ISF 2013
BRISBANE

INTERNATIONAL SEMINAR on URBAN FORM

Urban Form at the Edge

Proceedings from ISUF 2013
Volume 1

Editors
Paul Sanders
Mirko Guaralda
Linda Carroli

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND
Te Whare Wānanga o Tāmaki Makaurau

Griffith UNIVERSITY

Creative Industries Faculty
School of Design

QUT

Contents

Acknowledgements

Introduction

Urban morphology as a field of study has developed primarily in Europe and North America, and more recently emerging as a recurrent topic in China and South America. As a counterpoint to this centric view, the ISUF 2013 conference explored aspects of 'urban form at the edge'. In particular the conference examined 'off centre areas' such as India, Africa, Middle East, Central Asia and Australasia which require innovative approaches to the study of traditional, as well as post-colonial and contemporary, morphologies. Broader interpretations of urban form at the edge focus on minor centres and suburbia, with their developing and transilient character; edge cities and regional centres; and new technologies and approaches that are developing alongside established methods, tools and theories of urban morphology.

Sub-themes for the conference, which comprise the sections of this book, were:

- Cities on the Edge – cities on edge conditions, such as natural limits or political boundaries
- Off centre – urban form in emerging economies and postcolonial countries
- On the Edge of the City – peripheral areas and urban form in suburbia
- Edge Cities – new urban conditions
- Regional centres – cities and towns with local importance, but at the edge of national or regional urban networks
- Pushing the Edge – new technologies and new techniques.

Although Australia has historically been considered at the edge of the world due to its location, the conference will take advantage of its relative proximity to Africa, India and South East Asia, especially targeting the seminar to these geographical areas, and directly addressing the challenge for ISUF to develop into these continents.

The South East Queensland region incorporates both Brisbane and its neighbour the Gold Coast City. It is the fastest growing metropolitan region in Australia. The rapid processes of urban transformation have brought about challenges that are comparable with the experience of many developing nations.

We would like to thank QUT students and staff who volunteered their time before and during the conference; without their support the event would not have been possible.

<div align="right">

Conference Organising Committee
Paul Sanders, QUT
Mirko Guaralda, QUT
Kai Gu, University of Auckland
Tony Hall, Griffith University
Leigh Shutter, Griffith University

</div>

CITIES ON THE EDGE

cities on edge conditions

At the bustling edges of Empire: colonial cities founded on trade, extraction and conquest before 1700

Pedro Guedes

School of Architecture, University of Queensland, Brisbane, Australia
Email: p. guedes@uq.edu.au

Abstract. *Settlements established by Europeans in Asia, the Americas and Africa, some dating back to the 16th century, are at the core of many of today's global cities. Notions of siting, orientation, subdivision of land and the placing of important institutions in relation to ceremonial space are embedded in the urban tissue of a great number of surviving urban complexes. Strong traces of origins persist even in cases where the built fabric has suffered catastrophic or incremental erasure through conflict, natural disasters or property speculation. This paper describes and compares cities founded by the Portuguese, Spanish and Dutch. Using contemporary maps, views and other records, the study explores how their character and arrangements have endured and the importance ideas scripted into the ambitions of the original founders, which are still present.*

Keywords: colonial cities, Portuguese enclaves, Spanish grid, VOC outposts, overseas settlements

Recasting the world

Early in the 16th century, global shifts in networks of trade and power began when Portuguese fleets entered the Indian Ocean and Spain brought the Old World into contact with the New in the Americas (Boorstin, 1986). Both Spain and Portugal were seeking direct routes to the fabled lands of spices and luxuries in the East. During the 15th century, the Portuguese had explored West Africa, established fortified trading posts and colonised several Atlantic islands (Disney, 2009). In Spain, the final stages of the 're-conquest' of Iberian lands from Moorish kingdoms were completed in 1492, the year Columbus returned from the Caribbean, believing he had reached Japan. To avoid wasteful conflict, Portugal and Spain drew up the treaty of Tordesillas in 1494, dividing the globe between them, so that lands 'discovered' East would fall to Portugal, and those to the West of the line in mid-Atlantic, to Spain.

Portuguese overseas settlements

Having rounded the Cape of Good Hope in 1488, the way to India was opened by Portuguese navigators (Boxer, 1969). Ten years later, Vasco da Gama entered a world with long-established networks of trade stretching from Southern Africa to the Persian Gulf and from the Red Sea to the Far East (Margariti, 2008). He arrived at Calicut on the Malabar Coast to find a sophisticated cosmopolitan emporium whose ruler was unimpressed by the paltry gifts presented to him. Da Gama did, however, return to Lisbon with a profitable cargo, showing that the sea route to India could undercut the Muslim monopoly of the spice trade to Europe. The next fleet, led by Cabral discovered, during misunderstandings with the Zamorim of Calicut, that his ships with superior artillery could effectively terrorise towns with bombardments and harass under-defended shipping. Cabral also took advantage of local rivalries by entering into an agreement with the ruler of Cochin for a Portuguese fortified 'factory' to be set up in his territory in 1503.

In 1509, a Portuguese fleet gained dominance of the Arabian Sea at the battle of Diu, defeating a joint force of the Sultans of Gujarat and Egypt allied to the Ottomans and Venetians (Fig. 1L). The Portuguese then established a network of forts and trading posts either by making alliances with friendly rulers or by seizing territory by force along the shores of India, the East coast of Africa, the Persian Gulf, Sri Lanka, Malacca, islands in the Indonesian archipelago and Macao in China. Resources and manpower were stretched over this vast area, with nearly all outposts consisting of small forts accommodating the garrison and stores for merchandise as well as an existing or new settlement outside the walls built by the local population (Cortesão and Teixeira da Mota, 1960).
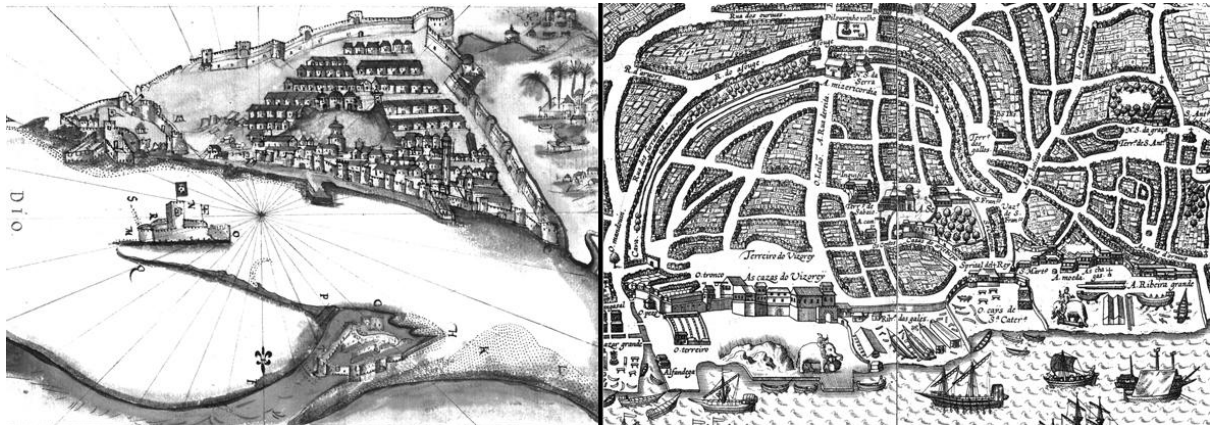
Figure 1. *Portuguese overseas. Adapting and extending existing settlements. L. Fortress and town of Diu, drawing from Dom João de Castro, Roteiro da costa do Norte, 1538. R. Detail from van Linschoten map of Goa, 1596.*

Very few women came to the East from Portugal, so it became common for the men to form relationships with local women. Many moved away from formal settlements, becoming intermediaries in trade with ever-increasing family networks. When the Catholic Church launched its ambitious missionary campaign, a penumbra of Portuguese influence extended far beyond the garrisons, with Catholic enclaves built around churches. Formal settlements were administered from Goa by 1510, which became the vice-regal capital of the Estado da India in the 1530s, growing into a major metropolis with large shipyards and a busy port from which the yearly 'spice fleets' destined for Portugal departed. The rapidly growing Portuguese diasporas and converts to Christianity were firmly linked by a network presided over by the Archbishop of Goa.

Figure 2. *Goa's main street, Rua Direita or Leilão on market day. As published by van Linschoten in 1596.*

As an example, the Plans of Goa show a haphazard layout (Fig. 1R) (Linschoten, 1596). In front of the imposing Viceroy's palace, "stood a large square, called Terreiro do Paço surrounded by beautiful houses" (da Fonseca, 1878). The main commercial street, Rua Direita or Leilão, was considerably wider than others, bisecting the town at right angles to the port, terminating in an open space in front of the

Mesericordia, a charitable institution found in many Portuguese towns. The Cathedral, municipality and the headquarters of the Inquisition were arranged around the Terreiro do Sabaio, an irregular open space, off to the side of the Rua Direita. Parallel rings of streets intersected at random by others resulted in blocks of various shapes and sizes, all edged with buildings forming continuous street fronts with large areas of garden behind (Fig. 2). The concentric arrangement arose from the city outgrowing the confines of its defensive walls. They were demolished as the city reached its peak of over 200,000 inhabitants in the mid-17th century.

> The buildings along the principal thoroughfares were in general spacious and good-looking; whilst in the interior of the city, far from the noise and bustle of the streets, were to be seen splendid mansions, surrounded by gardens tastefully laid out. Both the houses and mansions were not more than two stories high. They were built of stone and mortar, and covered with tiles … The houses were painted red or white both outside and inside; they had large staircases and beautiful windows furnished with jetties [sacadas] (Estevão Pinto, 1943).

> Instead of glass panes the windows had thin polished oyster-shells fitted into wooden framework, as is still the fashion in Goa, and were provided with lattice-work, to enable the Portuguese ladies to enjoy the view outside without being exposed to the public gaze (da Fonseca, 1878, pp. 158-9).

Old Goa's splendour was eclipsed towards the end of the 17th century, when the Dutch seized trade preeminence. The city was described in 1687 as falling into ruin:

> The greater part of Goa is abandoned, because its inhabitants cannot rebuild their houses when they have fallen; many streets once full of houses have now become lonely and uninhabited; it makes the heart bleed to see the metropolis of India so destitute of means as not to be able to maintain itself on its very foundation (da Fonseca, 1878, pp. 173-4).

Goa had been unhealthy, even at its height, and its decline was accelerated by several devastating cholera epidemics. Most buildings were quarried for stone and other materials for buildings in Pangim and elsewhere. All that remains are some of Goa's splendid churches, as well as the 16th century Archbishop's palace.

By 1535 Olinda in Pernambuco, Brazil was built on the prosperity of sugar plantations worked by African slaves from the Guinea Coasts and Angola (Gomes, 1998). The town has much in common with Goa in its urban form and buildings (Loureiro, 2008). Olinda's streets widen to form irregular spaces in front of churches, many occupying prominent hilltop positions (Fig. 3L). Again, oddly shaped blocks surround large areas of garden, separated from streets by continuous walls of buildings. Olinda was nearly completely destroyed by the Dutch, but a few surviving houses from the period are remarkably similar to contemporary buildings in Goa. Here, and in other early settlements such as Angra (founded in 1450) in Açores, the Portuguese chose to site their settlement on very hilly land reminiscent of Lisbon and villages in Northern Portugal. This was possibly for defense, but probably also to gain advantage of sea breezes and to be away from the swamps close to Recife, the port of this sugar region, which, before the Dutch occupation was little more than a ramshackle village.

Salvador was established in 1542 as the capital of Brazil (Fig. 3R). Its administrative, civic and ecclesiastical areas were built on high ground, separated by a steep cliff from the port and business district at sea level. The King's instructions were to found a city:

> In a healthy place with good air and ample water supply and a port where ships may be refitted … with fortifications … and for this work, I send in your company, some officers, masons and carpenters with others able to make lime mortar, bricks and tiles (Teixeira, 2009, p. 2).
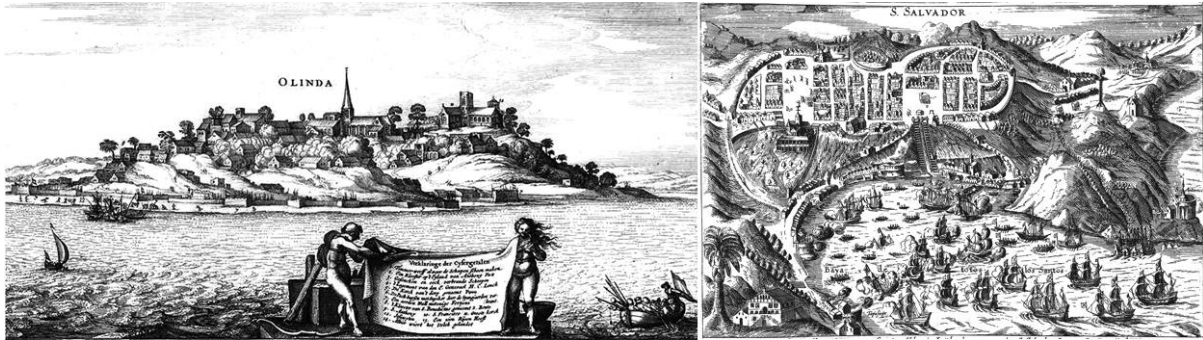
Figure 3. *Portuguese choice of sites with complex topography. L. Olinda in Brazil before Dutch capture – van Brosterhuyzen, 1630. R. Salvador showing complex topography – Frans Hogenberg, 1625.*

The choice of site with a marked division between the port from the rest of the city, echoed the arrangements in Lisbon and Oporto, both of which follow a similar model. In Salvador, the upper town has a rectangular layout on flat ground, which breaks down into familiar and picturesque adaptations to the complex topography (de Oliveira, 2004).

Generally, Portuguese settlements 'grew without being planned in a kind of picturesque confusion that is typical of Luso-Brazilian cities (Smith, 1955, p. 7). This legacy is perhaps most evident in Rio de Janeiro, founded in 1565, a city that expanded organically between hills and a curving shoreline in a spectacular landscape.

Fortifications and defense were a major consideration in the planning of nearly every European settlement overseas (Fig. 4L). Until the 1540s, Portuguese fortifications were medieval in character, with round towers and vertical walls such as those at Sofala, built in 1505, in East Africa, following a practice that had been used in West Africa at the Elmina Castle erected in 1482 as the first permanent European structure built in the tropics (Lawrence, 1963; Cruxen, 2011). By the 1540s, the latest Italian ideas entered Portuguese military architecture with very extensive rebuilding at Diu in 1546 and Moçambique in 1558, where Miguel de Arruda, who had spent time studying fortifications in Italy, designed bastions and curtain walls which were the first to employ modern fortifications outside Europe (Valla, 1996; Lobato, 1996) (Fig. 4R). Italian influence continued when Giovani Cairati, a Milanese military engineer, was sent to take charge of Portuguese fortifications in Africa and the East in 1583, carrying out works in Mombasa, Malacca, Muscat, Manar, Ormuz, with very major works being undertaken in Baçaim and Damão, starting in 1589, adapting these cities to near-regular layouts, with many aligned with evenly spaced bastions in their defensive perimeters.
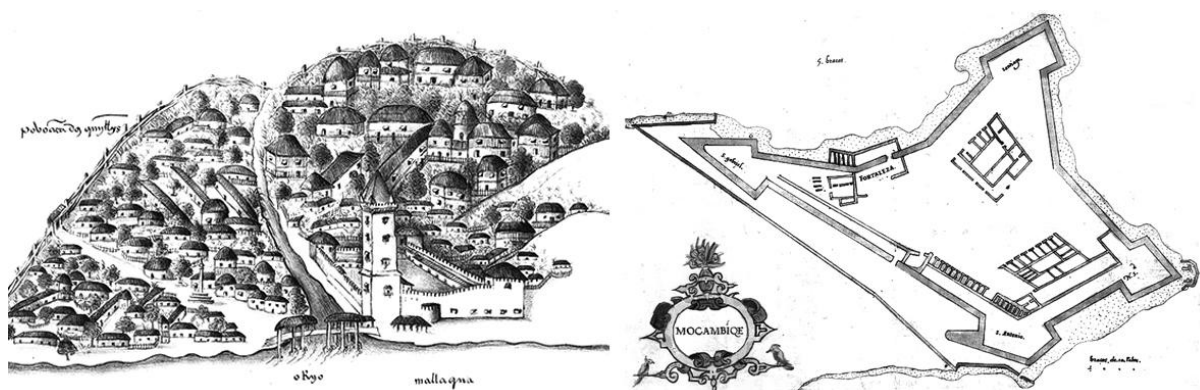
Figure 4. *Portuguese fortifications overseas: L. Malacca with mediaeval tower fortress – Gaspar Correia, 1556. R. Mozambique, first Italian style Renaissance bastions outside Europe – started in 1546.*

During the late 17th century, settlements began to be founded in the vast Brazilian interior and previously neglected parts of its coastline. Military engineers, who by then were being trained in Brazil, planned many of these with some regularity. Others, such as the mining settlement at Vila Rica established in

1652, continued the Portuguese tradition of responding to peculiarities of landscape with winding streets linking churches, each centred on its own formal but irregular open space, while the municipality and Governor's residence dominated a long and sloping square at the centre of the settlement.

Spanish overseas settlements

Spanish towns in the Americas could not have been more different. Unlike the Portuguese, whose coastal enclaves were established for trade, Spain's empire was built on territorial conquest combined with subjugation and conversion of indigenous populations, a continuation of the 'Reconquista' of the Peninsula. Even the Aztec and Inca empires were unable to resist Spanish cavalry, firearms and ruthless military tactics honed in centuries of fighting. Diseases brought by the Conquistadores also contributed to decimating and demoralising indigenous populations (Diamond, 2005; Mann, 2011).

The first two settlements founded by Columbus and his brother on Hispaniola in the West Indies failed, before Nicolás de Ovando, the new Governor established Santo Domingo in 1502, planting a seed for the morphology followed by nearly all cities in the Spanish Americas (Deagan, 2010). Ovando arrived in a fleet with many colonists and was actively involved in founding the city and distributing land, organised into regular blocks, in which:

> The streets are much more level and much broader and incomparably more straight; for as the town was founded in our time ... it was laid out by rule and compass with the streets all of the same size, in which respect it is far ahead of all the towns I have seen (Morse, 1962, p. 319).

The above description suggests how strikingly unusual this new approach was. An abstract grid did not yet dominate the city and the central square was unusual by having the cathedral within it as a freestanding structure (Fig. 5L).

Figure 5. *Early Spanish cities before regular grids: L. Santo Domingo, founded in 1502. C. Havana, founded in 1515. R. Cartagena, founded in 1533.*

Ovando had been at the siege of Granada, where a rectangular and regularly laid out camp had been transformed into the permanent settlement of Santa Fé in 1491, (Gutkind, 1967; Reps, 1965). He may have been influenced by its practical and ordered logic. Precedents in French Bastide towns or writings on ideal cities lay behind this precedent and may have played their part (Guixeras, 2009; Tout, 1948).

Within a decade, the Spanish had founded several towns on islands in the Caribbean of which, Havana [1515] and San Juan in Puerto Rico [1521] survive (Fig. 5C). The process was continued on the mainland where Pedrarias Dávila founded Panama in 1514 with the following instructions:

> let the city lots be regular from the start, so that once they are marked out the town will appear well ordered as to the place which is left for a plaza, the site for the church and the sequence of the streets; for in places newly established, proper order can be given from the start, and thus they remain ordered with no extra labor or cost; otherwise order will never be introduced (Morse, 1962, p. 319).

Founding towns was a cornerstone of Spanish policy for the occupation of the New World. Cortez transformed his band of soldiers into a municipal council and militia when he founded Vera Cruz in 1519, giving them a stake in the conquest (Kagan, 2000). He went on to create several other towns over conquered settlements, culminating in the founding of Mexico City in 1521 on the ruins of the Aztec capital Tenochtitlan (Scneier, 1990). Alonso Garcia Bravo, soldier and alarife [masterbuilder] with Cortez's army, laid out the city with a regular square grid (Fig. 6).

Figure 6. *Mexico City: L. Manuscript showing the city's extent in 1720. The city was founded over the Aztec city of Tenochtitlan in 1521. R. 1785 – Mexico City's growth – from a survey by Don Tomaz Lopez. Dark lines are water channels.*

Throughout the Americas, indigenous populations were also settled in regimented townships often laid out by mendicant friars and later by Jesuits who were charged with their conversion. Many Indians became virtual serfs of the Conquistadores through the system of encomienda, (Kubler, 1942). The rapidity of exploration, conquest and settlement was propelled by the hunger for gold and silver, both of which were found in Mexico and Peru. There were also opportunities for settlers to take charge of large cattle and agricultural estates, to be worked by Indian labour or imported African slaves.

By 1573, the Spanish had founded over 400 towns in the Americas. Early ones, Havana in 1515, Guadalajara in 1529, Cartagena in 1533, and Quito in 1534, had regular layouts, with straight streets, and roughly rectangular city blocks (Fig. 5R). Nearly all had a central square around which important civic and ecclesiastical buildings were sited (Goitia and Balbas, 1951). Others were far more regular, following more specific orders given by Charles V in 1523, for towns to be laid out with straight streets originating in the Plaza Mayor (Fosman y Medina, 1681). These include, Lima founded in 1535, Buenos Aires founded in 1536, Bogota founded in 1538 and Santiago founded in 1541, whose layouts were composed of identical square city blocks arranged in a continuous grid (Fig. 7). Blocks were divided into building plots allocated to settlers during the foundation ceremony, often by lot. In every case, one city block was left clear of buildings at the heart of the settlement, to become the Plaza Mayor. Facing the Plaza, land was reserved for the major church or Cathedral, the Cabildo (Town Hall – Municipality) and other public buildings along with shops and the residences of important citizens. In areas in the process of 'pacification', a stockade 'presidio' would be built on the Plaza as a defense against Indians. In Mexican settlements, many churches were fortified as refuges for the citizens (Kubler, 1942).

In 1758, the Plaza Mayor of Lima was described as follows (Fig. 8):

> The East side of the square is filled with by the Cathedral and archepiscopal palace, and higher than any other building in the city. Its principal foundations, and the bases of its columns and pilasters, together with the capital front which faces the West, are of free-stone; the inside resembles that of Seville, but not so large. The outside is adorned with a very magnificent façade or frontispiece, rising into two lofty towers... In the North side of the square is the viceroy's palace, in which are several courts of justice, together with the offices

of revenue and the state prison. This was formally a very remarkable building both with regard to its largeness and architecture, but the greatest part of it being thrown down by the dreadful earthquake with which this city was visited on the 20th October 1687 it now consists only of some of the lower apartments (de Ulloa, 1758, pp. 31-2) (Fig. 9).
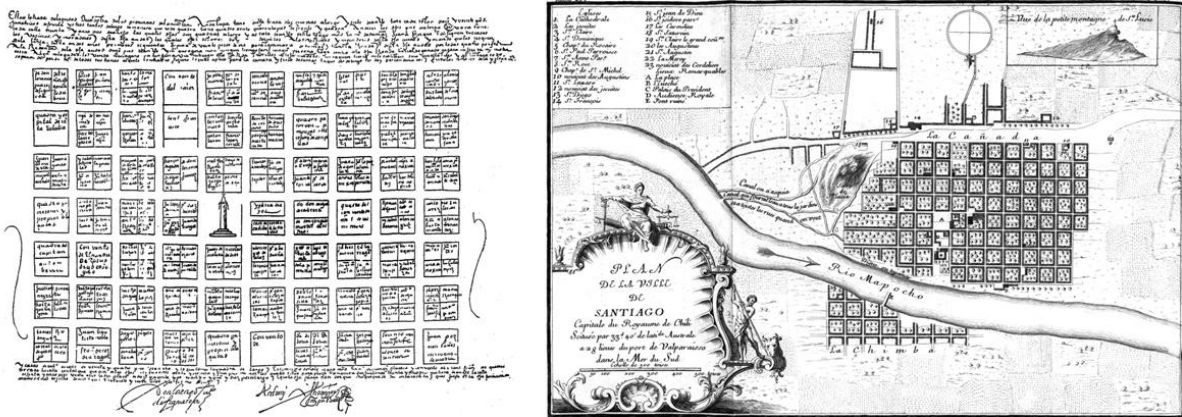
Figure 7. *Regular grids: L. 1577 Foundation plan of Cordoba, Argentina. Each city block is divided into four, each allocated to an individual. R. Santiago, Chile and its grid, from a plan by Frezier of 1712. The city was founded in 1541.*
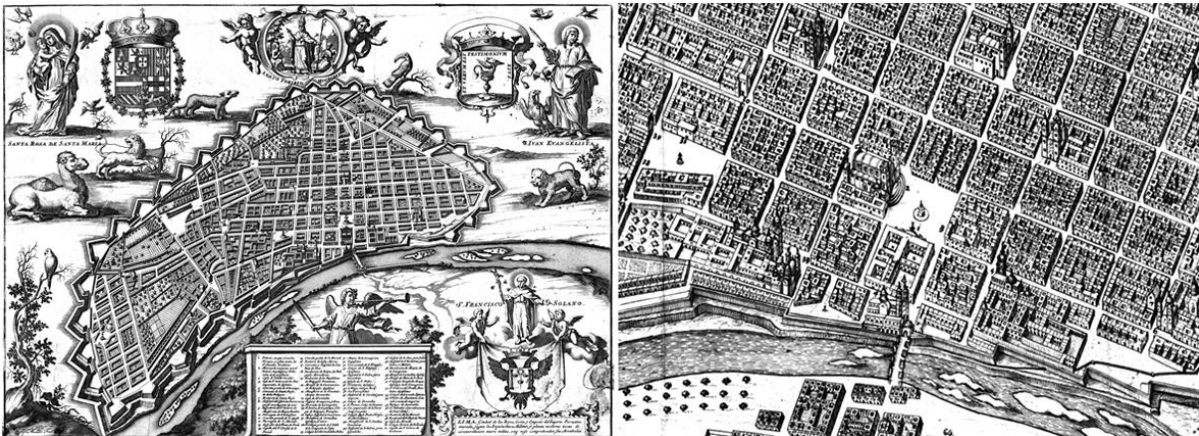
Figure 8. *Lima, Peru – Vice-regal capital. L. City plan by Joseph Mulder – c 1700 R. Detail showing city blocks around the Plaza – 'Plano scenographico' by Matthaus Meriam, c1650.*
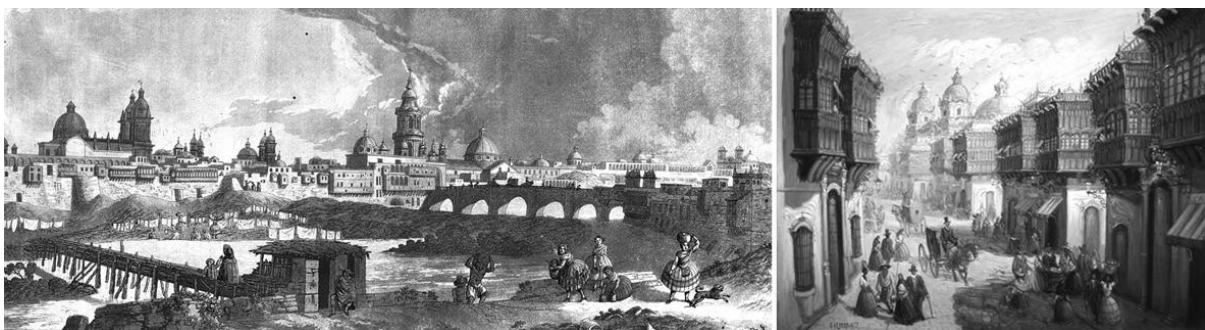
Figure 9. *Lima views: L. From across the River Rimac by Fernando Bambilla, c1790. R. Along one of Lima's better streets, c1750.*

In Lima, most domestic buildings were constructed of wattle and daub and were seldom more than two stories high. They were generally built around internal courtyards, with well-protected openings onto the streets. Similar plan-forms were used in hot-humid environments such as Cartagena, high deserts as in areas of what is now New Mexico or perpetually cold temperate towns at high elevations such as Villa de Leyva founded in 1572 in Colombia. Plazas were generally left unencumbered and used for public events such as bullfights, military parades and religious processions. Temporary staging was occasionally

installed to accommodate spectators. More elaborate embellishment with planting and urban furniture such as bandstands came with the 19th century (Fig. 10).
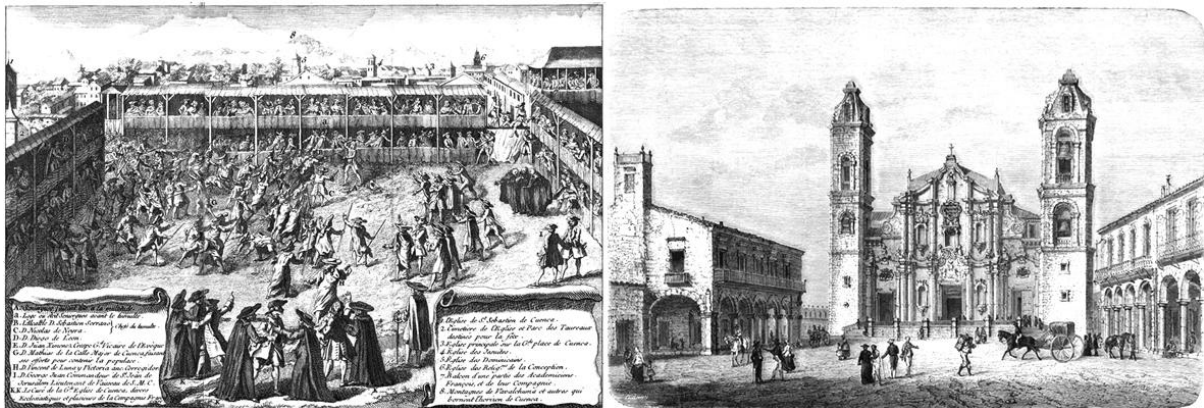
Figure 10. *Public Space: L. Temporary Plaza staging in Cuenca, Peru. Drawing by Condamine, 1775. R. Cathedral in Plaza de Armas, Havana, Cuba. Note the buildings with porticos facing the Plaza – c 1750.*

Santiago in Chile was laid out with city blocks the same size as those in Lima as were many other towns in the region. Its river, Mapocho, was tamed with walls and regulated by dykes:

> … water is constantly available to irrigate gardens and to clean all the streets – a convenience that can only be found in few European cities. From these streams, power is gained for mills dispersed throughout the city … Without this, gardens could produce nothing because there is no rain for eight months a year. Because of these circumstances … fruits and vegetables [are grown] during the day the gentle perfumes of oranges and flowers scent the houses (Frezier, 1717, 173-4).

Phillip II's *Leyes de las Indias* were signed in 1573 and formalised the principles upon which towns in the Americas had been established (Mundingo and Crouch, 1977a and b). Vitruvius' advice on siting, access and orientation are evident as are ideas from Alberti and other Renaissance writers, (Stanislawski, 1946; 1947). Care was to be taken to ensure that adequate water supply was available, that there was pasture for cattle and timber for building and firewood. Orientation in relation to prevailing winds and many other considerations were listed including a stipulation that inland cities were to have their main plaza at their centre, while those on the coast would locate this important public space close to the port. In all cases, sites were to be chosen with future growth in mind (Fig. 11).
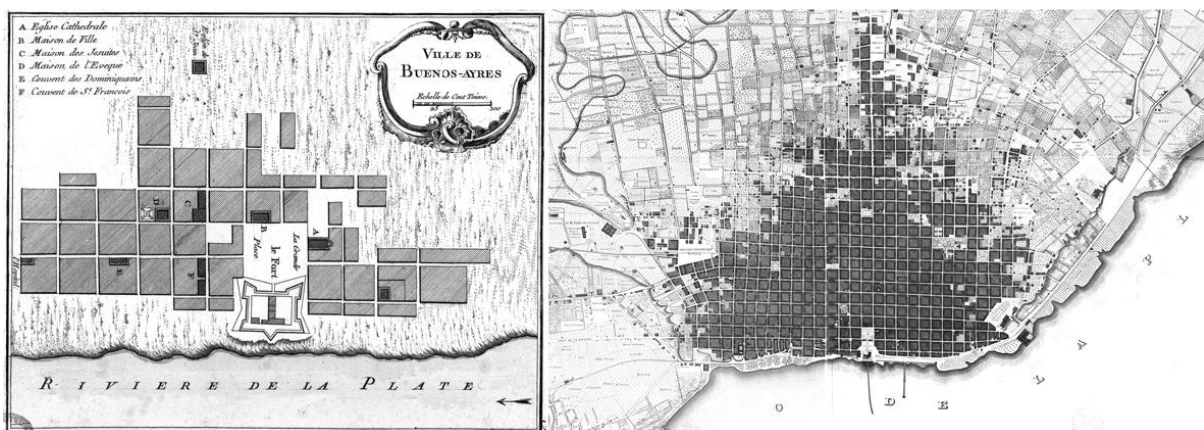
Figure 11. *L. Buenos Aires. L. as it was in the 1756, drawn by Charlevoix. R. City extended – 1867 – before diagonal boulevards were carved through the regular city blocks.*

Within the first century of Spanish rule, principal land and sea routes had been settled and each region had gained characteristics of their economy that would remain without major changes until the end of the

1700s. Many places chosen for settlement in the 1500s suffered from natural disasters such as flooding and earthquakes or became unviable for other reasons, so they were moved and rebuilt or allowed to disappear (Nicolinni, 2001).

