Addressing the Parking Crisis: A Spatio-Temporal Analysis and Policy Innovation in Yau Tsim Mong, Hong Kong

Boshi Wang

Master of Transport Policy and Planning, The University of Hong Kong, Hong Kong, China
Email: jacksonbobby2026@outlook.com

Abstract. As a high-density commercial, residential, and tourism center, Yau Tsim Mong (YTM), Hong Kong faces a parking problem that extends beyond an absolute shortage of spaces. This study investigates the spatial and temporal mismatch between parking supply and demand and examines user behavior and policy acceptance using multi-source evidence, including real-time occupancy information for 22 parking facilities, historical timed-parking data, field observations, and a questionnaire survey. The analysis shows that roadside timed-parking spaces in YTM are generally highly occupied, while off-street facilities exhibit substantial differences by location and land-use function. Commercial-office facilities tend to be highly utilized on weekdays but less utilized on holidays, whereas cultural and mixed-use facilities show different temporal patterns. The survey indicates that more than 70% of respondents spend over five minutes searching for parking and that long-duration parking is dominant. These findings suggest that the core problem is a combination of spatial mismatch, temporal mismatch, information asymmetry, and limited demand-management mechanisms. The study therefore proposes a staged strategy combining targeted roadside-space management, dynamic pricing, real-time reservation and virtual queuing, inter-facility demand guidance, park-and-transfer options, and carefully evaluated underground parking development. The findings provide a practical framework for parking governance in other high-density urban districts.

Keywords: parking supply-demand mismatch; spatiotemporal analysis; dynamic pricing; parking behavior; smart parking;

1 Introduction

Hong Kong's land scarcity and high urban density make parking a persistent transport and urban-governance issue. In 2024, Hong Kong issued 2.543 million parking-related penalty notices, accounting for more than 80% of traffic tickets; West Kowloon, which includes YTM, accounted for about 34% of the total. As shown in Fig. 1, parking-related fixed penalty tickets constituted the dominant category of traffic enforcement in Hong Kong in 2024; Fig. 2 further shows the regional distribution of parking-related FPTs, highlighting the substantial share associated with West Kow-

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loon. The scale of enforcement indicates that parking problems are not only a matter of insufficient capacity but are closely associated with road-space conflicts, inefficient searching, and management effectiveness. Existing facilities are distributed among public and private operators, with different prices, operating rules, and data systems. Consequently, a space may be available in the wider district while drivers still experience severe shortages at particular locations and times. The original study identifies this as a space-time efficiency problem rather than a simple aggregate capacity deficit.

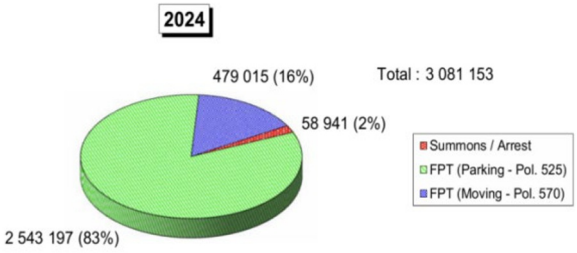


Fig. 1. Comparison of Fixed Penalty Ticket /Summons/Arrest in Hong Kong in 2024

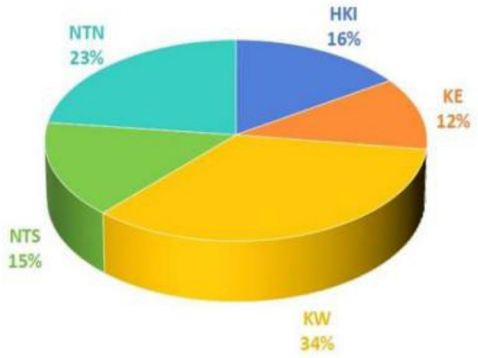


Fig. 2. Percentage of FPT (Parking) by Police Region in 2024

YTM is particularly suitable for examining this issue because it combines dense residential neighborhoods, major commercial corridors, tourist destinations, cultural facilities, and regional transport hubs. Roadside parking in the district is highly concentrated in demand hotspots, while some off-street facilities have substantial spare capacity at particular times. The resulting mismatch can encourage cruising, illegal parking, and inefficient use of public road space.

