong. For the data collection of the selected site study, morphological and typological detailed site observation and analysis, including existing and predicted pedestrian flow, using network analysis, OD Cost Matrix, which uses two sets (origins to destinations) of locations to find the distances between all of the locations at 2D level, and a 3D spatial design network analysis (sDNA) simulation for vertical transform elements was made, including the stairs, elevators, and escalators and traversal channels.

Redefining the key elements of the spatial layout of multi-level and hybrid public space

In general, Hybrid space refers to areas where two or more functions or characters exist. It can have multiple meanings (Krasilnikova and Klimov 2020). It can mean revamping an old building into a new use, the combination of different construction systems or contrasting activities and responses where users interact near the environment. This functions can be switched back and forth according to the person's use of space, or according to the time of day that allows multi-functions of the spaces without increasing any floor area.

From detailed term to general principles, as mentioned by Carmona (2019), the hybrid public space can be further defined as its right for users and responsibility for users, and responsibility as owners and managers of public space (see Table 1).

For this form of hybrid space, Marshall et al. (2019) and Bruyns et al. (2021) have argued that density, functional mix, compaction and compression, network complexity and interaction intensity, temporality and vitality are key

Table 1 An indicative charter for public space rights and responsibilities. Source: Carmona (2019), p. 52

All public space users have the right to:
Roam freely
Rest and relax unmolested
Associate with other
Use public space without the imposition of petty local controls
Unless carefully justified
Collect for registered charities
Take photographs
Perform
Demonstrate peacefully and campaign politically
Public space users have a responsibility to:
Respect the rights of others to conduct their business
Unhindered and unmolested
Respect public and private property
Act in a civil and safe manner at all times
Owners and managers of public space have a responsibility to:
Respect and protect the rights of all users
Treat all users in an equitable and inclusive manner
Keep spaces open and unrestricted at all times

characteristics to define spatial scales of perception. Prior to that, Cervero and Kikkoman's well-recognised urban design framework (1997) of three Ds—*density*, *diversity* and *design*, with *distance* to transit and *destination* accessibility added by Ewing and Cervero (2010), have been widely adopted to standardise the features of a built environment conducive to walking behaviour.

Hong Kong has more than 374 Public Owned Public space, a hybrid form of ownership and usage with a total area of more than 2.7 million sq.m. privately owned space statutorily registered and protected for public use in Hong Kong (Hong Kong Planning Department 2018a; b, c) has considered the nature of public space and its right of usage with the spatial qualities and character of the hybrid space as being '*not…confined just to streets and footpaths, but rather to all types of public space, making them accessible on foot and attractive for the enjoyment of people*' (https://www.pland.gov.hk/2018).

In Hong Kong, as with many other cities, public space is an *assemblage*, to use Dovey's term (1999) the outcome of intentional design, historical accretions, combined with a social and economic structure. This assemblage may be viewed as a continually negotiated construct, informed by the social and commercial institutions of the city, overlaid on a dense urban form, which in turn is the consequence of the morphological development of the city over a long period, constrained by the topographical condition of the landscape on which it has been built.

The predominance of such hybrid public space is at least in part accounted for by the sheer quantity of housing, workspace, commercial and supporting spaces required for local residents and the migrants to the city to live and work. This pressure for space has been a key driver of urban density. This driver also explains the hybrid nature of the public realm—the need for spaces of transit across three dimensions, combined with space hungry commerce, which has forced the city to produce a public realm that cannot easily be disaggregated into the publicly administered, and the space of private economic interest.

This research seeks to further redefine the key elements to characterize the spatial layout of multi-level hybrid public spaces. It can be viewed from three perspectives as a new driver of urban form—the *density* of its urban form, its *topography*, and the s*ocio-economic institutions* that occupy it.

In light of that, it is worthwhile to re-value the key elements of spatial layout to characteristics the multi-level and hybrid public space, using the high dense city of Hong Kong's building typology and morphology.

Firstly, *Density*—there is often an unusual marrying of 'open' space that is at times indoor and at times outdoor, at times above, below and on ground level, in a highly dense cities and regions such like Hong Kong, Seoul and Tokyo. This environment is 'negotiated' between public and private interests, becoming a bargaining chip between the government and private developers and users, due in part to the fact that such intermediary space is in very short supply and of ultra-high value. In Hong Kong's case, an additional factor that intensifies the feeling of density at street level is the planning regulation that allows building area up to 16 m in height on many sites to be set at 100% of the site area. This has led to any 'left-over' space–space effectively for non-commercial use, including circulation, being very limited; and to a situation in which private developers providing ground and upper level access routes through their podium blocks in order to profit from the footfall diverted from the truly public street. In some cases concessions from the local government allow private developers increased building rights on a plot, in exchange for supplementing the public space and footpath network in Hong Kong by offering public access through these podium spaces. Hong Kong Planning Department (2018a, 2018b, 2018c) noted that for the current total number of Private Owned Public Spaces (POPS), of the 374 spaces totaling 2,702,220 sq.m., with the type of POPS categorized as Malls (121,248 sq.m, 48%), Residential (865,330 sq.m, 32%), and Office (549,160 sq.m, 20%) (www.landsd.gov.hk).

Secondly, *Topography*—the topography of Hong Kong, and the typology of the built form constructed upon it, are keys to understanding how the additional network of interior and elevated walkable routes have come into being. Especially, at a topographic perspective, there is often a disconnect in the section of the street, with retaining structures at the road edge effectively elevating the footpath on one side of the road by two stories or more above the pavement on the other. Elevated walkways connecting podium to elevated ground, or from podium to podium, often give the most direct connection, and can offer lift access for those who prefer or need it. From a typological or morphological perspective, the often narrow pavements in Hong Kong, put in place in the nineteenth and twentieth century when the population of the city was a fraction of what it is today, can become overwhelmed with people. Elevated walkways and pedestrian bridges, and the supplementary routes through privately managed open spaces, together with pavement widening onto the building plot, offer a relief from this, and have hence become one of the defining characteristics of form of multi-level of public space in Hong Kong. These routes also support a wide variety of commercial activities and hence contribute to the city's economic vitality by various land use. The access and arrangement of the

lower floors of the office tower *Three Pacific Place*, in the Admiralty district of Hong Kong, are an example of this (Fig. 1). Built on a steeply sloping site, the developer negotiated additional building rights and gross floor area with the local government in exchange for an agreement to provide 24 h access through the building interior, and within the plot boundary for users and local residents (see Fig. 2). The agreed plans are

