

# Exploring the fringe-belt phenomenon in a Sino-Portuguese environment: the case of Macao

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**Abstract.** *The fringe-belt concept has been recognized as an effective means of investigating the growth and transformation of urban physical form. Hitherto case studies of fringe belts have been mainly conducted in fairly homogeneous cultural environments. In this paper the fringe-belt concept is investigated in a city characterized by a Sino-Western admixture of cultures. The investigation of three fringe belts in Macao Peninsula reveals major factors influencing their formation and modification processes, especially in relation to socio-economic conditions, land reclamation from the sea and industrial development. Understanding the characteristics of fringe belts has implications for the appreciation and management of urban landscapes.*

*Keywords: fringe belt, urban landscape, Sino-Portuguese culture, urban morphology, Macao*

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By reconstructing the processes by which urban form develops in different cultures, both morphological theories and our understanding of the richness and cultural diversity of urban form can benefit. Hitherto studies of fringe belts have mainly been conducted in fairly unitary cultural environments, either Western or Eastern. Here the fringe-belt concept is investigated in a city characterized by a Sino-Western admixture of cultures.

The fringe-belt concept, put forward by German geographer Herbert Louis in 1936, has been used to investigate the historical development of urban form over some 80 years (Conzen, 2009; Whitehand, 1988). These studies have demonstrated the validity of this concept in cities in many regions around the world. However, there has been little examination of it in a colonial city that includes a number of cultures. This study seeks to fill this gap, giving especial attention to Macao, a former colonial city in China,

which provides evidence of the confrontation and integration of different cultures.

Most historical cities are facing problems of reconciling vigorous urban growth and urban landscape conservation. An exploration of the relationship between the physical structure and the 'spirit of a place' is an important basis for historical urban landscape management. Taking Macao Peninsula, China, as a particular case, the main objective of this paper is to explore the formation and modification of fringe belts in Macao in relation to the process of urban development. In doing so attention will be drawn to the significance of fringe belts for historical urban landscape management.

## **Fringe-belt research**

Louis used the term *Stadtrandzone* (urban fringe belt) to help explain the morphological structure of Berlin. That structure included a

number of land-use zones representing former peripheral urban uses encompassed by later accretions to the built-up area and separating older from younger residential areas (Louis, 1936). Building on Louis's concept, M. R. G. Conzen used it as part of a theoretical framework for investigating the processes of urban growth and change (Conzen, 1960, 1962, 1969). He defined an urban fringe belt (or 'fringe belt' for short) as 'a belt-like zone originating from the temporarily stationary or slowly advancing fringe of a town and composed of a characteristic mixture of land-use units initially seeking peripheral location' (Conzen, 1969, p. 58). He recognized that the urban fringe did not extend outward steadily but underwent periods of acceleration, deceleration and even standstill. Fringe belts occurred during minimal outward advance of the built-up area, often associated with a physical limitation on urban growth, such as, in early times, a city wall: what Conzen (1969, p. 125) termed a fixation line. Once established, a fringe belt tended to be perpetuated, the subsequent advance of the built-up area taking place beyond it. Historical cities have commonly developed more than one fringe belt. In his study of the English market town of Alnwick, Conzen (1960) recognized a historical succession of fringe belts: an inner fringe belt, a middle fringe belt and an outer fringe belt. In his examination of Tyneside, Whitehand developed the fringe-belt concept in a multi-nuclear conurbation (Whitehand, 1967).

This concept is far more than an articulation of land-use associations: it provides ways of explaining the historico-geographical development of urban areas in terms of distinctive phases of growth and hiatus (Whitehand, 1994). For Conzen, a city's landscape is the 'objectivation of the spirit' of the succession of societies that inhabits it. It forms a framework with local historical meaning within which people orientate themselves both in space and time (Conzen, 1966; Whitehand and Gu, 2007).

Whitehand explored the relationship between the formation and transformation of fringe belts and bid-rent theory, fluctuations in housebuilding and innovations in transport

(Whitehand, 1972, 1977, 1987). He showed that during periods of minimal growth of new housing, when land values were low, a variety of generally extensive land uses, such as institutions, public utilities, cemeteries, parks and recreation grounds, tended to acquire sites at the edge of the built-up area. Often eventually becoming resistant to bids for their land by housebuilders, they formed a fringe belt embedded within the built-up area (Whitehand, 1988). Barke (1974, 1990) and Parkes and Thrift (1980) also provided economic interpretations of fringe belts. Openshaw (1973), Slater (1978), and Carter and Wheatley (1979) incorporated a social perspective into the relationship between the formation and modification of fringe belts.

From the late 1990s, there has been increasing concern for establishing the link between the spatial processes of fringe-belt formation and change and the practice of planning and urban landscape management. It has been noted that fringe belts have distinct physical characteristics. They provide a frame of reference that articulates physical and societal change, and is a basis for sound conservation planning (Whitehand, 1996, 2005; Whitehand and Morton, 2003, 2004, 2006; Whitehand, *et al.*, 2003). Ducom (2005) conceptualized the interrelations between decision takers, other influential factors, and the modification of fringe belts. The Urban Morphology Research Group in Birmingham UK is now collaborating with ecologists to study the relationship between fringe belts and ecosystem services (Whitehand, 2016; Zhang, 2016).

Although the study of fringe belts began in Germany, most of the key contributors in the second half of the twentieth century were from the English-speaking world and the main case studies were in Britain. However, fringe belts have been documented in a number of countries in the West, such as the USA, Italy and Brazil (Conzen, M. P., 1968, 1997, 2001, 2004, 2007), Spain (Vilagrassa, 1990), France (Ducom, 2003), the Netherlands (Bienstman, 2007; Suurenbroek, 2004), Iceland (Kristjansdottir, 2006), Croatia (Krajnik *et al.*, 2008), Canada, Russia and Zambia (Kukina, 2006; Whitehand, 2009), New Zealand (Gu, 2010),

and Turkey (Ünlü, 2012, 2013). The scale of investigations has ranged all the way from small towns to large metropolitan areas (Conzen, M. P., 2009). However, fringe belts were rarely investigated in the markedly different cultural environments of Eastern Asia until 2007. Whitehand and Gu have sought to rectify this in China (Whitehand and Gu, 2007, 2017; Whitehand *et al.*, 2011, 2016), and a number of cross-cultural comparative studies of fringe belts have been conducted (Conzen, M. P., 2009; Conzen, M. P. *et al.*, 2012).