By the 1520s Spanish merchant shipping was required be armed and travel in convoy because of increased pirate activity. The war with France in 1536, focused French corsairs and privateers into the Indies targeting shipping as well as coastal settlements. By the 1570s, garrisons were set up at key points along convoy routes, followed by belated investment in coastal defenses, which until 1588 were improvised, built by locals and mediaeval in character. Havana was an exception. French pirates had attacked the city in 1555 and a new fort, the first with modern angled bastions in the Spanish Indies, designed by Bartolomé Sánchez, was built. Drake had attacked settlements on the Pacific coast in 1758 and in 1586, sacked Santo Domingo and Cartagena. To counter these escalating threats, Bautista Antonelli and Juan de Tejeda conducted a comprehensive study of defenses in the region. The plan was approved in 1588 and Antonelli, his son and other members of his family were responsible for initiating a chain of modern fortifications ringing the Caribbean and Pacific coast by the end of the century (Gutierrez, 2005).

Manila in the Philippines was established in 1571 and has a small core composed of regular city blocks surrounded by a defensive wall, separating itself from adjacent settlements occupied by local people, traders and settlers from elsewhere. Here, the Spanish were in a different environment to the one they found in the Americas. Their response, in segregating their defended settlement from outsiders was similar to that of the Portuguese and Dutch and other colonial powers.

Dutch overseas settlements

The Dutch entered the arena of overseas settlements a century after the Iberians. They had waged a bitter war against Spain in the Netherlands, honing their skills and organization in the military arts, shipbuilding, financing commercial ventures. In 1580, when the crowns of Spain and Portugal united, their overseas empires became legitimate targets for the Protestant Republic (Boxer, 1973).

The Dutch East India Company, VOC, arguably the first multinational corporation, was established in 1602 to enter the European trade in spices and luxury goods from the East. Its sovereign powers meant it could wage war, establish colonies and negotiate treaties. The network of Portuguese strongholds was vulnerable and undermanned, so many of them were seized, including Jacarta where the VOC established its headquarters, renaming it Batavia in 1619, under the Governorship of Jan Pieterzoon Coen. The company was ruthless in establishing monopolies over the production, distribution and pricing of any merchandise that they could control. By the 1620s, their monopoly included virtually the entire world's production of cloves, nutmeg and mace (Schilder, 2011; Wieder, 1933).

In 1640, the VOC captured Galle and other strongholds in Sri Lanka, followed by Colombo in 1658, taking the cinnamon monopoly from the Portuguese. In order to consolidate this hold, they went on to drive the Portuguese out of most of the West coast of India, taking Cochin in 1662, thereby gaining a near monopoly of the pepper trade. Their successes in capturing strategic locations matched those of the Portuguese in the previous century (Fig. 12). The Dutch seized Malacca in 1641 and contributed to the expulsion of the Portuguese from Japan, gaining an exclusive trading foothold on the island of Dejima in Nagasaki in the same year. With their network of outposts, forts and larger settlements the VOC financed an increasing proportion of their core business by entering into local carrying trade, building a large fleet in Asia.

Batavia was built virtually from scratch, with a larger quadrangular fort replacing the captured Portuguese establishment (Fig. 13). The VOC consulted Simon Stevin, the celebrated Dutch engineer, inventor and polymath on the design of this important Asian outpost that was to be their headquarters in the East (Vanden Berghe and Devreese, 2010). Stevin had become a trusted military advisor to Maurice, Prince of Orange who had made him Quartermaster in his successful rebellion against Spanish rule over the Protestant Netherlands. Stevin wrote extensively on military matters, developing new ideas on fortifications using earth ramparts and wet moats, eminently suitable to the Dutch landscape, where

flooding could be used strategically and where stone was scarce. Stevin's interests included the design of military encampments, military discipline and carefully orchestrated tactics as well as the design of cities (van den Heuvel, 2004; van Oers, 2000).

Figure 12. *Dutch forts in Indonesia. L. & C. Ambon – the first headquarters of the VOC. R. Banda. Typical fortified outpost with earth ramparts – engravings from H A Chatelain Atlas, 1720.*
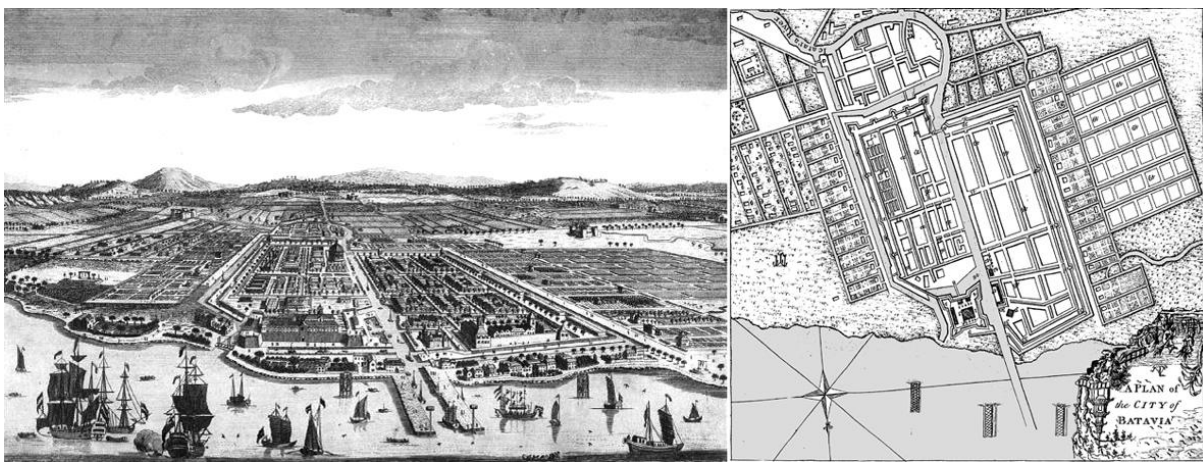
Figure 13. *Batavia, founded in 1619 – the VOC headquarters in the Orient. L. Aerial view of city, 1780. R. Plan from John Andrews, A Collection of Plans … 1771.*

Batavia was completely thought out, with a layout and general arrangement that is almost mechanistic in concept. From a military point of view and as a functioning settlement, its location, at the mouth of a river on low-lying land near a series of islands that could defend approaches, placed it in a familiar landscape for the Dutch. At the head, to the North and to the East of the canalized Jacarta River is the fortress containing the Governor's residence and other VOC buildings including the garrison barracks. On either side of the river, two rectangular areas are surrounded on the East, North and West sides by city walls with regularly spaced bastions aligned with streets and canals. All city blocks have canal and street frontages, with many bridges, making land communication convenient, but also easy to control in an emergency. Outside the walls a ring of villas, each on an artificial rectangular island, separated from others by canals provides a suburban setting with ornamental and market-gardens. Beyond this ring, to the West, still in a landscape regimented by canals at right angles to one another, is an area nearly the size of the city laid out as rice paddies.

The city was much admired by visitors as can be seen from the following accounts (Fig. 14):

> Batavia is the most agreeable of all cities in the Indies and in Europe it would gain accolades … The [canals] are a great ornament to the city and a great convenience for the inhabitants, who have the choice of going by foot or by boat as they take their leisure. During the heat, one can walk in the shade of the trees … The houses are even neater than the streets … they are cheerful and comfortable … The city walls are as white as snow (Chatelain, 1719, p. 128).

> The river … runs through the middle of the city, and forms fifteen canals of running water, all faced with freestone … There are over these canals sixty-six bridges, besides those built

without the town. The streets are generally thirty feet broad, and perfectly straight. The houses, which are built after the manner of those in Holland are mostly very high (Andrews, 1771, pp. 125-126).
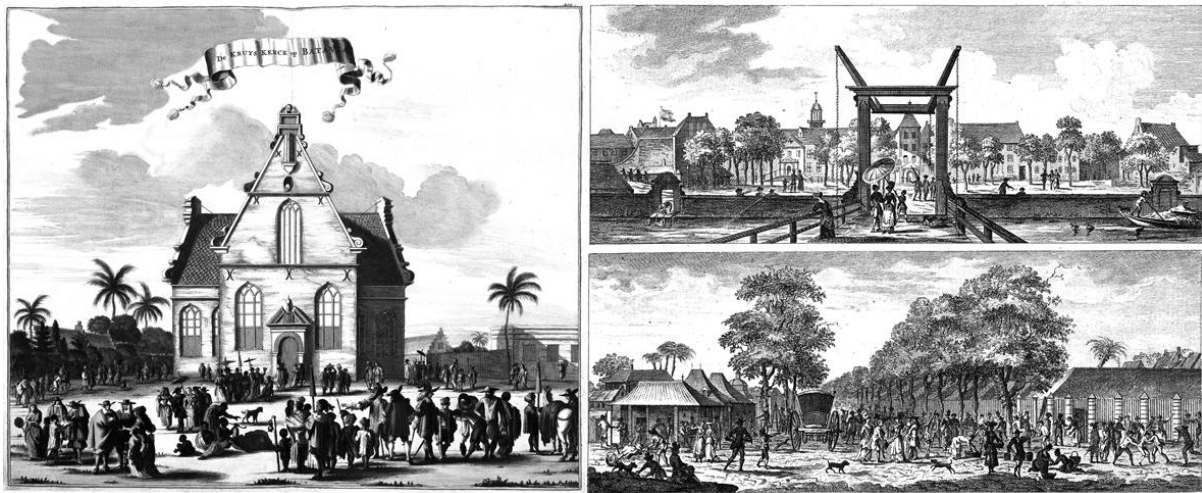
Figure 14. *Batavia views. L. Dutch Reformed Church in 1682- View by Johan Nieuhoff. R. View across canal to government buildings and tree-lined street in the market. Engravings by Mathias de Sallieth, 1779.*

Cape Town, founded in 1652, was established as a victualing station for VOC fleets on their way to and from the East and has features in common with Batavia. These include a rectangular layout focused on water management, arranged to irrigate the large Company Garden at the centre of the settlement designed to provide ships with fresh produce. Here, unlike Batavia, the town was less likely to be attacked from the land and in any case, it did not have warehouses of valuable cargoes worth protecting, so the settlement had no major walls and relied on its well-designed pentagonal fortress for defense (Fig. 15L). The VOC was careful not to overextend itself by tying-down large garrisons in overseas outposts, which were often defended by expensive professional mercenaries. When they captured Colombo, they made a careful study of the Portuguese defenses, salvaged some parts and reduced the perimeter considerably.

The Dutch West India Company was chartered in 1621, to further its monopolistic interests over the West African slave trade, Brazil, the Caribbean and North America. In 1624, a large invasion force easily overran Salvador da Bahia, the capital of Brazil, which the Portuguese soon regained in a guerilla campaign. Having captured a Spanish treasure fleet in 1828, the company could finance its Grand Design of taking over the African slave trade and the sugar producing regions of Brazil. This time they were successful. They established themselves in West Africa, seizing Portuguese 'factories', and took over Olinda and Recife, gaining control of a major part of Brazil's sugar producing region, with its vast estates, slaves and processing engenhos (Fig. 15R).

The Dutch found the Portuguese city of Olinda an alien environment and difficult to defend, so they reduced it to a quarry for building materials. Under the enlightened and far-sighted Prince Maurits Van Nassau-Siegen, who arrived in 1637, the Company consolidated its hold, built fortifications and founded a new city 'Mauritstadt' on the island of Antonio Vaz, linked by a bridge to Recife, which at the time was little more than a village. The new city was provided with an ordered street layout and canals adapted to the shape of the island, with well planned defenses and forts at each end. Prince Maurits brought with him a court of naturalists, astronomers and painters and built well-appointed estates for himself. His 'reign' was short. He was recalled in 1643, but the city he founded, different in almost every respect from Olinda, became the core of modern Recife, where its location, layout, property subdivisions all played their part in shaping this major Brazilian metropolis.
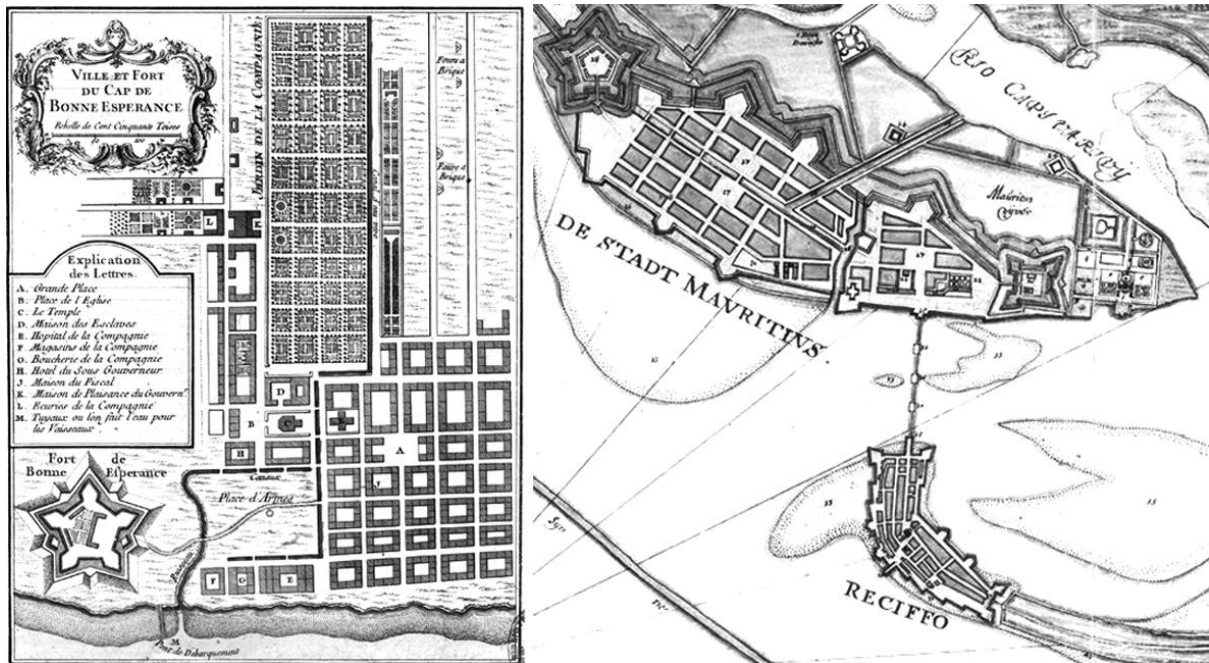
Figure 15. *Dutch overseas settlements. L. Cape Town: Pentagonal 'Castle' on the left, settlement to the right, the company's gardens centre. Plan from Bellin's Petit Atlas Maritime, 1764. R. 'Stadt Mouritius' in Pernambuco Brazil. Drawing by Johannes Vingboons, 1665.*

Conclusion

In the New World, in Asia and later in Africa, cities and their hinterlands became aligned with trade based upon shipping, moving goods between ports and across oceans to distant markets.

> In virtually all instances, the great cities that developed along the Asian coast by the end of the nineteenth century were founded by Europeans or grew under their influence from villages into cities because of the rapid growth of maritime trade. While the inland cities focused increasingly on the past and became centres [of conservatism], the coastal cities were points of transfer for culture and technology and became the dominant political and economic centres of Asia (Beckwith, 2009, p. 247).

Unlike the Portuguese and the Dutch in Asia and Africa, the Spanish saw their American dominions as continental territorial conquests, founded upon extraction of resources such as mining gold and silver rather than establishing self-sufficient internal economies. Transport and communication systems were strongest between coastal settlements and their hinterlands. The inland cities of these colonial empires were more focused on connections with ports than with each other.

Because they founded so many settlements so rapidly, the Spanish system of repetitive identical square blocks deployed upon sites chosen for their uniformity allowed their cities to grow by extending the system way beyond what had originally been envisaged. Buenos Aires is a good example. The standard grid was extended over the flat landscape with other systems superimposed such as railways and wide boulevards followed by highways and other elements of modern infrastructure. Cities in the United States, laid out on grid systems have been adapted and upgraded in a similar way.

The Portuguese approach was often finite and locked into the idiosyncrasies of landscape and like many medieval European towns is difficult to extend and adapt to motor transport. Cities that developed in this way, if they have survived, have a central core recognized for its cultural values, with surrounding growth developing along entirely different ideas. Dutch foundations, conceived of as functioning finite entities have rapidly lost many of their qualities of order and balance when pressures of traffic and public health conspire to fill in canals and remove avenues of trees that contributed to their urban landscape.

Colonial settlements often changed hands, some on numerous occasions during their history. These changes occurred through conquest, or by treaties related to resolving conflicts in Europe. Settlements built or extended after the end of the 17th century by the French, British, Danes and others took their cues from ideas embodied in the cities described above, blended with their own particular idiosyncrasies.

Google Earth allows us to make virtual visits to many of these cities – some, like Jakarta, have grown to a point where their original core has been swallowed up in infrastructure and land reclamation, while others, like Bassein in India, have become abandoned sites with vestiges of fortifications or, like Goa, had their major buildings marooned in a landscape constructed for tourists. Perhaps the most robust survivors are the Spanish American cities with their simple grid layouts and clearly understood central plazas.

References

Andrews, J. (1771). *A Collection of Plans of the Capital Cities of Europe, and some Remarkable Cities in Asia, Africa & America,* vol 2 (John Andrews, London).

Beckwith, C. I. (2009) *Empires of the Silk Road – A History of Central Eurasia from the Bronze Age to the Present*, (Princeton University Press, Princeton).

Boorstin, D. J. (1986) *The Discoverers – A History of man's search to know his World and Himself* (Pelican, Harmondsworth).

Boxer, C. R. (1969) *The Portuguese Seaborne Empire 1415-1825* (AA Knopf, London).

Boxer, C. R. (1977) *The Dutch Seaborne Empire 1600-1800* (Taylor & Francis, London).

Chatelain (ed) (1719) *Atlas Historique ou Nouvelle Introduction A l'Histoire, a la Chronologie* ... Volume V (Chez L'Honoré et Chatelain Libraires, Amsterdam).

Cortesao A. & Teixeira da Mota A. (1960) *Portugaliae Monumenta Cartographica*, Lisbon, Imprensa Nacional. V. 1, 4 and 5 [Manuscript maps & plans of Portuguese settlements from several archives].

Cruxen, E. (2011) 'A Arquitetura Militar Portuguesa no period de Expansão Ultramarina e suas origens medievais' *Aedos* 9, pp. 113-129.

da Fonseca, J. N. (1878) *Historical and Archaeological sketch of Goa* (Thacker & Co., Bombay).

de Oliveira, M. M. (2004) *As Fortificações Portuguesas de Salvador, quando cabeça do Brasil*, (Fundação Gregorio de Mattos, Salvador).

de Ulloa, A. (1758) *A voyage to South America describing at large the Spanish Cities, Towns, Provinces, v 2* (L. Davies & C. Reymers, London)

Deagan, K. (2010) 'Strategies of Adjustment: Spanish Defense of the Circum-Caribbean Colonies, 1493 – 1600', in Eric Klingelhofer (ed) *First Forts: Essays on the Archaeology of Proto-colonial Fortification* (Brill, Leiden) 18-39.

Diamond, J. (2005) *Guns germs and steel* (Vintage, London).

Disney, A. R. (2009) *A history of Portugal and the Portuguese empire: from beginnings to 1807* (Cambridge University Press, Cambridge).

Estevão Pinto, E. (1943) 'Muxrabis e Balcões', *Revista do Serviço do Patrimonio Historico e Artistico Nacional*, vol. 7, 309-340.

Fosman y Medina, G. (1681) *Recopilacion de leyes de los reynos de las Indias,* vol. 2 (Julian de Paredes, Madrid).

Frezier, A. F. (1716) *Relation du voyage de la mer du Sud aux cotes du Chili, du Perou* (Chez Jean-Geoffroy Nyon, Paris).

Geraldo, G. (1998) *Engenho & Arquitectura – Tipologia dos Edificios dos Antigos Engenhos de Açucar de Pernambuco* (Fundação Gilberto Freyre, Recife).

Goitia, F. C. and Balbas, L. T. Planos de Ciudades Iberoamericanas y Filipinas, Madrid, Instituto de Estudios de Administracion Local, 1951. [Compilation reproducing over 300 manuscript plans of Spanish cities in the New World and Philippines]

Guixeras, D. (2009) 'L'urbanisme al Dotzè del Crestià', *Mot So Razo* 8, 68-87.

Gutierrez, R. (2005) *Fortificaciones en Iberoamerica* (Ediciones Iberdrola, Madrid).

Gutkind, E. A. (1967) *International History of City Development: Urban development in southern Europe: Spain and Portugal* (Collier Macmillan, London).

Hobson Jobson (1903) *A glossary of colloquial Anglo-Indian words and phrases, and of kindred terms, etymological, historical, geographical and discursive* (John Murray, London)

Kubler, G. (1942) 'Mexican Urbanism in the Sixteenth century', *The Art Bulletin* 2, 160-171.

Lawrence, A. W. (1963) *Fortified Trade-Posts – The English in West Africa 1645-1822* (Jonathan Cape, London).

Lobato, M. (1996) 'A Ilha de Moçambique antes de 1800. Algumas notas sobre a história e o património de uma capital colonial', *Oceanos* 25, 11-23.

Loureiro, J. C. (2008) 'Olinda por suas imagens – um estudo sobre a formação do Espaço Urbano de Olinda a partir da iconografia do século XVI e XVII' *SCHU 1990 – Seminario de Historia da Cidade e do Urbanismo* 3, 1-23

Mann, C. C. (2011) *1493 – How Europe's Discovery of the Americas Revolutionized Trade, Ecology and Life on Earth*. Granta, London.

Margariti, R. E. (2008) 'Mercantile Networks, Port Cities, and "Pirate" States: Conflict and Competition in the Indian Ocean World of Trade before the Sixteenth century', *Journal of the Economic and Social History of the Orient* 51, 543-577.

Morse, R. M. (1962) 'Some Characteristics of Latin American Urban History', *The American Historical Review* 2, 317-338.

Mundigo, A. I. and Crouch, D. P. (1977a) 'The City Planning Ordinances of the Laws of the Indies Revisited. Part I: Their Philosophy and Implications', *The Town Planning Review* 3, 247-268.

Mundigo, A. I. and Crouch, D. P. (1977b) 'The City Planning Ordinances of the Laws of the Indies Revisited. Part II: Three American Cities', *The Town Planning Review* 4, 397-418

Nicolinni, A. (2001) 'La ciudad hispanoamericana en los siglos XVII y XVIII'. In: III *Territorio, arte, espacio y sociedad*, Vol. 2 (Congreso Internacional del Barroco Iberoamericano, Sevilla) 1287-1302.

Pommeranz, K. and Topik, S. (2006) *The World that trade created – Society, Culture and the World Economy – 1400 to the Present* (M E Sharpe, London)

Richard L Kagan, R. L. (2000) *Urban Images of the Hispanic World: 1493 – 1793* (Yale University Press, New Haven)

Reps J W (1965) *A History of Urban Planning in the United States* (Princeton University Press, Princeton)

Saavedra, J. G. F. (1980) *Las Leys de Indias: Observations on its influence on the physical space in Latin American Colonial Cities*, Unpublished Master of Architecture in Advanced Studies Thesis (Massachusetts Institute of Technology, Massachusetts).

Schilder G., Aikema, B., van der Krogt, P (eds) (2011) Blaeu, J. [1667] *The atlas Blaeu-van der Hem of the Austrian National Library /* v. 5. Africa, Asia, and America, including the "Secret" atlas of the Dutch East India Company (VOC) (HES de Graff publishers BV, Houten).

Scneier, G. (1990) 'America Latina: Una Historia Urbana', *Revista Internacional de Ciencias Sociales* 125 (UNESCO) 355-372.

Smith, R. C. (1955) 'Colonial Towns of Spanish and Portuguese America', *Journal of the Society of Architectural Historians* 4, 3-12.

Stanislawski, D. (1946) 'The Origin and Spread of the Grid-Pattern', *Geographical Review* 1, 105-120.

Stanislawski, D. (1947) 'Early Spanish Town Planning in the New World', *Geographical Review* 1, 94-105.

Teixeira, M. C. (2009) 'O Patrimonio Urbano dos Paises de Lingua Portuguesa. Raizes e Manifestações de um Patrimonio Comum', in *Passado & Presente – para o futuro* – III Simposio Luso-Brasileiro de Cartografia Historica, 1-13.

Tout, T. F. (1948) *Mediaeval Town Planning: a lecture* (Manchester University Press, Manchester).

Treib, M. (1993) *Sanctuaries of Spanish New Mexico* (University of California Press, Berkeley).

Valla, M. (1996) 'O Papel dos Engenheiros Militares na transmissao das formas urbanas portuguesas'. *URBANismo 1* – Comunicação apresentada no IV Congresso Luso-Afro-Brasileiro (Rio de Janeiro)

van den Heuvel, C. (2004) *'De Huysbou' – A reconstruction of an unfinished treatise on architecture, town planning and civil engineering by Simon Stevin* (University of Chicago Press, Chicago)

van Linschoten, J. H. (1596) *Itinerario, voyage ofte schipvaert, van Ian Huygen van Linschoten naer Oost ofte Portugaels Indien* (Cornelis Claesz, Amsterdam).

van Oers, R. (2000), *Dutch Town Planning Overseas during VOC and WIC rule (1600-1800)*, Delft, Walburg Pers,

Vanden Berghe, G. and Devreese, J. T. (2010) 'Simon Stevin and the Art of War', in Sloos, L. P. (ed) *Boeken van krijgshistorie* (Nederlandse Defensie Academie), 91-118

Wieder F. C. (1933) Monumenta Cartographica The Hague, Martinus Nijhoff, v. 5 (VOC Secret Atlas)

Informality on the edge: an insight into the formalisation of informal settlements in Tehran conurbation, Iran

Solmaz Hosseinioon

Faculty of Architecture, Building and Planning, University of Melbourne, Melbourne, Australia
Email: solmaz.hosseinioon@gmail.com

Abstract. *Informal settlements come in many forms and locations hence are named according to the type and reasons of their formation, some on the edge of cities and towns, some in the centres. Informal settlements in Iran have specific formal characteristics because of the socio-economic context of the country. They are called 'edge dwellings' in Persian as an indication of their locations which are mostly shaped on the edges of cities and metropolitan areas. It also indicates their socio-economic status. Their morphological formation is a result of their socio-economic and cultural context but any change in it will, in turn, affect these conditions. In studying the morphological transformations in an informal settlement in Tehran conurbation, the effects of formalisation on informality in shaping their built environment and their characteristics is revealed. This paper examines the consequences of morphological change of these areas on their condition of marginalisation.*

Keywords: informal settlements, Tehran conurbation, Golestan, edge, morphological changes

Informality is a worldwide phenomenon; ever more people are living in informal settlements due to rapid changes caused by phenomena such as climate change, economic global crisis, civil wars and so forth. According to Porter, "[i]nformality is firmly cast as not only one of the key problems facing cities and urban dwellers, but also one of the major challenges to both long-standing and contemporary approaches to planning" (2011, p. 115). Iran's informal settlements are no exception from this ever-increasing form of urbanity. As in many other developing countries, Iran has experienced unprecedented urban population growth in the second half of the 20th century. Informal settlements have emerged in most of its cities, especially in and around the provincial capitals.

Although Iran's informal settlements are not among the most famous in the world, UN-Habitat (2003) ranks Iran eighth among the 20 largest slum populations. According to Davis (2007), Islamshahr (Eslamshahr) in the Tehran conurbation ranks 21st among the world's 30 large mega-slums. Although it has now become a formal settlement, new informal settlements have developed around it, one of which is Golestan, the case study for this research.

Despite the presence of formal factors and forms in Iran's informal settlements – which are greater than many global cases of slums – there are many informal characteristics such as lack of proper sewage, poor quality construction and materials, lack of safety and social problems. Significantly, their formation has happened without the control of the state. The urban planning system in Iran has been tackling informal settlements as a problem. Many are located in Tehran conurbation due to access to sources of survival and income. It was estimated that 11 percent of the total population of the Tehran metropolitan region, lived in informal settlements in 1991 (UPARC, 1996, p. 32). This proportion reached 19 percent by 1996 (Athari, 2003, p. 28). An interview with the Deputy of Urbanism of Tehran's municipality (ISNA, Beigli, 2006) revealed that according to the official census, 5 to 5.5 million people now live in informal settlements around Tehran.

Golestan, formerly called Soltanabad, is one of the former informal settlements in Tehran conurbation. It is presented in this paper as an example of these informal settlements. Studying the effects of the formalisation process and the morphological changes that result can be indicators of how the identity, socio-economic and adaptation capacities of these areas are transformed. Such studies can also indicate if their status as 'edge' settlements has changed as a result of formalisation and morphological change.

Importance of morphological study of informal settlements

The spatial study of morphological aspects of the informal settlements as an increasingly growing phenomenon in the urban environment has been less favoured than other urban aspects such socio-economic studies. Dovey (2006; 2010; 2011), Dovey and King (2012) and McFarlane (2009; 2011; 2012) are among those who have provided insights onto the relationship of informal settlement with their urban spatial characteristics.

Morphological analysis of the informal settlements is an important part of developing knowledge about informal settlements as Oliveira and Pinho (2012) point out given that urbanity is both a social and spatial construct. This paper presents the morphological transformations caused by formalisation processes as a key to unravel the dynamics of change in them and its possible consequences. The aim of formalisation has been to provide a better quality of life for their residents

Tehran conurbation and its informal settlements

With reference to Habibi, Davis notes that "[t]he emergence of informal settlements dates back to early 1960s in Iran (Habibi, 1993, p. 62) around the capital of the country: 'due to a popularisation of capitalist movements in which major agribusiness companies and industrialisation outcompeted local businesses'" (Davis, 2006, p. 24). According to Zebardast (2008), moving to informal settlements on the fringes of Tehran, where work commutes could be 30 km and greater a day, has been the result of this modernisation and emergence of new sources of income in cities.

Tehran's geographical location is an additional cause of the numerous informal settlements emerging around it. The capital of Iran is located on the Southern slopes of Alborz Mountain ranges. Madanipour (1999, pp. 57–65; 2006) introduces the city as "located in a strategic and symbolic place". It has been inhabited for more than six millennia. He believes that "[t]he story of Tehran is one of tensions of modernity and of globalisation". Since becoming the capital of Iran 200 years ago, it has grown to be one of the largest cities of the world. According to Zebardast (2006) "most of the population increase in the Tehran metropolitan region has taken place outside of the Tehran City and in its periphery", resulting in new settlements many of which are called 'edge settlements' to indicate their informality. Studying Iran's informal settlement life cycles contributes to knowledge about their formation and adaptation capacities.

The urban formalisation process in Iran

The introduction of urban regulations in the late 1960s saw the commencement of widespread official urban formalisation processes in Iran. This has been a part of the state's desire for modernisation as well as for economic and political reasons as is the case in many countries. This led to the preparation of the first urban plans by specialists from western countries. Being able to control and oversee the formations and flows of population and sources of income was a primary reason especially with the growth of large scale industries and modernisation of agriculture. Additionally, there was increasing flow of immigrants from rural areas to the main cities in search of work and better opportunities. This made the control of the rapid expansion of cities a priority for the municipalities especially Tehran.

Athari (2013) describes the roots of formalisation in Iran in the 1960s:

> Urban formation in Iran was not formal, it was project based (such as design of Naghse Jahan square in Isphahan), but from the second half of the 1960s by shaping of the high council of architecture and planning, and introduction of formal master plans, the first sample of urban formal plan is introduced in Iran and it was the start of formalisation of urbanism in Iran. Tehran's master plan was prepared in 1968 and its structure plan in 1970.

These plans had instant effects on social divisions, income and economic dynamics which resulted in a new character, divisions and even new sets of residents for the city. One of the most tangible examples was the change in the minimum plot size and increasing it to 300 m^2 and unifying it. This plot size was prescribed in the urban plans with the assumptions based on the Fourth National development plans onward (1967 onward). This predicted that there will be no lower income classes in the cities and thus no need to provide for their spatial need. One of the main drivers shaping the informal settlements around the official edge of Tehran boundary has been the regulations which made the urban housing inaccessible for them. (Athari and Rafiee, 1995; Amoli, 2011; Athari, 2002; 2003; 2011)

Later on, land became one of the main assets for families and organisations alike. Land and the housing market have become main sources of income since the introduction of urban regulations, divisions, zoning and boundaries. This, in turn, has led to the growth of edge settlements, being the national naming convention for informal settlements. The tax revenue is not considerable as an income source for the municipalities and is not a sufficient reason for formalisation. Rather, the need and demand for services in the edge settlements (Bayat, 1994; 1997a; 1997b) led to formalisation of these areas.

Athari and Rafiee (1995) argue that "informal settlements did not exist prior to the implementation of the Tehran Master Plan in 1968". They assert that this is because

> low-income rural migrants and the urban poor could not afford the standards set in the formal urban development plans were forced to move to places where these standards were not applied.

As observed by other scholars too,

> once the population of the informal settlement, increases to a considerable size, then there is no other choice left for the authorities but to citizenize them by preparing urban development plans and providing them the necessary urban services.

Athari (2011) and Zebardast (2006) argue that "public policies, including the urban planning systems, urban land and housing policies are the main causes of formation of the informal settlements specially in Tehran metropolitan area" because of the nature of Iranian urban planning laws. These regulations are causing the displacement of the poor to marginal areas and leading to the developing of informal settlements. For example, one of the regulations requires "setting a minimum of 200 m^2 for plot size which has pushed the poor out of the city because of making it unaffordable". They believe that these formal processes are causing fundamental changes such as gentrification, displacement and change of identity and sense of place which will lead to a new state of urbanity in these areas.

The formalisation process of informal settlements in Iran

The Iranian Ministry of Housing and Urban Development released its *Strategies for Enabling and Regularising Informal Settlements* in 2004. This document applies learnings from unsuccessful experiences of the past which included physical interventions such as mass demolition and displacement. The Ministry sought to involve the habitants and encourage self-help and participation of local dwellers, representatives, instructors and organisations in the recent programs. There is also encouragement to use local resources and potentials in the new schemes which are not the subject of this study.

The focus of this paper is urban interventions in informal areas which involve upgrading plans; these are called "formalisation process of informal settlements in Iran". Many organisations and institutions are involved in upgrading informal settlements in Iran. The main criteria for these actions were set in 2005 by *The High Commission of Urbanism and Architecture* which is now a part of Ministry of Roads and Housing. The criteria and regulations are set for redevelopment of four types of urban development called "distressed urban areas or decayed urban fabrics". This includes the informal settlements being upgraded by these planning rules which affect their morphology and their spatial and socio-economic characteristics.