Fig. 1 Pacific place tower 3 in Hong Kong and multi-layered public space (source: Author)

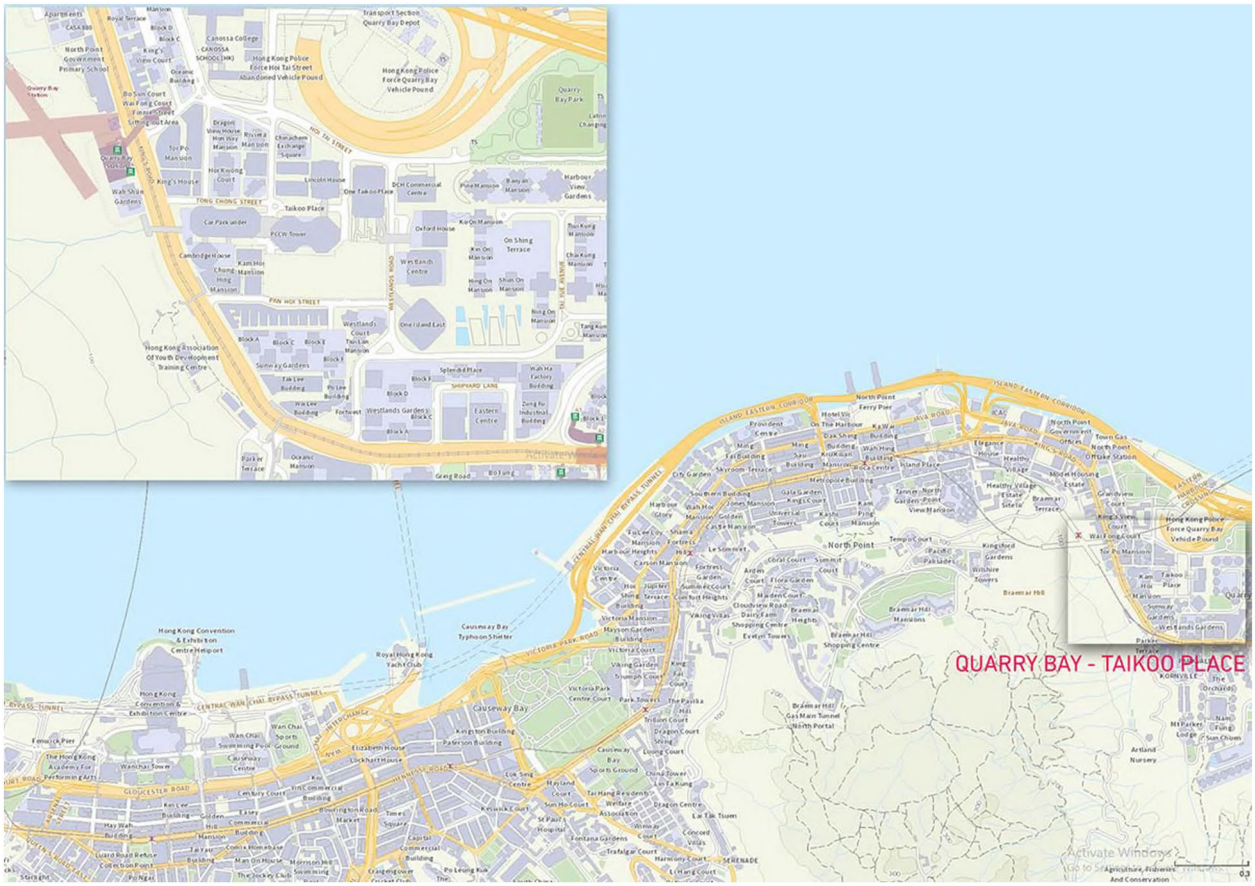

Fig. 2 Hong Kong Island and Taikoo Place map (source: Author 2019)

held on record on the website of the Hong Kong Building Department (see Fig. 3), and are publicly available. The basement of the building links to a pedestrian tunnel with a travellator to the closest underground railway station, and to a shopping mall run by the same developer, making it a popular route for both workers and residents to this building and the surrounding neighbourhood. Retail and restaurant units in the basement floor are arranged around the access route from the travellator up to the building interior, and exit points to the surrounding streets. The open areas are air-conditioned and include publicly accessible seating, washrooms, artwork and wifi access. As such, these hybrid-public spaces meet some of the commonly understood criteria used to define public space as such, by offering a limited opportunity for multi-valent use (Walzer 1986) such as gathering and recreation for small groups of both office workers and visitors. The most interesting and unique of the usage and operated form of multi-layered and hybrid public spaces in Hong Kong are the degree to which such privately owned space is now integrated with and inseparable from the public movement network of the rest of the city.

Thirdly, *Socio-economic institutions*—given the nature of public space, including pedestrian routes, as a hybrid public realm, the question that arises is what are the limits to the collective and individual freedom of users in such space; and how should these be determined? In other words, is there a conflict of interest between the state and commerce; or are these interests actually aligned in the contemporary political setting of Hong Kong? The possible contradiction between liberal conceptions of public space free of commercial (and in this case political) agendas, and the 'needs' of commercial investment to place greater limits on the uses of public space is highlighted when we look at the normative principles being applied to public space design elsewhere (e.g., CABE 2004). Whilst it is true that such principles have, arguably, only explicitly and actively been applied in a small number of cities—such as Melbourne and Copenhagen—there is a general, if largely Western, conception of the rights to the city which