### The case of Macao Peninsula

Macao Peninsula is the most populous and historical part of Macao, which is a Special Administrative Region of China. It is located at the south-western corner of the Pearl River Estuary, close to Guangdong Province, China. Portugal rented Macao Peninsula as a treaty port from 1557 to 1887, during which period the city was administered by the Portuguese under Chinese authority and sovereignty. Subsequently, Macao, which consisted of Macao Peninsula and the islands of Taipa and Coloane, was a colony of Portugal until 1999.

As an outpost of Portuguese commerce in China, Macao Peninsula has for several centuries been strongly influenced by the Portuguese. With the continuing influx of Chinese people, the majority of the population had become Chinese by the nineteenth century. In 2005, the Historic Centre of Macao was inscribed on the UNESCO World Heritage List. According to UNESCO 'Macao bears a unique testimony to the first and longest-lasting encounter between the West and China... The impact of this encounter can be traced in the fusion of different cultures that characterize the historic core zone of Macao'. Since the sixteenth century the urban form of Macao Peninsula has expressed a combined Chinese and Portuguese character.

### Sources

Historical plans, showing streets, building block plans and plot boundaries, are the basic

source for urban morphological research in the West. However, traditional Chinese cartography has tended to give emphasis to pictorial symbolization rather than accurate ground-plan records. A major merit of Macao for fringe-belt research is its rich historical records by Chinese standards. Though the historical maps of Macao in the nineteenth century were mainly diagrammatic, a number of maps prepared by Europeans provide a schematic plan of the street system and a rough indication of important sites and positions of buildings with special significance.

The earliest known map of Macao Peninsula was published in 1635. It was produced by Willem Janszoon Blaeu. As in the case of other seventeenth-century maps, the broad description of Macao Peninsula in this map is largely accurate. The first map that clearly showed the city wall and forts was prepared in 1639.

The first quasi-plan was published in 1726 by Francois Valentyn. It contains a number of indexes in which the defence system has been emphasized. More details of the city are shown in a map of 1792, which was published in a book by Chretien Louis Joseph. This map highlights 45 places. It includes the city wall, the city gates, the hills, the landing places, the street system, the military facilities, the factories of European merchants (East India Companies of European countries), Christian churches, Chinese and Portuguese custom houses, government agencies and cemeteries. A navigational chart was compiled in 1796 by John Barrow. It provides a detailed map of the city of Macao and its harbour, indicating the forts, names of parishes, colleges, convents, chapels and other notable buildings and places in Macao Peninsula.

In the nineteenth century, maps put more emphasis on geographical features, and the city elements were represented more completely and clearly. A chart prepared in 1834 by Heinrich Berghaus covers part of the southern Chinese coast, focusing on the area from Guangzhou to Macao and Hong Kong. It includes an elaborate map of Macao and five illustrations of important scenes in Macao. A map published in 1853 by Edward Belcher

documents the city's structure and the hydro-graphic condition of the seas adjacent to Macao Peninsula. A coloured map published in Portugal in 1889 shows the street pattern, important buildings, cemeteries, physical relief and agricultural fields.

The twentieth-century maps, at scales of 1:10 000 or 1:20 000, show more details of Macao Peninsula, including land use and reclamation. Plot boundaries are shown on the cadastral maps of 2009 and 2015. Nevertheless, Macao's records of the spatial configuration of early periods are poor compared to those of most cities that have hitherto been the subjects of fringe-belt research. Therefore, even if maximum use is made of all available cartographic sources and relevant historical documents, the detailed tracing of fringe-belt development is disadvantaged relative to the large majority of previous fringe-belt studies.

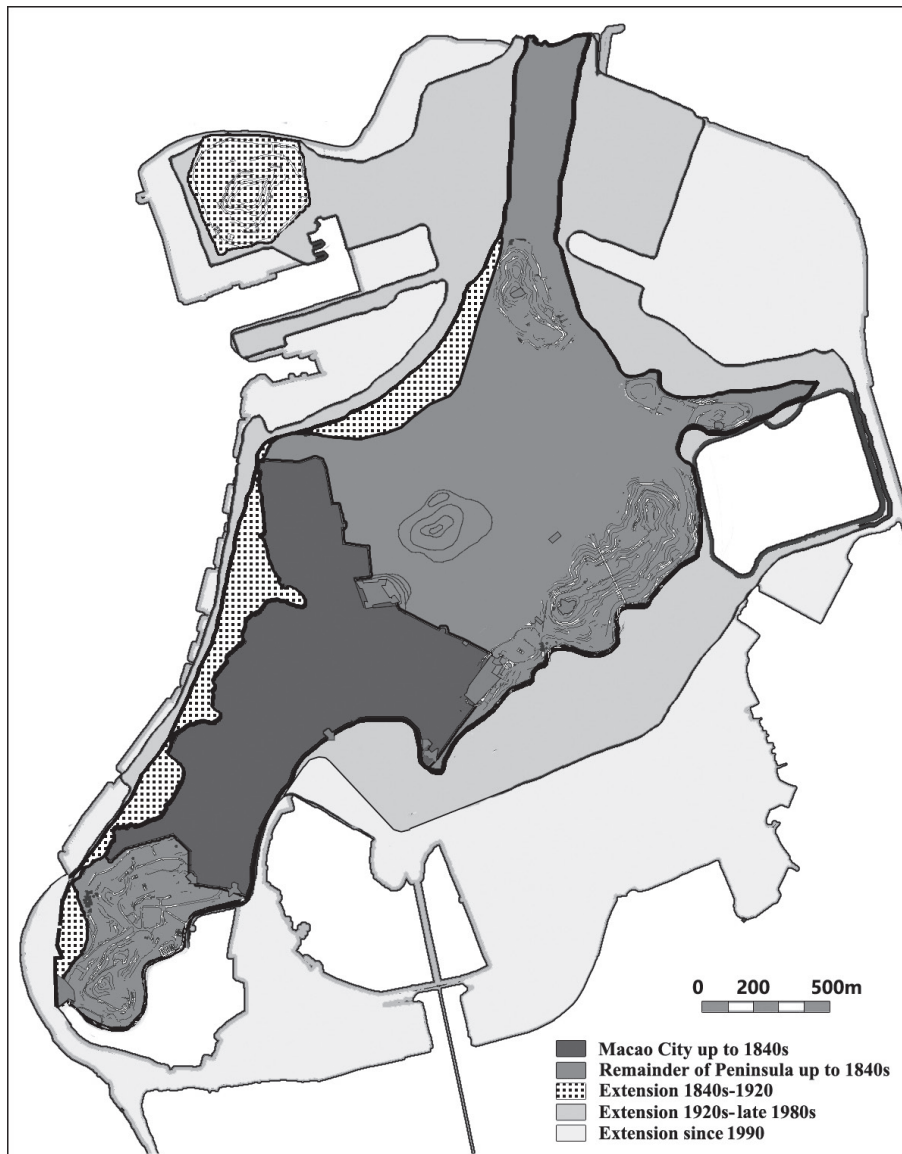
#### *Urban growth and fixation lines in Macao Peninsula*