Based on these regulations, three parameters should be considered as the main criteria for identification and categorisation of these areas including:

1. Plot size (less than 200 m²)
2. Width of existing access ways (less than 12 m)
3. Structural strength of buildings (more than 20 years old).

If any of the mentioned criteria is present and exceeds more than 50 percent in each block, the area will be recognised as "distressed, obliterated or worn out urban fabrics" and subject to reformation plans based on special projects delivered by municipalities or dedicated organisations. While the social empowerment programs have recently been added to the spatial, structural interventions, the mentioned criteria are still the main change factors in these areas.

These projects and the formal regulations have changed not only the spatial but other fundamental characteristics of these areas over time. The first two criteria directly affect the urban form and cause morphological changes which have consequences for other aspects of urbanity. It is worth mentioning that the consolidation of small plots to bigger plots of 200 m² (which are usually 1-2 storeys) leads to building 3-4 storey buildings which can be profitable. This is now the biggest driver for the upgrading action in the so-called obliterated areas.

According to Athari (1993; 1995; 2002; 2003), Sheikhi (2002; 2003), Habibi (1993) and Zebardast (2006; 2008), this kind of formalisation process have caused morphological, economic and social structures of these areas. It has resulted in loss of identity, segregation and social exclusion in these settlements; the poor and homeless have been pushed further towards the fringes. The first name given to informal settlements was 'fringe settlements' which clearly defines their spatial and socio economic status.

Zebardast (2006, pp. 439-454) argues that "the largest cities of the Tehran Conurbation except Tehran and Karaj, namely Eslamshahr, Ghods and Gharachak, are former informal settlements that have been transformed into formal cities". Further, he argues that "the informal settlements located in the vicinity of the Tehran's major transportation routes were stratified. Six of them are located on the Saveh Road corridor" (2006, p. 442). This area includes the case studies for this research.

Most of Iranian informal settlements have formal plot subdivisions layouts and street patterns made by the settlers, private dealers and informal developers. Consequently they have the morphological aspects of many formal areas in the country. In establishing the edge settlements, there was some possibility of easier gain of formal status of ownership by building close to the formal styles and regulations as Martin and Mathema (2006, p. 135) and Davis (2006) have observed in several cases around the world, including Lusaka where "the houses were built in straight lines, and matching lot-sizes to the minimum necessary for future legalization".

Introduction of Golestan

Golestan (previously called Soltanabad) is located in south east Tehran, along the Saveh-Tehran Highway (Fig. 1). The reason for choosing this city is the presence of sequential formation phases as an informal

settlement which are traceable in its different neighbourhoods. It has different phases of growth and formalisation which are recognisable at present. It is shaped around the Saveh Road as an important transit route in Tehran conurbation since the 1960's, connecting industrial zones and warehouses which are located around it to the capital and surrounding cities. Many residents commute and work in Tehran and surrounding areas.
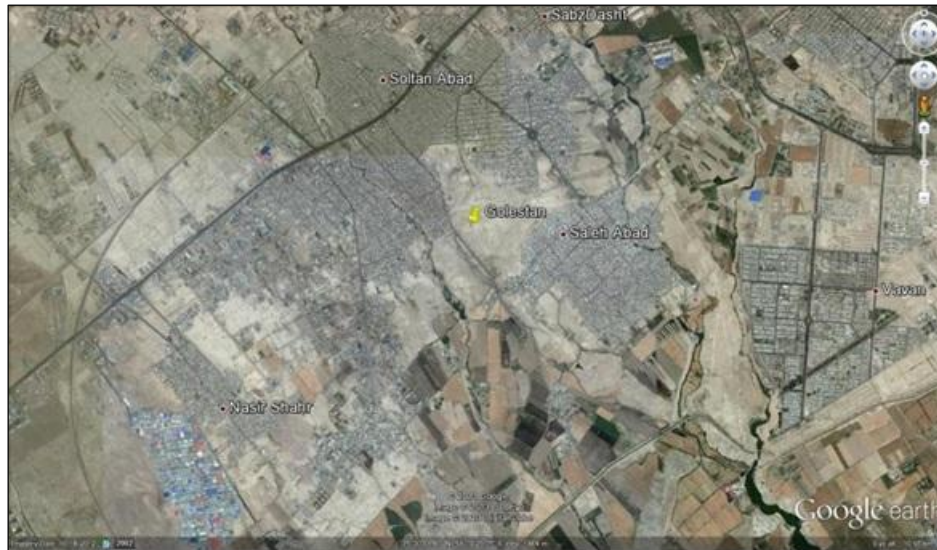
Figure 1. *Location and footprint of Golestan*
Source: Google Earth, 2013

According to the official census (2011), part of the population of Golestan has migrated from other old informal settlement in Tehran conurbation. Its main spatial development constitutes of an amalgam of rural areas and farmlands overtaken by poor immigrants. Although most of Golestan has been shaped as an informal settlement, it is now a formal city although much of it remains informal. Golestan was recently divided into three official districts by its municipality, with the municipality subdivisions assuming responsibility for infrastructure and maintenance which will increase the control and the hasten formalisation process.

The data gathered and analysed for this article is gained both by on site observations and documentation of urban and morphological characteristics as well as human activity and behaviour in the public realm (which was undertaken as part of the PhD fieldwork through the University of Melbourne). Data was also gained from the consulting engineer who is working preparing its structure plan, 'Parsumash' and Sohrab Mashudi (2012-2013), to document the process of change in these areas.

Main characteristics of Golestan

In general, the city of Golestan has formal plot subdivision layouts and street patterns which are prepared by the settlers, private dealers and informal developers, although traces of its organic original formation as a village and on site subdivisions by the inhabitants reveal it as an informal place (Table 1).

Table 1: *General characteristics of Golestan*

Population	Distance from Tehran	Plot size ratio	Unofficial ownership	Population working in Tehran	Official urban development plan
231,905 persons	17 km	50 percent: 15-50 m² 30 percent: 50-100 m²	79 percent	61 percent	Urban structure development plan prepared

Source: Derived from official census and data

The main reason for its formal looking subdivisions is due to early recognition of the possibility of gaining formal status of ownership by building close to formal styles and regulations as Martin and Mathema (2006) and Davis (2006) have observed in several cases around the world. Most of these settlements demonstrate the morphological aspects of many formal areas in the country.

Golestan is undergoing formalisation due to the structure planning process (2013). As the speed and type of the upgrading varies in different parts, this research was conducted by studying three areas, each of about nine hectares (based on the GIS database by the consulting engineer: Parsumash, 2013) and in different phases of transformation (Fig. 2).

The first area is called Soltanabad, the central core of its formation which has not changed much in the last 20 years. The second is the area on the south of the Saveh Road and is undergoing transformation and formalisation. The third area is located on the south and has formal land subdivisions since around 20 years ago when a land owner made arrangements for the workers of his factory. It is built according to formal urban regulations and shows the final product of the formalisation process although the socio-economic characteristics of the people are similar to the other areas. However, the unbuilt subdivided lands have been overtaken by the poor as squatters instead of the workers of 20 years ago. While there are very few houses left from that period, traces of informality can be found in it. Most of its buildings are built by formal looking materials such as brick and cast iron.

Informal (20-25 years old)

Figure 2. *The sequential formalisation in the three cases*
Source: Solmaz Hosseinioon, 2013

The transformation of Golestan

Starting from a village and the farmlands around it, its development has continued its growth in the empty lands on the south of Saveh Road, along a high voltage electricity line and moving westwards. The latest part of its growth has happened in the north around the railway line and also on the south side of the river which have both been limits for expansion. As Golestan's shape and growth is affected by many economic, geographical, regional and local forces due to its location, these elements have encouraged the shaping and growth on one hand and have acted as barriers and limitations on the other. Due to the population and economic pressures. they have served as barriers only at certain stages and, as pressures increase, the barriers have been encroached (Fig. 3).

Although Golestan has become an official city with a legal boundary, it is still a mixture of varying phases of formality and informality, rural and urban, industrial and residential, with different official and unofficial status of tenure ownership.

Figure 3. *Figure ground maps indicative of morphological characteristics of the three chosen neighbourhoods*
Source: Solmaz Hosseinioon, 2013

Introduction to the morphological changes of Golestan's neighbourhood

As the maps indicate (Fig. 4), the increased degree of formalisation is followed by more order and ease of access for the buildings as well as increased open space for individual houses. The morphology includes bigger plot sizes with public and private open spaces becoming more available. The plot size increase has attracted a new social class with higher income into these areas. This phenomenon has been observed and analysed as the main cause for marginalisation of the poor to farther areas (Athari 2002; 2003; Athari and Rafiee 1993; 1995; Sheikhi, 2002; 2005).

Figure 4. *Plot ratio increase by formalisation*
Source: Solmaz Hosseinioon, 2013

As a natural consequence, the way the public space is used and perceived has changed, as have preferred modes of movement and transport. Observations in different times of the day and week show that car usage increases drastically as formalisation happens. As the urban fabric allows more cars in, the informal pedestrian and bike friendly areas which were full of activity become devoid of life in the most formalised areas. It is an example of how these morphological interventions affect the lifestyle of the inhabitants and have cultural and social consequences. Their 'edge' status changes as they look more like any official city in the country in the formalised areas.

Figure 5. *Street scenes in Golestan*
Source: Solmaz Hosseinioon, 2013

The economic status of people is higher in the more formalised areas (according to official data and field observations of key indicators such as rate of car use and ownership). The residents of more formalised areas include some poor middle classes who migrate from the capital as inflationary pressures affect their ability to secure housing as well as residents of the more informal areas of the same city who move here as their economic status improves (inner migration). The behavioural typologies and use of public space show a remarkable change among the three areas. Interviews and observations revealed that the sense of community and place security and 'eyes on the street' decreases as formalisation prevails; where there is official control was, safety increases.

This study is concerned with the consequences of the planning and design regulations on fundamental issues of safety, security, sense of place and community bonds as well as, more generally, the 'edge' state of these settlements. In a case like Iran, studying these places can be a step in revising and reconsidering the causes and aims of upgrading which is undertaken as a generic solution in all urban fabrics with the assumption of betterment. However, this process can lead to the creation of more edge situations, habitations and re-creation of the problems they were intended to eradicate. According to Athari (1993; 1995; 2002; 2003), Sheikhi (2002; 2003), Habibi (1993) and Zebardast (2006; 2008), this kind of formalisation process and the changes they have caused in morphological, economic and social structures of these areas, lead to changes in identity and character of the areas. In many cases segregation, social exclusion has resulted with the poor and homeless being pushed further to the fringes.

As in the case of Golestan, it can be observed that after the formalisation process in these areas, formation of new informal settlements in the adjacent areas such as Meymunabad, Salehabad, Reyeh, Miyanabad and Vajhabad occurs. Although this was not part of this study has been observed and documented for further studies. This phenomenon is common in many informal settlements in the world as the general literature review on informal settlements show (UN-Habitat, 2003a; 2003b).

It seems that although the morphological change caused by upgrading regulations bringing these areas out of their 'edge' status, is producing new 'edge' areas as well as causing new challenges for the formalised areas. This raises the need for serious revision of the urban upgrading criteria for informality reduction which has been used for many years without an analytical study of the consequences.

Acknowledgement

References

Athari, K. (2002) 'Informal Settlement in Iran; Problems and Policies' (in Persian), *Quarterly Journal of Urban Development and Rehabilitation* 9–10, 88–90.

Athari, K. (2003*)* 'Planning Evasion and the Shortcomings of the Housing Planning for the Low-Income Groups' (in Persian), *Bulletin of Housing Economics* 34, 28–45.

Athari, K. (2011) *De-Citizenizing by State's Housing Policies*, Sharg newspaper, 1 August

Athari, K. & Rafiee, M. (1995) *Informal Settlements in Iran; a Survey of Causes and Solutions* (in Persian) (UPARC, Tehran).

Athari, K. & Rafiee, M. et al. (1993), *Informality (Hashieneshini), reason and consequences*, (Ministry of housing and urbanism, Tehran).

Amoli, S. (2011) *Effectiveness Of National Strategies To Secure Participatory Slum Upgrading: A Study of Iran's Commitment Towards Enabling and Empowering Communities Within Informal Settlements*, Research report submitted in partial fulfilment of the requirements for the MSc in Sustainable Development for Distance Learning Students of the University of London, (Centre for Development, Environment and Policy (CeDEP), School of Oriental and African Studies, University of London, London)

Bayat, A. (1994) 'Squatters and the State: Back Street Politics in the Islamic Republic', *Middle East Report* 191 (November-December 1994), 10-14.

Bayat, A. (1997) 'Un-Civil Society: the Politics of the `Informal People'', *Third World Quarterly* 1, 53-72.

Bayat, A. (1997) *Street Politics: Poor People's Movements in Iran* (Columbia University Press, USA).

Bentley, I. (1999) *Urban Transformations: Power, People and Urban Design* (Psychology Press).

Davis, M. (2004) *'Planet of Slums: Urban Involution and the Informal Proletariat', New Left Interview* March/April 2004, 5-34.

Dovey, K. (2008) *Framing Places: Mediating Power in Built Form* 2nd edition (Routledge, London).

Dovey, K. & King, R. (2011) 'Forms of Informality: Morphology and Visibility of Informal Settlements', *Built Environment* 1.

Dovey, K. (2012) 'Informal Urbanism and Complex Adaptive Assemblage', *International Development Planning Review*.

Dovey, K. (2010) *Becoming Places: Urbanism/Architecture/Identity/Power* (Routledge, London).

Dovey, K. & Raharjo, W. (2010) *Becoming prosperous*, in Dovey, K. *Becoming Places* (Routledge, London), 79-101.

Dovey, K. and Polakit, K. (2007) *Urban Slippage: Smooth and Striated Streetscapes in Bangkok*, in Franck, K. A. & Stevens, Q. (2006) *Loose Space: Possibility And Diversity in Urban Life* (Taylor & Francis), 113-131.

Dovey, K. & King, R. (2012) 'Informal Urbanism and the Taste for Slums', *Tourism Geographies: An International Journal of Tourism Space, Place and Environment* 2, 195-212.

Hillier, B. (2008) *Space and Spatiality: What the Built Environment Needs From Social Theory* (Building Research & Information).

Hillier, B. (2001) 'A Theory of the City as Object Or, How Spatial Laws Mediate The Social Construction Of Urban Space', Conference Proceedings (3rd International Space Syntax Symposium, Atlanta).

Habibi, S. M. (1993*)* 'Eslamshahr; a Perfect Human Settlement or a Mixed Human Settlement', *Ghofteghoo Magazine* 1, 62–85.

Huchzermeyer, M. & Karam, A. (2006) *Informal Settlements: A Perpetual Challenge?* (Juta and Company Ltd).

Madanipour, A. (1999) 'City Profile-Tehran', *Cities* 1, 57-65.

Madanipour, A. (2006) 'Urban Planning and Development In Tehran', *Cities* 6, 433–438.

Martin, R. & Mathema, A. (2006) *Clash of Civilizations*, in Huchzermeyer, M. and Karam, A. (Eds) (2006*) Informal Settlements* (UCT Press, Cape Town), 126-145.

McFarlane C. (2011) 'The City As Assemblage: Dwelling And Urban Space', *Environment and Planning Department: Society and Space* 4, 649-671.

McFarlane C. (2012) *Rethinking Informality: Politics, Crisis, and the City*, (Planning Theory & Practice, Department of Geography, Durham University, UK).

McFarlane C. (2009) *Translocal Assemblages: Learning, Space and Development*, (Department of Geography, Science Site, Durham University, Durham).

McFarlane C. (2011) *Learning the City: Knowledge and Translocal Assemblage*, (Wiley –Blackwell, Oxford).

Oliveira V., Pinho P. (2010) 'Evaluation in urban planning: Advances and prospects', *Journal of Planning Literature*, (http://jpl.sagepub.com/content/24/4/343)

Sheikhi M. (2002*) Informal Settlements, From Problem to Solution: The Transformation Process and Socio-Economic Characteristics of Self-Growing Population Hubs with an Emphasis on Case Studies: Islam Shahr, Nasimshahr and Golestan* (in Persian), (SID publications, Iran).

Sheikhi M. (2005) 'The Process of Shaping and Transformation of Informal Settlements around Tehran: Case Studies: Islam Shahr, Nasimshahr and Golestan' (in Persian), *Haftshahr magazine* 8.

UN-Habitat (2003) *Slums of the World: The Face of Urban Poverty in the New Millennium (*United Nations Human Settlements Programme, Earthscan, London).

UN-Habitat (2003) *The challenge of slums: global report on human settlements,* (United Nations Human Settlements Programme, Earthscan, and London).

Zebardast, E. (2008) 'The Housing Domain of Quality of Life and Life Satisfaction in the Spontaneous Settlements on the Tehran Metropolitan Fringe', *Social Indicators Research* 2, 307-324.

Zebardast, E. (2006) 'Marginalization of the urban poor and the expansion of the spontaneous settlements on the Tehran metropolitan fringe', *Cities* 6, 439-454.

Confronting ideological struggles: urban enclaves within the growing enthusiasm for privatisation in China

Jiawen Han

Faculty of Built Environment, University of New South Wales, Sydney, Australia
Email: jiawenhan@gmail.com

Harry Margalit

Faculty of Built Environment, University of New South Wales, Sydney, Australia
Email: h.margalit@unsw.edu.au

Abstract. *The recent proliferation of walled or fenced housing developments at a mega-scale is transforming the urban landscape in contemporary China. However, relatively little attention has been paid to how these gated communities are rationalised by contemporary China's emerging market economy, socio-political constructs and ideological struggles. Moreover, the research in regard to how the urban landscape is rhetorically and psychologically accepted and promoted in this transitioning stage is also thin. This paper aims to enhance the understanding of this specific urban form in China's social, cultural and economic transition, the core of which lies between the private and public realms. Since public state agencies and private associations combined in complex ways from the 1990s onwards, the blurred boundary and unpredictable relationship between private and public sectors in the emerging market economy has entangled the vast majority of Chinese citizens, pushing people to secure their private property and space in a process associated with the loss of confidence in the collective mindset. It could be argued that the gated community in China has largely reflected a deep psychological desire for privatised assets and space in China's post-socialist transition. This paper will explore the growing enthusiasm for privatisation in order to shed light on the new urban enclaves by engaging with broader ideological concerns, rather than orthodox explanations of fear, collective culture and so on.*

Keywords: urban enclaves, private and public, privatisation, post-socialist transition

The recent proliferation of walled or fenced housing developments at a mega-scale and high density is transforming the urban landscape in contemporary China. While historically gated communities originated from South America (Blakely and Snyder, 1997; Low, 2003), they have dominated Chinese cities in recent years and many scholars have given due consideration to this unique phenomenon in its Chinese context (Douglass, Wissink, and van Kempen, 2012; Huang, 2006; Miao, 2003; Pow, 2007a; 2007b; 2009; Wu, 2005; Wu and Webber, 2004; Xu and Yang, 2009). From their perspectives, the gated community in contemporary China is considered as "an enclosed neighbourhood helping China to define a sense of collectivism and foster social solidarity" (Huang, 2006), "an instrument for the partitioning of derelict socialist landscapes produced by economising urbanisation and a post-socialist imagined good life" (Wu, 2005), or "physical forms and organisational patterns ingrained in the Chinese history of city design" (Xu and Yang, 2009) and so on. However, relatively little attention has been given to the impact of blurred public-private boundaries in the emerging market economy on this urban form.

The aim of this study is to understand how these gated communities in contemporary China are rationalised by contemporary China's socio-political constructs and ideological struggles, resting on the distinction between private and public. To do so, this paper will explore the relationships between the gated community, ideology and Chinese people's psychological variations. We argue that gating is the

manifestation of psychological anxiety in the face of the current ideological struggles, and, more specifically, a new expression of the growing enthusiasm for privatisation. Increasingly, the loss of confidence in collective house-keeping drives people to seek privatised living in the gated communities in China.

Gated Community in China

New residential housing estates, which often take the form of China's gated residential district or community (*Xiaoqu*), appear as planned neighbourhoods where housing is integrated with communal facilities like kindergartens, clinics, restaurants, convenience shops, sports facilities and communications infrastructure all under the control of a professional property management company (Bray, 2006; Read, 2003). The public space within the neighbourhoods is very diverse. Depending on the price range of the flats, the amenities range from a concentrated green space as a minimum, to a variety of extras such as playgrounds, clubhouse, and even stores and a swimming pool (Miao, 2003, p. 47). Public services in these communities, such as street cleaning, gardening, and security, that were previously provided by the government or work units, are now provided by a private developer or professional Property Management Companies for a monthly fee (Huang, 2006, p. 518). Miao (2003) stated that almost all the added housing stock in China took the form of gated communities. While gates have become the standard feature of new masterplanned communities in suburban areas, they also feature in the central city. While national statistics are not available, gated residential districts or communities have emerged as the dominant pattern in the commodity housing market and is influencing both the urban form and people's lives in contemporary China. Bray (2006) observes that the appearance of large numbers of gated residential communities has become the key feature of China's urban transformation. The reason for the booming of gated communities in urban China can be attributed to scarcity of land and population pressure, which has influenced planning authorities to promote highrise and high-density development (Bray, 2005, p. 176). The concept of the gated residential district was developed in the late 1980s and has gradually become the model for residential development throughout China (Bray, 2005, p. 177). Increasing numbers of urban residents from very different backgrounds have moved from types of pre-1949 traditional urban block and work-unit settlements to gated community-type settlements (Xu and Yang, 2009, p. 111).

Most of the research in this field has so far recognised that the traditional spatial pattern of the walled compound to some extent affects spatial patterns of residential development in China (Douglass et al., 2012; Wu, 2005; Xu and Yang, 2009). Pow (2009, p. 5) pointed out that Chinese architectural canons and urban history are replete with examples of enclosed housing forms ranging from the ancient walled cities in the Shanghai and Chou dynasties, to the enclosed courtyard houses (siheyuan) of the gentry and walled villages in the countryside, and later the walled "work-unit compounds" constructed in the post-1948 socialist era. Douglass, Wissink and Kempen (2012) stated that the urban transformation of China seems to accord with the wider trend toward enclave urbanism. Closer inspection of the work-unit reveals its similarity to recently developed urban enclaves. In comparison with the gated community, the Maoist work-unit city, with its cellular structure and mixed functions in pre-reform China, is a designated functional and cultural enclave according to a centrally planned directive. The main aim of establishing walled work-units was to enhance political control by tying every individual's wellbeing to recognised working units, under a collective umbrella. In other words, living in the work-unit is the only way of living and the only way of enjoying work opportunities, housing, health care and social intercourse in pre-reform China. But as the country was propelled from a centrally planned command economy to a market oriented economy, although with the government continuing to direct many aspects of life, few studies responded to the question of why people, who are no longer strictly politically controlled, are still obsessed with the seemingly conventional gated model. Therefore research addressing how the urban landscape is rhetorically and psychologically accepted and promoted in this transitioning stage is still missing.

In most social circumstances, gating primarily comes with insecurity. In America, Low (2001) explored how the discourse of fear of violence and crime and the search for a secure community by those who lived

in gated communities in the United States legitimates and rationalises class-based exclusion strategies and residential segregation. For a majority of Americans the contrast between suburb to city gives rise to an anti-urban sentiment that is often expressed as fear of the violence and crime that is seen to pervade the city, and it also rationalised gated communities (Low, 2001). Moreover, the process that produces urban and suburban segregation in the United States also has a long history based on racism and racial segregation (Bullard and Lee, 1994; Massey and Denton, 1993). In contrast to the "fear" factor in the prototype of the fortress-gated community in the US, the primary concern of gating in China's post-reform transition remains far from racism, violence and crime. In the Chinese cultural context, Wu (2005) has taken the factor of fear into consideration, and further argues that urban fragmentation is paving the way to a new urban experience of insecurity, which has begun to appear in the discourse of "community building" in urban China. Yet this argument is tenable only in a later phase in the development of gated communities. Hence it will be useful to consider the gating form beyond the concern for security first. Our paper will shed light on the new urban enclaves by engaging with broader ideological concerns, rather than orthodox explanations of fear, collective culture and so on.

Urban form, ideology and psychology

When Chinese cities are characterised by an increasing prevalence of a particular built form, that is, a walled or fenced enclave to which public access is restricted, people who are living in the cities and their psychological reactions are unavoidably drawn into the discussion. The relationship between psychological self-reinventing in the ideological struggle and urban form seems suspicious at first sight. Proshansky et al. (1983, p. 57) pointed out that there is an almost complete neglect of the role of places and spaces in the aspect of human psychological development. The main concept shared by the existing literature (Masso, 2012; Proshansky, Fabian and Kaminoff, 1983) in the multidisciplinary areas is "place identity", locating the conceptualisation of selected problems of the physical environment. The tastes and preferences of a person touch upon numerous aspects of the built environment, extending from the specifics of housing design, colour, and lighting to more general landscape preferences regarding urban, suburban, or rural styles (Proshansky et al., 1983, p. 69). However, the existing research concerning people and place is still limited to the conceptual discussion of space or the experience of space and does not touch upon the urban area.

In addition, for more than a generation, social scientists have been sceptical that ideology is an important force in people's lives (Jost, Nosek and Gosling, 2008, p. 134). If one assumes that "money is the language" in contemporary China, it should be noted that China is still under a "command structure". The command structure developed over the past 80 or more years of the Party's existence, and especially over the half-century or more of the People's Republic, remain in place, although with modifications in the way in which they are used (Porter, 2011, p. 167). Looking at the financial side of China's miracle, Walter and Howie (2011, p. 23) argued, "[o]ver the past 30 years, China's state sector has assumed the guise of Western corporation, listed companies on foreign stock exchanges, and made use of such related professions as accountants, lawyers, and investment bankers". Consequently, the state sector and its ideology are still driving forces in the lives of the Chinese people, and embracing a psychological approach to the study of ideology in China is crucial for explaining the roots of those beliefs.

In the research of the "political psychology of public space", Masso (2012) pointed out that our individual and shared interpretations of space and place-behaviour are also culture-bound discursive resources that accomplish functions in a larger sequence of social (inter)action, often echoing broad ideological processes. In the Chinese context, the urban representations of psychology reflect Chinese notions of ideology in the discursive process of urban transformation. A recent flurry of studies in social, personality, and political psychology suggests that the general ideological proclivities are rooted in basic antinomies of human nature, such as the underlying needs for stability versus change, order versus complexity, familiarity versus novelty, and conformity versus creativity (Jost et al., 2008, p. 134). Pow (2009) pointed out that unlike in the old system of work-unit-based housing and in traditional residential estates, where state surveillance and grassroots control were relatively strong, commercial housing estates in contemporary gated communities are built and managed by property developers, real estate management

companies and private home-owners' associates, which are primarily interested in protecting the housing investments of private home-owners (p. 49). The paper draws primarily on several well-known ideas in social psychology, environmental psychology, and human geography. Therefore, the gated community as an urban form in contemporary China should be based on the understanding of the particular people and ideological relationships in China's contemporary context. Our study considers the individual and shared expectations of space and housing investments as ideologically bound resources that manifest in the new urban form in contemporary Chinese cities.

Ideology: blurred boundaries in the public-private realm

Before China's transition to a market economy, the idealised public realm ultimately displaced private sectors. In pre-reform socialist China, the Communist Party-State in its early years attempted to hijack the "social" and transform Chinese society into a massive bureaucratic structure under the rule of the Chinese Communist Party where society is organised as a massive "super human family" under the gigantic nationwide administration of "collective house-keeping" where "private interests assume public significance" (Arendt, 1998). Prior to economic reform and the opening up of mainland China in the 1980s, privacy rights of Chinese citizens and private life were seldom invoked, if rarely debated in the open (Pow, 2007a, p. 814). When the new Communist government nationalised urban land in the 1950s and presented a socialist property regime where all new urban housing could only be collectively owned, there was little opposition (Davis, 2003). In the People's Commune, which was born in 1958, everything was shared. Private kitchens in the commune became redundant. Everything originally owned by the households, private animals, stored grains and household items were also contributed to the commune. The collectivism stressing collectivised work activities began to pervade China and further lead to no distinction between private and public. In the liberal-economic model dominant in public-policy analysis, public-private distinction is primarily marked out in terms of the distinction between public state administration and the private market approach. Yet the "state-hegemonic public sphere" (Kraus, 2000) in the pre-reform socialist regime to some extent denigrates any attempt to identify the distinction between the state and the private sectors; to some extent it rendered private life as merely selfish activities.

The emergence of the market as a central legitimating institution brought the public/private distinction into the core of legal discourse during the nineteenth century (Polyani, 1944). However, China's trajectory, which began from the pre-reform socialist regime of production and accumulation dominated by and designed solely for the state's extensive socialist industrialisation program, then moved to a more market-based and uniquely hybridised system of production marked by quasi-public, quasi-private forms of ownership, production and accumulation (Francis, 2001). China's emerging market system displays a wide range of quasi-public, quasi-private trends and is frequently described by adjectives such as quasi-public, quasi-private, paragovernmental and semiofficial (Francis, 2001, p. 276). Further steps of reform in the 1990s created a fundamental break with the "great union" between private and public that have prevailed in China from1949 to 1989. However, it is also impossible to exactly discern how they integrated with each other.

The private and the public have been combined and entangled together in complex ways, the complexity of which cannot be conceptualised and explained in any existing grand theory. The liberal perspective on the emergence and development of the modern state and modern capitalism is grounded in the distinction between public and private (Francis, 2001, p. 276). However, China's economic transformation away from state socialism should be viewed as a prolonged process of change with unpredictable consequences, instead of as a transitory short phase leading to a Western capitalist system of production (Ma, 2002, p. 1546). The assumption of the dominant neoliberal ideology is that post-communist market transitions will lead to and require a sharpening of the boundaries, both legal and practical, between the state and the expanding private sectors. However, the post-communist economic transitions belie these assumptions (Francis, 2001, p. 276).

Private society and its actors flourish, but they do not stand across a clearly delineated divide from the public. For example, in 1949, China, as a socialist country, adopted a welfare housing system where the

production, allocation and maintenance of housing became the responsibility of the relevant work unit (Danwei)(Yeung and Howes, 2006, p. 344). Yet housing reform has been a crucial component of the overall economic reforms in urban China from the mid-1980s. In 1988, the government issued a major reform document, the Ten Year Reform Strategy. Its main objectives were to encourage urban residents to buy their houses, to formulate new housing finance arrangements and to restructure rents in the public sector. Since then various central and local legislation and regulations for the privatisation of urban housing have been issued (Wang and Murie, 2000, p. 397). In other words, the residential space which has been de-commodified to a public welfare benefit in the Communist victory has been nominally re-privatised, but urban residents still only hold the right to use privately and sell privately for a limited number of years, rather than being private property owners. That is to say, they are still in public urban housing stock with leasehold title.

Psychology: loss of confidence in the public and the enthusiasm for privatisation

The active, intensive, unorthodox and opaque interaction between the public and the private puzzles and entangles Chinese citizens. The transformation has affected all kinds of state entities—local and municipal governments, national ministries, the army, national and local public security bureaus, party organisations, universities, scientific research institutes—many of which have become profit-seeking market actors who run their own often extensive business empires (Francis, 2001, p. 285). An ever-growing proportion of people feel anxious about with the opaque cooperation between state agencies and private associations. According to Ma's analysis, the pursuit of entrepreneurial activities by state officials and newly emerging individuals has proved to be politically acceptable and economically rewarding; the most critical aspect pointed out by Ma is this pursuit of activities is socially admired (Ma, 2007, p. 558).

Therefore, the sense of ownership and the sense of place do not fall easily into the private-public dichotomy. The accumulation of anxiety was further accelerated by the "loss of sense" in China, in which people feel difficulty grasping what is taking place and attempt to desperately predict the future. Anxiety has emerged among different social groups throughout the Chinese society. Farmers feel anxious that their distributed and so-call privatised farmlands formerly cultivated by themselves would be compulsorily purchased and turned into urban land by the government at any time. Migrant workers have no access to private urban housing in terms of eligibility and affordability, as the emerging political and economic structure is not capable of providing public and urban welfare to a growing labour force from rural areas not covered by traditional welfare system. The new middle class in the cities are not clear about which part of privately owned assets would be nationalised or de-commoditised along with the policies.

This psychological anxiety around the private/public struggles and the desire for privatisation was not obvious in the high-speed gross domestic product (GDP) growth period. China's GDP growth has averaged 9.4 percent per annum since 1978, according to a report published in 2006. But such a high-speed growth rate has been associated with increasing inequality (Kuijs and Wang, 2006). For example, the rural immigrants – a curious majority class – took on the task of feeding themselves without claiming their share of welfare right from the government in the past 20 years, which seems at odds with the aspirations of a socialist society. But under the impressive growth millions they were at least lifted out of poverty, compared with the hardships of the countryside. The poor rural immigrants also hold the belief that they must experience some particular hardships moving from the rural area to the city in order to privatise some pieces of "GDP cake" growing at a unprecedented speed.

Yet the impressive GDP growth in China would require the investment-to-GDP ratio reaching unprecedented levels of 55 percent on average in 2014-2024 to maintain GDP growth of 8 percent per year (Kuijs and Wang, 2006, p. 11). It seems even harder to maintain in the global economic crisis. Meanwhile, the Chinese state agencies and public institutions have gradually engaged directly in commercial activities, becoming, rather than simply regulating, market actors (Francis, 2001, p. 285). The psychological tolerance towards corruption, the rural-urban income gap and so on cannot be as low as it was in the impressive growth of the "GDP cake". When the increment speed of GDP slows down, and social

inequality becomes more serious, it is easy for the groups who have no hope of benefiting in the privatising struggle to start to question the groups who are benefiting from the current system, many of whom have gone into private business while retaining their public identity. Traditional shared values such as communism and Confucianism have lost believers, while no new ideals have been established. Within such a vacuum of shared values, people increasingly focus on personal material wealth rather than any common good, and the society becomes more stratified and tribalised (Miao, 2003, p. 58).