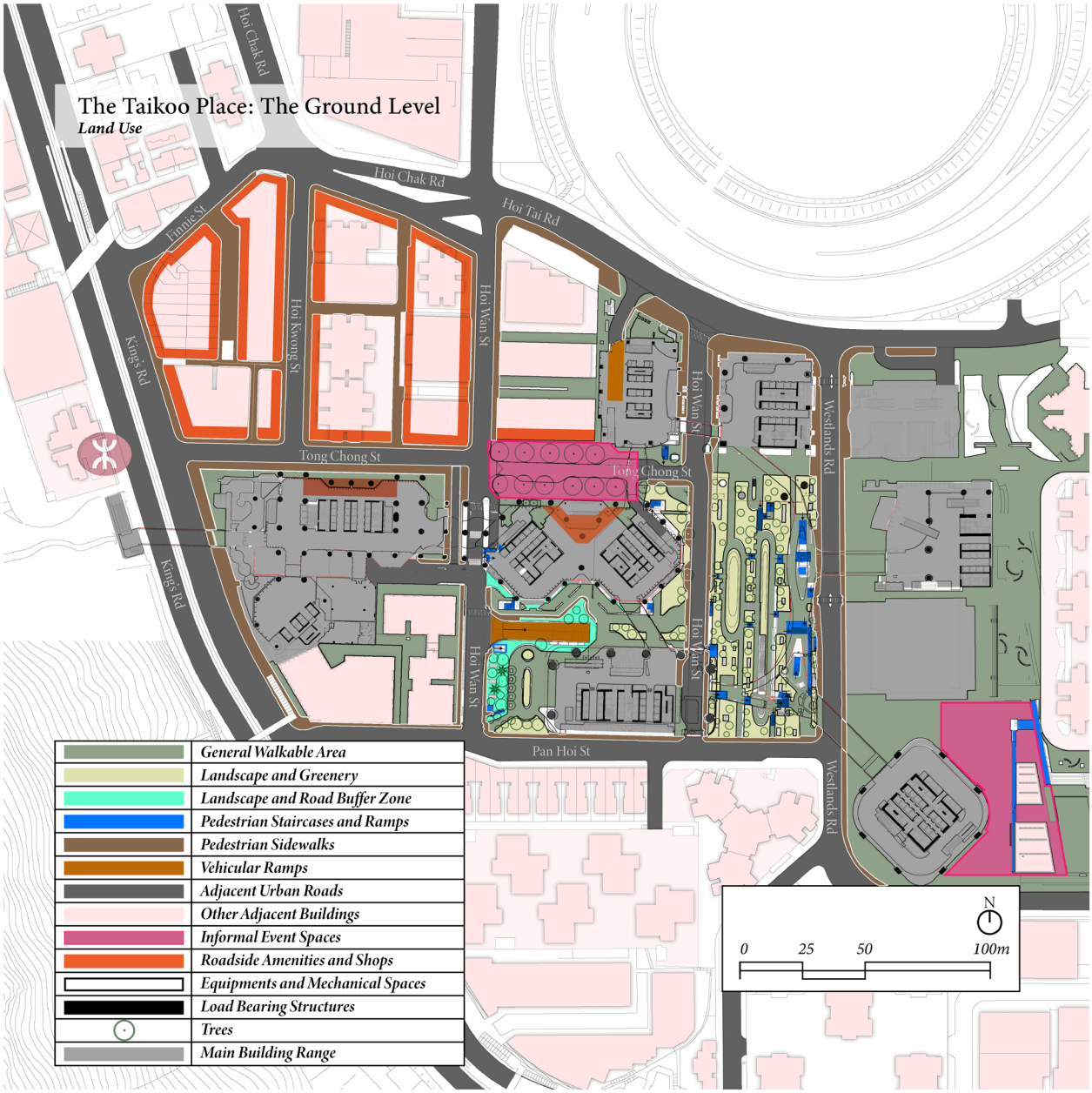

Fig. 3 Taikoo Place Ground level landuse and amenities (source: Author)

underpins them which is commonly aspired to (Reeve 2019).

The particular combination of density, demand and topography in Hong Kong highlights that the normative, one size fits all approach (Carmona 2019) has its limits (Table 2).

At the time of writing there is considerable interest in Hong Kong, amongst local communities as well as professionals in various fora regarding the need for the involvement of a range of stakeholders in the creation of public space. Currently, there are very limited opportunities for such involvement and for consultation to take place in Hong Kong. Compared with the UK, where planners and designers are both mandated and required to facilitate the involvement of a range of stakeholders in the creation of public space, and to an extent its management, in Hong Kong there is a significant gaps in planning and planning processes, for the delivery of development projects which respect the participation of end users and citizens. Interests are largely defined, and

Table 2 New driver of the characteristics the multi-level of public space form in Hong Kong. Source: Author 2021

Density	Providing ground and upper level access routes through their podium blocks in order to profit from the footfall diverted from the truly public street. Private developers increased building rights on a plot, in exchange for supplementing the public space and footpath network in Hong Kong by offering public access through these podium spaces
Topography	Elevated walkways and pedestrian bridge, and the supplementary routes through privately managed open spaces, together with pavement widening onto the building plot, offer a relief from this and have hence become one of the defining characteristics of form of public urban space in Hong Kong. Importantly, these routes also support a wide variety of commercial activities and hence contribute to the city's economic vitality
Socio-economic institutions	Public space should be valued and regulated in a way that enhances commercial activity, and there is a least a tactic assumption that the social life of the city takes second place to its economic life

prescribed by the government, which very much sets the agenda in terms of public space design in a highly top-down manner.

Many factors may well explain this, including the nature of the political system in the city, along with a culture of paternalism that dates back to colonial times. The underlying presumption in Hong Kong is that public space should be valued and regulated in a way that enhances commercial activity, and there is a least a tacit assumption that the social life of the city takes second place to its economic life. What has also been evident in Hong Kong is the absence of any real form of public participation that draws on the knowledge and interests of different stakeholders in both decision making and in the design process. The approach to public space planning in Hong Kong is rather confined to technical issues, resulting in a design framework which deals with only a narrow range of considerations for mixed use settings (Hong Kong 2018)—principally to do with sloping sites and multi-level access. This framework is expressed through a series of planning standards and guidelines (Hong Kong Planning Department Bureau 2018a; b, c) including the provision of public facilities and in relation to public open space in private developments. Together these stipulate guidance in relation to three general aspects of urban design. The first concerns visibility, and recommends that views are kept open and uncluttered to encourage a sense of safety; the second deals with weather protection and natural light; and the third is concerned with the accessibility and connectivity of multi-level public space. In interior multi-level space the emphasis is on connectivity, with less concern for planting, seating, and the recreational activities that are encouraged in outdoor space.

It should be noted that the problems associated with creating spaces that are neither clearly public nor private in their use have been well documented in the urban design guidelines, at least since 1998 by the Planning Department (pland.gov.hk). One outcome of this lack of prescription from the HK government to define what is genuinely public space, has been the evolution of a particular form of interior public space that can be best be termed 'hybrid' public space. This brings a wider debate into how the 'rights to the city' (Mitchell 2003) indicates a greater restriction of access to hybrid public space for certain user groups. This relates to both the recreational activities that make up everyday life, be it alfresco picnics, buskers and other impromptu performances or group exercise, and to the position public space has traditionally held in allowing forms of peaceful protest and demonstration within a civilised society. As such, the large landholders of the city controlling hybrid public space become key decision makers and arbiters of the life and spirit of the city, of who and what should be allowed or excluded.