This paper has three objectives: (1) quantify the spatial and temporal utilization patterns of parking resources in YTM; (2) identify the main mechanisms behind supply-demand mismatch and parking-search difficulty; and (3) develop practical management strategies that combine demand guidance, information technology, pricing, and selective infrastructure expansion. The study uses a mixed-method design integrating parking occupancy data, spatial information, field observations, and user survey evidence.

2 Literature Review

In high-density urban areas, parking issues have become a key factor limiting urban transportation efficiency. As Hong Kong's core commercial and tourist district, Yau Tsim Mong faces severe parking challenges, including a critical shortage of spaces and pronounced spatiotemporal imbalances. This chapter reviews the literature from three perspectives parking demand and user behavior, management difficulties, and international innovative practices to provide theoretical foundations for subsequent analysis.

2.1 Parking Demand Estimation and User Behavior

Accurate parking demand estimation is fundamental to refined management. Guan et al.[1] proposed a big data-driven framework that integrates statistical information grids with machine learning methods, significantly improving demand assessment accuracy in central urban areas. At the behavioral level, Hassine et al.[2] examined the factors influencing drivers' choices among on-street, off-street, and underground parking, identifying cruising as a primary contributor to urban congestion. Yang et al.[3] found that search distance, walking distance, parking fees, and personal attributes collectively shape parking space preferences. Lu and Liao[4] further demonstrated that approximately 30% of urban congestion stems from parking searches; their predictive parking allocation framework (PPA) enables real-time availability prediction and optimized space distribution. Cornejo et al.[5] focused on park-and-ride (P+R) facility evaluation and developed comprehensive site-selection methodologies.

2.2 Challenges in Parking Management

Dynamic pricing is widely regarded as a key approach to reducing inefficient cruising. Mackowski et al.[6] developed a dynamic non-cooperative two-layer model for real-time price adjustment; numerical simulations indicate that this model can significantly reduce both cruising and congestion. As an alternative strategy, Chen et al.[7] compared the efficiency and fairness of three reservation approaches, first-reserve-first-served (FRFS), auction-based, and a hybrid scheme. Liu et al.[8] investigated a reservation system with expiration times and found that appropriately combining reserved and non-reserved spaces helps spread departure times and lower overall travel costs. Mei et al.[9] evaluated the combined benefits of pricing versus reservation systems, concluding that the pricing strategy yields the greatest overall benefits when fees are higher. Wang et al.[10] proposed a hybrid management scheme integrating pricing mechanisms and parking permits for P+R networks.

2.3 International Innovation Practice and Experience

Represented by San Francisco SFpark[11], the parking fee is adjusted in real time according to the occupancy rate, and the occupancy rate is maintained at about 80%,

reducing cruising location search and improving the turnover rate. Singapore implements differentiated pricing in subdivisions and time divisions to guide demand diversion through price signals.

3 Data and Methodology

The analysis combines four evidence sources. First, real-time occupancy information for 22 parking facilities was collected from HKeMobility. Second, historical timed-parking-space information was obtained from the CSDI/SCDI spatial data infrastructure. Third, field observations were used to verify the observed parking conditions and identify operational issues. Fourth, a questionnaire was designed for drivers who had actually driven and parked in YTM, covering travel purpose, parking duration, search time, parking fees, perceived difficulty, and acceptance of policy measures.

The quantitative analysis compares occupancy by location, land-use function, and time period. The survey results are used as a behavioral complement to the occupancy analysis. Particular attention is given to parking-search time, duration of stay, and potential responses to higher prices or alternative facilities. Because the source data are updated at limited frequencies and do not provide complete coverage of all facilities, the results are interpreted as evidence of spatial and temporal patterns rather than as a fully observed causal model. This limitation is explicitly recognized in the original study.