Portugal was one of the first European countries to undertake colonization outside the mainland of Europe. Evangelism and the pursuit of wealth were the primary driving forces behind its overseas expansion. The Portuguese began to develop a series of colonial cities in the East, including Goa in India, Malacca in Malaysia, and Macao in China. These cities combined the roles of fortresses and business stations. As the bases of colonizing and missionary activity, these cities shared certain common features in their configurations. Unlike their gaining of colonial cities elsewhere by military force, in Macao the Portuguese rented the land with the permission of the Ming government of China. In other Portuguese colonial cities, such as Goa and Malacca, the local cultures were completely destroyed by the Portuguese (Yan, 2005). In contrast, the local temples in Macao Peninsula, which were the symbols of Chinese culture, were well preserved when the Portuguese city was built. From a city management standpoint, Macao experienced

a reciprocal relationship between its Chinese and Portuguese populations until the Opium War of 1840. This gave rise to the urban growth pattern in Macao having distinctive characteristics.

The urban growth of Macao Peninsula consists of four morphological periods: pioneer development (1557–1840s), colonial expansion (1840s–1920), the period following the first massive sea reclamation (1920s), and since the second massive sea reclamation of the 1990s (Figure 1). The first Opium War (1840–1842) was an important influence on the urban growth of Macao Peninsula: it separated the first two morphological periods. After that, the initiations of sea reclamations in the early 1920s and the early 1990s were the beginnings of the last two morphological periods.

The original nucleus of the city was in the southern half of Macao Peninsula, north of Penha Hill and south of Mount St Paul. Owing to the nature of Macao's founding, there was a lack of strong political power in the early city construction. Maritime trade was the basic influence on urban growth. The city was built with a focus on catering for commercial trade. The opening of a port in Macao provided spaces and opportunities for profit seeking by both Chinese businessmen and Portuguese merchants. In the early period most of the residents in Macao were immigrants from mainland China and Portugal. The exceptions were small numbers of inhabitants in a few scattered villages. To acquire a greater sense of security and spiritual support, the Chinese and Portuguese developed their settlements separately, imitating their hometowns with the aim of maintaining their customary living styles. The Portuguese community was in the eastern part of the city, and the Chinese community in the western part. The city walls were completed by the Portuguese in 1632 after half a century of negotiation between the Portuguese and Chinese governments. They were along the eastern coastline and the ridges of the Mount of St Paul and Penha Hill. The lines of the city walls and positions of the city gates are partly matters of conjecture based on historical maps and written records. In light of



**Figure 1. Successive extensions of the area of Macao Peninsula, based on city maps of Macao (Library of Congress 1639, 1726, 1792, 1796, 1834, 1853, 1889, 1921, 1922, 1927, 1960, 1970, 1983, 1990) and cadastral maps of 2009 and 2015 (Cultural Affairs Bureau of Macao).**

the significance of the city walls as defensive features, it is quite credible that they acted as a fixation line of an inner fringe belt.

With the opening of the Treaty Port in Hong Kong after the first Opium War (1840–1842), Macao lost its dominance of maritime trade in East Asia. In order to increase its colonial profit and competitiveness, Queen Maria II of Portugal unilaterally declared Macao a free port in 1845. In the next year, Governor

Amaral extended expansionist policies and taxed the local Chinese. The Portuguese army devastated the Chinese local government office in Mongha Village, expelled the Chinese officer, and extended by force the Portuguese domain into the northern half of Macao Peninsula, which contained several Chinese villages. Thereafter the city walls were progressively demolished. Moreover, in the middle of the nineteenth century, the land

area of Macao Peninsula increased from 2.78 to 3.4 km<sup>2</sup> as a result of sea reclamation along the western coastline. The increase in land availability created opportunities for modern urban planning and construction. Associated with the movement outward of the coastline and the implementation of Inner Harbour improvements, the new western coastline began to serve as a further fixation line and a new trading harbour was developed along it.

The first massive sea reclamation took place between 1922 and 1936. This resulted in the land area of Macao Peninsula increasing to 5.2 km<sup>2</sup>. At the same time as the formation of the new coastline, the modern Outer Harbour area along the eastern coastline and the industrial district in the north-west of Macao Peninsula were constructed. The second massive sea reclamation was carried out between the late 1990s and the beginning of the twenty-first century, increasing the land area of the Peninsula to 9.3 km<sup>2</sup>. The most obvious change was the development of a recreational area in the southeast of the Peninsula and a new residential district in the northeast.

### **The development of the fringe belts of Macao Peninsula**

According to the historical records of Macao, the population of the city has grown significantly since the middle of the nineteenth century. In 1839, before the first Opium War, there were about 13 000 people in Macao Peninsula; of whom 54.1 per cent were Chinese and 43.2 per cent were Portuguese. By 1860, after the second Opium War, the population had increased to 85 471, subsequently increasing to 157 805 in 1927 and 566 400 in 2013. Population growth on this very large scale inevitably meant extensions of the urban area. The form of these extensions is the focus of our attention.