Case study: Taikoo Place

Taikoo Place is a business district that is privately owned and managed by one such large landholder, Swire Properties, on the east side of Hong Kong Island. The district utilizes a combination of exterior and interior public and hybrid public realm spaces to support a network of public and private functions.

Using Taikoo Place as an instance of multi layered hybrid public space in the context of Hong Kong (see Fig. 2), the paper examines in this section the implications of the relationship between the interests of private owners, and those of users in terms of pedestrian behavior. It does this by taking lessons from other studies of such behavior in the use of multi-level hybrid public space settings (e.g., in the work of Gehl, PPP).

Doing that, morphological and typological detailed site observation and analysis, including existing and predicted pedestrian flow, using sDNA within the three dimensional multi-leveled public realm of Taikoo Place in Hong Kong are measured.

Background and geographical location in Taikoo Place

Taikoo Place is an office complex located in Quarry Bay, in the eastern part of Hong Kong Island. Quarry Bay is one of the sub-districts of the Eastern District of Hong

Kong Island, with an overall area of approximately 209 hectares and a total population in the region of 143,000 (Hong Kong Government 2017).

The development includes ten office buildings, some with open external areas, internal atrium spaces, restaurants and amenities including a large art gallery. The complex is set within a residential neighbourhood, with some commercial and banking facilities in the surrounding streets. Adjacent to the site to the east are the elevated parklands of Mount Parker, and across the East Coast Expressway is a harbor-side promenade (see Fig. 3).

The City Plaza office and shopping complex, next to the case study site, is also part of the Swire portfolio, is surrounded by the 12,000 unit apartment complex of Taikoo Shing, also constructed by Swire. These three developments have all been constructed on the site of the former Taikoo Sugar Refinery, and Taikoo Dockyard. In effect, 70% of the public realm (including both streets and pedestrian-only routes), as well as other public open spaces belong to the private developer (Land department in Hong Kong 2018).

The private developers' ambition for the area as a business district is for it to become a new CBD area in Hong Kong. Since 2014, three warehouse style office buildings have been demolished to make way for two new office towers, and a large publicly accessible square. Connecting the square to the surrounding buildings will be an elevated and enclosed first-floor walkway, due to be completed in 2023 (Swire Properties 2019, see Fig. 4).

The sequential development of Quarry Bay began in 1990, with the commercial buildings along Tong Chong Street, linked by an elevated pedestrian bridge to Quarry Bay MTR station. Building work continued until the completion of One Island East tower in 2009. At 67 floors, this is the tallest building in the development, and the tallest in the district, acting as a landmark structure visible from the centre of Hong Kong. Construction work began again in 2014, with the office towers of One Taikoo Place opened in 2019. Two Taikoo Place is due to open in 2022, together with new

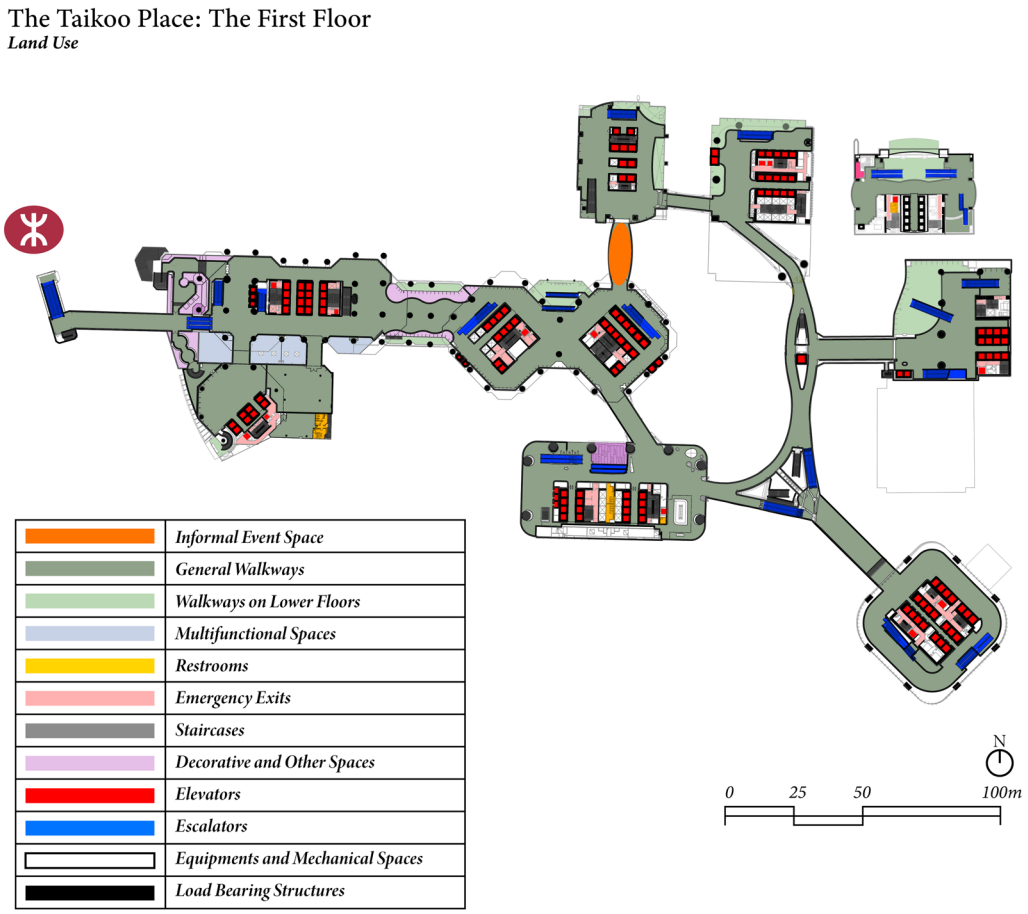

Fig. 4 Taikoo Place First level Interior Public realm amenities, event places and facilities in Taikoo Place (source: Author)

public space at street level, 'Taikoo Square' enclosed by a series of office landmark buildings.