Urban form: sharp division between private and public

In contemporary China, people find that it is difficult to discern whether the state agencies are still involved in "collective house-keeping", which was unchallenged for forty years before 1990s, or are going to exploit them like an enterprise. Since the emergence of a relatively autonomous private demand is irresistible, increasing numbers of people in China are urged to own more than one safe asset to secure privatised property and space. Therefore, gated communities become the most prevalent and acceptable urban housing settlements in China: there seems no blurred and transgressed boundary between public and private spaces. The tolerance toward sharing space in the neighbourhood is particularly low. It is also uncommon for the domestic activities to encroach into the public space in a gated community. As a result, people usually do not know each other in one residential development, but are willing to be zealously guarded and protected under the property management company's control. The psychological lure of protecting private property potentially pushes people to retreat to gated communities. Furthermore, it also induces architects and urban dwellers to retreat to an easy solution.

The physical division between private and public spaces and enclosed form of the gated community embody the sense that nobody wants to be a loser again in the changing urban property regime. When most urban housing—new and old—was still distributed or sold through bureaucratic channels controlled by enterprise leaders or governmental official, production was least able to shape how public assets would be distributed into private hand (Davis, 2003, p. 192). In the analysis of social composition in gated communities in Nanjing, Mushu Garden, a middle-class estate, sees a relatively wide spread of government official, enterprise managers and private-sector entrepreneurs. Dihao ("Empire and Elite Garden") at the luxury end of the market sees an exclusive concentration in two sectors: managers of joint-ventures and entrepreneurs (Wu, 2005, p. 246). As discussed above, in contemporary China, bureaucratic officials and state agencies always play ambiguous roles in the mutual intervention between public and private, thus, many of the residents in Mushu Garden and Dihao gated communities who have benefited from the deconstruction and reconstruction, to some extent, took advantage of the blurred boundary between public and private. The unstable "lucky" timing makes them even more anxious with their personal property, and deepens their urge to privatise even further. Wu's (2005) fieldwork also shows that industrial workers are the main occupants in the Nanhu workers' village (p. 246); the new housing distributed during the 1980s did not immediately advantage white-collar over blue-collar families. But starting with the early sales of use-rights in 1993, working class families began to fall behind their better-paid white-collar neighbours who outranked them in the workplace (Davis, 2003, p. 194). When the blue-collar workers realised they were becoming the losers in the late 1990s and early 2000s, they began to desperately fight for their housing.

Therefore, the gated community in China seems to be the easiest urban strategy to address the psychological discomfort: "Gates are reassuring in the face of anxiety levels heightened by economic, demographic, and social change. They shield us from a world where we feel vulnerable (Blakely and Snyder, 1997)." Hence how the urban enclaves address the anxiety, on one hand, is through this physical division and enclosed form which enhances the sense of ownership and privatisation, and on the other hand, the housing buyer in a Chinese gated community is not only the owner of his or her apartment but also the joint owner of the open space and community buildings. In other words, a Chinese housing buyer purchases an apartment and at the same time he purchases part of the public area in the city, which is a psychological attraction for people to privatise assets and space. This is how the eagerness for privatisation aids proliferation of gated communities in the Chinese context. The psychological change makes people demanding in the sharp spatial division between private and public in order to ensure the

stability of their personal space and assets. Therefore the implications of gating highlight the anxiety in the elapsing of the sense of collectivism and dynamic relationships between the private and public in current ideological struggles. In other words, the old urban patterns are giving way to new urban forms, reflecting the enthusiasm for privatisation in contemporary China, simultaneously shedding light on the country's ideological changes.

Conclusion

China's urbanisation trend has a mixture of changes and continuities in many respects (Zhang, 2008, p. 467). However, the interpretation of the changes and continuities are fundamentally geared towards the material side of the development. Although there is an explosion of research focusing on the quantitative elements of strategy and policy in dealing with the rapid urbanisation, and the daunting urban condition, the reason that people adhere to this urban form, and their commitment to the values of order underlying this urban form, attracted less attention. Hence it is imperative to look into the convergence of governmental strategies, autonomous agents in the market, and most significantly, the psychological side of people who are capable of adopting or rejecting urban enclaves. Our analysis above shows that the ideological transformation between private and public to some extent creates a psychological shift to a growing enthusiasm for privatisation, but also a latent enthusiasm, which quickly edged out collectivism in the urban expansion, pushing people to secure their private property and space as a reaction to the loss of confidence in the collective mindset, and finally dragging the cities into anti-social forms of development. We are not intending to downplay the importance of any aspects in analysing these urban enclaves in contemporary China, but to open new lines of enquiry on the urban form by highlighting the ideological shift's impacts on the psychological acceptance and promotion of gated communities, an idiosyncratic betweenness halfway between a planned and a market nature. It could be argued that the gated community in China has largely reflected a deep psychological desire for privatised assets and space in China's post-socialist transition.

References

Arendt, H. (1998) *The human condition* (University of Chicago Press, Chicago).

Blakely, E. J., & Snyder, M. G. (1997) *Fortress America: gated communities in the United States* (Brookings Institution Press, Washington, D.C.).

Bray, D. (2005) *Social space and governance in urban China: The danwei system from origins to reform* (Stanford University Press: Stanford, California).

Bray, D. (2006) *Garden estates and social harmony: a study into the relationship between residential planning and urban governance in contemporary China,* Conference Proceedings (China Planning Network 3rd Annual Conference, Beijing).

Bullard, R. D., & Lee, C. (1994) 'Racism and American apartheid', *Residential apartheid: The American legacy*, 1-16.

Davis, D. S. (Ed.) (2003) *From welfare benefit to capitalized asset: the re-commodification of residential space in urban China* (Routledge, London).

Douglass, M., Wissink, B., & van Kempen, R. (2012) 'Enclave urbanism in China: Consequences and interpretations'. *Urban Geography* 2, 167-182.

Francis, C. B. (2001) 'Quasi-public, quasi-private trends in emerging market economies: the case of China', *Comparative Politics*, 275-294.

Huang, Y. (2006) 'Collectivism, political control, and gating in Chinese cities', *Urban Geography* 6, 507-525.

Jost, J. T., Nosek, B. A., & Gosling, S. D. (2008) 'Ideology: Its resurgence in social, personality, and political psychology', *Perspectives on Psychological Science* 2, 126-136.

Kraus, R. C. (2000) *Public monuments and private pleasures in the parks of Nanjing: a tango in the ruins of the Ming emperor's palace*, Conference proceedings (Consumers and consumer culture in contemporary urban China, Berkeley).

Kuijs, L., & Wang, T. (2006) 'China's pattern of growth: Moving to sustainability and reducing inequality', *China & World Economy* 1, 1-14.

Low, S. M. (2001) 'The edge and the center: Gated communities and the discourse of urban fear', *American Anthropologist* 1, 45-58.

Low, S. M. (2003) *Behind the gates: Life, security, and the pursuit of happiness in fortress America* (Routledge, London).

Ma, L. J. C. (2002) 'Urban transformation in China, 1949-2000: a review and research agenda', *Environment and*

planning A, 9, 1545-1570.

Ma, L. J. C. (2007) 'From China's urban social space to social and environmental justice', *Eurasian Geography and Economics* 5, 555-566.

Massey, D., & Denton, N. (1993) *American apartheid: Segregation and the making of the underclass* (Harvard University Press, Cambridge).

Masso, A. D. (2012) 'Grounding citizenship: Toward a political psychology of public space', *Political Psychology* 1, 123-143.

Miao, P. (2003) 'Deserted streets in a jammed town: the gated community in Chinese cities and its solution', *Journal of Urban Design* 1, 45-66.

Polyani, K. (1944) *The great transformation* (Rinehart, New York).

Porter, R. (2011) *From Mao to Market: China Reconfigure* (Columbia University Press, New York).

Pow, C. P. (2007a) 'Constructing a new private order: gated communities and the privatization of urban life in post-reform Shanghai', *Social & Cultural Geography* 6, 813-833.

Pow, C. P. (2007b) 'Securing the'civilised'enclaves: Gated communities and the moral geographies of exclusion in (post-) socialist Shanghai', *Urban Studies* 8, 1539.

Pow, C. P. (2009) *Gated communities in China: the politics of the good life* (Routledge, London).

Proshansky, H. M., Fabian, A. K., & Kaminoff, R. (1983) 'Place-identity: Physical world socialization of the self' *Journal of environmental psychology* 1, 57-83.

Read, B. L. (2003) 'Democratizing the neighbourhood? New private housing and home-owner self-organization in urban China', *The China Journal* 49, 31-59.

Walter, C., & Howie, F. (2011) *Red capitalism: the fragile financial foundation of China's extraordinary rise* (John Wiley & Sons (Asia) Pty Ltd, Singapore).

Wang, Y. P., & Murie, A. (2000) 'Social and spatial implications of housing reform in China', *International Journal of Urban and Regional Research* 2, 397-417.

Wu, F. (2005) 'Rediscovering the 'gate'under market transition: from work-unit compounds to commodity housing enclaves', *Housing Studies* 2, 235-254.

Wu, F., & Webber, K. (2004) 'The rise of "foreign gated communities" in Beijing: Between economic globalization and local institutions', *Cities* 3, 203-213.

Xu, M., & Yang, Z. (2009) 'Design history of China's gated cities and neighbourhoods: Prototype and evolution', *Urban Design International* 2, 99-117.

Yeung, S. C. W., & Howes, R. (2006) 'The role of the housing provident fund in financing affordable housing development in China', *Habitat International* 2, 343-356.

Zhang, L. (2008) 'Conceptualizing China's urbanization under reforms', *Habitat International* 4, 452-470.

Transformation of the position of historic centre in modernisation: case study of Skopje's Old Bazaar, R. Macedonia

Aleksandra Krstikj
Graduate School of Engineering, Osaka University, Osaka, Japan
Email: sandra.krstik@gmail.com
Hisako Koura
Graduate School of Engineering, Osaka University, Osaka, Japan
Email: koura@arch.eng.osaka-u.ac.jp

Abstract. *In developing countries the concept of urban centre has been changing with modernisation. In this paper the aim is to examine the position of Skopje's historic centre, the Old Bazaar, in the modern urban centre and discuss a design concept to sustain and even promote its significance. First, we examined modern developments that restructured the urban form and transformed the position of the Bazaar in the city. Secondly, we examined the formation of Skopje's Bazaar developed by the Ottoman urban concept. The analysis evaluated the authentic significance of historic places as 1) Main Centre 2) Bazaar's components and 3) periphery points of urbanisation. The change of the urban centre's concept transformed the position of the Bazaar from city centre to edge of the modern city centre, physically and functionally isolated from the modern centre. However, even though Skopje's Bazaar is today recognised as edge of the city centre, the authentic significance of its position can be clarified by careful examination of the Ottoman urban concept. The evaluation of place significance can serve as base for a new urban concept that can integrate historic place and modernisation in the future centre and conserve Skopje's identity and authenticity.*

Keywords: Skopje's Old Bazaar, historic centre position, restructuring of centre, significance of place

Introduction

The modernisation and rapid urban growth of the 20th century significantly altered the position of the historic centres in the urban structure of the cities. In developing countries the conservation of historic centres has started to attract social concern. Republic of Macedonia is a developing country rich in cultural heritage where 24 traditional bazaars, developed during the Ottoman era, still exist as historic urban centres. However, until now only Skopje's Old Bazaar was proclaimed a *Cultural Heritage of Significant Importance* ('Службен весник на Република Македонија', 2008). This paper concentrates on analysing the impact of modernisation on the position of Skopje's Old Bazaar, one of the biggest "complex weblike bazaars of medieval oriental character in the Balkans" (Mateska, 2011).

Research aim

The location and layout of Skopje's Bazaar, developed by the Ottoman urban strategy, have been losing their authentic meaning due to the modern development that ignored the Ottoman concept. In this paper the aim is to examine the position of Skopje's Bazaar in the modern urban centre and discuss a design concept to sustain and even promote the significance of the historic centre.

Therefore, first we examined modern urban developments that impaired the Ottoman concept of city centre. Second, we examined more closely the Ottoman concept of urban centre by identifying the

primary roads and location meaning of main public facilities. Careful consideration of the authentic significance of place in the historic centre can serve as a base for future favorable development that will sustain and integrate the Bazaar in the modern urban centre.

Previous research and originality of our study

Previous research on the Bazaar concentrated on: historical facts about the construction of Ottoman facilities and their architectural features (Sokoloski 1977; Богоевиќ 1998); the modern development in the Bazaar following Skopje's earthquake (Institute for Urbanism and Architecture-Skopje, 1967); or the typology of shops (Krstikj, Hyuga and Koura, 2012). The study by Boykov (2011) clarifies the consistent Ottoman urban strategy—*Ottomanisation*, applied in the conquered Balkan cities, including Skopje, during the 15th century. Concurrently, Mateska (2011) analysed the typology and function of all traditional Bazaars in the structure of Macedonian cities without focusing on Skopje in particular. In 2006, the National Institution – Conservation Centre Skopje executed a Reevaluation survey of Skopje's Bazaar that served as a base for enacting the *Law for Proclamation of Skopje's Bazaar as Cultural Heritage of Significant Importance* ('Службен весник на Република Македонија', 2008).

Previous studies present the place history, physical data of buildings and survey records. However, they do not analyse the spatial relations and Bazaar's position in the city's structure. Therefore, our study focuses on clarifying the historical significance of the location of Skopje's historic centre and the transformation of its position imposed by modernisation.

Methodology

The method of this study was based on document analysis. The documents consisted of previous research and historical data. Previous research was used to analyse modern urban transformations in Skopje (Institute for Urbanism and Architecture—Skopje 1962; 1964; UN Development Programme, 1970; Arsovski, 1988; Marina and Pencic, 2009). From the publications of the Institute for Urbanism and Architecture—Skopje (1962; 1964) we used the masterplan for Skopje produced in 1914/29, 1948 and 1964 for analysis of the planning strategies used in reshaping Skopje's central area. Previous research regarding Ottoman urban strategy (Cezar, 1983; Boykov, 2011), year of built and location of facilities (Sokoloski, 1977; Богоевиќ, 1998), social circumstances (Gorgiev, 1997) and urban planning of the Bazaar after the 1963 earthquake (Institute for Urbanism and Architecture—Skopje, 1967) was also examined. From the historical data we used maps by Hall (1828), Evans (1883) and a map of Skopje from 1887/95. The 1887/95 map was found in an article by Urošević (1973) published by the Macedonian Academy of Science and Arts' 'Contributions IV-2', 1973. Urošević found the 1887/95 map as an appendix in a book titled *Detailbeschreibung des Sandžaks Plevlje und des Vilajets Kosovo* printed in Vienna 1899.

Skopje's position on the regional transit network

Skopje city is located in Skopje's valley, which is elongated river plain in the northern part of today's Republic of Macedonia. Enclosed by mountains – Vodno (1066 m) on the south, Suva Gora (1857 m) on the southwest and Skopska Crna Gora (1561 m) on the northeast (Institute for Urbanism and Architecture, Skopje, 1967) – the valley is naturally accessed in the northwest-southeast direction which is along the flow of river Vardar.

Skopje's valley had been inhabited since ancient times. In the Roman Empire, main highways connected Rome with Constantinople. One of the most important Roman roads, *Via Egnatia* (A Fig. 1), passed through the southern parts of today's Republic of Macedonia (Ohrid-Bitola) (Castellan, 1992). In this context Skopje's valley occupied a periphery position. However, the situation drastically changed after 1392 when Skopje was conquered and renamed Üsküb by the Ottomans (Castellan, 1992). Since then, Skopje served an important military and political role as a base for further conquests of the North and Central Balkans (Castellan, 1992). These new circumstances gave strategic significance to Skopje and its location in the region (Mateska, 2011).

On the map from Hall (1828) we traced the regional transit network passing through Skopje, already firmly established in the 19th century (Fig. 1). It became clear that Skopje was a traffic link between Central/East Europe and Thessalonica on the Aegean Sea, from where the Middle East was accessed. The road Skopje-Thessalonica was along Vardar's riverbed (B, Fig. 1). Another route of more local importance connected Skopje as urban centre with its hinterland, the villages in Skopska Crna Gora (5) and Vodno Mountain (6). This route was in SW-NE direction and its vital link was the Stone Bridge on river Vardar. We can clarify the main significance of Skopje's location on an important intersection on the regional network between Central/East Europe and the Middle East as well as urban hub for the local villages.

In Fig. 2 we traced the regional network through Ottoman Skopje based on map from Evans (1883). We marked the entrances of the regional roads in the city that are called hereafter Gates.
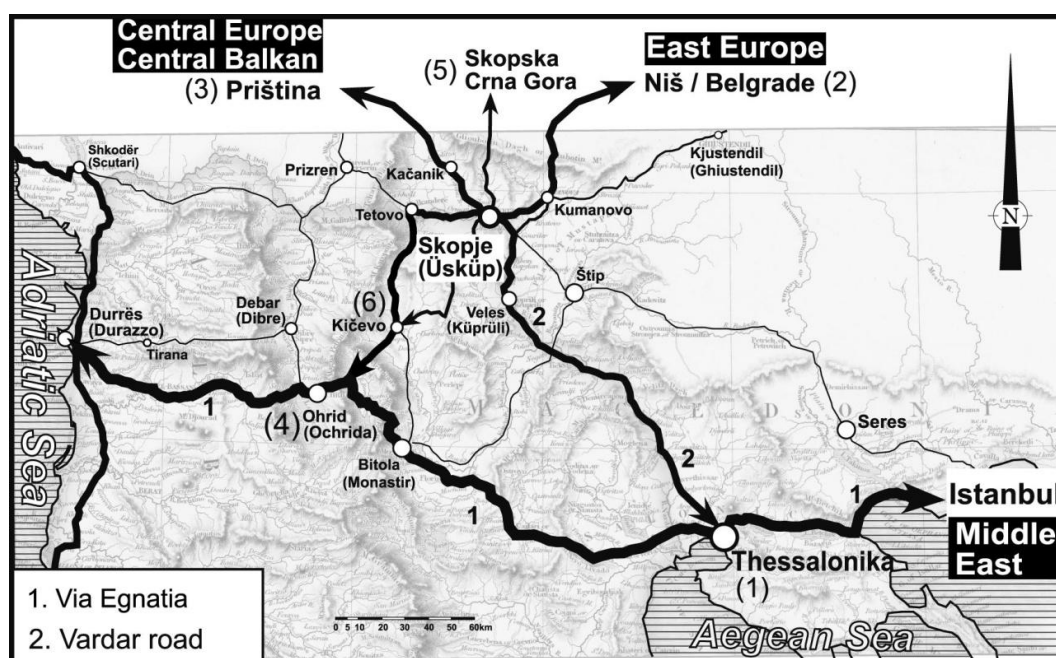
Figure 1. *Skopje's location in the regional network – adapted by the author based on Hall, 1828*
Source: Aleksandra Krstikj and Hisako Koura, 2013

(1) Skopje—Veles—Thessaloniki (Aegean S.) — Istanbul — Middle East
(2) Skopje — Kumanovo — Niš — Belgrade — East Europe
(3) Skopje — Kačanik — Priština — Central Balkan — Central Europe
(4) Skopje — Tetovo — Kičevo — Ohrid — Durrës (Adriatic Sea)
(5) Skopje — villages in Skopska Crna Gora Mountain
(6) Skopje — villages in Vodno Mountain (Nerezi) — Kičevo
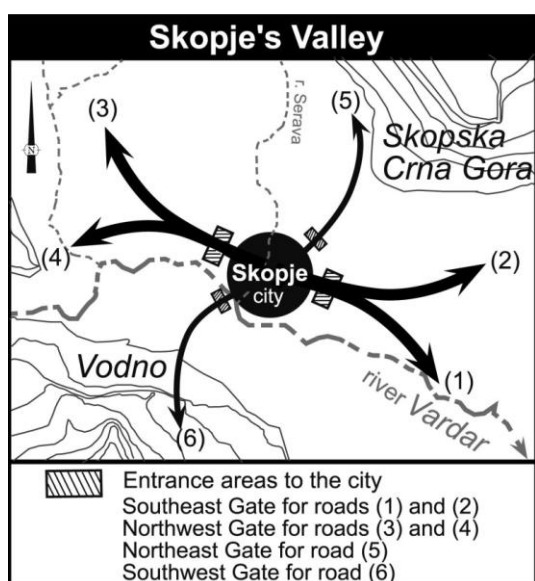
Figure 2. *Skopje's valley (based on Evans 1883)*
Source: Aleksandra Krstikj and Hisako Koura, 2013

Transformation of Skopje's urban form

Ottoman Skopje and the Bazaar

After the Ottoman conquered Skopje in 1392, the city was gradually reorganised according to the basic principles and guidelines of the Ottoman urban concept that derived from the law – *Sharia* (Boykov, 2011). In conformity with these basic principles, Ottoman Skopje had three main urban zones: urban centre with the Main Mosque and Bazaar, a fortress adjacent to the Bazaar, and residential neighborhoods *(mahalle)* around the urban centre (Mateska, 2011). In the *mahalle* the privacy of family life was respected while commercial activities such as provision of food, import of raw materials and trade culminated in the noisy streets of the Bazaar (Castellan, 1992), hereafter called historic centre.

The urbanised area in 1887/95 was ~260 hectares, with only a small area (~45 hectares) on the southeast, between river Vardar and the first railway station in 1874 (Urošević, 1973). We mapped the location of the Bazaar in Skopje in 1887/95 in Fig. 3-I.

The traditional Ottoman strategy in forming the urban centre was based on the concept of *waqf* endowments developed by powerful Ottoman individuals or officials (Cezar, 1983). The endowment—*waqf* is a property that is "frozen", exempt from changes and subdivision for centuries, and dedicated to serve public benefit (Cezar, 1983; Gorgiev, 1997). In the Ottoman urban concept, the most important *waqf* endowments that symbolised the urban centre were the Main Friday Mosque and the Bedesten. In Skopje, these Ottoman Main Centres were the first Mosques built after the Ottoman conquer – Yiğit Paşa's Mosque in 1414 and Skopje's Bedesten in 1439 (C, Fig. 3-I). Until the beginning of the 20th century these buildings symbolised the centre of Ottoman Skopje. Around the Centre facilities, individual shops (Krstikj, Hyuga and Koura, 2012) and other public facilities (Богоевиќ-К, 1998) were gradually built, forming the Bazaar as historic central area without clear demarcation of its boundaries.

First urban plans

The first urban plan for Skopje was produced in 1914 by architect D.T. Leko, after the Ottoman's withdrawal from Skopje in 1912 (Institute for Urbanism and Architecture – Skopje, 1962; Арсовски, 1988). This plan is considered a turning point in Skopje's urban history because for the first time coherent urban planning approach was used to deal with urban issues (Institute for Urbanism and Architecture – Skopje, 1962; Арсовски, 1988). Leko's plan was not implemented but served as a conceptual base for the next official masterplan by architect Mihajlovic in 1929 (Marina and Pencic, 2009).

The 1914 and 1929 urban plans exhibit general lack of appreciation for the Ottoman city model and promote radical change of Skopje's urban structure (Fig. 3-II). One of the significant urban elements brought into use in these plans was the Public Square (S on Fig. 3-II). The Squares were envisioned as main traffic hubs enclosed by large public buildings.

One large square in the historic city on the left side of Vardar and two smaller squares on the right side were planned. However, only the square adjacent to the old Stone Bridge on the right bank of Vardar – today known as Square Macedonia – was gradually formed by erecting public facilities of the new government. The facilities included the Chamber of Industry and Commerce, Army Officers' Club, National Bank, Ristic Palace, Natural Science Museum and Post Office (Institute for Urbanism and Architecture – Skopje, 1962). Thus, Skopje's urban centre was relocated on the right bank of Vardar. We concluded that the Ottoman symbol of centre, embodied in the Main Mosque, was substituted with the symbol of the Public Square. The symbol of Skopje's centre became the newly developed Square on the right bank of river Vardar—the New Centre.
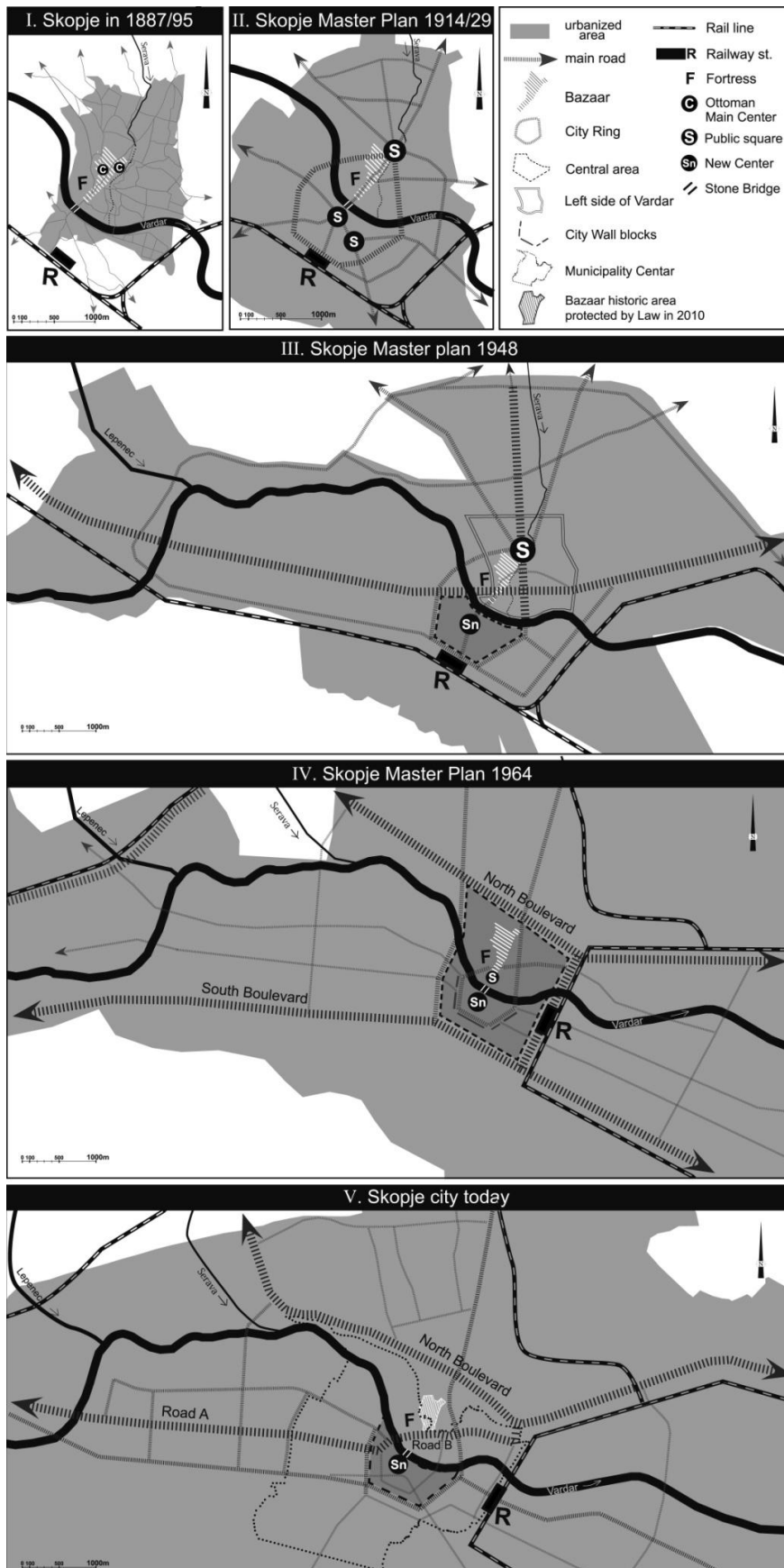
Figure 3. *Diagram of the urban transformations of Skopje and its central area, from 1887 till today*
Source: Aleksandra Krstikj and Hisako Koura, 2013

This new urban concept of centre radically changed the position of the Old Bazaar from historic urban centre to a commercial zone adjacent to the New Square. The Stone Bridge served as a main communication link between these two zones. The majority of Ottoman public facilities in the historic centre were abandoned while some were used by local craftsmen and merchants for storage and manufacturing (Mateska, 2011; Institute for Urbanism and Architecture – Skopje, 1967; National Institution – Conservation Centre Skopje, 2006).

Moreover, for the first time the idea of encircling the central area with roads, called hereafter the City Ring, was introduced. The City Ring will continue to be a dominant urban form of Skopje's Central area in the future plans.

Planning of Inner central area

After the Second World War, Skopje began a process of intensive development and urban growth (Institute for Urbanism and Architecture – Skopje, 1962; Арсовски, 1988). In 1948, a task of developing a masterplan for Skopje was entrusted to a team of Czech experts (L. Kubes) (Institute for Urbanism and Architecture – Skopje, 1962; Арсовски, 1988). They proposed a plan that implemented the new ideas of the Modern Movement with urban zoning of all city functions, as well as reorganisation of the infrastructure and traffic systems (Institute for Urbanism and Architecture – Skopje, 1962). The Government of Socialist Republic of Macedonia accepted the plan in 1950 (Institute for Urbanism and Architecture – Skopje, 1962).

The plan, developed under the influence of Mata's "Linear city" and Tony Garnier's "Cite industriell", proposed a model of linear urban development in NW-SE direction (Fig. 3-III) (Marina and Pencic, 2009). The main road axes were in north-south and east-west directions. The City Ring remained as a delineator of the new urban centre. This zone encircled by the City Ring was for the first time planned as an Inner Central Area in a Specific Urban Plan for Skopje's Centre in 1961 (Institute for Urbanism and Architecture – Skopje, 1962). In the Specific Plan, the Square Macedonia is treated as a focal point of the Inner Centre, where all political, social and economic facilities were located (Institute for Urbanism and Architecture – Skopje, 1962). Thus, the Inner Centre delineated by the City Ring became the main business district of Skopje.

The Old Bazaar was planned in a separate Specific Plan for the left side of Vardar (Institute for Urbanism and Architecture – Skopje, 1962). This approach illustrates the intention of exclusion of the Old Bazaar from the Inner Central Area. Moreover, in the Specific Plan, the historic city on the left bank was planned for complete restructuring, with orthogonal street pattern and rectangular blocks. The idea of a Square on the north border of the Bazaar, as a symbol of urban centre for the historic city was again included in the plan. However, only a small area was restructured according to this Specific Plan. The area of the historic centre—the Old Bazaar remained largely unchanged.

Urban planning after the 1963 earthquake

Skopje was heavily damaged in an earthquake that occurred on 26 July 1963, when 75 percent of the buildings were destroyed or damaged (Institute for Urbanism and Architecture – Skopje, 1964; United Nations Development Programme, 1970; Арсовски, 1988). The Institute for Urbanism of city Skopje took the task of deciding the directions and guidelines for rebuilding the city. In a cooperative workshop with experts from "Polservis in Warsaw, "Doxiadis" in Athens, USA and Soviet Union, a masterplan for Skopje was made in 1964 (Institute for Urbanism and Architecture – Skopje, 1964). The masterplan had two main tasks:

1. Deciding the main road network based on the best topographical conditions
2. Deciding the zoning, especially the location for residential development based on a research of seismically suitable areas (Institute for Urbanism and Architecture – Skopje, 1967).

According to this masterplan, the main road channels became the North and South Boulevard in NW-SE direction (Fig. 3-IV). The boulevards were linked with a NE-SW road, east of the Inner Central Area, where the New Train Station was relocated. The area enclosed with these wide roads—called Major Ring – was subject to urban planning competition supported by the UN. The competition's objective was reconstruction of Skopje's urban centre. The area planned as Skopje's New Urban Centre included the Old Bazaar on the left bank. Moreover, the competition's requirements emphasised the need for careful consideration of the historical heritage (Арсовски, 1988). Thus, the Old Bazaar became an integral part of Skopje's central area in the urban planning of 1964.

The Institute for Urbanism organised a team of experts, including members of Kenzo Tange and Mishchevic-Vencler teams that ranked highest in the competition, to work on a final synthesis of a Specific Urban Plan for Skopje's Centre (Institute for Urbanism and Architecture – Skopje, 1967; United Nations Development Programme, 1970). The main characteristics of the specific plan were:

- Complete restructuring of the right bank of the centre with urban megastructures, including infrastructure and modern facilities. Major traffic hub was the New Train Station
- Enclosing a smaller part of the of the inner centre with roads—a minor ring that was delineated on the right side with mixed use block structures, called the City Wall
- Demarcation of the Old Bazaar area on the left side. A separate project for the Old Bazaar conservation was made by the Institute of Urbanism in 1967 (Institute for Urbanism and Architecture – Skopje, 1967; Institute for Urbanism and Architecture – Skopje, 1962).

Some of the planned restructuring on the right bank of the centre, including the New Railway Station and the City Wall were developed. The main government and business facilities were located again on the right bank (Institute for Urbanism and Architecture – Skopje, 1962). A major part of the planned spatial restructuring on the left side was not realised. Therefore the Old Bazaar, although for the first time marked as historical centre, remained as an adjacent commercial and cultural area to the business district on the right bank of Vardar that functioned as the city's urban centre.

Skopje city and its centre today

The main road network reorganisation proposed in the masterplan of 1964, was not developed as planned (Fig. 3-V). The Southern Boulevard was not constructed and today the main traffic link in the right side of the city is road A (Fig. 3). The road A connects with the Northern Boulevard through road B, which passes through the south part of the historical centre and marks the south edge of the Old Bazaar preserved area today. This disrupts the primary idea of the Specific Plan from 1964 for the integration of the Old Bazaar in the city centre and physically isolated the Old Bazaar from the rest of the central area on the south. Further, the dominant policy of the planning authorities to retain the main political and business centres on the right bank of Vardar resulted in functional isolation of the Old Bazaar from the main business district. Moreover, with the Law on Territorial Division introduced in 2004, the Old Bazaar area was divided between Centre (south) and Cair municipality (north). This legal action further depreciated the authentic significance of the Old Bazaar as historic centre and made future reintegration in the city centre even more complex. In this context, the position of the historical centre today is transformed from urban centre to an edge of the modern urban centre with cultural and commercial function.