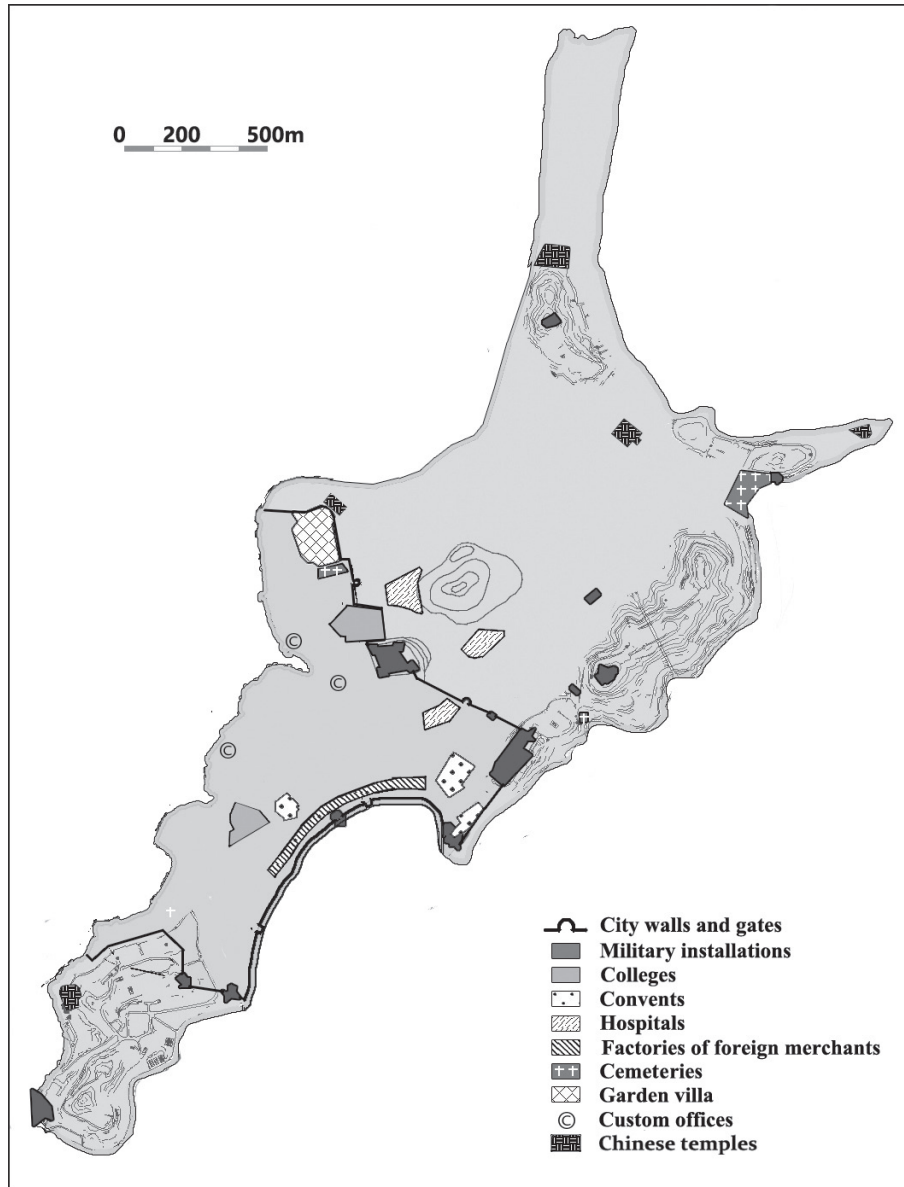
#### *The period from 1632 to the 1840s*

Early research on the formation of fringe belts drew attention to attempts by cities to place cordons around their built-up

areas – for example, by the creation of fortification zones – which acted as fixation lines (Whitehand, 1994). The inner fringe belt in Macao Peninsula is related to a fortification zone. Accompanying the construction of the city wall in the 1630s, ten forts were built. Between the middle of the seventeenth century and the 1830s, a number of institutions, including a college, three convents, three hospitals, a military camp and a garden villa, occupied large sites along the northern part of the city wall (Figure 2).

The eastern part of the city wall was not continuous. The eastern coastline acted as another fixation line. As the ‘outer port’ of Guangzhou since the seventeenth century, Macao preserved an important role in maritime trade. Many of the foreign merchants based in Guangzhou established branches in Macao, where they could take advantage of the lower customs duties and better exchange rate for silver – notably when the scale of illegal opium trade enlarged in the 1760s, and Macao served as a unique place of opium transaction (Hsia, 2012). The Outer Port of Macao Peninsula was located on the eastern coastline, and all foreign merchant ships called here before obtaining permission to enter Huangpu Port in Guangzhou. Consequently, the wharf and a series of factories of foreign merchants were located close to the eastern coastline. These were characteristic features of the eastern part of the inner fringe belt. Being in the vicinity of the Portuguese settlement and serving foreign trade, the buildings along the eastern coastline tended to be in Portuguese style (Figure 3).

The three oldest churches, St Anthony’s in the north-west corner, St Lazarus’s in the north-east corner and St Lawrence’s in the south, defined the early area of Portuguese settlement in Macao Peninsula. St Joseph’s College, which was close to St Lawrence’s church and embedded in the city centre later, acquired its site in 1728. At this time, the main Portuguese settlement did not extend farther south than St Lawrence’s church. In spite of the distance between the College and the southern part of the city wall, St Joseph’s College was effectively a constituent of the inner fringe belt.



**Figure 2. Fringe-belt land use in Macao Peninsula in the 1840s, based on city maps of Macao (Library of Congress, 1834).**

Similar to the role of the eastern coastline, the western coastline served as a fixation line. A harbour business area based on internal trade developed along it. Most of the population in this area was Chinese, and many of the buildings constructed in the western part of the inner fringe belt were in traditional Chinese style. A number of these survive today. For example, the A-Ma Temple, the earliest Chinese temple in Macao, is located at

the south-west end of Macao Peninsula, facing the sea, and the Temple of the Local God of Land, one of the five earliest Chinese temples in Macao, is located between the western coastline and northern city wall. The Chinese and Portuguese Customs offices were close to the western coastline.

In general, the land use in the northern and southern parts of the inner fringe belt tended to reflect the functions of a Portuguese city.



**Figure 3. Buildings in Portuguese style on the eastern coastline of Macao Peninsula in 1813** (<https://lcn.loc.gov/2003627000ngress>).

That in the eastern and western parts was consistent with Macao's role as a port city, the eastern part being Portuguese in character and the western part Chinese.

#### *The period from the 1840s to c.1920*

After the northern part of Macao Peninsula was annexed by the Portuguese and the city walls were gradually demolished, wider development of the Peninsula occurred. During this period, two major initiatives to improve the city environment were taken by the Macao Government. The first was reclamation along the western coastline between 1866 and 1910. The reclaimed land became part of the Inner Harbour, providing scope for developing the port economy. A boom in the fishing industry was marked by the construction along the southern part of the western coastline of the fishery wharf, a warehouse, a wholesale market and a distribution centre of marine tackle. It is a Chinese cultural tradition that streets were named after the industries in them. In this area there remain today many streets and lanes named after the fishing industry, such as Anchor Lane, Fishnet Lane, Salted-fish Street

and Sailor Street. A good many names relate to wholesale businesses – Warehouse Street, Salt Lane and Grass-mat Lane, for example. They provide a broad indication of the distribution of land use associated with the fishing industry.

The opium trade and labour trafficking were the other two major industries of Macao in the nineteenth century. The opium pier, the taxation office of the opium trade, the opium mill and the labour trafficking market, were located in the middle of the new west coast, eventually merging with the fishing industry area to the south. The north-west part of the reclaimed land had the greatest concentration of dockyards, and the new western coastline acted as a part of a fixation line of the extended inner fringe belt. The urban landscapes here were a Chinese-Western admixture (Figure 4).