Spatial urban structure and multi-level public realm

The existing built form and spatial structure in Quarry Bay is varied and multi-levelled. The street layout at the perimeter comprises a block pattern of roads and back alleyways that is typical to Hong Kong, and pre-dates the introduction in the 1980s of the Taikoo Place business district. The Taikoo Place masterplan includes some enlarged plazas and green spaces at street level, with a first floor network that links directly to the MTR railway station and provides an air-conditioned quasi-public realm at ground and first floor levels to the Taikoo Place buildings and amenities. In addition, the first floor hybrid public realm dedicated to event space, and social gathering spaces. There are also public atria with restaurants, cafes and other amenities, with sculptures and other art works, through the public accessible areas within the hybrid public realm within the series of buildings.

Both internal and external facades are walled with glass which enhances the visual connectivity for users of the elevated hybrid public realm. There are, however, limited options in terms of access from ground floor to first floor. There is also no public furniture, or information desks in between the internal podium levels; this is in line with local design regulations that prohibit the placing of street furniture and other landlord controlled items that may interrupt pedestrian flow, or that might allow people to sit down or relax.

Sennett (1977) has argued that part of the definition of 'energetic' public space is 'space with sufficient occupancy and usage to support neighbouring uses', and in this sense Taikoo Place falls short of generally accepted standards of being authentically public, i.e., of being 'liveable', balancing societal and commercial needs and values, as well as encouraging participation in cultural and community activities. This does not deny that the balance between these qualities may vary from place to place, or that the magnitude or quality of such benefits may also vary from one location or city to another, particularly with respect to such things as access, minimising public or private cost, efficiency of land use, health effects, economic development and social equity.

As a way of measuring these benefits, and as mentioned above, data were collected through a small empirical study of pedestrian behaviour and walkability patterns within Taikoo Place. The data and findings were recorded in relation to the location of hybrid public space and to its amenities and facilities (Fig. 4).

Usage patterns in both exterior and interior public realm in Taikoo Place

The site observations from Quarry Bay MTR station and the neighbouring Taikoo Shing MTR station included a count of 11,000 people per hour arriving at Taikoo Place in the morning, before the start of the working day via both stations on foot. Each of the nine Taikoo Place office buildings have an entrance at ground floor, with all but one being also accessible via the first floor internal walkway system. There is an entrance to the elevated and internal quasi-public realm via an escalator adjacent to Quarry Bay MTR station, and an entrance through the One Island East lobby, which is a 5 min walk from Taikoo MTR station. From these two arrival points, the pedestrian traffic is split, with a proportion of visitors choosing the elevated internal walkway system to reach their destination, and a proportion remaining at street level.

The data was collected at each building entrance point and where the pedestrian traffic can be split and where the users changed their destination between public and interior quasi-public realm. Twelve different points, at junctions and intersections where the pedestrian traffic can split to different destinations were selected. These covered:

(1) Cambridge House entrance, (2) Devon House entrance, (3) the junction between Taikoo Place Apartments and Dorset House, (4) between Lincoln House and PCCW Tower entrances, (5) elevated walkway from Quarry Bay MTR towards PCCW Tower, (6) the intersection between One Taikoo Place and Berkshire House, (7) the elevated walkaway between One Taikoo Place and One Island East, (8) the interior of the quasi-public realm between Dorset House and PCCW Tower, (9) the interior of the quasi-public realm between Lincoln House and PCCW Tower, (10) Oxford House entrance, (11) One Island East Main entrance and side entrance, (12) Taikoo Shing MTR entrance/exit.

The figures for pedestrian flow, taken from Overview of the time Cost (OD) analysis (Figs. 5 and 6) and a direct observation of footfall (Fig. 7), indicate that approximately two thirds of those arriving on foot from the train station use street level access to approach their destination, whilst approximately one third use the first floor bridge access to reach their destination (see Fig. 6). During the day and at the end of the working day this proportion of usage changes, with a greater proportion of people using the first floor walkway to reach the train station to depart the district (see Figs. 6, 7).

Further comparison of the pedestrian speed and flow relationships to walking facilities (Lam and Cheung 2000) through the hybrid public realm in Fig. 6, shows a time-based pedestrian flows. This is indicative of individual responses to the environment, events and facilities that in

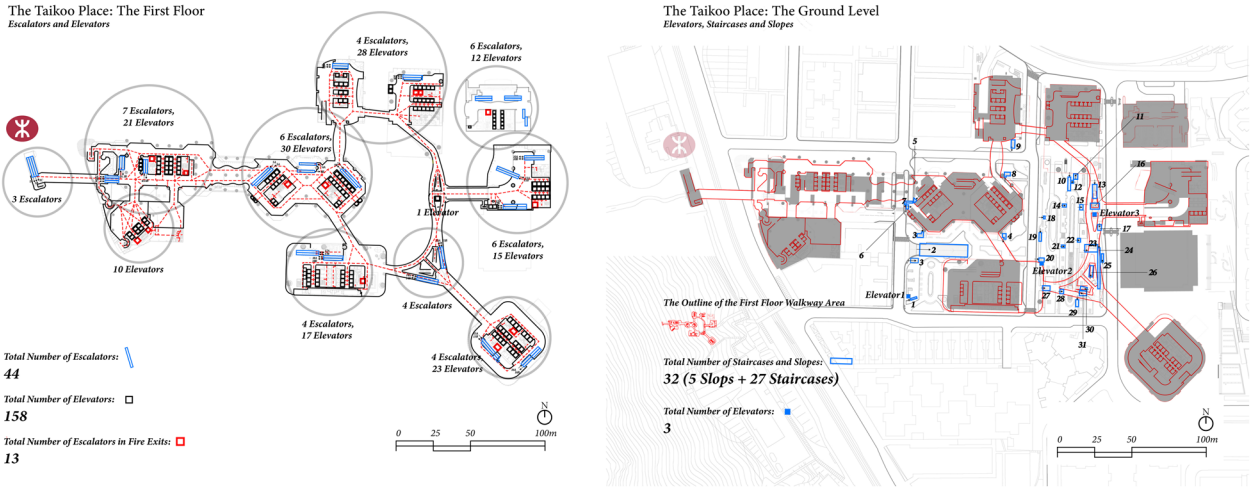

Fig. 5 Taikoo Place Ground and First Level Accessibility in details (source: Author)

turn translate into behavioral logics. Different pedestrian flows, translates as flow types, defined through speed. Speed type A is characteristics to an indoor commercial area and average walking speed. Speed type B, the most rapid, predicts the time cost and speed efficiency during morning rush hours. Speed type C, the slowest, responds to density.