4 Results

4.1 Spatial Distribution and Occupancy

Based on field surveys and data retrieval, YTM contains approximately 1,955 roadside parking spaces. These spaces are relatively dispersed across dense residential and small-commercial areas such as Mong Kok North and Yau Ma Tei and mainly serve short-term demand. In contrast, larger off-street facilities are concentrated in the southwestern tourism and commercial core, including West Kowloon, Tsim Sha Tsui, and Kowloon Station. Parking resources are distributed unevenly across the high-density urban area, illustrating the spatial contrast between dispersed roadside spaces and concentrated off-street facilities. Dense residential areas therefore face a different supply structure from tourism and office clusters.

Roadside timed parking is under particularly strong pressure. The study reports district occupancy generally above 90%, compared with a Hong Kong reference range of approximately 65–80%. At selected peak times, about 1,388 spaces, or 71% of the total, were occupied. Because the historical data are not sufficiently frequent to calculate true turnover, the observed occupancy should not be interpreted as a direct measure of turnover efficiency.

4.2 Temporal Differences Among Facility Types

Off-street parking exhibits strong temporal variation. Weekday peaks are concentrated around 09:00 and 15:00, while holiday demand remains high from approximately 13:00 to 20:00. Parking associated with office activity, such as facilities around Kowloon Station, can exceed 90% occupancy during weekday daytime but fall below 50% on holidays. Cultural destinations show the opposite tendency, with higher holiday utilization. Mixed-use facilities such as Hoi Fu Court and Olympian City remain highly occupied for longer periods because they serve residential, commercial, and public functions simultaneously.

4.3 Parking-Search Behavior

The questionnaire provides evidence that the observed capacity problem is experienced directly by users. As shown in Fig. 3, more than 70% of respondents reported spending over five minutes searching for a space, and 40% reported a search time of 6–10 minutes. Parking duration was also relatively long: about half of respondents parked for 6–9 hours, 33% for 3–6 hours, and only 17% for less than three hours. Commuting accounted for 33% of reported travel purposes and shopping, dining, and entertainment for 27%. The preferred facility types were residential/office-building parking and commercial/shopping-mall parking.

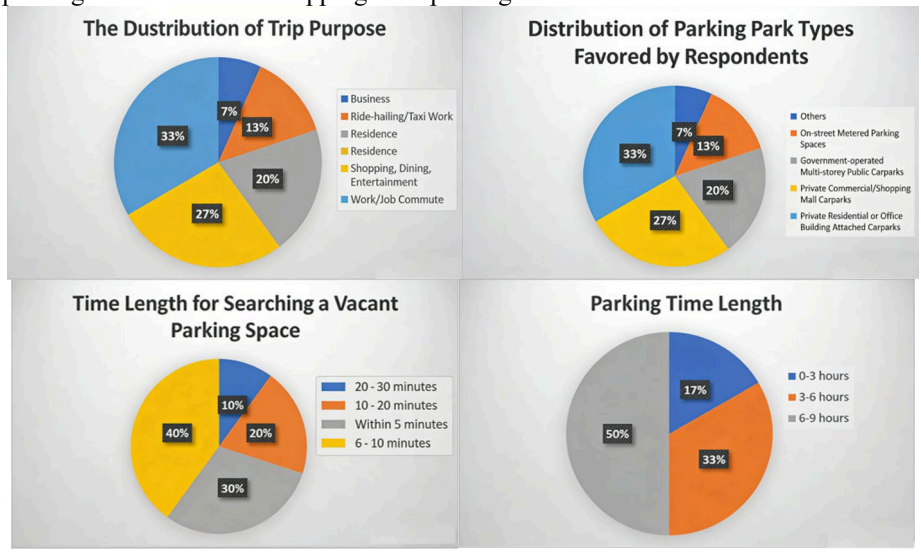


Fig. 3. Distribution of parking characteristics

4.4 Key Problem Diagnosis

Three linked problems emerge. First, there is a spatial mismatch between saturated roadside and destination-area facilities and underutilized facilities elsewhere. Second, there is a temporal mismatch: facilities serving office demand may be underused on