The second initiative was the implementation of a Landscape Improvement Project. Before the nineteenth century, there had been a lack of urban afforestation. To improve the ecological environment and create a better investment climate, the Macao Government introduced a host of measures as part of this project. As the name implies, the project focused on improving and beautifying the



**Figure 4. Mixed Chinese and Western urban landscapes on the western coastline of Macao Peninsula in 1890 (<http://macauoldmap.com>).**

city environment. Besides green spaces in the residential areas, a number of public gardens, mainly in Western style, were created. The opening in the 1880s of Francisco Garden, which had been an open space within the Francisco Convent, was the start of a green revolution in Macao. The buildings in the Convent were converted into an Army Club. Camoes Garden, which commemorated a famous Portuguese poet, was created from the garden of a Western private villa in the north-west corner of the walled city. Other public gardens were located close to Mount Guia in the east, the highest hill in Macao Peninsula. Large parts of Macao had become wooded garden suburbs by the end of the nineteenth century (Figure 5).

Many kinds of infrastructure were constructed in the course of the nineteenth century, for example associated with telecommunications (1844), drainage (1873) and public lighting (1871). Two cemeteries were added to the northern part of the inner fringe belt in the 1850s. The military camp at the south-west end of Mount Guia was converted into an observatory and a hospital. The area along the west side of Mount Guia became part of the inner fringe belt.

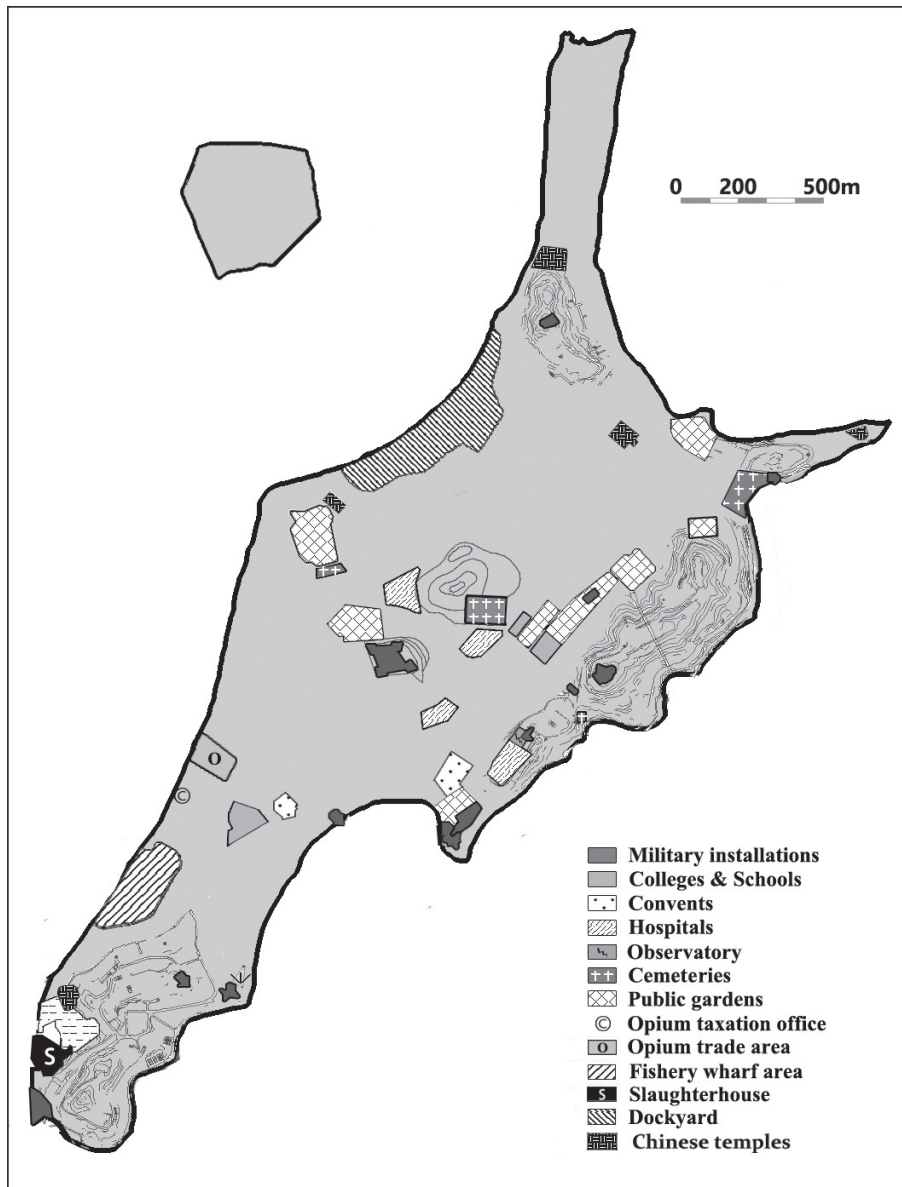
Accompanying developments by the Portuguese in the Nanwan area, the former

factories of foreign merchants along the eastern coastline were converted into an administrative area. A building to house the Macao government was constructed here in 1851. Foreign consulates, the Governor's house, a post office, a telecommunication office and a courthouse were added. A Portuguese urban landscape took shape (Figure 6).

#### *The period from the 1920s to the late 1980s*

Associated with the wars and the Cultural Revolution in mainland China, there were large movements of migrants into Macao. During this period the demands for land for both residential building and extensive fringe-belt land uses in Macao were high. The first massive sea reclamation, from 1923 to 1938, was concentrated in the northern and south-eastern part of the Peninsula.

Whereas maritime trade was the major industry of Macao during its first 300 years, diverse sectors of the economy were developed in the century. The population of Macao nearly doubled between 1920 and 1927. In 1921 the proportion of the population that was engaged in the fishing industry and in traditional handicraft industries, such



**Figure 5. Fringe-belt land use in Macao Peninsula in the late 1880s, based on city maps of Macao (Library of Congress, 1889).**

as incense, firecracker and match making, was more than 90 per cent (Wu, 2004). Most of the working population was Chinese, having entered the Peninsula through the Barrier Gate in the north. Their settlements were located in the western part of the northern reclaimed area and between Mount St Paul and Mongha Hill, which had been a large area of agricultural land before the 1920s. There was a sharp rise in population density here, and this area gradually became a major

slum. Handicraft workshops, a racecourse and a public sports ground were located on its periphery. At roughly the same time, modern infrastructure was constructed in the eastern part of the reclaimed land. This included a wireless station, an electricity power station, a water supply installation and a very small airport.