However, OD analysis shows the limitation of the pedestrian flows in relation to the speed of walkability on a single level when measuring a multi-level spatial network. Cross comparison of walkability options (Fig. 7) at ground level and first level public realm in Taikoo Place are all well used and provide a variety of route choice as well as access to public facilities, amenities, cultural events and commercial space. Deeper observations from these results centre on the route characteristics of the pedestrian traffic at different times of the day. Morning pedestrian traffic crossing Taikoo Place is in a rather linear format, with the dominant directional flow from the nearest Quarry Bay and Tai Koo train stations, and to a smaller degree from the limited parking spaces available in Taikoo Place, to the dominant office buildings. Smaller amounts of traffic make use of the indoor and outdoor restaurants and retail spaces. Of note, it is the indoor restaurants accessed via the first floor internal walkway system that prove more popular than the outdoor restaurants at street level. In comparison, afternoon pedestrian traffic remains more varied, with travel between offices and restaurant, retail and outdoor garden rest spaces, and inter-office journeys a significant and noticeable feature. The event spaces, for example the Artistree Gallery, are well used by both office tenants and for those visitors access the sites by train and car. Evening flows is as expected; a reverse directional movement to the morning's flows, directly linking offices to their commuter homes via the train stations and (to a lesser extent) the car park. However there is a greater deviation in relation to the morning's movement, as more people frequent restaurants, retail and garden rest stops in the evening than during the morning.

In addition, accessibility data across the multi-levels of public realm show that the users' route selection choice depends on whether pedestrians seek most direct and time-saving route from one destination to another, in comparison to those who take a more circuitous route. This may entail the stopping at one of the amenities or facilities where pedestrians can interact with events, and amenities and other urban functions within the district.sDNA Spatial analysis software, in ArcGis, was used to quantify the potential pedestrian traffic, to compare access layouts pre and post completion of both Taikoo Garden and Taikoo Square. sDNA Spatial analysis software, developed by Cardiff University and related to the more commonly used Space Syntax software, was chosen for its capacity to simulate vertical movement along paths via stairs, escalators and elevators (Cooper and Chiaradia 2020). The analysis uses the 3D pedestrian network provided by HKSAR LandsD (2020) and chooses "betweenness" as the measured value, representing the path's potential to be used as traversal channels. As both angle change and the metric distance will affect pedestrian wayfinding, a hybrid distance measurement method combining angular and metric is used to analyze the accessibility of pedestrian networks. This body of work used 400 m as the analysis radius, based on a 2011 Hong Kong resident survey and the specific modes of travel. The

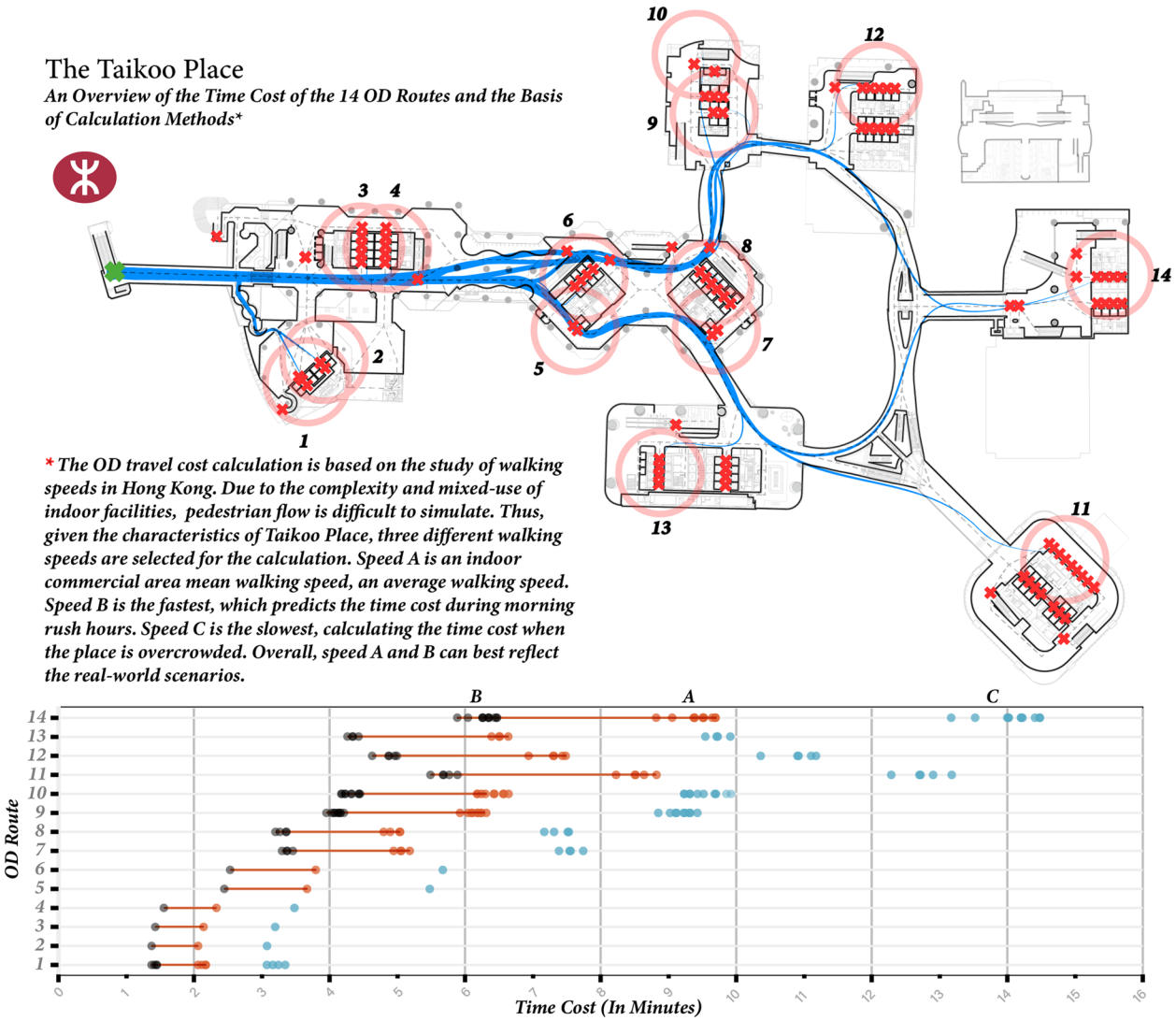

Fig. 6 Pedestrian flows and accessibility analysis within Taikoo Place (see Additional file 1 for detailed information) (source: Author)

survey itself found that 75% of residents walk over 5 min (about 400 m) on average to their destination or transport station (Transport Department 2014).