The authentic significance of historic centre's position

In this chapter we discuss the significance of historic centre's position by analysing the purpose of facility location and primary road in the Ottoman urban strategy.

Purpose of facility's location in Ottoman urban strategy

The Ottomans used an urban strategy for reshaping their conquered cities – *Ottomanisation* (Boykov, 2011). The strategy consisted of:

1. Placing a main communal Friday mosque in the centre of the city, with the purpose of developing a commercial zone – Bazaar – in that area
2. Placing T-shaped community centres – complexes consisting of Mosque, public kitchen, religious school, hospital and other facilities in the outskirts of the city – with a purpose of facilitating urban growth of new residential neighborhoods (Boykov, 2011).

In Skopje, *Ottomanisation* started in the 15th century. The main communal mosque built in Skopje's urban centre was identified by Boykov as the first mosque built by the conqueror Paşa Yiğit Bey (Fig. 4, A) in 1414 (Boykov, 2011). In the Bazaar that started to develop around the Main Mosque, Paşa Yiğit's successor Ishak Bey built the Bedesten in 1439 (Fig. 4, B), as a hub of all commercial activities (Богоевиќ-К, 1998; Boykov, 2011). Therefore, these two public facilities signify the origin of the Ottoman city and hereafter we refer to them as **Main Centres** of Ottoman Skopje (C, Fig. 3-I).

Boykov identified the first period complexes built on the city's outskirts in the first half of the 15th century (Boykov, 2011) in Ishak Bey, Sultan Murat and Gazi Isa Bey Mosque complexes (C, D, E on Fig. 4). From Gorgiev's (1997) research, on the demographical changes in Skopje after the Ottoman conquest, we can discern the steady growth of Skopje's population which supports Boykov's claim that location of the first complexes were aimed at facilitating Skopje's growth. Since the population continued to increase rapidly, we concluded that the city growth intensified after the establishment of Burmali, Yaya Paşa and Dükkânçik Mosque (F, G, H on Fig. 4) in the 16th century. We concluded that these outskirt facilities most probably had the meaning of second period complexes after the first period complexes were engulfed in the new neighborhoods. Skopje's growth was abruptly stopped by the 1689 fire, set by the retreating Austrian army during the Great Turkish War in 1683-1699. The city gradually recovered and the 1887/95 map indicates the city's urbanised area is spread well beyond the second period complexes.

Purpose of primary road in Ottoman urban strategy

In our analysis the term *primary road* is used in the context defined by Hakim (1998): "a road continuation of the regional highway that enters through the city Gate and its final destination is the Main Mosque, the Bedesten or the Fortress". The primary roads form the backbone of the city and all main public facilities are located in their vicinity (Hakim, 1998). We used the 1887/95 map of Skopje to identify the primary roads that were utilised to connect the regional transit network and the main public facilities in Ottoman Skopje. We focused on identifying roads that connected the City gates to open markets for wholesale, Main Mosque, Bedesten and the Fortress.

First we identified the precise location of Skopje's City Gates (Fig. 4). The term Gate is used for naturally formed entrances into the city area. The topography of the terrain allows open entrance to the city only from the northern plain while the traffic from the other three sides is forced through natural passages. The passage formed by the northwest slope of the Fortress Hill and the hill adjacent to it on the north side is named in this study NW Gate. Historically, this place was called *Tetovska Trošarina* meaning Toll Gate for traders coming from Tetovo city on the west (4, Fig. 1,2). The Stone Bridge, as the only entrance over river Vardar, was named SW Gate. The strategic positioning of the Fortress Wall and the direction of its defensive posts and towers suggest a clear intention of guarding the bridge as an important city entrance. The passage between the Gazi Baba Hill and river Vardar is the SE Gate. For its precise location we used a historical name of a place below the Hill called *Kumanovska Trošarina* meaning Toll Gate for traders coming from Kumanovo city (2, Fig. 1,2). On the northeast, the contour of the city itself is considered a NE Gate. We assume that in the early Ottoman time a NE Gate could have been a passage over river Serava as a natural border. Second, we marked the location of two big open markets (OM1 and OM2): OM1 in front of the Fortress Gate and OM2 on the plain between Ishak (C) and Gazi Isa Bey Mosques (E) (Fig. 4). From

previous research we know that these were the two biggest open markets in Ottoman Skopje (Mateska, 2011). Third, we marked the location of the Ottoman Main Centres as arrival points of primary significance (A, B in Fig. 4). The first and second period complexes were also considered vital traversal locations.
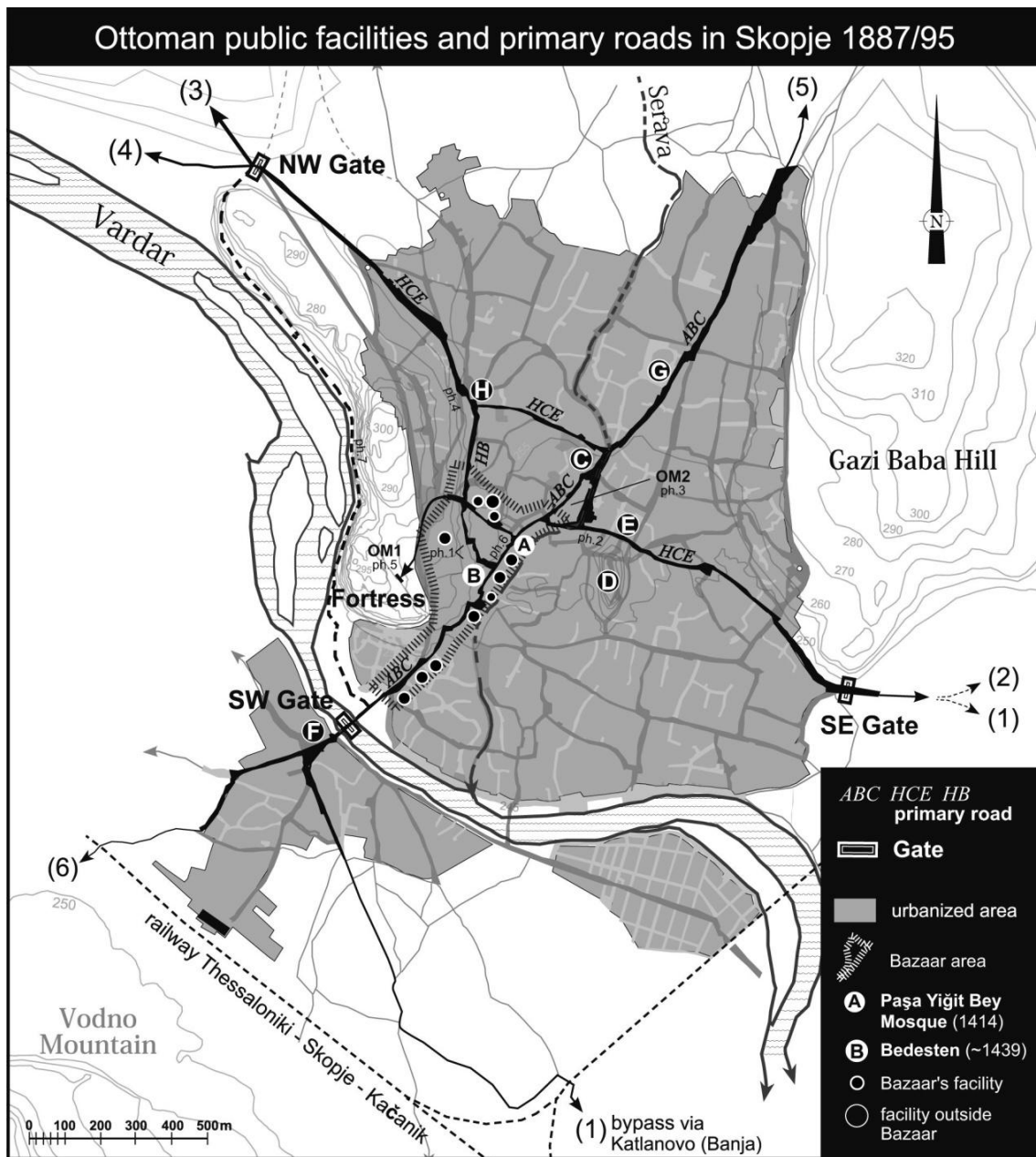
Figure 4. *Ottoman public facilities and primary roads in Skopje in 1887/95*
Source: Aleksandra Krstikj and Hisako Koura, 2013

We traced the roads that connect the City Gates, open markets and the main Ottoman public facilities (Fig. 4). The road in SW-NE direction was identified as primary road ABC. Along this road the majority of the Bazaar's facilities are placed so this road had a meaning of *Main Bazaar Street*. From the NW Gate, the road that connects Dükkânçik (H), Ishak Bey (C) and Isa Bey (E) Mosques and exits at the SE Gate was named primary road HCE. The ABC and HCE primary roads intersect near Ishak Bey Mosque where OM2 is located. This is the same location where a Square was planned in 1914/29 and 1948 urban Plans (Fig. 3-II, III).

We identified a south branch of the HCE primary road that starts at Dükkânçik Mosque (H) and provides direct entrance to the Bedesten (B) Main Centre. This road was named primary road HB. From HB an access to the Fortress (west) and the Main Mosque Paşa Yiğit (A-east) is also provided. Therefore, we identified the primary road network of Ottoman Skopje that functioned as link between the regional network and the main public facilities.

Facilities and primary roads in Bazaar's development

From 1392 to 1414, the centre of the city and the location of the Bazaar were determined by the construction of the first Mosque Paşa Yiğit (Boykov, 2011). Near Paşa Yiğit Mosque, Arasta Mosque was built ("*arasta*"—street or row of shops whose income is allocated to *waqf* support (Fig. 5/I) (Cezar, 1983). To boost the commercial and social activities, powerful individuals gradually erected other public facilities that served as communal or trading centres (Mateska, 2011; Богоевиќ-К, 1998). Paşa Yiğit's successor Ishak Bey (1414-1439) built the most important commercial building in the Bazaar—the Bedesten building, as well as a big Han on river Serava named Suli Han (su—water, Fig. 5/II). Isa Bey (1439-1475) constructed the Kapan Han and Çifte Hamam (Mateska, 2011; Богоевиќ-К, 1998) (Fig. 5/III). Until 1550, a large number of public facilities were already established (Fig. 5/IV,V) and the Bazaar was well developed with the *waqf* construction significantly slowed down (Mateska, 2011; Богоевиќ-К, 1998). Therefore, we can conclude that the main urban structure of the Bazaar was developed in the first 150 years of the Ottoman rule in Skopje. It consisted of two Main Centres (Paşa Yiğit Mosque and Bedesten) as the origin of the Ottoman Skopje's urban centre and other facilities located mainly along the Main Bazaar Street – part of the SW-NE Ottoman primary road (road ABC on Fig. 4).
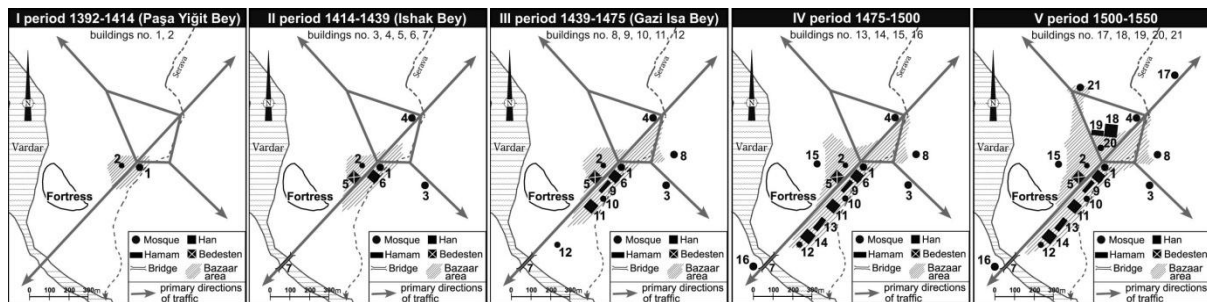
Figure 5. *Diagram of the gradual development of the Bazaar area by founding of Ottoman facilities —waqf endowments Source: Aleksandra Krstikj and Hisako Koura, 2013*

Significance of historic place in the Old Bazaar

Skopje's masterplan of 1964 and the conservation project for the Bazaar by the Institute for Urbanism in 1967 brought about destruction to the spatial context of the Ottoman urban concept. Major developments that damaged Bazaar's urban structure were:

- Museum of Macedonia built on the primary road that connects the Bazaar to Dükkânçik Mosque (21) and NW Gate (road HB, Fig. 4, 6). The primary road network was cut off and the entrance to the Centre, where Bedesten is located, was obscured.
- A major auto road constructed across the south area of the Bazaar (road B, Fig. 3-V, 6). This auto road cut off the historic primary road that linked the Stone Bridge (7) with Main Bazaar Street (ABC, Fig. 4, 6). The south area of the Bazaar, where Daut Paşa Hamam (13) is located, is now physically separated.
- Relocation of river Serava in 1968 promoted redevelopment at the periphery of the Bazaar and resulted in loss of recognition for the authentic edge and the waterfront character (Fig. 4, 6).

Figure 6. *Bazaar's area after 1967-70 reconstruction*
Source: Aleksandra Krstikj and Hisako Koura, 2013

Table 1. *Main Ottoman public facilities built from 1392 to 1550 and evaluation of facility location*

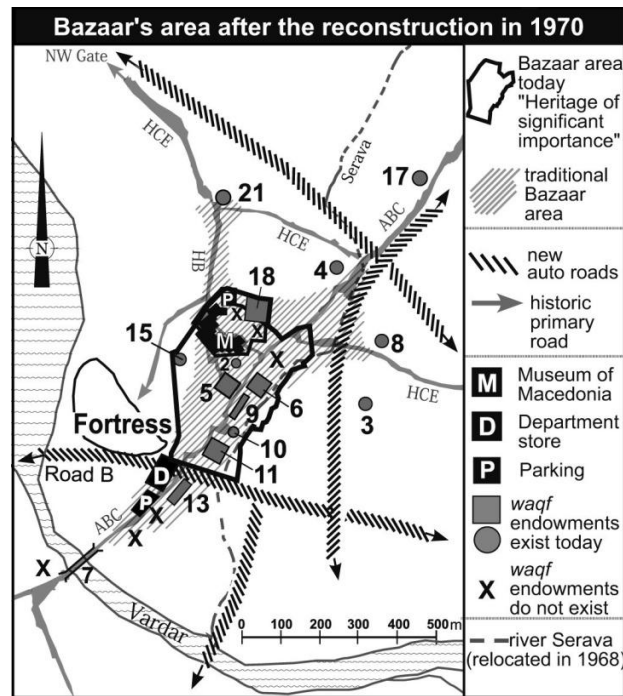|	built year	exist today	orig. location	location now	kept orig. function	authenticity*	value**
1. Paşa Yiğit Bey Mosque	1414	X	■	■	-	-	I
2. Arasta Mosque	~1414	●	■	■	●	△ RO; RR	II
3. Sultan Murad II Mosque	1436	●	□	□	●	△ RO; RE	III
4. Ishak Bey Mosque	~1439	●	□	□	●	▲	III
5. Bedesten	~1439	●	■	■	X (mixed use)	△ RO; RE	I
6. Suli Han	~1439	●	■	■	X (culture)	▲ RO; RE	II
7. Stone Bridge	1421-1451	●	□	□	●	▲	III
8. Gazi Isa Bey Mosque	~1475	●	□	□	●	▲	III
9. Çifte Hamam	~1475	●	■	■	X (culture)	▲ RR	II
10. Murat Paşa Mosque	~1475	●	■	■	●	△ RO; RR	II
11. Kapan Han	~1475	●	■	■	X (mixed use)	▲ RO RE	II
12. Ibn Payko Mosque	~1475	X	■	□	-	-	II
13. Daut Paşa Hamam	late 15th c.	●	■	□	X (culture)	▲	II
14. Daut Paşa Han	late 15th c.	X	■	□	-	-	II
15. Mustafa Paşa Mosque	1492	●	■	■	●	▲	II
16. Burmali Mosque	1495	X	□	□	-	-	III
17. Yaya Paşa Mosque	1504	●	□	□	●	▲	III
18. Kurşumli Han	~1549	●	■	■	X (culture)	▲ RE	II
19. Ǵurčiler Hamam	~1549	R	■	■	-	- (R)	II
20. Kazančiler Mosque	~1549	X	■	■	-	-	II
21. Dükkânçik Mosque	~1549	●	□	□	●	△ RR	III

Historical information as year of built and original location was taken from Богоевиќ (1998) 9); *authenticity valorization for Bazaar's monuments is from N.I.-Conservation Centre Skopje (2006) 15) and for monuments outside the Bazaar from Богоевиќ (1998) 9); **author's evaluation of location significance (chap.7)
●- Yes; X- No; R- ruins; ■- in Bazaar area; □-out of Bazaar; ▲- preserved; △ - partly preserved; RO - interventions in late Ottoman era (18th-19th cen.); RE - interventions in 1964-70 reconstruction; RR - interventions 1990-now; I - Main Center; II - Bazaar components; III - periphery point of urbanization

Even though modern developments altered the authentic urban structure of the Bazaar, the location and layout of facilities and primary roads still carry the meaning of place developed by the Ottoman urban strategy. For example, the significance of Bedesten's location as Main Ottoman Centre is preserved although the authentic building is lost and the entry from the north side is obscured. The Stone Bridge still holds the significance of South Gate to the historic centre. The significance of place was evaluated from three aspects:

1. Main Centre – Pasa Yiğit Mosque and the Bedesten signify the Main Centre that is the origin of the Ottoman city. Although the original buildings were lost, preservation of the location concept of Bedesten and Pasa Yiğit Mosque, in terms of place making, is crucial for recognizing the centre of the historic city (Table 1).
2. Bazaar components – Ottoman facilities in the Bazaar carry the Ottoman concept that formed the

Bazaar as an urban centre. Even though some of them have been altered due to repairs and rebuilding, their layout and original functions are significant to understand the Ottoman urban structure of the Bazaar (Table 1).

3. Periphery point of urbanisation – First and Second period outskirt complexes signify the periphery of Ottoman urbanisation. Their visibility from the Bazaar's area provides orientation and thus the location of the Bazaar in Skopje is understood (Table 1).

Moreover, the primary road network signifies a link between the regional network and the historic centre. Preservation of the primary roads is vital for providing meaning to the location of Skopje in the region and the location of the Bazaar in the city. In the Bazaar, the most significant road is the Main Bazaar Street along which most of the Ottoman facilities are located.

Conclusion

In Skopje, the concept of urban centre has changed at significant periods. The changes progressed from:

- The Ottoman concept, where the symbol of urban centre was the Main Mosque (1392-1912)
- The European concept, where the symbol of urban centre became the Square (1914-1948)
- The Modern concept that impelled central area redevelopment (1948~).

The change of the urban centre's concept transformed the position of the Old Bazaar in the city from:

- City centre where the Main Mosque is located (1392-1912)
- Common city area that lost the meaning of urban centre (1914)
- Historic centre that is integrated in the city centre (1964)
- Historic centre that is isolated, physically and functionally, from the city centre by modern developments (today).

Therefore, the position of a city's centre can vary according to the planning concepts of different periods. While the Old Bazaar's location remained constant, its position in the city transformed from city centre to edge of the city centre. However, even though Skopje's Old Bazaar is today recognised as situated on the edge of the city centre and its historic urban form is impaired, the authentic significance of its position in the city can be clarified by careful examination of the Ottoman urban concept. The evaluation of location significance of Ottoman facilities and primary roads can serve as a base for a new urban form concept that can integrate the Old Bazaar in the city centre and promote its authentic meaning as historic centre. The integration of historic place and modernisation in the future city centre has the possibility to conserve Skopje's identity and authenticity.

References

Арсовски, Т. (1988) 'Старо Скопје', Skopje's Committee for Urbanism, Skopje (in Macedonian)

Богоевиќ-К.,Л. (1998) 'Османлиски споменици во Скопје', Исламска заедница во РМ-Скопје, Сектор за наука и исламска култура, Skopje (in Macedonian)

'Службен весник на Република Македонија', Бр.130, Год. LXIV, 2526, 15.10.2008, pp. 6-13 (Official gazette of Republic of Macedonia) (http://www.slvesnik.com.mk/Issues/788085D60367EB4196670B798E3B989A.pdf,) accessed 29 July 2013 (in Macedonian and Albanian)

Boykov, G. (2011) 'Reshaping urban space in the Ottoman Balkans: a study on the architectural development of Edirne, Plovdiv and Skopje (14-15 century)', in Max Hartmuth (ed.), *Centres and Peripheries in Ottoman Architecture: Rediscovering Balkan Heritage* (Sarajevo), 32-45.

Castellan, G. (1992) *History of the Balkans from the Mohammed the Conqueror to Stalin* (Columbian University Press, New York) 132.

Cezar, M. (1983) *Typical Commercial Buildings of the Ottoman Classical Period and the Ottoman Construction System* (Türkiye Iş Bankasi Cultural Publications, Istanbul).

Evans, A. J. (1883) *Antiquarian Researches in Illyricum, Part III and IV* (Nichols and Sons, Westminster) 82-152

Gorgiev, D. (1997) *Skopje from the Turkish Conquest till the end of XVII century* (Macedonian Institute of National History, Skopje) 37-59

Hakim, S.B. (1998) *Arabic-Islamic Cities-building and planning principles* (Kegan Paul International, London).

Hall, S., (1828) *Greece*, David Rumsey Map Collection (Longman, Rees, Orme, Brown & Green, Paternoster Row, London), (http://www.davidrumsey.com) accessed 07 April 2012.

Institute for Urbanism and Architecture – Skopje (1962) 'Скопје, планови-реализација – I', Skopje (in Macedonian).

Institute for Urbanism and Architecture – Skopje (1964) 'Скопје урбанистичка студија 2', Skopje (in Macedonian).

Institute for Urbanism and Architecture – Skopje (1967) 'Стара чаршија', Skopje (in Macedonian).

Krstikj, A., Hyuga, S., Koura, H. (2012) 'Study on typology of shops and their transformations in Skopje's Old Bazaar-based on analysis of vernacular units' form and design elements', *Journal of Architecture and Planning*, 678, 1881-1887.

Marina, O., Pencic, D. (2009) 'Urban Transformations of Skopje: Fragmented City-Legacy of History', Conference proceedings (The Spatial Planning in Southeastern Europe (until the Second World War), Belgrade).

Mateska, G. S. (2011) 'Bazaar in the Architectural and Urban structure of Towns in the Republic of Macedonia', in *Cultural and Historic Heritage of R. Macedonia LVII ed*. (N.I.-Conservation Centre Skopje, Skopje) (in Macedonian).

National Institution – Conservation Centre Skopje (2006) *Revalorization Report of Old Skopje's Bazaar* (Skopje) (in Macedonian).

Sokoloski, M. (1977) 'Les Biens des vaqyf a Skopje et dans la region environnante au XVᵉ et XVIᵉ siecle', Contributions of the Macedonian Academy of Science and Arts, Vol. 8/2, Skopje, 27-82 (in Macedonian).

Urošević, A. (1973) 'Le Plan de Skopjé de la fin du XIX siécle', Contributions of the Macedonian Academy of Science and Arts (Social Sciences), Vol. IV/2, Skopje, 23-30 (in Macedonian)

United Nations Development Programme (1970) *Skopje resurgent: the story of a United Nations special fund town planning project* (UNDP, New York).

ON THE EDGE OF THE CITY

peripheral areas and urban form in suburbia

Expression of city edges in different cultures and its influence on urban landscape design: a comparison between the urban-rural interface in Brazil and New Zealand medium-sized cities

Glauco de Paula Cocozza

Faculty of Architecture and Urban Design, Federal University of Uberlândia, Uberlândia, Brazil
Email: glauco_cocozza@yahoo.com.br

Silvia Garcia Tavares

Faculty of Environment, Society and Design, Lincoln University, Christchurch, New Zealand
Email: SilviaGarcia.Tavares@lincolnuni.ac.nz

Abstract. *Medium-sized cities are common in Brazil and are responsible for local regional development. The rapid development of these cities results in urban territorial expansion and the substitution of natural landscapes for urban ones. That is, productive land is substituted for urban development. A similar phenomenon has occurred in New Zealand in the last 15 years, where farms located close to cities have recently become urbanised. The main objective of this study is to compare and analyse the cities' edges and the interface between urban and rural environments, based on socio-cultural, political and economic values. Both cultural urban landscapes studied in this paper have specific characteristics. This paper explores the conceptual differences of urban fabric in both cities and discusses principles that should be respected in urban landscape design to achieve urban forms that respect the local cultures.*

Keywords: medium-sized city, urban edges, urban-rural landscape, Uberlândia, Christchurch

Introduction

Comparative studies between cities allow the understanding of different situations and contexts, essential to the body of knowledge related to varied urban topics. The main objective of this article is to compare and analyse city edges and the interface between urban and rural environments. This analysis is based on political and economic values.

The central hypothesis of this work is that the cultural relationship between the citizen and the natural environment is reflected in the peripheral urban form of both cities, creating different morphological patterns. In these areas, morphological characteristics determine the local landscape, and socio-cultural, economic and political characteristics define the urban form of these landscapes. Focusing on this central hypothesis and the main objective, two medium-sized cities were compared: Uberlândia in Brazil, located in the Triângulo Mineiro region, Minas Gerais State, and Christchurch in New Zealand, located in the Canterbury region (Fig. 1).

(a)	(b)
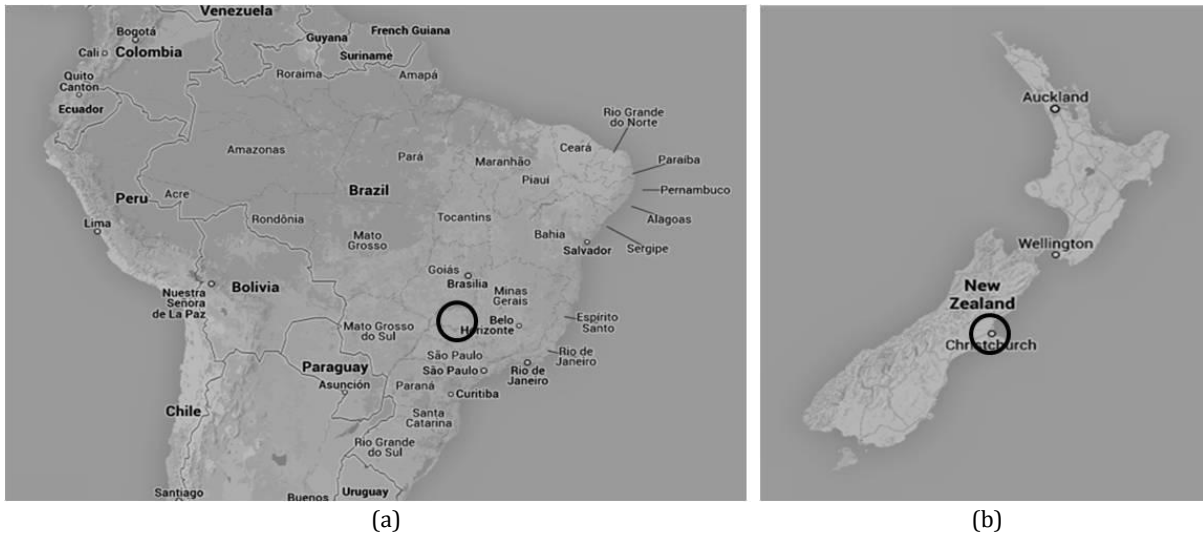
Figure 1. *Satellite image showing Brazil (a) and New Zealand (b), identifying the cities of Uberlândia and Christchurch*
Source: Modified from Google Earth, 2013

Methodology

The adopted methodology was based on the concept of landscape unit[1], which was used to investigate the morphological characteristics of each city. The results were analysed and discussed based on the resulting condition of the city edges.

The case studies

The investigation was based on two case studies: Uberlândia in Brazil, and Christchurch in New Zealand.

Uberlândia

Uberlândia is located in Triângulo Mineiro, a region situated between Grande and Paranaiba rivers in the west of Minas Gerais State. The region plays an important role for the country's economy and has experience rapid urban development. Uberlândia is the second largest city of the interior of Brazil.

The development of Uberlândia urban area started in 1835. The implementation of the new urban development displayed some basic characteristics such as the choice for a site located on a hillside, in a place with little slope, and perpendicular to the church and a river. Like many cities in the region Uberlândia was based on a morphological pattern where the Catholic Church and its churchyard formed the core of new settlements.

Uberlândia has a high human development index and is the second most populous city in population in the state of Minas Gerais. Its economy is based on services and agribusiness.

Christchurch

Christchurch is New Zealand's third largest urban area and the largest city on the south island. The city is bordered by the Port Hills and the Pacific Ocean, and is situated on the edge of the Canterbury Plains. Between 2010 and 2012, Christchurch experienced a series of destructive earthquakes. Many areas of the city, such as its Central Business District (CBD) parks, squares, hills and beaches, have also been affected. Before the February 2011 earthquakes, Christchurch had 376,700 inhabitants, but the population has since declined to around 363,000 (Statistics New Zealand, 2013).

The city is known as the Garden City for its many green areas and urban landscapes; a result of a Victorian style of planning adopted by the Canterbury Association in 1850 (Christchurch City Council, 2013).

Surrounding the historic area – or the Central City – is the area that transitions to the peripheral region, characterised by a region with multi-storey building fewer public spaces and intended for offices and other commercial and industrial activities. The peripheral region – the suburbs – is characterised by generally homogeneous architectural typology. Some differences can be perceived especially near the hills, but almost all with lower density, predominantly residential land use and directly interfacing with the landscape surrounding the city.

Christchurch is also regarded as the most English city outside of England and it carries the legacy of an urban design based on the quality of open spaces and intense urban-rural relationships. These relationships are a result of an economy based on the value of agriculture land which comprises the green belts surrounding the city. The landscape units identified in Christchurch highlight the premises that guide the city's urban design, enhancing a public life and greater contact with the natural environment.

Medium-Sized Cities

According to Costa (2002), the concept of medium-sized city was first adopted in France at the end of the 1960s. At that stage the 6th Economic and Social Development Policy was under development (1971-76). The concept of medium-sized cities has gained importance in the 1970s because of the crisis of many metropolitan areas. These cities also became an alternative for businesses and population of the big cities.

The concept of medium-sized cities varies according to the country where it is applied, and two aspects can be highlighted as the most common for its definition. The first aspect is related to the cities' size and its urban scale, where each country defines the number of inhabitants that characterise the population of a medium-sized city. The second aspect is based on the city structure and its relationship with the territory where it is located. In this article we define both studied cities as medium-sized cities due to their urban structure and regional importance. Both cities are important regional centres in their countries.

Medium-Sized Cities in Brazil

In the past 40 years Brazil has been developing its interior regions through a rural economy. Medium-sized cities are very important to the country's development. These cities concentrate investments, skilled labour, universities, and other important services. They also provide a better quality of life than in most large Brazilian cities. The concept of medium-sized cities in Brazil is related to the number of inhabitants in the settlement. From 100,000 to 500,000 inhabitants is considered a medium-sized city, and there may be variations according to its regional status (Andrade and Serra, 2001). Although Uberlândia's population is larger than this limit with a population of approximately 600,000 inhabitants, it still fits the medium-sized city profile because it maintains characteristics that distinguish it from a metropolis.

Medium-Sized Cities in New Zealand

New Zealand is a young country with a much smaller population. The number of people and size of urban centres is reflected in its urban network (Fig. 2), and the adopted definition of a medium-sized city is different from the Brazilian model. In New Zealand, any urban area with a minimum of 30,000 inhabitants is considered a main urban area.

Figure 2. *Urban network in Canterbury (a) and Triângulo Mineiro, in Minas Gerais State (b)*
Source: Google Maps modeified by Glauco Cocozza, 2013

Auckland is the only city that has a population larger than Uberlândia, and only seven cities in the country have more than 100,000 inhabitants (Statistics New Zealand, 2013). In Uberlândia's region, six cities have over this population and together they total two million inhabitants.

Landscape Units

Landscape unit is understood as a territorial portion of the city where the morphological patterns are similar (streets, buildings, blocks, lots and others). According to Silva (2012), the method of reading the landscape through its units contributes to the understanding of urban form. We understand that this concept provides a broad understanding of the combination between natural, contextual and built environment.

The concept of landscape units was used as a tool to identify the elements of urban form that conform due to the urbanisation process of medium-sized cities, provides an important discussion of the interfaces between urban fabric, environmental quality, ownership and management of urban spaces.