Whereas the northern part of the reclaimed land was developed quickly, the south-eastern part remained largely unused for a long



**Figure 6. Buildings in Portuguese style fronting Nanwan Lake in 1890**  
(<http://www.macaouldmap.com>).

period, except for the Amaral Circus built in 1940. In Planning Area A (Figure 7), a series of public facilities was built after the middle of the twentieth century. For example, a large theatre was built in 1952, and a sports ground and a Portuguese middle school in 1958. The first five-star hotel in Macao, Hotel Lisboa, was opened in 1970.

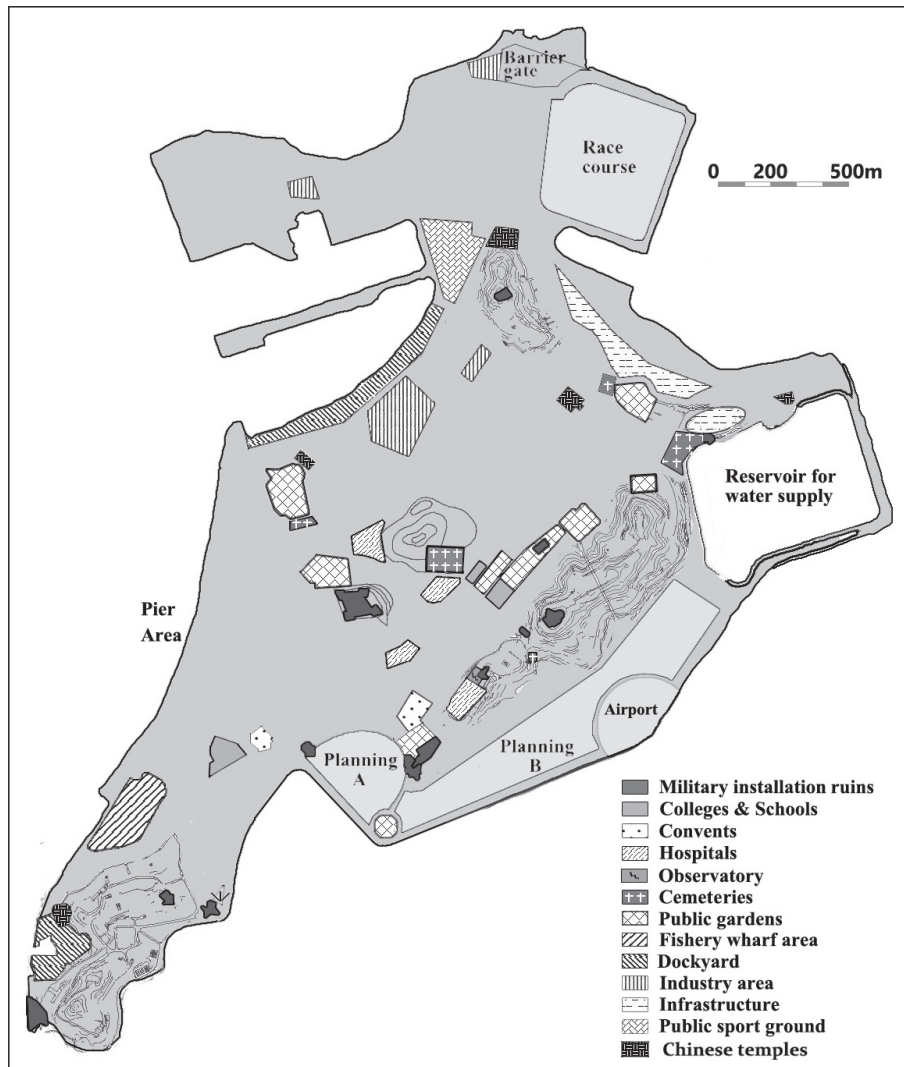
The land in Planning Area B (Figure 7) was not fully developed until the end of the twentieth century. Many piers were constructed along the western coastline. Large dockyard areas were located at each end of this coastline, bringing into existence a middle fringe belt.

Within the inner fringe belt, several land uses changed in the course of the late-twentieth and early twenty-first centuries. All of the forts were decommissioned. Some were changed to other uses – a museum in one case – and the others were demolished. The ruins of St Paul's College, St Paul's Church and St Paul's Fort were converted into tourist attractions, becoming the best-known landmarks in Macao. The land along the old south-east coastline became part of the city centre. Conzen (1969, p. 125) termed such replacement of fringe-belt components as 'fringe-belt alienation'.

#### *The period since 1990*

Macao manufacturing has experienced a gradual decline since the 1990s, and gambling and tourism have become the backbone of Macao's economy. Macao's gambling industry has a long history. It was first legalized in 1847. In February 1961, Macao was approved as a *Perpetual Gambling Area* by the Portuguese government, and it was planned to make it into a low-taxation area reliant on gambling and tourism. In the subsequent 40 years, the gambling industry in Macao was operated by a company with a government-issued monopoly license. The gambling industry was liberalized in 2001, and several new casino operators entered the market. As a result, the demand for land increased for the development of gambling and tourism.

The second massive sea reclamation has been in progress in the north-east part of Macao Peninsula since the end of 1980s and in the south-east parts since 1992. The south-east reclamation area and Planning Area B merged, and a large number of hotel casinos on large sites were built in this area. Some large cultural facilities, including a Cultural Centre (opened in 1999), a Science Centre (opened in 2009), and several museums were