The findings (see Fig. 8) show that roads connecting Taikoo Place and Quarry Bay station at ground level and 1st floor level both have relatively high pedestrian flow. The predictive analysis result after the renovation project demonstrates how the elevated walkway from Quarry Bay MTR station to One Island East building or Oxford House has high pedestrian flow potential. Compared with the current situation, pedestrian flow at street level has decreased after construction. The completion of the first floor walkway system post-renovation increases the possibility of pedestrians to use the 1st floor as interior thoroughfare through Taikoo Place.

From the data, it was clear that the varied and interesting spatial usage is strongly associated with a number of design elements, including multilayered accessibility from street level, new garden, escalator and elevator access to office space above and parking below, and the hybrid public realm which offers direct physical and visual connectivity and permeability to the surrounding buildings.

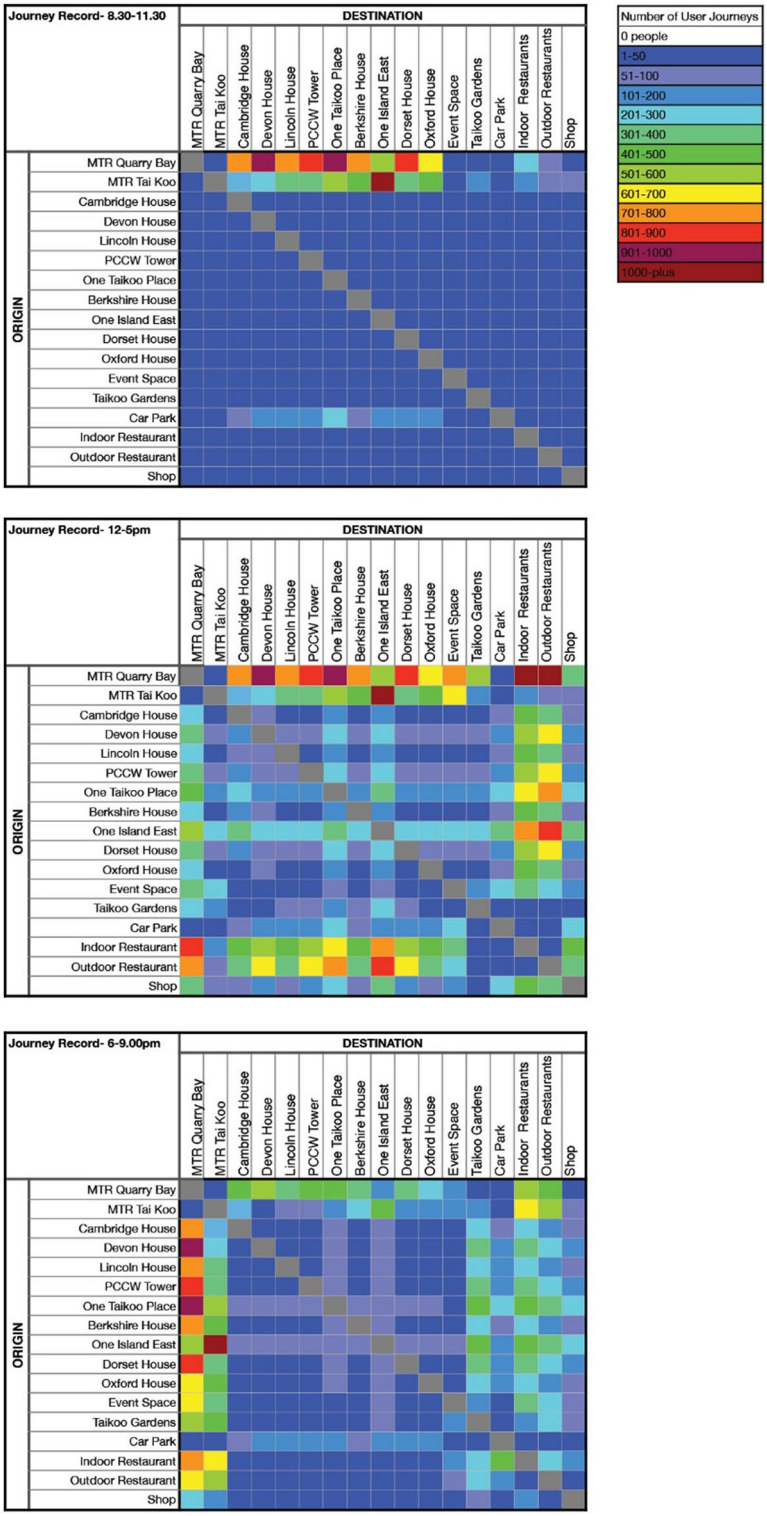

Fig. 7 Matrix for mobility demand from origins to the final destination (source: Author)