holidays, while cultural and tourism facilities experience stronger weekend demand. Third, information and monitoring are insufficient for efficient real-time guidance. These conditions create an environment in which drivers may cruise in a saturated area even when capacity exists within a reasonable walking distance. The study also notes that a direct causal relationship between parking occupancy and road congestion has not yet been established, so the congestion mechanism should be treated as a hypothesis requiring further high-frequency observation.

5 Policy Framework

The evidence supports a staged governance strategy rather than a single supply-expansion project. The first priority should be to improve the use of existing capacity; the second should be to guide demand across nearby facilities; and only then should new parking supply be considered where demand is demonstrably persistent and alternative measures are insufficient.

5.1 Targeted Curb-space Management

Additional metered parking may be considered at carefully screened locations such as the Kowloon Park Trail and the area near Gansu Street/Shanghai Street. As shown in Fig. 4, these candidate locations are identified as possible sites for new metered parking spaces. The latter requires particular attention to loading and unloading demand, because converting curb space without managing freight activity could shift illegal stopping elsewhere. The purpose of any new metered space should therefore be short-term turnover and network management, not simply adding long-stay capacity.



Fig. 4. Possible Locations for New Metered Parking Spaces (Blue Dots)

5.2 Dynamic Pricing and Inter-facility Demand Guidance

West Kowloon Station illustrates the potential for coordinated demand management. When occupancy exceeds a predefined threshold (the original proposal uses 90%),

drivers could be directed to the nearby Xiqu Centre facility, where temporary and night parking may be more attractive. A coordinated pricing and transfer-discount mechanism could reduce cruising while increasing utilization of nearby spare capacity. The exact price differential should be calibrated using higher-frequency occupancy and user willingness-to-pay data rather than fixed assumptions.

5.3 Reservation and Virtual Queuing

For facilities serving highly concentrated visitor demand, such as the Hong Kong Palace Museum, real-time reservation can reduce unproductive circulation. When capacity is nearly exhausted, a navigation-linked system could allow a short reservation window and use virtual queuing to rank vehicles according to distance and expected arrival time. Drivers unlikely to obtain a space could be redirected to nearby facilities, with discounts or destination-related incentives used to encourage voluntary diversion. Such a system should be piloted first because reservation rules affect fairness and operational complexity.

5.4 Selective Underground Supply Expansion

Residential areas such as Hoi Fu Court present a different problem. Overnight parking demand is relatively rigid and long-duration, so simply increasing turnover or adding curb spaces is unlikely to resolve the shortage and may create safety conflicts on narrow internal roads. As shown in Fig. 5, commercial-residential integrated buildings can maintain relatively high parking occupancy, supporting the need to distinguish residential-oriented demand from other facility types. The original study therefore explores underground parking beneath Cherry Street Park as a possible long-term supply option. As shown in Fig. 6, the proposed site is identified as a candidate location for this selective supply expansion. A preliminary site area of about 8,256 m² was estimated.