In both studied cities, some specific features can be observed in morphological patterns which define landscape units. These are the result of a centre-periphery occupation, which consolidate the ring that surrounds the central regions and intensify the relationship with the city limits.
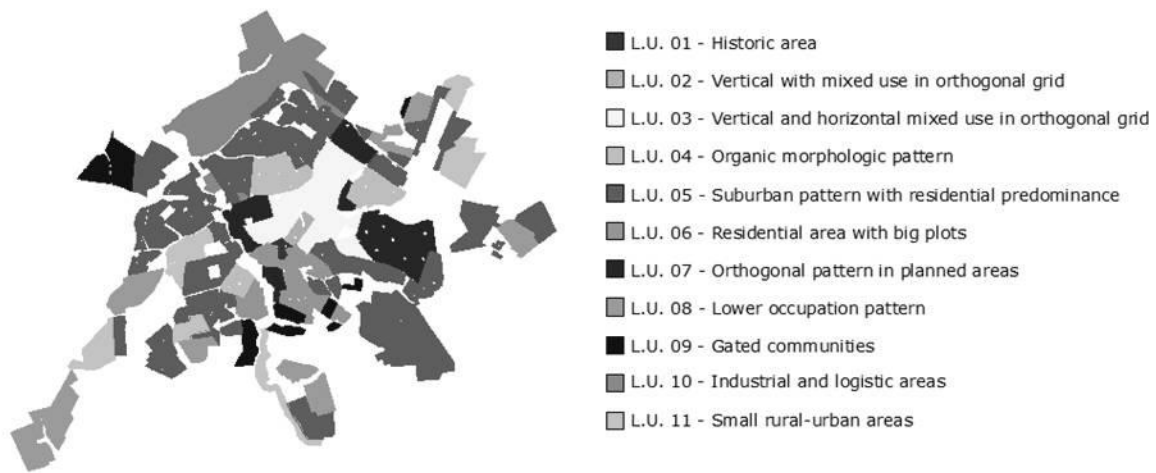
Uberlândia

In Uberlândia, landscape units occur in larger quantities[2] (Cocozza et al., 2011), due to the diversity of patterns derived from the historical process of its urbanisation, by policy and by new settlements that emerge on the city's periphery (Fig. 3).

Uberlândia's peripheral zone is predominantly residential with varied morphologic patterns. These patterns are mainly low rise buildings, residential neighbourhoods with large lots, and both a standard orthogonal neighbourhoods for low income families and areas intended for high income earners.

The units identified demonstrate the morphological diversity of the two cities, which is partly a consequence of specific socio-cultural values in each country. Uberlândia's historical areas are a result of Portuguese urban styles combined with Brazilian urbanisation processes. The urban environment is a result of the transformations that both Portuguese and Brazilian urbanism had throughout history. Its historical part is poorly preserved, but traces remain of urban culture that prevailed in the mid 19th century. The city is currently expanding in different directions, converting the countryside into urban. In this process some valleys are protected for specific leisure uses.

Figure 3. *Landscape Units in Uberlândia*
Source: Lucas Oliveira, 2013

Christchurch

Christchurch is in a different context and, despite the recent challenges imposed by the earthquakes, the city is an important regional centre and commercial gateway to the south.

In comparing the cities, the main difference is the geographical condition of each city. While Christchurch is located on the Canterbury plains, between the coast and a mountain range, the Southern Alps, Uberlândia is located in a region of plateaus in the interior of Brazil. The characteristics of each spatial production process define its resulting urban form, and consequently Christchurch has fewer morphological units within the city, resulting in a more homogeneous urban configuration, while Uberlândia presents a greater number of units throughout the urban fabric.

Christchurch is defined by six landscape units as shown in Fig. 4. The most iconic one, which stands out in satellite images, is the central and historic area, with historical buildings, the highest density in the city, and a good relationship between built and open spaces[3].
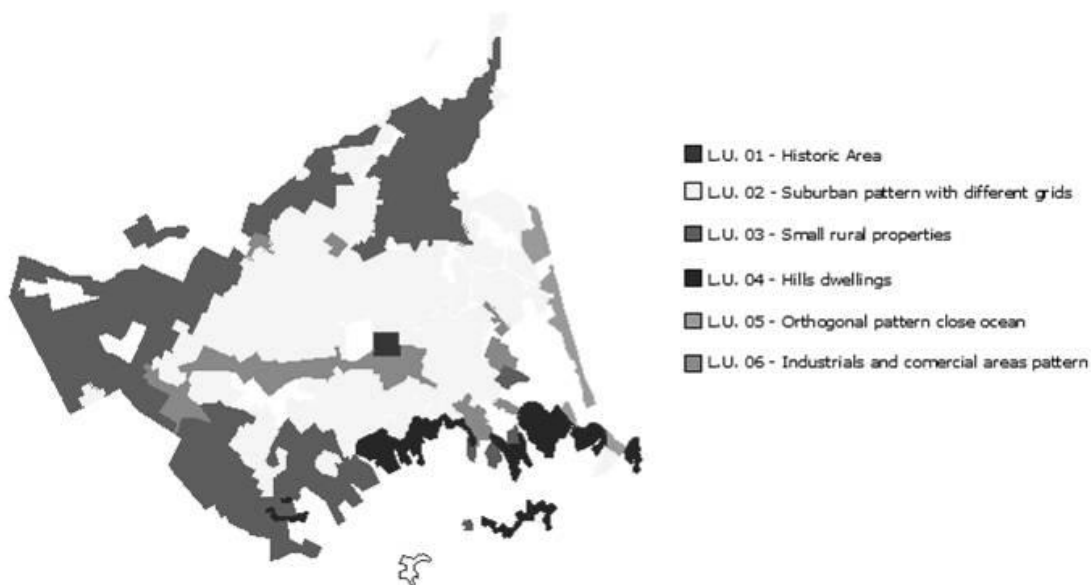
Figure 4. *Landscape Units in Christchurch*
Source: Lucas Oliveira, 2013

Edges of the cities

In a general sense, Uberlândia is similar to Christchurch in its macrostructure, as the old centre is bounded by a more vertical region. It is different in relation to its uses, which are more diversified than in Christchurch. Therefore, the main difference is the existence of a transitional area, separating the centre from the periphery. Morphologically, this transitional region has orthogonal design, medium density, old houses and sheds, and hosts a concentration of services and trades, which generates a diversity of building typologies[4], moreover it has recently presented vertical growth.

As a result of the urban-rural configuration process, six factors can be highlighted. These factors or characteristics determine the differences and similarities between the morphological patterns of Uberlândia and Christchurch peripheral regions:

- The limits between urban and rural
- The relationship between farm size and morphological pattern configuration
- The spatial heterogeneity or homogeneity
- Policy and specific plans for areas
- Discontinuity and continuity of urban fabric
- The local cultural condition.

These six factors generate three main topics that differentiate the condition of the edges of the cities. As discussed below, the three main topics are spatial quality, adaption to the land and the configuration of rural areas.

Spatial quality

In Uberlândia property speculative, especially in the periphery, is also resulting in large land holdings owned by a few people. Therefore market interests dictate the type of occupation and this results in large properties surrounding the urban centre. In some cases they are gradually parcelled and divided between families. As a result of this process, many areas were turned into urban land.

Uberlândia's periphery is configured for providing shelter for people who cannot live downtown. Housing for low income families is built in the periphery and leased by the government or private companies. The same region is also the focus of the speculative activity of high income groups, due to its large available areas with high construction potential. If the coexistence of both social classes occurred in a less segregated way this type of occupancy would be a good strategy, but marked spatial segregation is perceived in the edges of cities that adopt this approach.

The dichotomy between private and luxurious neighbourhoods with low spatial quality is also a consequence of market characteristics in Uberlândia's peripheral region. The ideal of a suburban life where families can have better environmental quality, lower density and more interaction with the natural environment is the aim of the population of both cities. Although the ideal exists for both, it occurs with greater intensity in Christchurch, where living in the peripheral zone is more an option than the "only solution". In many Brazilian cities, including Uberlândia, to live in the suburbs, which are an ideal but not a reality of high quality of life, is the only option.

Christchurch's periphery presents a very different reality. The great homogeneity perceived in Christchurch is also a consequence of New Zealand's social condition, where there is less difference between classes, greater income distribution and higher quality of life in the urban suburbs. A downside is related to the spatial quality, as this homogeneity also generates monotonous suburbs without much spatial variation (Figure 5).

The situation identified in Brazil is a consequence of urban policies that have been adopted by local authorities. Many Brazilian cities were concerned with their peripheral areas and acted to plan these areas and develop proposals for low density occupation, mostly focused on rural environments and connecting them to the urban areas. Brazil experienced rapid urban growth in the middle 20th century and the lack of management and planning are evident in many suburban patterns. In medium-sized cities that process was consolidated mainly in the early 1980s, when middle class families moved to the suburbs searching for a better quality of life. Concomitantly, urban and housing policies were focused on allocating housing to low income families, although the housing provided was of very low quality; the resulting urban space defines the current Brazilian peripheries landscape.

(a)

(b)
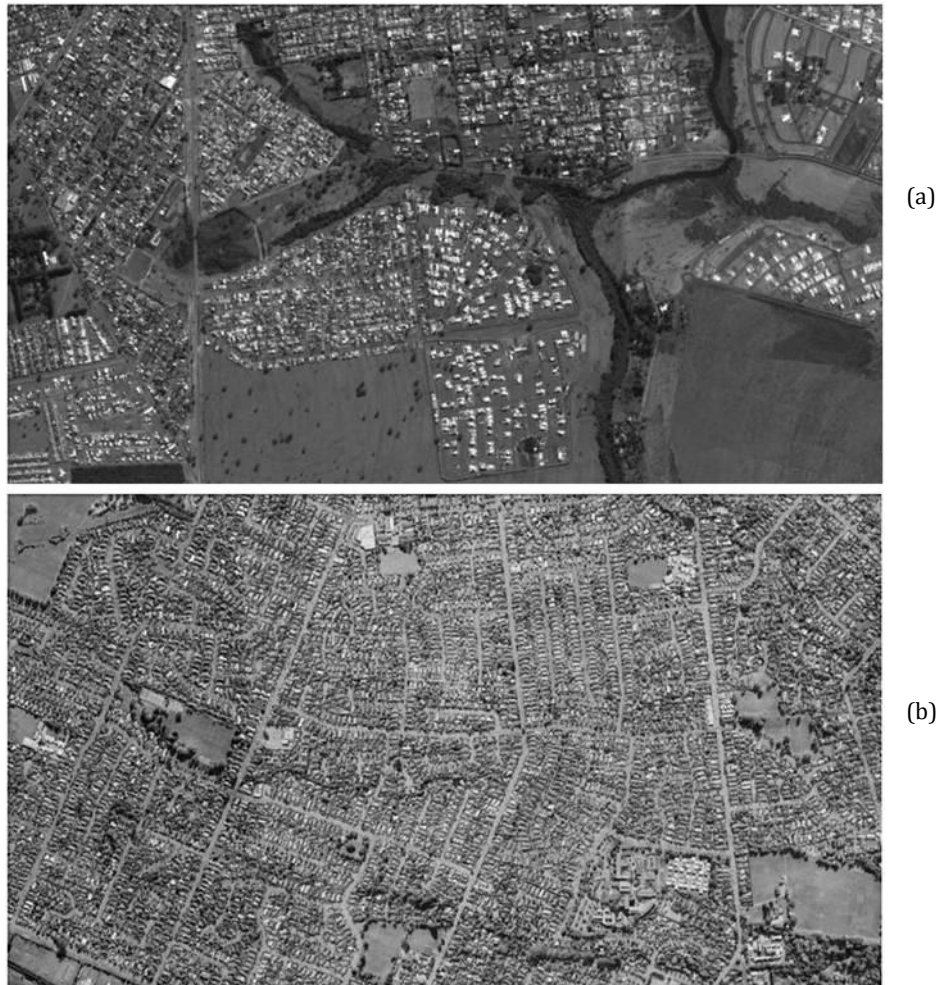
Figure 5. *Heterogeneity and homogeneity. Uberlândia with many morphologic patterns (a), and Christchurch less morphologic variations (b).*
Source: Google Earth, 2013

In contrast to Brazil's planning, Christchurch City Council undertakes careful planning for peripheral neighbourhoods. The planning is focused on several aspects such as commercial areas and green spaces, as well as policies for rehabilitation and reuse of urban and rural areas. With the intention of promoting the quality of urban environment, Christchurch City Council has adopted some strategies focused on respecting the local context and characteristics, promoting diversity, creating varied urban connections and developing a sense of urbanity within the local community.

Figure 6. *North West Christchurch occupation plan. This image shows the care with the edge areas.*
Source: Google Earth modified by Glauco Cocozza, 2013

The ability of the local government in defining these strategies in accordance with local economic, urban, socio-cultural and environmental conditions is an important characteristic. This ability becomes clearer on urban plans that emphasise both the city's history and spatial characteristics, and its contemporary characteristics. The difficulties faced after the recent earthquakes highlighted social and political cohesion in a post-disaster context of a city that has to be largely rebuilt. Uberlândia, on the other hand, seeks to promote urban quality through build infrastructures focusing on generating employment and quality of life.

Another important difference is the amount of information and proposals provided by the Christchurch City Council and available to the community in contrast with the absence of Uberlândia's local plans. In Uberlândia zoning law determines how the city's territory is occupied, and a consequence of this process is limited morphological urban design potential. Therefore, most of Uberlândia's urban area has not been planned according to morphological aspects, and its morphology is a result of land regulations and its zoning law. The city relies on large urban restrictions to innovative planning and design, while facilitating profit related activities in the process of spatial production, especially in the periphery of the city. This scenario reflects the current context of Brazilian urbanism, which is focused on specific and speculative urban design actions with little integration with the local landscape.

Adaption to the land

The second aspect of peripheral urban form in both cities is the cultural relationship that residents have with urban, rural and natural spaces. New Zealand's outdoor culture and relationship with the environment is a main factor influencing the aspects previously discussed (Tavares et al., 2013). Christchurch is located between the mountain and the sea; recreational activities related to these landscapes prompt a strong interaction and attachment with the natural environment. This relationship is reflected in the edge of the city, where residential unities count on a large amount of open space. Christchurch is also known as the Garden City, as previously described, and extensive care for the front and backyards is easily perceived. Also at the neighbourhood scale there are a large number of public parks.

In the interior of Brazil, interaction with the environment also exists, but it is not translated into morphological patterns that foster greater integration between peripheral urban spaces and natural environment. The surroundings of Uberlândia present various spaces for outdoor activities – such as farms, ranches, rivers and dams – but the disconnection between the peripheral urban space and the natural environment interferes with the daily life of the edge areas residents.

Regarding the social classes, there is also a difference in the possibilities of enjoying and being connected to natural spaces. Neighbourhoods intended for low income population lack quality public spaces, while in upper class neighbourhoods the stronger relationship with nature is a consequence of marketing conditions that favour private spaces reserved for this small portion of the population.

Rural areas

In Uberlândia, an interesting aspect of the urban perimeter is that large properties induce a design disconnected to the pre-existent landscape around it. There are still large urban voids within the city, which are configured by unoccupied areas due to specific interests defined by the market. The investors' strategy is usually to create neighbourhoods in the peripheral areas while they wait for the inner city lands to increase in value. As the owners of these unoccupied urban lands are the same owners of large peripheral urban areas, urban voids are generated.

Christchurch limits between urban and rural are less evident (Fig. 7). The integration between the city's morphological patterns and the peripheral spaces for rural activities are represented in a gradual and more connected change in the landscape. This circumstance generates a morphological pattern that allows for greater continuity between the urban area and its surroundings. In contrast, Uberlândia has its city limits as physical, cultural and environmental segregated areas.

(a)

(b)

Figure 7. *Rural properties around the city. Larger properties in Uberlândia (a), smaller rural areas in Christchurch (b). Source: Google Earth, 2013*

Both Canterbury and Triângulo Mineiro historically have a close relationship with the rural environment, and in both cases it enhances the local economy and defines urban networks. A remarkable feature in the peripheral morphological patterns is the size of farms around Christchurch. The farms form a ring of small properties used as productive farms or lifestyle blocks[5], which extends into the great plain around the city. Small towns are connected to Christchurch through these properties, creating an urban-rural network,

and producing a cultural landscape for a common way of life for the local population. These small farms produce an urban fabric where the urban-rural transition is gradual and integrated. As a result, the landscape references the territory through a design that responds to the specific local lifestyle requirements and land conditions.

Historically, Brazil is characterised by large rural properties, due to the country's large territorial area and the difficulties in ocupying the interior of the country. The occupation of these interior areas was only consolidated in the middle of the 20th century and Triângulo Mineiro's urban network was consolidated during this period. Nowadays the region is still comprised of cities that are located long distances from each other, and this is a result of large properties that formed the local ancient villages. Uberlândia's region relies on varied farm types based on agriculture or livestock, and these farms are mostly large properties, the product of the process of occupation of the Brazilian countryside. Whereas the large properties are predominant, some small farms coexist in the area as a result of large farms subdivision. These small properties are called "chácaras" and many of them are provide leisure for the local population, similar to the lifestyle blocks found in Christchurch.

Conclusion

In this paper we identified six main factors that generate the discussed configuration of city edges. They are: the urban-rural limits; the relationship between farm size and morphological pattern configuration; spatial heterogeneity or homogeneity; policy; urban fabric discontinuity or continuity; and the local culture.

This work demonstrated some socio-cultural, political and economic aspects that define the relationship between the citizen and the natural or rural environment. This relationship is reflected in the urban form of peripheral areas of both Christchurch and Uberlândia, creating different morphological patterns. This study also showed that different processes of spatial configuration are crucial when the topic under study is the peripheral region. The periphery is economically valued in Brazil, but it is also a place of contrasts and social conflicts which is segregated from the rural and the natural environments. In constrast, peripheral regions in New Zealand are culturally valued and intensely connected to urban and rural environments.

The comparison of these two different realities highlights some thoughts that individual case studies would not reveal. It is like looking from outside to our own reality, without preconceptions, where we can observe what actually defines some patterns and morphological characteristics in diverse contexts.

The diversity of morphological patterns presented indicates that the cities' peripheral edges reflect a cultural condition which integrates or segregates the cities' urban and rural spaces. The identification of socio-cultural values, in both Brazil and New Zealand, in relation to the cities' peripheral regions reflect the value that the nations attribute to these two spheres of life – urban and rural – in medium-sized cities. While in New Zealand living in the periphery is an option for most residents who wish to be directly connected to rural and natural environments, in Brazil it is less an option as an area occupied by those excluded from the central areas. The conditions of peripheral areas in Brazil also vary according to political, economic and social aspects.

The condition of the city limits are a socio-cultural consequence. Brazilian medium-sized cities are generally focused on establishing themselves as regional centres with great economic potential and varied activities that attract people of various regions[6]. The surrounding rural areas supply food for the city and generate employment, income and recreation for residents. Therefore the rural areas were and still are important to the city sustainability, but nowadays they configure a barrier to urban development. In Uberlândia there are still some natural areas and agricultural production within the urban limits, but these areas are disconnected from the urban surroundings. The reality in Christchurch is different, as the agrarian economy and outdoor culture are factors that contribute to the integration between urban and rural limits (Tavares et al., 2013).

Every society seeks to identify with their environments and generate a sense of place. However, in this comparative study, it became clear that New Zealand's society has a much clearer idea about the role of cities' periphery and its environment than Brazilian society. In Brazil the cities' periphery is fragile and unstable as a consequence of the lack of identity combined with poor political and economic conditions for providing quality of life to medium-sized city residents. Urban section configurations in specific areas of the city are a consequence of socio-cultural, environmental and economic variables. The understanding of the morphological patterns of peripheral urban areas helps to identify spatial production processes.

Acknowledgement

Endnotes

[1] Morphological units identified in the urban fabric. These morphological units are aggregated by similarity of morphological elements.

[2] Shows how the average Brazilian city with its centre, sub-centre, peripheral ring and discontinuous periphery.

[3] In 2010 and 2011 earthquakes extensively destroyed Christchurch Central City. After two years some buildings are still being demolished, and the area has been turned into a "rebuilding site" through a redevelopment project of its urban space.

[4] In the case of Uberlândia, the Mogiana Rail Company was responsible for orthogonal urban design that connected the old town to railway.

[5] "Lifestyle block", as it is known in New Zealand, is also known as "hobby farm" in other countries. It is a small farm maintained for recreation without expectation of being the main source of income, although some can generate an additional profit. It is more a country home than a business.

[6] The last demographic survey showed that 70 percent of Uberlandia's residents are not born in the city. In Christchurch the opposite occurs and many residents move to Auckland or Australia searching for opportunities.

References

Andrade, T. A.; Serra, R. V. (2001) 'O desempenho das cidades médias no crescimento populacional brasileiro no período 1970/2000', in Andrade, T. A.; Serra, R. V. (org.) *Cidades médias brasileiras* (IPEA, Rio de Janeiro).

Amorim Filho, O. B.; Sena Filho, N. (2005) *The medium-sized cities morphology* (Vieira Press, Goiânia).

Christchurch City Council (2013) Christchurch City Council (http://www.ccc.govt.nz) accessed 10 February 2013.

Cocozza, G. de P; Oliveira, L. M. de. (2011) 'Urban form and open spaces: the case of Brazilian medium-sized cities', Conference proceedings (18th International Seminar on Urban Form – ISUF, Montreal).

Costa, E. M. da. (2002) 'Cidades Médias: contributos para sua definição', Finisterra, XXXVII, 101-128

Statistics New Zealand, Tatauranga Aotearoa (2013)

(http://www.stats.govt.nz/Census/about-2006-census/2006-census-definitions-questionnaires/definitions/geographic.aspx#secondary-urban-area) accessed 15 January 2013.

Silva, J. M. P. (2012) 'Landscape Unit and the Urban Form studies: reflections about its contributions to the disciplinary field of architecture and urbanism', 7th COLÓQUIO QUAPÁ-SEL, 2012, Campo Grande (7th Colóquio QUAPÁ-SEL. Campo Grande).

Tavares, S., Swaffield, S. Stewart, E. (2013) 'The socio-cultural meaning of urban comfort and its implications for urban landscape design' (CELA Annual Meeting, Austin).

Precarious housing in risk areas: perspectives within vulnerable communities in Brazil

Gabrielle Astier de Villatte Wheatley Okretic
Pontifícia Universidade Católica de Campinas, São Paulo, Brazil
Email: gabrielle.astier@gmail.com
Laura Machado de Mello Bueno
Pontifícia Universidade Católica de Campinas, São Paulo, Brazil
Email: laurabueno@uol.com.br

Abstract. *This paper analyses the case of an irregular settlement in the suburban region of Campinas in Brazil, situated by the margins of the Picarrao Creek. We focus on the family reallocation process and its consequences on the community. Our goal is to show the local reality of these communities and how the assumed risks and related governmental policies are assessed. The analysis will be based on reports from a social services agent from the city hall, as well as local leaders and people living in the described reality (having no means to change it).*

Keywords: dwelling, precarious housing, vulnerability, risk areas

Several factors – political, economic, social and environmental – compel a significant portion of the Brazilian population to live in precarious housing arrangements in environmentally vulnerable suburban regions. The majority of this population has no chance of inserting themselves in urban centres or of participating in the formal real estate market. Examples of such regions are cliff tops, landslide prone hills, river margins and flood susceptible areas. These areas are associated with urban development models that restrict water percolation in the soil, increasing flooding, landslide and runoff events, and incurring frequent material damage. The precarious houses are typically constructed with no technical support and often employ low quality materials, contributing to the risk for incidents.

In Campinas, second largest city in Sao Paulo state situated 100 km from the state capital, the described scenario can be readily observed in suburban areas. With the increasing rate of disasters in the last years, the government is starting to act by implementing new housing options and removing populations from dangerous areas. The new settlements are often far from the original neighbourhoods and public infrastructure such as schools, health clinics, commerce and services.

Methodology

The development of this work was accompanied by bibliographic review, with the intention of deepening knowledge of the subject in question. By comprehending the origins of the problems, and not just its effects, root causes can be extracted, enabling action at several scales and focus.

A survey of local legislations and public and private investments was undertaken with the intention of understanding how public powers coed with the habitational question in Campinas.

Interviews were conducted with representatives of Campinas Hall and the local leadership of settlements which are suffering in the removal process. A questionnaire was conducted with the population who live in local risk conditions or suffered the relocation process.

Introduction

Housing is a basic human need postulated as a human right (Universal Declaration of rights of human OUN 1948). This right must be recognised and protected in the urban sphere, given its positioning as a fundamental right in the current Brazilian Constitution (Constitution of 1988). Regardless of age gender, social class or ethnicity, the realisation of the right to housing should be basic to all human beings and their security. This extends beyond the production of housing to the quality and health criteria for decent housing as well as the cultural representation and social subjects who inhabit it. Thus, the right to housing is presented and the right to property, as a play space of the human person.

According to Vaz (2002), the most important element of the built environment is undoubtedly housing. Occupying a substantial portion of urban land, housing is a basic element in reproduction of labour power and a privileged element of capital investment in the city. As part of everyday life, housing influences social practices, supports individual and collective memory, guards meanings for different segments of the population and is part of the formation of social identities. It is therefore at the centre of the space-society relationship.

Housing extends beyond built housing. Having access to adequate housing requires access to essential services such as natural and common resources, safe drinking water, sanitary facilities, infrastructure for waste disposal and drainage, and others. In addition, housing should be located in areas that allows access to employment, health care and education, in order to decrease expended time and financial resources as a result of dislocation (Maricato, 1999; 2001).

Adequate housing is understood as the provision of decent housing, quality of life and economic and social development to citizens. Furthermore, according to the World Charter for the Right to the City (Article 14 – Right to Housing), it should represent bearable spending in relation to a resident's income, good living conditions and be in an appropriate place, with infrastructure and supply of urban equipments and services. The adoption of appropriate public policies contribute to the access to adequate housing, such as the establishment of grant programs and funding to acquire land and property; land regulation and upgrading of informal settlements and poor neighborhoods, as well as compliance vulnerable groups (Plano Municipal de Habitação de Interesse Social, p. 98).

Housing in Brazil

In Brazil, housing is a major social issue. Integrated into the question of the right to the city, the claims in relation to housing emerge under various facets: solutions to the serious problems of infrastructure, housing construction to meet the alarming number of families without their own homes and questioning urbanisation in peripheral areas and slums (Motta, 2012).

Is important to understand how current urban problems, especially those related to housing, reflect a century of policies that have not considered the poorest. Since 2003, but especially since 2007, there was a significant expansion of financial resources in Brazil in the area of housing ($1.76 billion in 2002 to $18.3 billion in 2007, $29 billion in 2008, $32.9 billion in 2009, and finally $23.8 billion in 2010) (Maricato, 2011, p. 61). However, the lack of adequate and affordable housing persists, exacerbated due to the enhancement of land and built space, reinforcing the logic of rental housing and large houses on cheap land in the suburbs.

Knowledge of the problem: urbanisation of Campinas and the issue of housing

In the Campinas Metropolitan Region (CMR) about 97.3 percent of the population live in urban areas, equivalent to 72.022ha of land, representing 19 percent of the total area of the RMC (Metropolitan Plan for Social Housing). While considered urban, these areas lack the infrastructure and services necessary to provide quality of life for the entire population, as a proportion lives in poor housing conditions.
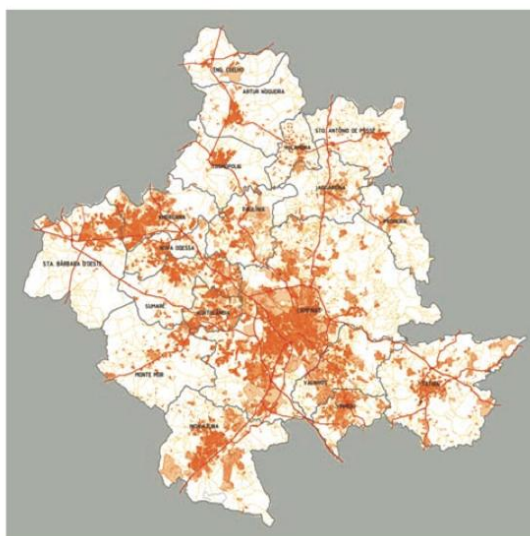
Figure 1. *Região Metropolitana de Campinas: área urbanizada e área rural – 2005*
Source: EMPLASA

The population growth in large cities in recent decades has brought unacceptable consequences in regard to the occupation of areas on the urban fringe. People barely survive in precarious housing situations. In the region of Campinas, in the state of São Paulo, a considerable portion of the population lives in precarious conditions. According SEADE Research (State System Data Analysis), 5.6 percent of the population of the Metropolitan Region of Campinas live in risk areas, slums or tenements, or inappropriate areas, which is equivalent today to more than 200,000 people. In 2000, according to the IBGE, the MRC recorded a housing deficit of 45,196 households. In addition, there was a mismatch of households in relation to infrastructure (more than 60,000 households), increased density (more than 40,000 households), land property inadequacy (almost 30,000 households) and households without toilets (over 5000) (Metropolitan Plan for Social Housing). This picture is reflects social inequality within the urban context, and demonstrates the differences between the city of the rich and the poor, the legal and illegal city. Much of the urban population is excluded and no longer has access to public policies and services, or to the urban land (Plano Municipal de Habitação de Interesse Social).

Figure 2. *Location map of Campinas*
Source: Caroline Pera and Laura Machado de Mello Bueno

In Campinas, the process of accelerated urbanisation, coupled with periods of expansion and contraction of the economy, has resulted in the growth of the municipal population. This is attributable to the opening of jobs that attracted workers from different regions of the state and the country. Many of these workers, excluded from this process, represented the only supply of labour at low cost, resulting in socio-spatial segregation in the region.

The early 20th century was marked by rapid urbanisation driven by coffee production, which intensified over the century and experienced strong growth from the 1950s onwards. The city's strategic position in relation to rail and the coffee producing region placed it in a privileged position to receive initial investments from the surplus of coffee production channeled into industrial activities. This growth was responsible for the increase of the urbanised area of the city although this was not accompanied by urban and housing policies addressing the needs of the poor workers who migrated to the city (Municipal Plan for Social Housing Campinas).

The presence of slums and irregular settlements in the municipality of Campinas is historically related to the dynamic of the city's urban development. The formation of slums in the city of Campinas, indicated by early records, coincides with the period of most rapid population growth. The peripheral growth in Campinas is characterised by the opening of popular allotments on land far from consolidated areas of the city. They are close to new industrial districts and new roads but are isolated and disconnected from the city and lack environmental and urban quality.

Since the 1960s, the process of land occupation by the excluded population occurred through increasingly precarious areas such as along railway lines (disabled or not), roads, river banks, among other places. Irregular subdivisions, mostly implemented in 1950s in the regions of the Southwest and Viracopos International Airport, feature dense urbanisation and are extremely far from the downtown area (Plano Municipal de Habitação de Interesse Social de Campinas).

The characteristics of precarious housing in Campinas are directed related to urban development of the city which, in turn, has been marked in recent decades by different processes of urban occupation in their macro-regions. Two antagonistic forms of suburbanisation with residential use can be identified: that of closed condominiums, occupied by population layers of middle and high income; and the subdivisions and peripheral and popular neighborhoods which are occupied by low income residents (Freitas, 2008).

As indicated by the geographer Harvey, a heightened appreciation of real estate has taken away the 'right to the city' and pushed people from the lower classes to the periphery, as a result, those working in central areas or with more infrastructures cannot afford to live in these areas (Harvey, 1980). The high value of the land affects the final cost of the house, making it more inaccessible to these families, who find a solution to their housing problem in the informal market.

The World Charter for the Right to the City raises the question of urban reform and democratic management in relation to development of public policies that aim to guarantee the basic rights of all to quality housing, water and sanitation. To influence these policies, democratic management of the city is proposed, that is, the participation of social actors is encouraged in decisions concerning management and city planning. These participatory practices include participatory budgeting, masterplans, and Councils. According to the Metropolitan Plan for Social Housing, the RMC only has the Thematic Chamber of Housing.

The Statute of Cities – Law 10.257/2001 – already stipulated the need to ensure the "right to sustainable cities, understood as the right to urban land, housing, environmental sanitation, urban infrastructure, transport and public services, work and leisure for present and future generations"(Article 2 Statute of Cities).

The main national housing program "Minha Casa, Minha Vida", initiated in 2007, supports low income individual house buyers directly, houses in condominiums or apartments. Development companies are the

main entrepreneurs in the projects, with their projects approved by the city administration, as is the case in Cosmos and Bassoli housing projects to which the residents of Jardim Florence neighborhood are being transferred. The implementation, urban insertion and architectural urban project of these places repeat several mistakes already criticised by world literature about social housing.

Figure 3. Picture of the local removals. Local Plan for Social Housing.
Source: Plano Local de Habitação Social de Campinas

The federal government and private sector are also denying financial and knowledge resources – including technical skills – for slum urbanisation and restoration. There is a need for a diversity of solutions – for example, within neighborhoods in relation to land possession and informal layout, quilombos and human centres in conservation units. These programs, which are more adequate to different social needs, have few resources and are ignored by the private sector and have low acceptance by the municipal teams.

Research area: Jardim Florence II

In the southwest region of the city, a process of occupying peripheral areas has been established since the 1940s, associated to a planned production of infrastructure for the movement of goods.

This infrastructure includes the Anhanguera Highway, Viracopos Airport which is currently expanding to become the largest cargo airport of Brazil, the railroad which was the first modern export corridor, the Bandeirantes Highway which is Brazil's first blocked expressway of the 1980s and 1990s and sections farms and housing developments. In the same period the first sets are constructed to receive ex-squatters from downtown Campinas.

In the predatory process of urbanisation, the public and the private sectors have implemented local high impact activities for disposal – public and private dumps and landfills and legal and illegal spaces for popular housing. This way an entire precarious and unregulated region has been produced.

The postwar period has also seen the city of Campinas attract an expressive contingent of skilled labour which puts pressure on the municipality to meet housing needs (Municipal Plan for social housing). This process has resulted in many neighborhoods with inappropriate or inadequate urban infrastructure and services. They have become hostages of various land possession irregularities, featuring a 'peripherisation' process of the municipality supported by real estate speculation and profiteering for those responsible, although this excessively penalises the first residents these new neighborhoods.

In the 1970s, the development of a 'second fringe' began, characterised by the large incidence of clandestine or irregular slums described as 'peripheral'. Both housing modalities are mainly located around the planned housing projects or on unused land along highways and areas for the protection of water courses. They have attracted residents poorer than those in the first stage of formation of this urban region. The allotment, Jardim Florence I and II, was implemented in 1970 with 730 lots. Public areas were occupied.

The region of Jardim Florence, where the study area is located, has a total area of 93,123.44 m² and is comprised of 542 households. The type of settlement is classified as slums by the Municipal Housing Plan.

Figure 4. *Jardim Florence II*
Source. Barbara Ghirello

Resident testimonies provide different starting dates for the removal process. The need for removal is recognised by residents. The local leadership says that the population has been waiting for several years for a response to people living in dwellings in hazardous areas without decent housing conditions.