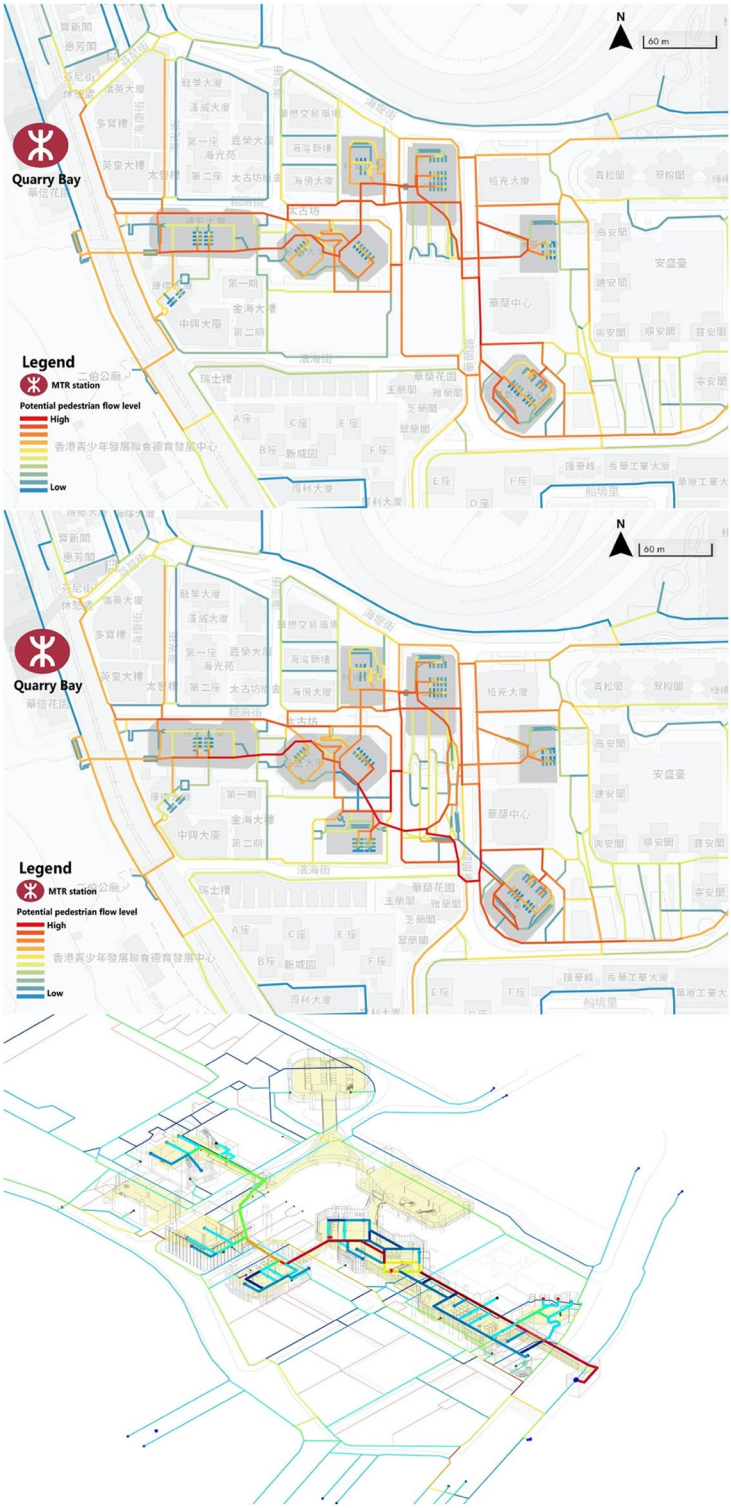

Fig. 8 Potential pedestrian flow level base on the 3D exterior and interior pedestrian network in Taikoo Place district, using sDNA (source: Author)

Finding and discussion

Three main findings should be highlighted: first, the unique pedestrian behaviour patterns, and spatial use at multi-levels of public realm, represents a movement and mobility assemblage unique in nature and specific to a hybridised public realm. Not only specific to Taikoo Place, the pedestrian behavioural pattern mirrors a general observation of pedestrian behavior patterns and flows in hybrid public space of dense settings.

Secondly, the resolution of the OD analysis, combined with other direct pedestrian flow observations, movement studies, 3D sDNA spatial network and human flows on both ground and elevated walkways, all emphasise the importance of 'a fully volumetric urbanism' which addresses the ways in which horizontal and vertical extensions (Bruyns 2020). This further laminates the importance of advancing a volumetric approach at the levels of interpersonal connections, pedestrian to pedestrian and pedestrian to the larger environmental relationships.

Thirdly, and specific to the nature of the study here, is the definition and characterization of hybrid public spaces, in their use, legibility and functional expression, as settings through which users intensity and programmes converge.

In summary, the multilayered character of the public and hybrid public realms in Taikoo Place, and more broadly across Hong Kong, show the distinct and important role of this spatial network in creating a higher density of linkage within a multi-layered public realm. Sun et al. (2021) in particular notes that the complete pedestrian network of Hong Kong, a network of 8,112,462 m is 8.5 times the size of the vehicular road network, thus, an evidenced based understanding of how multi-layered public realm networks and spatial layouts associated with a 'link structure' is a key aspect to the creation and formulation of a hybrid public realm and its role for the 'spatial capital' (Marcus 2010) of Hong Kong.

In this analytical framework, the finding of the cases presented here underlines the importance of combining hybrid morphological analysis—as spatial systems—with users' behavioural patterns and their responses to physical settings. In parallel, this renders further obligations, necessitating developers as responsible parties to ensure public space as create, liveable, permeable, and intensive public spaces that in hybrid layering can establish particular forms of place identity unique to Hong Kong, and the other three dimensional driven cities.

Conclusion

This paper has harnesses empirical and typological analysis to examine the urban design issues to do with the extent, quality and nature of public space, particularly multi-levels of hybrid-public realm and its value in contemporary Hong Kong. In response to the research question 'how in practice does the city of Hong Kong operate and make use of this *hybrid public realm?*', this research has focused on pedestrian behaviour patterns, and spatial characteristics, landuse at multi-levels of public realm, in order to understand the nature of usage and movement through this hybrid public realm, together with public space design and management mechanics.

It is clear that internal and covered public space is a key part of the design and management strategy of dense urban areas including Hong Kong where residential and employment densities are such that the interior and upper floors of buildings necessarily become part of the public realm network. After considering the factors highlighted in the research and Taikoo Place in particular, including the city's urban morphology, population density, juxtaposition of the built and natural environment, and the value of multi-level hybrid public spaces for the accessibility of pedestrian network can be identified which are important to Hong Kong, not only in Quarry Bay.

One conclusion that we draw from this research is that the character of user behaviour patterns within the hybrid public realm and spatial network—whether it be publicly owned and managed, or privately owned space—can be synthesized based on the choices and access routes offered, and the character of the particular environment being observed.

Although there is still long way to go for the urban transformation of Hong Kong in making it truly liveable and walkable within its multi-level public realm, this paper has highlighted the particular factors to consider in making a truly social city. It has highlighted the importance of different dimensions of design, management, equity, business ownership, behaviour and interaction in working places (Penn et al. 1999), linking accessibility, density and diversity to explain 'spatial capital' (Marcus 2010) in this unique setting.

Furthermore, to state that the important value of *public realm routes, through multi levels of hybrid walkway* still need to further developed as 'institutional projects' with planners, producers and consumers' that drive synthesis and implant of the urban design policy for public spaces and public realm in Hong Kong as a form of the 'spatial capitals' and specific multi-functional hybrid public spaces in this unique setting.

Supplementary Information

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Additional file 1. The Taiko place. Origin–destination analysis.

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None.

Author contributions
HSC: development of research structure, questions, methods, and data collection and analysis. AR: literature review. MC: sDNA analysis. All authors read and approved the final manuscript.

Availability of data and materials
The data that support the findings of this study is available from the corresponding author upon reasonable request. The data is 'raw research data' for the open data pilot.

Declarations

Competing interests
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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