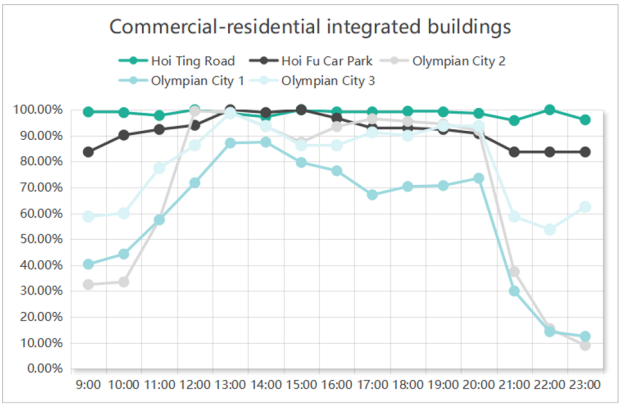


Fig. 5. Occupancy rate of commercial-residential integrated buildings

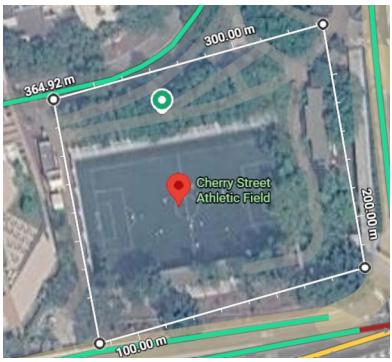


Fig. 6. Select a new location

Parking layouts can generally be classified into three types: perpendicular, parallel, and angled parking, as shown in Fig. 7. Perpendicular parking places vehicles at 90° to the aisle and provides the highest space utilization and parking capacity, making it common in large parking lots and underground garages. Parallel parking aligns vehicles with the road and requires greater driving skill, but occupies less road width and is mainly used along urban streets and narrow roads. Angled parking positions vehicles at an intermediate angle, offering easier access and a smaller turning radius, while its parking capacity and space utilization fall between those of perpendicular and parallel parking.

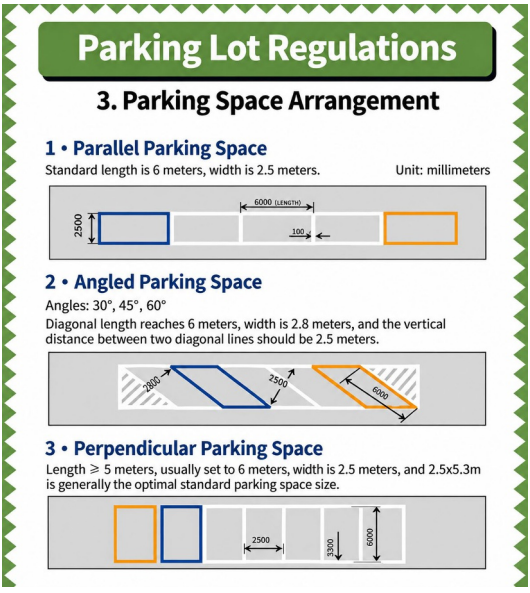


Fig. 7. Classification of Parking Methods

Since this project involves constructing an underground garage, a vertical design is more appropriate and optimizes land use efficiency.

According to the available information, the Hong Kong Planning Standards and Guidelines specify that private car parking spaces must meet the following dimensions: 5 meters in length, 2.5 meters in width, and 2.4 meters in height. As shown in Fig. 8, the schematic illustrates these basic parking-space dimensions for the proposed vertical parking layout:

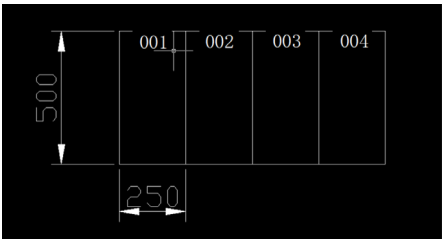


Fig. 8. Parking space dimensions

Based on the available data, a preliminary estimate of the approximate dimensions and design basis of each parking facility component has been determined. As shown in Table 1, the estimate includes the planned land area, area requirement per parking space, estimated single-level capacity, column-grid dimensions, lane widths, and other supporting facilities:

Table 1. Dimensions and Basis of Parking Facility Facilities

project	Number/Description	Calculation Method/Basis
Planned land area	8,256 m^2	Based on 1:1 map surveyStreet Park Football Field)
Total area of the parking space (including lanes, post grids, equipment, residential pool area)	25-30 m^2 per parking space	Standard reference values for underground parking lots
Estimate the number of parking spaces in a single layer	300	8256 ÷ 27.5 ≈ 300 Find the median of the total area of bicycle parking spaces
Column grid dimensions	8 m × 8 m	A common underground garage column grid allows three vehicles to be parked within each column span
lane width	Unidirectional: 4 m Bidirectional: 7 m	Comply with fire safety regulations and the required turning radius
Other public facilities	Entrances and exits, staircases, elevators, equipment rooms, charging stations, fire compartments	stimate together with the parking space area

However, the proposed underground parking scheme still has several limitations. First, converting the football field in Cherry Street Park into a parking facility would reduce community green and recreational space, potentially causing opposition from local residents. Second, the additional 300 parking spaces may increase traffic entering and exiting the facility and create new bottlenecks on surrounding roads such as Cherry Street and Haiting Road, particularly during peak hours. Third, the scheme does not account for parking demand elasticity and induced travel demand, meaning that additional supply may attract more vehicles and therefore have a limited effect on overall congestion. Finally, its economic feasibility and operating model remain unclear, as construction costs, funding sources, pricing mechanisms, and management arrangements have not yet been fully assessed.

This concept should not be presented as a finalized engineering proposal. It requires traffic-impact analysis, geotechnical and fire-safety assessment, cost-benefit analysis, public-space evaluation, and a clear financing and operating model. The original study itself identifies the loss of public recreation space, possible road-network bottlenecks, induced parking demand, and uncertain construction economics as major unresolved issues.

6 Discussion

The central implication is that parking difficulty in YTM should be understood as a network allocation problem. High occupancy in one location does not necessarily mean that the district lacks capacity in aggregate. Instead, drivers value proximity, information certainty, time reliability, and price, while parking operators and land uses generate different demand profiles. A policy that only adds spaces may therefore be absorbed by latent demand without improving cruising or congestion.

Three implementation principles follow. First, policies should be matched to demand type: short-stay commercial demand is more amenable to turnover and pricing, whereas residential overnight demand is more rigid and requires dedicated supply or shared-capacity solutions. Second, information should accompany pricing. A higher fee without credible information about alternatives may simply increase user costs; dynamic pricing should instead be linked to real-time availability and route guidance. Third, infrastructure expansion should be selective and evidence-based. Underground parking may be justified in persistent residential shortages, but only after environmental, traffic, financial, and social impacts are assessed.

The study also highlights a data-governance requirement. Current update frequency and coverage are insufficient to estimate roadside turnover reliably or establish causal links between parking conditions and congestion. A future smart-parking platform should integrate occupancy, price, duration, curb regulations, and road-traffic information at a higher temporal resolution. This would enable before-and-after evaluation of pilots and allow policy thresholds to be calibrated from observed behavior rather than assumptions.

7 Conclusion

This study shows that the parking crisis in YTM is characterized by a combination of high local occupancy, spatial and temporal mismatch, long-duration demand, and incomplete information. Roadside spaces are persistently pressured, while off-street facilities show substantial differences according to land use and time. Survey evidence further indicates that parking search is a common user burden and that long-duration parking accounts for a large share of observed demand.

A practical response should therefore combine demand management and selective supply expansion. Dynamic pricing, real-time information, reservation and virtual queuing can redistribute demand among existing facilities, while targeted curb management and carefully assessed underground development can address persistent local shortages. The recommended sequence is to improve information and monitoring, pilot demand-guidance measures, evaluate behavioral responses, and only then scale infrastructure investment. This approach is more consistent with Hong Kong's land constraints and the heterogeneous needs of residents, commuters, visitors, and commercial users.

Future research should obtain higher-frequency occupancy and traffic data, enlarge and stratify the questionnaire sample, estimate price and walking-distance elasticities statistically, and conduct a full traffic and economic feasibility assessment of underground parking options. These steps would strengthen causal inference and make the proposed policy package more suitable for formal implementation.

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