Vulnerability and risk

Under the effects of globalisation, contemporary Brazilian cities are characterised by profound social inequalities and exposure to environmental risks. In addition to the uncertainties of unemployment, lack of social protection and job insecurity, workers are subjected to the risks of housing on dangerous slopes, water course banks subject to flooding, and areas contaminated by toxic waste pipelines located on or under electricity transmission lines. They also have uneven access to environmental resources such as water, sanitation and safe ground (Acselrad, 2001).

Phenomena such as landslides, floods and other events associated with the urban built environment are linked to natural rainfall and rugged topography. Their impact is felt through the complex process of human occupation of urban areas, as well as the interventions or omission of the authorities that reconfigure the design of the city. There is a conflict, involving various social actors, that outlines the confrontation between an inhomogeneous technical discourse of a widespread and dominant idea of 'risk' and the counter-discourse of the population that reclassifies this dominant notion (Cardoso, 2005).

Silva (2013) registered several zones of sacrifice[1] in the area, one being the Export Corridor[2], one of the area's boundaries. In the case of Campinas, several sites have been sacrificed for excavation of sand, earth and stone for construction. Also, eroded areas lack infrastructure works – which besides having great visual impact can be disease vectors – create enclosure, and are used for circulation of residents.

The other edge of the area on the East is the Piçarrão stream, a tributary of the river Capivari with flood plain and gentle topography. These rivers were rectified in the 1970s to reduce the flood areas, increasing the velocity of domestic and industrial sewage released. These areas have been explored for the removal of clay and sand for the construction industry; activity which is currently illegal.

The Export Corridor was built in the 1980s, becoming a barrier in the socio-spatial relations intraurbanas. Accidents occur daily because the residents must cross the tracks for mobility. They are also subject to noise and air pollution produced by cargo rail system.

Legislation and vulnerability

The Forest Code, Federal Law n.4.771 1965[3], sets the standard for protection of forests and the environment in general, including protection of springs and water bodies and particularly vulnerable areas, such as mangroves and salt marshes. These are designated as Permanent Protection Areas – APPs. In 1986 the Federal Law n.7511 extended the protective strip along the water courses with less than 10m in width from 5m to 30m. In 1989, the enforcement of the Forest was also applied to cities.

The issue of risk is attracting more attention in public policy, including urban policies, and generates diverse initiatives with respect to the identification, mapping and control of risks associated with floods and landslides in irregular areas inhabited by low income populations.

Urbanisation in Latin American countries is driven by economic interests – and the demand for extraordinary profits – which favours the access of elites and the more affluent to a urbanised city. This means the perverse exclusion of the lower classes from access to such resources. As pointed out by Cardoso (2003), there is an opposition between the 'formal city' and the 'non-urbanised or informal town' which is marked by sustaining a pattern of urbanisation with low levels of public investment and a high degree of competition between social groups for the access to these 'scarce' resources. Characteristics of the land market, for example, make risk areas (near landfills, subject to floods and landslides) the only affordable areas to lower income groups, who build local households in precarious conditions and are subject to other health and nutritional issues. This accumulation of socio-economic and environmental risk implies a great challenge in terms of public policy that, in most cases, tends to be compartmentalised according to sectors and areas of intervention (Torres, 2000).

In 2003 the Ministry of Cities[4] was created, with four departments. The Department of Precarious Settlement Urbanization (DUAP), inside SNH, has the authority to propose the development and promote the implementation of programs to support the public sector and non-profit civil entities with the goal of improving the conditions of habitability of precarious settlements as well as expand access to decent housing of low income populations in urban and rural areas. Programs for improving the living conditions of precarious settlements aim to address precarious housing characterised by several attributes including land and/or urban irregularity, infrastructure deficiency, subject to flooding, landslides or other environmental risk, high levels of density and poor building construction (Department of Housing – DUAP). This is also the Secretariat engaged in the selection of housing projects by FNHIS (National Fund for Social Housing), public provision by the *Minha Casa Minha Vida* (MCMV) program, and private provision in relation to the demands generated the population at risk.

The National Secretariat of Urban Programs (SNPU) develops the program, Land Regularization of Precarious Settlement and of Prevention and Containment of Risks Associated with Precarious Settlement, and promotes the development of studies and municipal plans to eradicate risk situations through financial support. However, these actions are not sufficient in terms of resources, scale and the design of policies which are structured sectorally.

In April 2012, law 12.608 passed the National Policy of Protection and Civil Defense, creating a council, a fund and a national alert system, under the coordination of the Ministry of National Integration. The federal effort should improve provincial and municipal Civil Defenses, present mainly in the capitals of the provinces. This law also modifies the Statute of Cities. The new law states that those municipalities that want to expand the urban perimeter must prepare geotechnical studies to map areas of risk and establish rules for the implementing the works. However, accidents and disasters continue to generate large numbers of human losses as well as destruction of environmentally sensitive areas and facilities.

Conclusion

Cities should be considered as complex ecosystems, involving a dense network of metabolic processes and non-linear exchanges of matter, energy and information. They should be seen as having circular metabolism that integrates the components of a system under different paths (Andrade, 2005). They differ from each other in terms of their economic, social, cultural and environmental interactions. The development and maintenance of the autonomy of a city, for example, are related to a large number of educational, cultural and technical networks and the interconnection of their interaction units.

If we consider the city as an ecosystem composed of subsystems of complex networks, such as villages and urban neighborhoods, we must understand the interrelationship as systemic processes of disorganisation and organisation. These parts of the city are interconnected and interdependent, and a change in one part of the city results in a change in another.

It is necessary to consider the city as a whole and think about the changes as beneficial processes both in local housing and the relationship with the environment. Simply removing the population from risk areas will not necessarily bring better quality of life. It is necessary to address the inclusion of these people in the city. Many of the housing complexes offered to this population are isolated, as can be evidenced by the interviews, and are not always risk-free. This population, which was subject to environment risks, is now subject to social risks. The only alternative offered by the City to this population is to relocate them to these housing complexes.

It takes cooperation between the government and the local population to achieve greater insertion of the population in the city; better planning and infrastructure for low income populations is also required. Local development must be undertaken so that these people develop their economic and social opportunities and position within the context of the city. It is the role the government to work together with citizens towards the improvement of the city as a whole.

Acknowledgement

Endnotes

[1] The expression of Sacrifice Zone (Acselrad, 2010; Silva, 2013) is rooted in social movements in North America have been used in order to designate the locations with overlapping projects and facilities responsible for damages and environmental risks and living areas of populations low income. The land value is lower, as well as access of residents (with organisational weakness and political representation) decision making processes, which determines the choices of locations targeted for use and disposal of hazardous waste industrial and urban.

[2] Connects the central-western Brazil and the state of São Paulo to Port of Santos, the largest in the country.

[3] In October, 2012 the Congress approved a new Forest Code, Law no. This decreased the buffer zones, expanding areas agricultural production for export.

[4] Four departments – Housing (SNH, the National Housing), Sanitation (NHS – National Bureau of Sanitation), Urban Mobility (SeMob – National Department of Transport and Urban Mobility 2003) and Urban Programs (SNPU, the National Urban Programs).

References

Acselrad, H. (2010) *Ambientalização das lutas sociais – o caso do movimento por justiça ambiental. ESTUDOS AVANÇADOS* 68 (http://www.scielo.br/pdf/ea/v24n68/10.pdf), 103-19.

Andrade, L. M. S. (2005) 'Agenda verde X Agenda marrom: inexistência de princípios ecológicos para o desenho de assentamentos urbanos', Tese (Mestrado) (Faculdade de Arquitetura e Urbanismo da Universidade de Brasília. Brasília).

Cardoso, A. L. (2005) 'A construção social do risco ambiental em uma favela do Rio de Janeiro', Desenvolvimento, crise e democracia na América Latina: anais do XXV Congresso da ALAS (ALAS, Porto Alegre).

Department of Housing – DUAP (http://www.cidades.gov.br).

Freitas, E. (2008) L. H. de. Loteamentos Fechados (USP, São Paulo, Brazil).

Harvey, D. (1980). *A justiça social e a cidade* (HUCITEC, São Paulo).

Harvey, D. (1993) *Condição pós moderna* (Edições Loyola, São Paulo).

Maricato, E. (2011) *O impasse da política urbana no Brasil* (Editora Vozes, São Paulo).

Maricato, E. (1999) T. M., "Habitação e cidade" (Atual Editora, São Paulo).

Maricato, E. (2001) Brasil, cidades: alternativas para a crise urbana (Editora Vozes, Petrópolis).

Motta, L. (2012) *A questão da Habitação no Brasil: Políticas públicas, conflitos urbanos e o Direito à* Cidade (Minas Gerais).

Plano Metropolitano de Habitação de Interesse Social. (2011) Agência Metropolitana de Campinas. Agemcamp.

Plano Municipal de Habitação de Interesse Social em Campinas (2011) Prefeitura Municipal de Campinas.

Sarlet, I. W. (2003) 'O direito fundamental à moradia na constituição: algumas anotações a respeito de seu contexto, conteúdo e possível eficácia', *Revista Brasileira de Direito Público*, Belo Horizonte 2, 65-119.

Silva. R, (2013) *A. da. O processo de expansão urbana recente da região sudoeste de Campinas/SP – agentes e impactos.* Dissertação Mestrado (POSURB PUC Campinas).

Torres, H. (1997) *Desigualdade ambiental na cidade de São Paulo. 263 f. Tese de Doutorado em Ciências Sociais* (Programa de Pós-Graduação em Ciências Sociais/Universidade de Campinas).

Vaz, L. F. (2002) *Modernidade e Moradia – Habitação coletiva no Rio de Janeiro, Século XIX e XX, Ed* (7 Letras, Rio de Janeiro).

Suburban zone of 'The Transect': comparing morphologies and design qualities of residential neighbourhoods in Sydney, Kolkata and Miami

Sumita Ghosh

School of the Built Environment, University of Technology, Sydney, Australia
Email: Sumita.Ghosh@uts.edu.au

Abstract. Morphologies of human environments vary in terms of their nature, spatial characteristics, and intensity of development. 'The Transect', an integrated zoning code for the City of Miami in USA, provides form based guidelines for development along rural and urban continuum. 'T3 Sub-Urban' is a suburban zone out of a total of six types of zones classified under 'The Transect'. This paper focuses on examining morphologies and qualities of suburban neighbourhoods in three cities in three different countries of the world. Three cities: Sydney, Australia, Kolkata, India and Miami, USA are selected as their social conditions, cultural backgrounds and planning controls vary. An urban to rural cross section will be identified for each of these cities. Three typical suburban residential case studies, one from each of these three cities will be selected at a local scale. Using Geographic Information Systems (GIS), a spatial analysis estimates land cover pattern, dwelling density, and others relevant values for each of these three case studies. A visual analysis is conducted to understand design features, aesthetic qualities, and characteristics of these neighbourhoods. Outcomes of spatial analyses on the case studies are compared. Morphological characteristics can significantly influence neighbourhood sustainability and design performance.

Keywords: transect, form based zoning, morphology, suburban, neighbourhood

Introduction

Morphologies are shaped by socio-economic conditions, peoples' lifestyle preferences and perceptions, performance of economies, and spatial geographies of locations, functions and interrelationships (Gleeson 2006; Forster 2004; Whitehand et al., 1999). Theoretical foundations of urban morphological research include three main theories. First, 'a theory of city building' was developed through Conzen's pioneering analytical research on Alnwick, Muratori's descriptive work on historical evolution of cities and Whitehand's establishment of new interdisciplinary inquiry methods and interactions (Moudon, 1997). Second, Caniggia's 'procedural typology' considered building types as the basis of urban form. 'A theory of city design' evolved focussed on understanding urban form for prescriptive purposes. Panerai, Castex and DePaule aimed to understand how urbanisation processes were influenced by social practices. Third, the theory of design 'as idea' and theory of design 'as practised' were assessed (Moudon, 1997). Potential of urban morphological research in understanding the design dimensions and qualities from a cross-disciplinary perspective is well recognised.

> The essential proposition is that urban morphology is the missing constituent in the process of urban design. Its value is in the provision of detailed physical characteristics in the evolution of urban form, bridging the divide that exists between this geographical knowledge, urban planning and architectural design (Sanders et al., 2008).

The three fundamental morphological components are form, resolution and time (Moudon, 1997). Form covers the physical characteristics of buildings and related open spaces, plots or lots and streets. Resolution is hierarchical and varies across four spatial levels of resolution: building/lot, the street/block, the city and the region. A classification system of urban forms conforms to a spatial hierarchy of scales of human habitat patterns (Ghosh, 2009). Micro and macro levels of this hierarchy are linked as the parts can be aggregated to form a whole settlement. Time relates to the capabilities of urban forms to undergo continuous transformation, replacement and evolution into new forms. The smallest 'cell' of the city is a combination of an individual parcel of land and building(s) and open spaces on that land (Moudon, 1997). The characteristics of the smallest block are determined by the socio-economic profile, configuration, density patterns, actual and potential use, and urban morphogenesis or evolution of the urban form over time (Whitehand et al., 1999; Moudon, 1997).

In this paper, morphologies and qualities of suburban residential neighbourhoods in three cities Sydney, Australia, Kolkata, India and Miami, USA in three different countries of the world will be investigated at block scales. 'The Transect' line is selected along a transport corridor either road or rail from the case study cities. A review of literature and visual and spatial analysis are conducted to understand backgrounds, design qualities, and patterns of these neighbourhoods. A comparative analysis of morphologies and visual characteristics and links to 'T3 Sub-Urban' design are identified to understand how meaningful solutions could be provided. As this is a pilot study, the scope is only limited to small scale patterns. In future, larger urban cross-sectional analysis will be conducted on the 'The Transect'.

Backgrounds of the cities

Three suburban neighbourhoods from three cities: Miami, USA; Kolkata, India and Sydney, Australia in three different countries of the world are selected as case studies. These three cities vary in population density, demographic profiles and are located in three different parts of the world. The City of Miami is located in eastern part of United States in the state of Florida. The City of Miami has a total population of 5.8 million in 2013, a population density of 1916 people per square kilometre and covers a total area of 3029 km² (Demographia, 2013). An estimated population of Miami-Dade County where the case study site is located was 2,591,035 in 2012. This county has an area of 4915 km² and a population density of 508 persons per km² (United States Census Bureau, 2012).

The case study in Sydney, the largest city of Australia, is located in Turrella – Bardwell Valley which is under the jurisdiction of Rockdale City Council. This council has a total population of 102,843 over an area of 28 km² with a population density of 3673 persons per square kilometres (Rockdale City Council 2013a). Rockdale City Council is located in the south subregion of Greater Sydney and this subregion has a population of 650,000 in 2011. Greater Sydney Region (Infrastructure NSW, 2012) has a total population of 4.6 million (Australian Bureau of Statistics (ABS), 2011). Sydney's social atlas (ABS, 2008) map shows that it had a population density of 2058 people per square kilometre in 2006.

Kolkata case study is located in the Kolkata Municipal Corporation (KMC) with an urban area covering 185 km² and is located on the eastern bank of the River Hooghly in the state of West Bengal in India (KMC, 2013). It is a part of a larger urban agglomeration of Kolkata Metropolitan Region (KMR) with an area of 1204 km²; a population density of 12,100 people per square kilometre and is governed by Kolkata Metropolitan Development Authority (KMDA) (Demographia, 2013). According to the provisional 2011 Census India, population of Kolkata under KMC was nearly 4.5 million while the population of KMR was 14.1 million people and the literacy rate of the population is as high as 87.14 percent (Population Census India, 2011). The central city core of Kolkata has a population density is 24,000 people per square kilometres, very similar to the population density of Manhattan and De Ville Paris and the population density of the suburbs of Kolkata is around 9000 people per square kilometre (Cox, 2012).

'The Transect' and T3 suburban zone

Transect is a broader geographical concept of systematically measuring and recording observations on varying physical or natural or human environments such as soils, vegetation, flora, fauna, land uses, landforms, settlements and other relevant factors across a selected cross section (Gerlach, 2008). Transect has been applied in geography, science, planning and other disciplines to investigate different morphologies of environments across an urban/rural/urban to rural continuum. In this paper, 'The Transect' is defined to contain varying characteristics of human habitats along an urban to rural continuum. 'The Transect' is described as 'an index of diversity' (Duany, 2002, p. 257) and offering 'contemporary ways of envisioning' (Bohl and Plater-Zyberk, 2006, p. 5). It connects to new urbanism theory and provides a realistic basis of zoning for different types of urban and suburban land uses (The City of Miami, 2013).

> The transect approach is a planning strategy that seeks to organize the elements of urbanism—building, lot, land use, street, and all of the other physical elements of the human habitat—in ways that preserve the integrity of different types of urban and rural environments (Talen, 2002).

Miami 21, an integrated zoning code developed based on the conceptual framework 'The Transect', provides form based guidelines for development along rural and urban continuum for the City of Miami in USA. Within Miami 21, each zone of the transect regulates building disposition, configuration, function and intensity as well as the share of different uses to be accommodated in a building, standards landscape and parking, successful integration of each property with public realm and justifiable connections across the different zones of 'The Transect' (The City of Miami, 2013). 'T3 Sub-Urban' is a suburban zone out of a total of six types of zones classified under 'The Transect'. Transect zoning is being developed and applied in other cities of the USA, for example, Nashville, Mississippi and Texas.

T3 suburban zone is the transition zone between urban and rural zones; it needs careful design and planning of nature and the built environment and is strategically important (Metro Government of Nashville and Davidson County, 2012). This zone is susceptible to significant morphological changes in its form and specific characteristics and, thus, it could be classified within other possible urban zones within a shorter period of time. T3 zone is low density with single and two family residential units, ample open spaces as setbacks, linear or irregular road networks with natural and historic features. As narrated by the Metro Government of Nashville and Davidson County (2012) in T3 zones, dominance of nature and open spaces in framing the quality of the environment and building should be integrated to merge within that framing. T3 zones require thoughtful integration of urban design elements of built form, vegetation, paths, character, landmarks, district in enhancing the new urbanism characteristics of walkability, connectivity, mixed use and diversity, traditional neighbourhood structure, sustainability and a good quality of life (NewUrbanism.org, 2013).

Research Methodology

Selection of case studies

All the case studies are located at approximately 10 km from the central business district (CBD) of each case study city with predominant residential land use pattern. The City of Miami is the reference city as it has already adopted a form based zoning code Miami 21.

In the City of Miami, the Transect – rural to urban continuum is assumed to route along the southern part of Miami CBD. There are altogether three types of subzoning within T3 suburban – T3R (restricted), T3L (limited) and T3O (open) and varies in density patterns (The City of Miami, 2012, IV.5). According to the Miami 21, the case study area (Case study One) selected is located in Miami-Dade County in the City of Miami and is zoned T3O suburban zoning and permits maximum density of eighteen dwellings per acre or seven dwellings per hectare (Fig 1). Parcel or cell level, lot occupational characteristics for T3O suburban

zone include a maximum 50 percent as first floor coverage, lot size 465m², 15m permissible minimum lot width and 25 percent of the lot area as green spaces and front and rear setbacks are 6.1m while the side setbacks are minimum 2m (City of Miami, 2012, p. V.11). The case study in Miami is suburban characterised by detached separate houses and follows a traditional neighbourhood pattern.

Figure 1. *Transect and location of case study one, Miami*
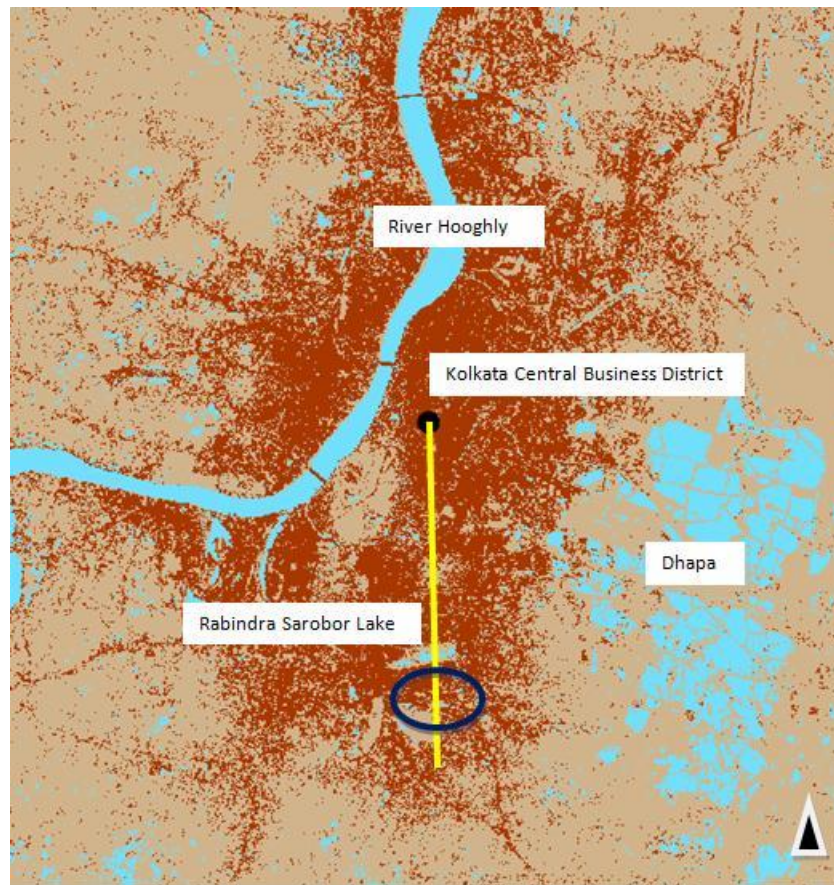*Data Source: City of Miami, Prepared by Sumita Ghosh*

In Sydney, the transect section is assumed to run towards the southern part of from the Sydney CBD. The case study (Case study two) selected is located close to Wolli Creek and two rail networks, Wollongong and Campbelltown in the Turrella-Bardwell Valley under the jurisdiction of the Rockdale City Council in Sydney (Fig. 2). In 2006, the main household type was couple families with dependents which constituted 40.1 percent of all households and 70.9 percent 'separate house' dwelling type increased to 75.8 percent in 2011 (Rockdale City Council, 2013b; 2013c).
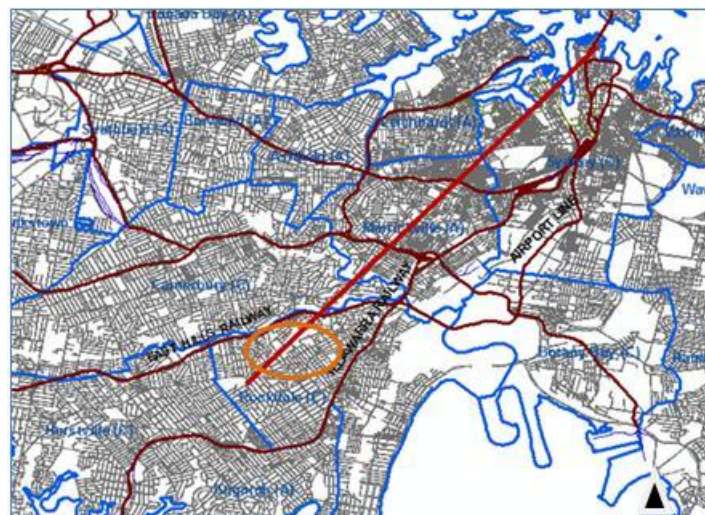
Figure 2. *Transect and location of case study two, Sydney*
Image: Google Maps, 2013' with 'Data Source: Sinclair Knight Mertz (SKM) imagery, Prepared by Sumita Ghosh

In Kolkata, the Transect is selected along the corridor Raja SC Mullick Road adjacent to Sealdah to Garia rapid transit rail corridor towards the southern part of Kolkata city from the CBD. The selected site (Case study three) is located within the suburb of Salimpur in close proximity to a number of shopping areas and public transport by rail and road (Fig. 3). This case study site is selected as this area is undergoing tremendous urban transformations, with single detached houses being transformed to four to five stories,

mixed use developments and parts of these areas have been transformed into high density residential skyscrapers.

Figure 3. *Transect and location of case study three, Kolkata*
Image: Google Maps, 2013 with 'Data
Source: http://www.lincolninst.edu/subcenters/atlas-urban-expansion/gis-data.aspx,
Prepared by Sumita Ghosh

Data Collection and Methods

A review of literature, as presented earlier in this paper, is conducted to analyse the concept of 'The Transect', T3O suburban zone in Miami 21 zoning code and backgrounds of the cities where the case studies are located. Aerial photographs sourced from Google Earth were geo referenced using Geographic Information Systems (GIS) methods, cross checked for the accuracy of its coordinates and reprojected to the correct coordinate system of each country for conducting spatial analysis. Using GIS, new data is generated from the aerial photographs on land cover patterns (such as impervious cover including roads considering half road width of peripheral roads, building roof area, green infrastructure (tree canopy cover and productive land areas), setbacks and parcel areas. Based on this spatial analysis, density patterns and urban residential morphologies of case studies in Miami, Sydney and Kolkata are calculated and compared. The demographic and basic community profile data is collected from the census data of three countries, Australian Bureau of Statistics (ABS), Population Census India and United States Census Bureau. More information and data are collected from relevant research reports and internet resources.

A visual analysis was conducted on each of the three case studies to understand urban design qualities and urban morphological changes. Visual analysis includes analysis of photographs of case studies to understand architectural styles, street patterns, public realm, mixed use patterns, tree types, visual amenity values and evidence of morphogenesis. GIS methods are applied to generate new data from aerial photographs on urban design parameters such as block length, front and rear setbacks, building

footprints and tree locations. While visual analysis allowed subjective analysis of the case study sites, GIS analysis assisted in further objective assessment of the sites such as land use patterns. An analysis and discussions are provided based on the results. An analysis on overall transect or large cross sectional level would require application of remote sensing methods in addition to GIS methods. This analysis is not within the scope of this paper and therefore not included.

Analysis and discussions

Using GIS, the land cover pattern of five morphological characteristics: building roof, ancillary structures, road area (half road width) and footpaths, tree canopy and productive land areas are calculated from the rectified aerial photographs. In addition, total site area, total parcel area, average parcel size, average building foot print, total number of dwellings and dwelling density are estimated. Land area under other uses such as driveways, entry paths, footpaths swimming pool, walkway within parcels, paved surfaces in backyards and sides of the buildings is calculated by subtracting areas of building roof, ancillary structures, road area (half road width) and footpaths, tree canopy and productive land areas from the total site area. Productive land area calculates the pervious land area currently available on site for growing vegetables and fruits and includes lawn cover as it has the potential to be converted into productive land. Tree canopy measure could be effectively associated with stormwater, carbon, energy and air pollution benefits, and productive land could provide carbon benefits through local food production and better stormwater management. It is considered that the land area under the tree canopy cover will not be counted as productive land due to shade and potential conflict with tree roots. Overlap areas on land covers such as tree area overlapping with road area are calculated using geo processing methods and the overlapping area is calculated only in one land cover category to avoid duplication.

An analysis of morphological characteristics of case study one in Miami, Florida show that the building roof area with ancillary structures, such as garages and sheds, cover only 23.2 percent of the overall site while tree canopy covers 14.5 percent. Tree canopy cover is mainly in the rear gardens and the not along the streets. A higher percentage of the site is paved mainly driveways and footpaths in the front and other uses (29.5 percent) include mainly impervious areas with a very little land area that could be used for productive purposes and stormwater benefits. The total area of the site is 20.7 hectares, with an average parcel area of 660m², average building roof area (without ancillary structures) 168m² and a density of 14 dwelling per hectare. The mapping of land cover pattern shows spatial distributions of different land cover patterns (Fig. 4) and frequency distributions of building roof areas (without ancillary structures) (Fig. 5).

A visual analysis of case study one reveals that it is a typical low density suburban neighbourhood with one to two storied contemporary and traditional houses (Fig. 6). Most of the driveways and footpaths along the main road are paved and landscaped front gardens contribute positively to the aesthetic quality of the environments. Large setbacks of the buildings from the road create appreciation spaces along the road. Again, minimal number of trees, larger setbacks in the front up to 8m and lower building heights on wider neighbourhood street create minimal enclosure.
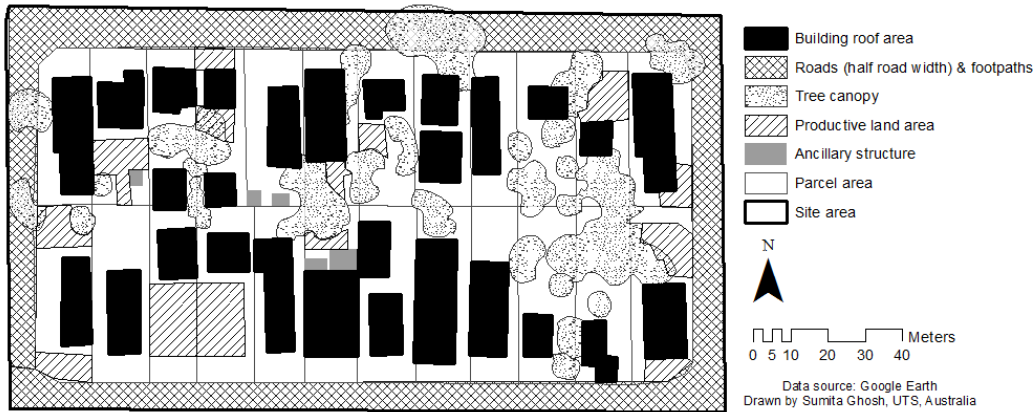
Figure 4. *Land cover pattern and parcel areas in Case Study One, Miami, Florida*
Source: Prepared by Sumita Ghosh
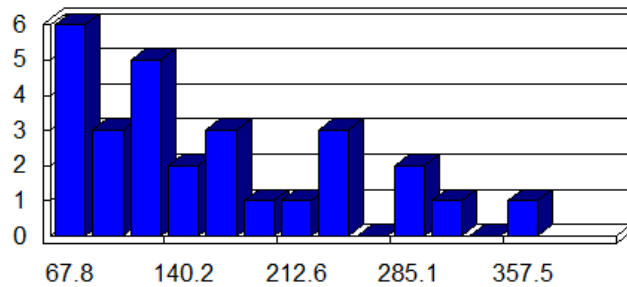
Figure 5. *Frequency distributions of building roof areas in Case Study One, Miami*
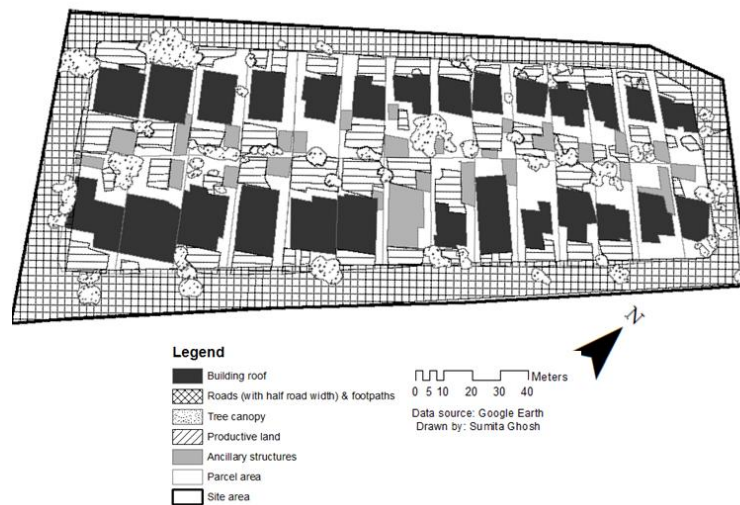*Source: Prepared by Sumita Ghosh*

The characteristics of low density T3-O suburban zone are clearly visible in this neighbourhood. The pattern is legible and well linked as the overall street pattern of the area is grid iron and approximate block length 192m. Mainly rectangular linear shaped houses overlook the streets and the architectural styles of the houses conform to local style of buildings. The side lanes at the sides of buildings are narrow and the houses are constructed close to the boundary to facilitate sufficiently wide driveway on the other side in the plot.

Figure 6. *Built form and streetscape in Case Study One, Miami*
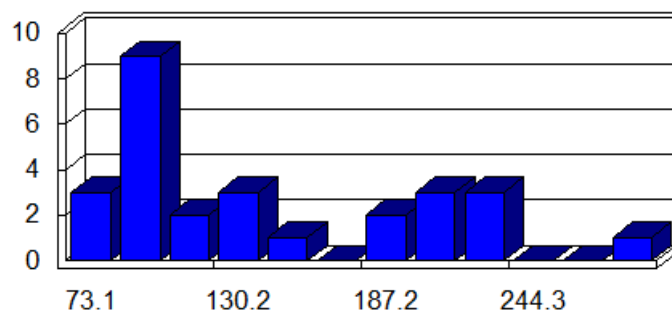*Source: Sumita Ghosh*

Morphological characteristics in case study two in Sydney, Australia show that it is low density development with detached single and double storied houses. The total area of the site is 16.9 hectares,

with an average parcel area 430m², average building roof area (without ancillary structures) 149m² and a density of 16 dwelling per hectare. The percentage of building roof area with ancillary structures covers 29.3 percent of the overall site; the road area is as high as 30.8 percent while tree canopy covers only 8.0 percent. The area of tree canopy cover is sparsely distributed throughout the site, limited number of large trees and trees along the streets. There is an ancillary structure almost for each building and some buildings have more than one ancillary structure. The total area of ancillary structures is 942 m² which is equal to 8.7 percent of the total site. Mainly lawns as pervious land covers are seen in the front and rear gardens and 14.9 percent of the site is calculated to be available as onsite productive land. Availability of onsite productive land could provide many sustainability benefits. Due to less impervious surface cover, the percentage of other uses (17 percent) is significantly lower in case study two than the case study one. The land cover pattern map (Fig. 7) and frequency distributions of building roof areas (without ancillary structures) is presented in Fig. 8.