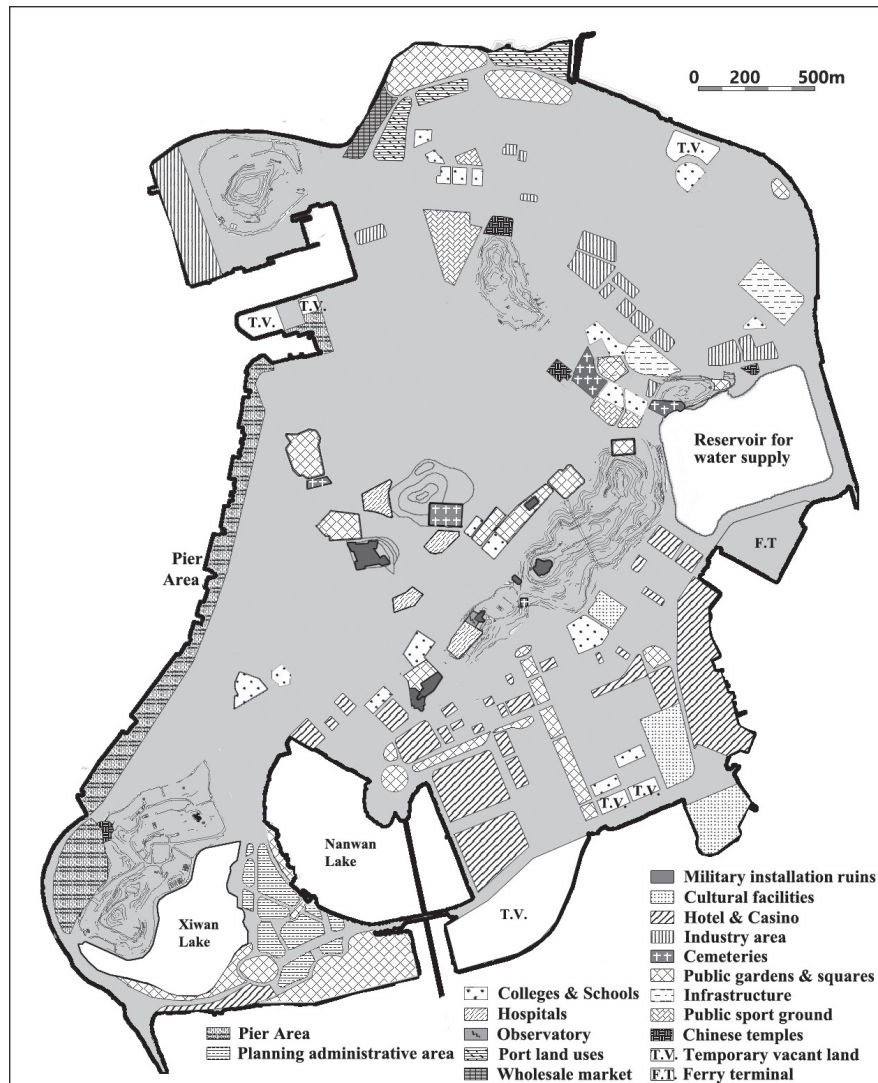
**Figure 7. Fringe-belt land use in Macao Peninsula in the 1930s, based on city maps of Macao (Library of Congress, 1936).**

located here. The other major land uses in this area are open spaces, commercial buildings and colleges. To the east of this area, a new ferry terminal, Outer Harbour Ferry Terminal, was opened officially in 1993. It contains a terminal building, a helipad and 6 boat docks, and significantly improves the external transport connections of this new tourism and leisure area (Figure 8). These public facilities in the south-east reclamation area formed the south-east part of a further fringe belt.

Housing is the major land use in the northern part of the new reclamation area. The racecourse and the dockyard area along the northwest coastline, which were in the middle

fringe belt, were redeveloped as residential areas – large-scale examples of fringe-belt alienation. Following the traditional land use of manufacturing in the north, two industrial areas were developed, one in the north-west corner and another on the southern periphery of the north-east reclamation area. Similarly, a sewage plant and power plant were situated in this area. Together with a number of schools and a public sports ground located at the edge of the new residential area, these formed the northern part of the further fringe belt.

Thus an outer fringe belt matured step by step in the new reclamation area. Compared to the mixed land uses in the other two fringe



**Figure 8. Present-day land use in the fringe belts of Macao Peninsula, based on the cadastral maps of Macao (Cultural Affairs Bureau of Macao, 2015).**

belts, the development of distinct sectors is more obvious in the outer fringe belt: a cultural and tourism area in the south-east, and an industrial area in the north. This is the main feature that distinguishes the outer fringe belt from the other two.

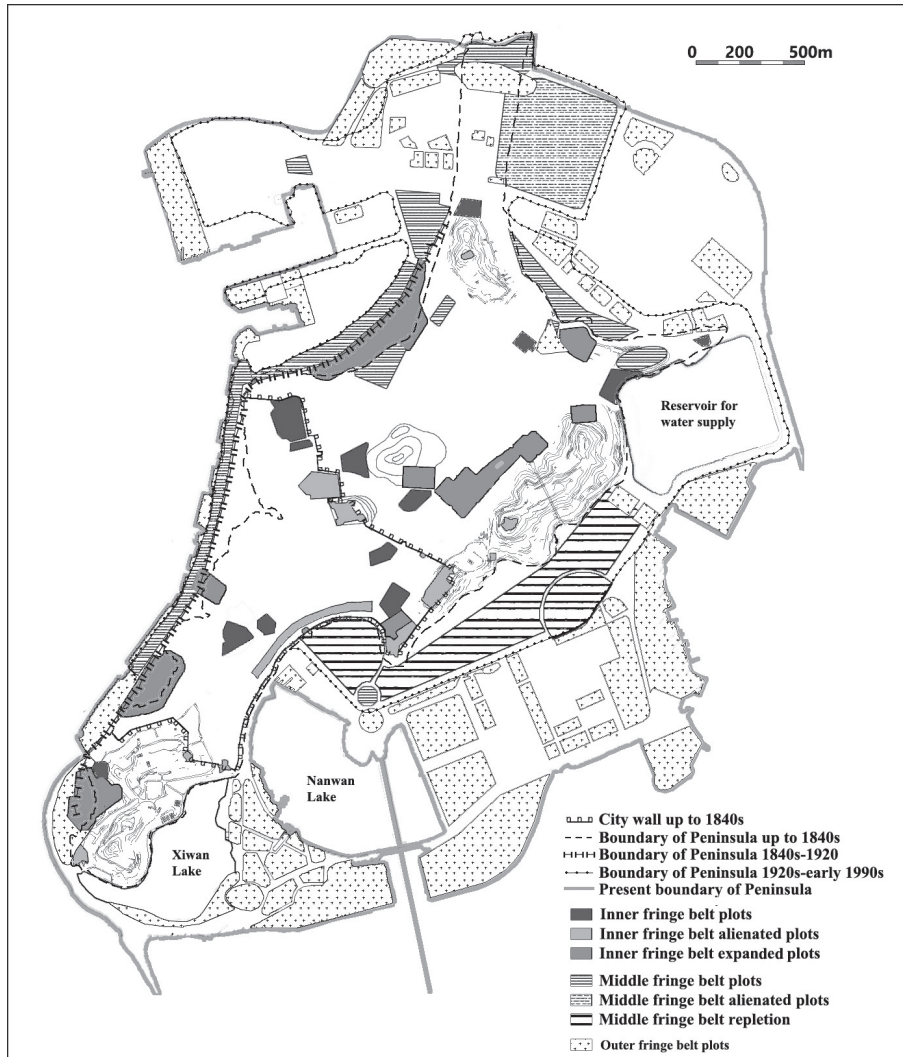
### Principles underlying fringe-belt development in Macao Peninsula

During a period of nearly 400 years, Macao Peninsula developed a succession of fringe belts (Figure 9). Fringe-belt development can

be divided into two main phases according to evolutionary stages and their associated processes, *fringe-belt formation* and *fringe-belt modification* (Whitehand, 1967). The principles underlying these two phases in Macao Peninsula are bound up with a combination of socio-economic factors and natural geographical factors.

#### *Fringe-belt formation*

Areal conditions and certain periods have been conducive of fringe-belt formation



**Figure 9. The fringe belts of Macao Peninsula.**

(Whitehand, 1967). Areal conditions conducive of fringe-belt formation in Macao Peninsula include natural obstacles and artificial limitations to the outward growth of the residential area. The successions of eastern and western coastlines have tended to act as fixation lines for a succession of fringe belts. Several hills, such as Mongha Hill in the north, Mount Guia in the east, Penha Hill in the south and Mount St Paul in the centre, have also formed natural obstacles to the growth of residential areas. The combination of scenery and fringe-belt location attracted a number of public gardens, adding to the inner fringe belt. Up to now, the fringe-belt areas along these hills have developed into the main leisure and

recreational 'green belt' in the Peninsula. In respect of artificial limitations, the city wall up to the early 1840s had a striking influence on the location of the inner fringe belt. The character of much of that fringe belt, which was long ago embedded in the built-up area, has survived to this day.

Periods conducive of fringe-belt formation have been particularly associated with political events, extensions of land into the sea, and industrial development. The two centuries preceding the first Opium War were notable for the scattering of a variety of land uses at the fringe of the Portuguese settlement. Land use related to marine trade along the coastal parts of the inner fringe belt, Chinese

style in its associated forms in the western part and Portuguese in the eastern part, was consistent with Macao's role as a port city. This was mainly a period of relatively slow development. After the first Opium War, the Portuguese annexation of the northern part of the Peninsula by force and the demolition of the city wall led to the northward extension of the inner fringe belt. However, the main residential area remained within the former walled area until the 1920s. The land uses in the northern extension of the fringe belt were relatively homogeneous – most of them were public gardens. Particularly evident in this period was the close relation between the western extension of the inner fringe belt and the fishing industry and wholesale businesses.

In the period between the 1920s and the 1980s, the influx of migrants into Macao associated with the turbulent situation in mainland China created a further increase in the already high density of population in the Peninsula and led to the first massive sea reclamation. Fishing and manufacturing were the major industries in Macao in this period. The main working population was Chinese, many of the immigrants settling in the northern part of the reclamation area. The middle fringe belt, mainly comprising industries and infrastructure, was developed at the periphery of the Chinese residential areas.

The main land uses in the southern part of the reclamation area are associated with the second massive reclamation from the sea, beginning in the late 1990s, and were founded on what was now the main basis of the economy, gambling and tourism. At the same time, manufacturing spread into the northern part of the Peninsula associated with the development of a new residential area and the formation of the outer fringe belt.

On the whole, fringe-belt formation since the 1920s has been associated with land extensions. These provided space for the development of industries. Exclusive hotels and cultural buildings acquired sites on the scenic south-east coastline and Nanwan Lake, while manufacturing land uses concentrated on the periphery of the working-class residential areas in the north.

### *Fringe-belt modification*

Once a fringe belt is embedded in the built-up area rather than at the edge of it, it is subject to various forces for change. The older the fringe belt, the greater the amount of change there tends to be. These changes include extension, alienation and repletion (Figure 9).

The first change to take place in Macao Peninsula was inner-fringe-belt extension. Despite the demolition of the city walls in the 1840s, until the 1920s the agricultural areas to the north remained at the edge of the residential area which until that time was extending outward only slowly. As a result, the area associated with the fishing industry in the reclamation area along the western coastline and the public gardens at the foot of several hills merged into the inner fringe belt.

Some fringe-belt sites were acquired for redevelopment for residential building and lost their fringe-belt character. They are referred to as alienated plots in Figure 9. A notable example is the redevelopment of the racecourse for housing. Many plots in the inner fringe belt are still in their original use (for example, the three oldest hospitals and the cemetery in the north-east). Some plots in the inner and middle fringe belts have undergone adaptation. For example, the adaptation of the forts as observation decks. Some inner and middle fringe-belt plots underwent increases in their building coverages. This 'repletion' eventually occurred in many plots (Figure 9). However, the land created in the southern part of the first massive reclamation gradually became replete with hotels and casinos.

### **Conclusion**

This research began against a background of existing fringe-belt research in very different cultural and physical environments from those in Macao Peninsula. Nevertheless, the findings described here confirm the applicability of the fringe-belt concept in the Peninsula. Three conclusions emerging from this study are especially noteworthy. First, there were close connections between fringe-belt development

and reclamations from the sea. Secondly, fringe-belt development was closely related to industrial development. Thirdly, as has been shown for each period of fringe-belt development, different parts of the fringe belts present differences of landscape that reflect their different cultural provenances: in the past 400 years, Macao Peninsula has in some respects developed a dual identity, and the co-existence of different cultures continues to be a notable characteristic. These events and relationships are etched in the landscape of the Peninsula. They have present-day relevance not least in contributing to a basis for the management of this historical urban landscape.

Much of the fringe-belt formation in Macao Peninsula was related to land extension and industrial development far beyond the lines of the former city walls. However, consistent with the findings of a number of other fringe-belt studies, the formation of the inner fringe belt took place in relation to the city walls and associated features. In spite of their becoming embedded within the built-up area, most of the plots in the inner fringe belt retained distinct physical features – notably those along several hills that maintained their early land use as public gardens. These have value for the ecosystem services they provide. They are important urban ecological corridors and places for leisure and recreation for the urban population, and add significantly to the character of the urban landscape. Recognition of the characteristics of fringe belts can both contribute to urban landscape management and benefit the tourist potential of Macao. The relationship between fringe belts and ecology merits further investigation both here and more widely.

Fringe belts tend to be ‘signatures’ of quiescent periods in urban growth, and a reflection of urban space needs beyond those of residential and commercial areas (Conzen, 2009). Owing to the high population density in Macao Peninsula, the requirement for residential land has continued to increase. The formation of middle and outer fringe belts has been associated with land reclamations rather than the slumps in residential area development that have been emphasized in a number of

previous fringe-belt studies. Industrial developments have been important pulses underpinning distinctive features of land use in each fringe belt. This reflects the political pattern and socio-economic environment that have influenced Macao. Their cumulative effects over time, especially since Macao’s return to being part of China, need to be investigated in order to clarify bases for future development.

The main contribution of this paper is to articulate the growth history and characteristics of the fringe belts in Macao Peninsula and the influencing factors. More work is needed in pursuing the task of linking the findings of this and other fringe-belt research to planning practice.

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