Figure 7. *Land cover pattern and parcel areas in Case Study 2, Sydney*
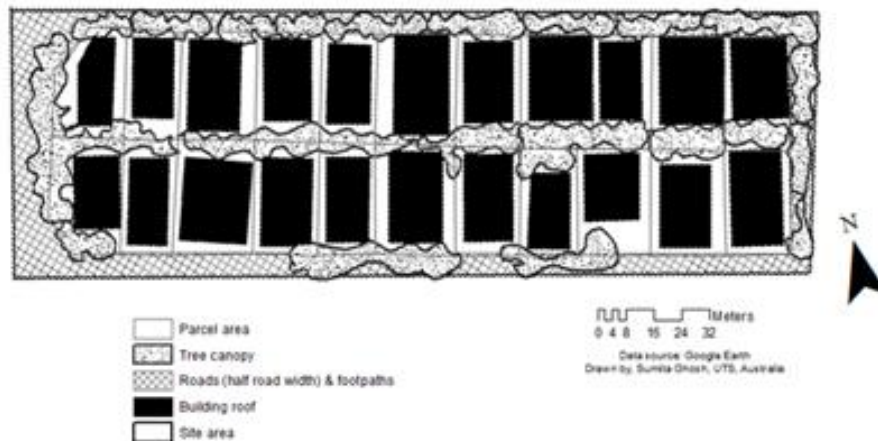*Source: Prepared by Sumita Ghosh*

Visual analysis of case study two indicates a number of similarities in the building massing, streetscape with minimal trees, and in creating typical suburban neighbourhood qualities. The street façade if not well defined by the buildings then the feeling of an enclosure could be lost. All the houses in case study two have generous open spaces in the front and rear and the block length is approximately 208m. The surrounding street patterns are a combination of irregular and regular patterns with cul-de-sacs and irregular block patterns which provides a semi walkable neighbourhood. This development provides an enormous opportunity for future infill development. It represents the typical characteristics of suburban zone T3O and, as mentioned earlier, could act as a transition zone for morphological transformations from suburban to urban.

Figure 8: *Frequency distributions of building roof areas in Case Study 2, Sydney*
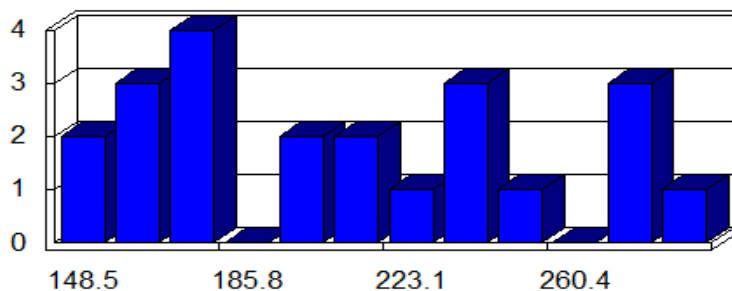*Source: Prepared by Sumita Ghosh*

Morphological characteristics in case study three in in Kolkata, India show that it is a medium density development with two to five storied houses. The total site area is 10.8 hectares, with an average parcel area 379m², and dwelling density of 60 per hectare assuming on average three apartments per ground foot print of each dwelling. The percentage of tree canopy cover is significantly high and up to 22.7 percent and building roof area with ancillary structures covers 43.4 percent of the overall site. It has a high impervious cover; no front gardens as the building façades are constructed along the road. Case study three lacks in onsite availability of productive land area and there are minimal land spaces at the rear. Morphologies though do not exhibit typical characteristics of T3O suburban zone, but transformations are clearly evident from its built forms.

Figure 9: *Land cover pattern and parcel areas in Case Study 3, Kolkata, India*
Source: Prepared by Sumita Ghosh

The land cover pattern map (Fig. 9) and frequency distributions of building roof areas (without ancillary structures) is presented in Fig. 10. A comparative analysis of land use patterns of three case studies is presented in Table 1. The morphologies in case study three located in Kolkata, India show very different visual characteristics. The streets are lined with mature trees, and the three to four storied apartments, narrow footpaths and the roads create a well-defined street facade and enclosure (Fig. 11). The block length is much shorter and is equal to 179m. Scale is appropriate to experience the street features, views and vistas. With surrounding smaller block grid iron pattern of street layout creates a legible environment. A number of grocery, corner shops and other types of compatible retail shop create a public realm at the ground level which offers a continuous network of social exchange and use by the community. The residential uses on the upper floors and ground floors are connected visually and experientially through the balconies immediately to activities on the ground level. The outdoor becomes an extension of indoor for experiencing and engaging the communities but at the same providing sufficient privacy for the people who would like to only observe.

Figure 10. *Frequency distributions of building roof areas in Case Study 3, Kolkata*
Source: Prepared by Sumita Ghosh

Table 1. *Morphological analysis of suburban forms*

Parameters (ground coverage in m²)	Case study One (Miami, USA)	Case study Two (Sydney, Australia)	Case study 3 Three (Kolkata, India)
Site area	20711 (100%)	16981(100%)	10842 (100%)
Total building roof area with ancillary structures (% to total site)	4815 (23.2%)	4972 (29.3%)	4710 (43.4%)
Road area (half road width) and footpaths (% to total site)	4974 (24.0%)	5237 (30.8%)	1337 (12.3%)
Tree canopy (% to total site)	3202 (14.5%)	1354 (8.0%)	2457 (22.7%)
Productive land area (% to total site)	1613 (7.8%)	2524 (14.9%)	Negligible value (0.0%)
Land area under other uses (e.g. driveways, entry paths, side lanes, swimming pool, paved backyards etc.) (% to total site)	6107 (29.5%)	2894 (17%)	2238 (21.6 %)
Average building roof area without ancillary structures	168	149	214
Average parcel area	660	430	379
Total number of dwellings	28	27	22
Dwelling density per hectare	14 (single to two storied detached houses)	16 (single to two storied detached houses)	60 (three to four storied residential houses and flats)

A visual analysis of the built form of case study three shows that it has travelled through the journey of morphogenesis. Changes are visible as additions and alterations of two storied residential houses, infill developments, demolition of older houses and replacements by four to five storied apartments to accommodate urban growth. Some old photographs of the houses in the area give evidence of this process. Further a GIS and remote sensing analysis of urban growth by Bhatta (2009) support a significant increase in the built up area coverage in south Kolkata where case study three is located. The built up area coverage increased from 11.39 percent in 1975 to 70.31 percent in 2005 (Bhatta, 2009: 4739). Surrounding morphologies in this case study establish that it is still going through further transformations into denser neighbourhoods with skyscrapers for residential purposes (Fig. 12).

Figure 11. *Streetscape Case Study Three, Kolkata, India*
Source: D. Ghosh

Figure 12. *Changing surrounding morphologies in Case Study Three, Kolkata, India*
Source: D. Ghosh

Is this natural self adjusting capability of urban and suburban forms to transform? Would case study one, two and three or all T3 suburban zones of the Transect go through the similar or different processes of morphogenesis over time? In this paper visual analysis and GIS methods are applied to complement and to determine suburban morphologies and their urban design qualities. Visual analyses of case studies show different morphological transformations and urban design qualities of built forms that are shaped by different drivers such as historical backgrounds, planning regulations, traditional architectural styles, climatic patterns, location, people's choices, social and economic conditions and many more over temporal scales. Future research should importantly explore these aspects in detail. It is also essential to recognise importance of developing integrated understandings of urban and suburban morphologies. Therefore, urban morphological transformations should be comprehensively analysed considering three fundamental morphological components of form, resolution and time together with qualitative socio-cultural-economic variables that guide changes.

Applications of new options and technologies for retrofitting urban forms would be essential. The roofs of case study three could recreate the open space lost to the building footprint as green roofs. Street trees could play a very important role in defining suburban streets when it is less well defined by the buildings in lower suburban densities in some urban and suburban forms. Vertical building walls with a variety of openings can create visually attractive and safer environments. Appropriate detailing of elements of design is important to experience the environments at human scale. The overall city structure has a crucial role in this process. Kolkata region with its population of 14 million people may be accommodating morphological changes due to urban growth through a further consolidation process such as four to five storied apartments are replaced by skyscrapers. Miami and Sydney with comparatively smaller population sizes could accommodate future urban growth in these suburbs through infill developments including apartments and terrace houses. Outcomes would be different for different cities. 'The Transect' for different cities will also vary. The zones of 'The Transect' can calibrate considering these varying elements of urban morphologies and design qualities as required on a case by case basis and can reinterpret evolution of the urban form in a more useful, adaptive and functional manner. 'The Transect' can create an order in planning new or retrofitting existing urban environments at the different spatial resolutions of buildings, blocks, neighbourhoods and regions, and can shape the human habitat over time in different contexts. All these components should be understood holistically for informed planning and policy decision making.

Conclusion

Morphological studies can develop understandings on urban structures and form specific layout patterns of human environments. Morphological characteristics and design qualities could significantly influence neighbourhood performance. Integrating objective assessments and subjective qualities in neighbourhood design and planning through the applications of 'The Transect' as a planning strategy will be able to provide meaningful solutions.

Acknowledgements

References

Australian Bureau of Statistics (2008) A Social Atlas 2006 Census of Population and Housing (Australian Bureau of Statistics, Australia).

Bhatta B. (2009) 'Analysis of urban growth pattern using remote sensing and GIS: a case study of Kolkata, India', Vol. 30 (18), 4733-4746.

Cox, W. (2012) *The Evolving Urban Form: Kolkata: 50 Mile City* (http://www.newgeography.com/content/002620-the-evolving-urban-form-kolkata-50-mile-city) accessed on 16 April 2013.

Duany A. (2002) 'Introduction to the Special Issue: The Transect', *Journal of Urban Design* 3, 251-260.

Demographia (2013) *Demographia World Urban Areas (World Urban Agglomerations)*, 9th Edition March 2013 (http://www.demographia.com/db-worldua.pdf)

Forster, C. (2004) *Australian Cities: Continuity and Change*, Third Edition (Oxford University Press, Melbourne).

Ghosh, S. & Vale, R.J.D. (2009) 'Typologies and Basic Descriptors of New Zealand Residential Urban Forms', *Journal of Urban Design* 4, 507-536.

Gerlach, A.M. (2008) 'Geography Inquiry', in Gerlach AM (ed), *Essential Geography for Queensland Three,* (Macmillan Education, Australia), 1-15.

Gleeson, B. (2006) *Australian heartlands: making space for hope in suburbs*, (Allen and Unwin, Crows Nest, Australia).

Infrastructure NSW (2012) State Infrastructure Strategy 2012-2032, (http://www.infrastructure.nsw.gov.au/media/16973/sis_report_section4.0_print.pdf) accessed on 18 April 2013.

Kolkata Municipal Corporation (KMC) (2013) *Basic Statistics of Kolkata* (https://www.kmcgov.in/KMCPortal/jsp/KolkataStatistics.jsp) accessed on 10 April 2013.

Metro Government of Nashville and Davidson County, Tennesee (2012) *T-3 Suburban* (http://www.nashville.gov/Portals/0/SiteContent/Planning/docs/CCM/2012Certified/7_CCM_T3_adopted%20Oct%2025%202012.pdf) accessed on 11 April 2013.

Moudon, AV. (1997) 'Urban morphology as an emerging interdisciplinary field', *Urban Morphology* 1, 3-10.

NewUrbanism.org (2013) *Creating Liveable and sustainable communities* (http://www.newurbanism.org/) accessed on 12 March 2013.

Population Census India (2011) *Kolkata City Census 2011 data* (http://www.census2011.co.in/census/city/215-kolkata.html) accessed on 16 April 2013.

Rockdale City Council (2013a) Welcome to Rockdale City Community Profile (http://profile.id.com.au/rockdale) accessed on 18 April 2013.

Rockdale City Council (2013b) Rockdale City Council: Population and Household Forecasts –Turrella –Bardwell Valley, Profile.id.

Rockdale City Council (2013c) Turrella – Bardwell Valley, Dwelling type, Profile.id. (http://profile.id.com.au/rockdale/dwellings?WebID=240) accessed on 18 April 2013.

Sanders, P. S. (2008) 'Presenting the past: the impact of urban morphology in shaping the form of the city', in: ACSP-AESOP 4th Joint Congress, Bridging the Divide: Celebrating the City, July 6-11 2008 (University of Illinois, Chicago).

Talen, M. (2002) 'Help for Urban Planning: The Transect Strategy', *Journal of Urban Design* 3, 293–312.

The City of Miami (2013) *The Transect* (http://www.miami21.org/TheTransect.asp) accessed on 16 April 2013.

The City of Miami (2012) '5.3 Sub-Urban Transect Zones (T3)' in Miami 21 Code Volume I, City of Miami, Florida, USA (http://www.miami21.org/PDFs/AsAmended-April2012-VolI.pdf) accessed on 18 April 2013.

United States Census Bureau (2012) Miami-Dade County, Florida US Department of Commerce, (http://quickfacts.census.gov/qfd/states/12/12086.html) accessed on 18 April 2013.

Whitehand J.W.R, Morton, N.J. & Carr, C.M.H. (1999) 'Urban morphogenesis at the micro scale: how houses change', *Environmental Planning B: Planning and Design* 26, 503-515.

EDGE CITIES

new urban conditions

Front and back of Taipei railway stations: modernity, hybridity and diaspora of the postcolonial city

Po Ju Huang

Graduate Institute of Urban Planning, National Taipei University, Taiwan

Email: pajuhuang@gmail.com

Chaolee Kuo

Graduate Institute of Urban Planning, National Taipei University, Taiwan

Email: chaoleek@gmail.com

Abstract. *Influenced by Western centrism and globalisation, the discussions around typo-morphology look beyond the centre of the matter for an understanding of the periphery. As we begin to look out from the centre to the periphery, the relative direction of research shifts from 'unity' to 'diversity'. This is precisely the effect of deconstructionism on various trends in theory, generating new theoretical gaps and a new spatial imagination, which appear to originate from such a closed system of spatial science and a deconstructionist world. After 1895, Taiwan became a colony of Japan. The city walls were demolished and replaced by the railway that extended island-wide. The stretches of railway and supporting infrastructure meant significant changes for Taipei and Taiwan. Railway stations formed a new core for urban development. While the front of the stations was a passage into a bright new world of colonial order, the back of stations was a reminder of a darker colonial past. No doubt Taiwan's expansion is linked to these opposing forces of East versus West, and old versus new world order. It is a prime example of how Taiwan is constantly duplicating and reproducing 'diasporas typo-morphology'. In order to analyse the diaspora phenomenon, we attempt to explore the historical changes that took place along the city's borders and explore Taipei through morphological analysis and narrative scenes in order to understand the diasporas typo-morphology as it relates to the edge. We also look ahead to the development of a creative nucleus, introducing a sense of otherness to creating a dialogue that deals with the contradiction of innovation and urban space, beginning with the fringe of deconstruction.*

Keywords: de-construction, postcolonialism, edge, diaspora typo-morphology, hybridity, peripheral

Introduction

Diaspora is a spatial representation of colonialism, which refers to a migration of people or communities, voluntarily or by force, temporarily or permanently. During this dynamic process, a variable is constructed through new examples that can be highlighted spatially. In the context of Taiwan's development, there were three major migrations: the early settlements of the Han Chinese, the Japanese colonial immigrants, and the large-scale postwar retreat of the Nationalist Chinese. These migration processes instigated the spatial transformation, introduced hybrid cultural values, and clearly manifested on the capital Taipei (Fig. 1).
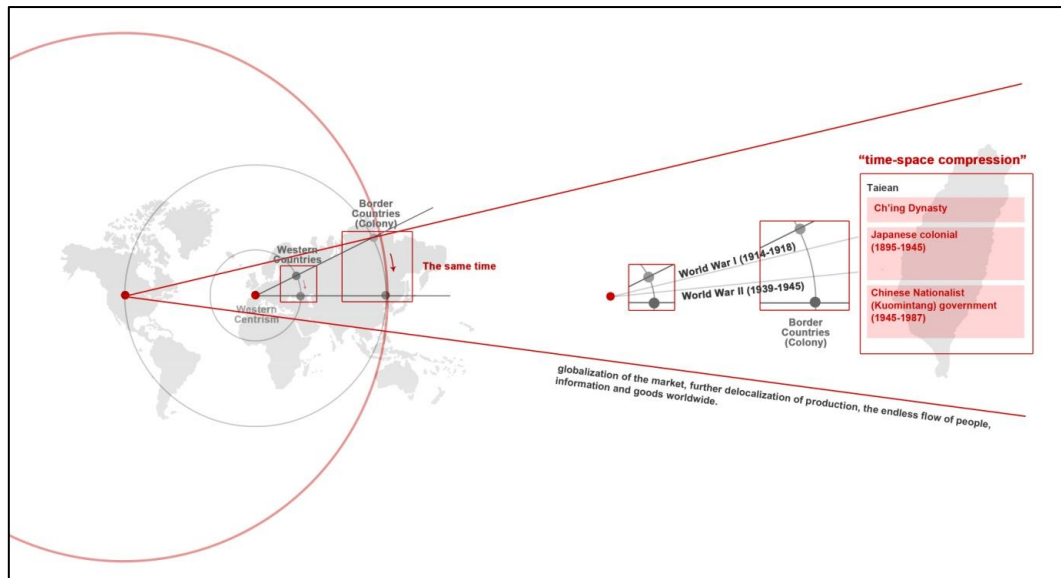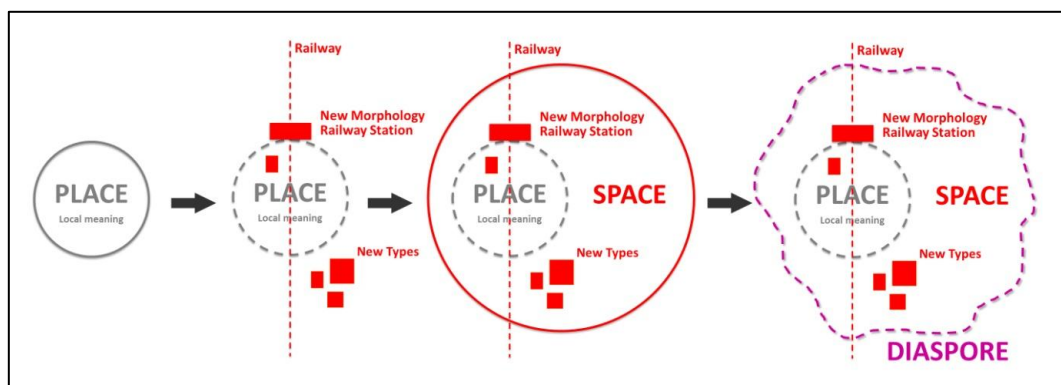
Figure1. *Diaspora is a spatial representation of colonialism, a migration of people or communities.*
Source: Prepared by Po Ju Huang

With the rise of capitalism and imperialism in the 19th century, railroads became the tool by which the empires extracted plunder from colonies. They symbolised the end of traditional society and the coming of modern world. Railways weakened symbolic society and gave rise to spatial rationality. This article discusses the transformation of Taipei's urban form from 1880 to 1945, and acknowledges the natural result of its expansion is an artificial outgrowth of the modern nation state's authority mechanism. An analysis of the transitional processes affecting cities that develop around rail stations indicates that beneath spatial transformation and technological advancement, we can see the reflection of spatial and sequential development and distinguish urban characteristics and differences in governance from the Qing Dynasty to the Japanese Empire.

The railway is a new urban morphology in Taiwan, and the railway station is a new typology introduced by railways. It is the most conspicuous spatial transformation relating to the fading of localised society and the transition towards spatial universality. Giddens states that "spatial planning has only become necessary after the emergence of modern nations; it means to take away the 'place' meaning of the land so it becomes a space with nothing to hold it back, a tool of governmental authority" (Giddens, 1991, p. 16).

This article will examine the process of changing urban space to understand how localised society collapsed during Japanese colonial rule, and how traditional qualities started to diminish and develop the unique characteristics of diaspora (Fig. 2).


Figure 2. *This will examine this changing process of urban space to understand how localised society collapsed during Japanese colonial rule, and how traditional qualities started to diminish and develop the diaspora.*
Source: Prepared by Po Ju Huang

In order to analyse the diaspora phenomenon, we attempt to explore the historical changes that took place along the city's borders and explore Taipei through morphological analysis and narrative scenes in order to understand the diasporas typo-morphology as it relates to the edge. We also look ahead to the development of a creative nucleus, introducing a sense of otherness to creating a dialogue that deals with the contradiction of innovation and urban space, beginning with the fringe of deconstruction.

Pre-modern Society: walls and railways lay the foundation for the unique characteristics of diaspora

In the Man-Ga and Twa-Tu-Tia districts, between 1882 and 1884, the late Qing government's construction the city walls of Taipei Fu created an administrative settlement with other two ethnic groups not strongly associated with an enclosed regional urban landscape (Fig. 3). At the same time, belief that the introduction of the modern western rail system would risk opening late Qing China to the Western colonial powers resulted in the first railway not being built in 1893 in the cities of Chinese mainland. Instead, it was build on the island frontier of Taipei, located today on the north side of Chunghua Road.
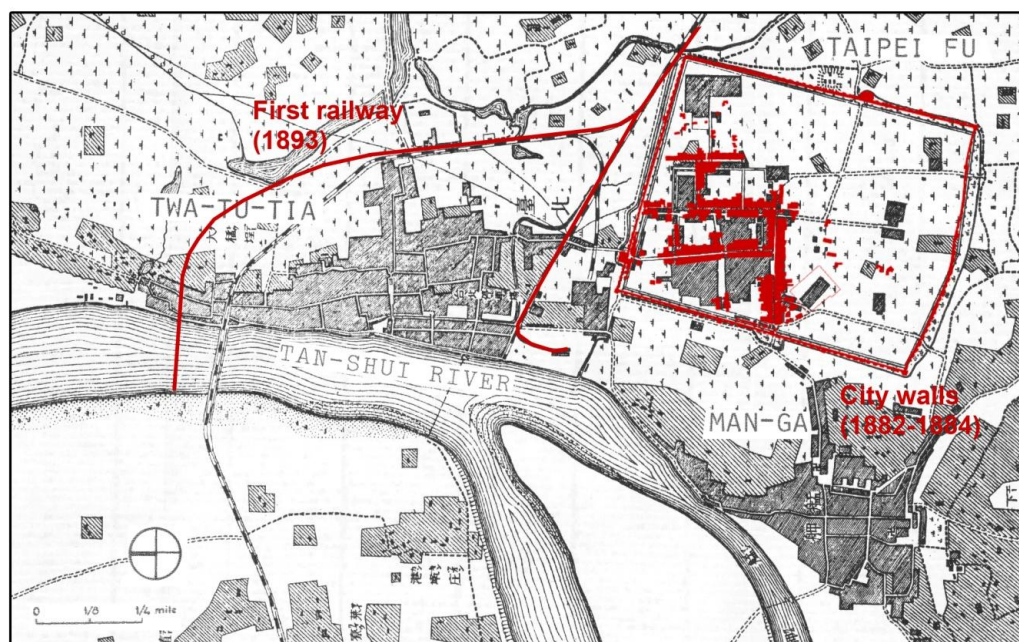
Figure 3. *In the Man-Ga and Twa-Tu-Tia districts between 1882 and 1884, the late Qing government's construction of Taipei Fu created an administrative settlement with other two ethnic groups not strongly associated with an enclosed regional urban landscape.*
Source: Redrawn map of Taipei from the Japanese colonial government in 1958. Prepared by Po Ju Huang

Two projects of walls and railway were designated for the late Qing Dynasty Taipei city, but the presence of both, common to feudal cities, created a challenge. Planners were presented with a conflict of modern and traditional ideas, with the city wall adopting the periphery to imperial order, while the modern railway would see the development as modern. Though the two ideals are in conflict, they did develop a symbiotic relationship in the beginning.

In the second half of the 19th century, the Qing government shifted its policies from "passive governing" to "active governing". However, its governance of epistemic rationality (Foucault, 1970) differed from the conservative views of local society and restricted Taipei's layout to the three segregated settlements, rather than a single unified modern urban landscape. Nevertheless the relationship between government and society was not one of tense isolation and confrontation, but rather isolation with cooperation, contributing to the unique nature of diaspora as one that accepts and tolerates differences.

Rise of the modern society: railways penetrate local society

After the 1895 Sino-Japanese War, Taiwan became the first colony of the Empire of Japan and as such was a symbol of the Empire's vision for modern urban development and infrastructure improvement (Fig. 4). The stretches of railway and supporting infrastructure meant significant changes for Taipei and Taiwan. The importance of the island's traditional harbour cities in Taiwan's economic development was superseded by the rise of the industrial cities that developed along the new mountain line. With the transformation of the island-wide regional production space, many cities within this new urban landscape faced unprecedented change (Fig. 5). This resulted in a "space compression" era in which the sense of distance disappeared with the growth of personal mobility and transit speed (Lardner, 1968).
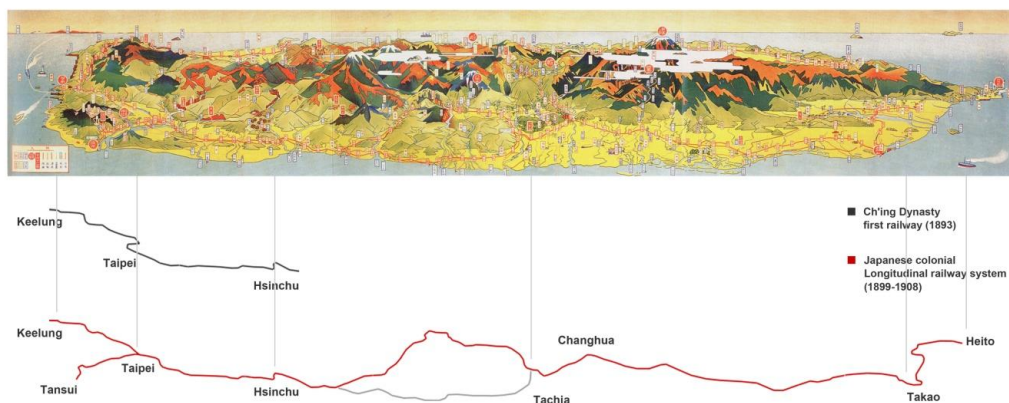
Figure 4. *With the rise of capitalism and imperialism in the 19th century, railroads became the tool by which the empires extracted plunder from colonies.*
Source: Redrawn map of Taiwan railway travel from the Japanese colonial government in 1928. Prepared by Po Ju Huang
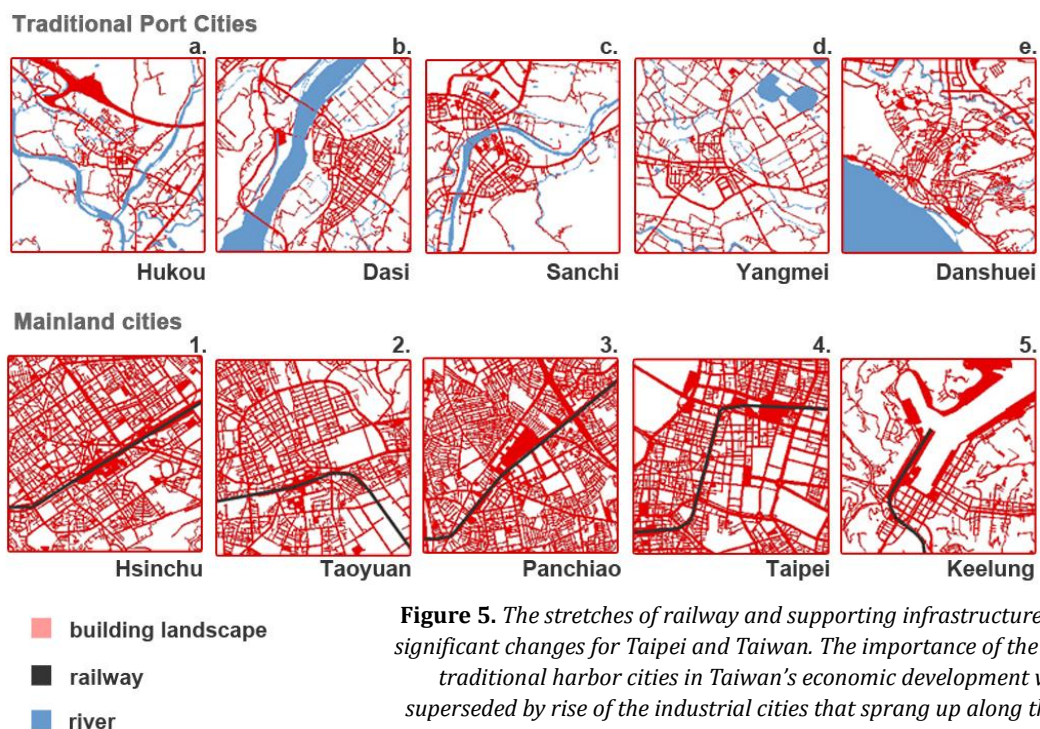
Figure 5. *The stretches of railway and supporting infrastructure meant significant changes for Taipei and Taiwan. The importance of the island's traditional harbor cities in Taiwan's economic development was superseded by rise of the industrial cities that sprang up along the new mountain line by the 1990s.*
Source: Redrawn map of some settlements from the National Land Surveying and Mapping Center (NLSC) in 2012. Prepared by Po Ju Huang

In Taipei, the colonial Japanese government immediately destroyed the main buildings housing Chinese government offices and temples. The city walls were torn down and replaced by the railway and extended island-wide in 1899-1908. Railway stations formed a new core for urban development. However, at the same time communication between the front and back of the railway stations was hindered because development focused on the front of the station while space to the rear of the station was largely ignored. While the station front was a passage into a bright new world of Western imperial order, the rear was a reminder of an outdated Chinese traditional past. No doubt Taiwan's expansion is linked to these opposing forces of East versus West and old versus new world order (Toshio, 1992) (Fig. 6).

Figure 6. *Railway stations formed a new core for urban development, but at the same time hindered communication between the front and back of the railway stations, because development focused on the front of the station, so back of the station was largely ignored.*
Source: Redrawn map of Taipei from the Army Map Service (AMS) in 1944 and Taipei City Government in 2012. Prepared by Po Ju Huang

The rise of Taipei: a new city layout centered on rail stations

After a major flood in northern Taiwan in 1912, the colonial government implemented urban renewal of Taipei's three settlements, acknowledging a planning attitude as guidance rather than spontaneous. For viceroy authority to have an impact, the concept of "place" must be eliminated. There can be no spatial differences; the original differentiating characteristics must be forgotten. After the integration of the three

settlements, the residents no longer enjoyed a sense of togetherness (place), and began to experience feelings of metropolis, separation and anonymity.

In the Japanese period the empty space among three settlements was developed as Seimoncho new district, which would include Japanese shops, residential gathering areas, and Seimon Market on the east side of the boulevard (Chunghua Road), which serviced mainly Japanese residents (Fig. 7).
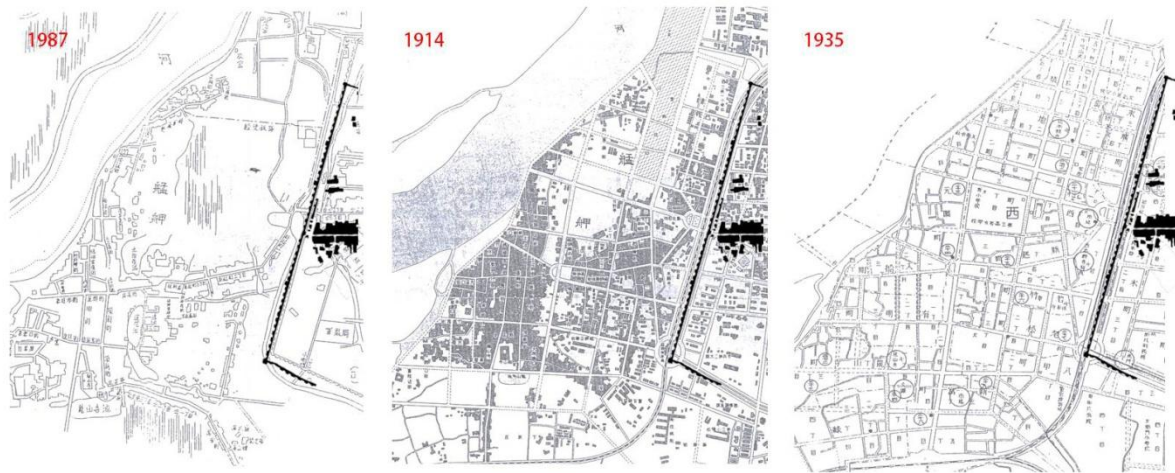

Figure 7. *After a major flood in northern Taiwan in 1912, the colonial government took the opportunity to implement urban renewal in connection with three settlements of Taipei, that processing of space engineering attitude is guidance not rather than spontaneous.*
Source: Redrawn map of Taipei from the Japanese colonial government in 1985, 1914 and 1932. Prepared by Po Ju Huang.

Late at night, shops and street vendors remained open and the area buzzed with the sights and flavors of a Japanese night market. Other activity in the Shinkicho area included the opening up of the boulevard on both sides and the beginning of construction on the official institutions (e.g. Civic Hall) and Japanese Shrine (West Honganji Temple).

The periphery of the three settlements began to develop a new morphology. For example, the creation of law enforcement institutions (such as colonial administration, prison and police stations) established constitutional politics, while the emergence of banking (e.g. Imperial Bank of Taiwan) introduced economics into the equation. Next, there was the establishment of numerous elementary and middle schools (e.g. Lao Song Elementary School) aimed at ideological indoctrination under the colonial power structure. Other building types developed, such as industries (including distilleries, tobacco factories and sugar refineries) and healthcare facilities (e.g. Imperial Taiwan University Hospital and Public Health Bureau) (Fig. 8).

The colonial government expanded the role of spatial power with its new system of knowledge and ruling institutions. Nevertheless, to combine and distinguish the self from that which is alien or the other, reconstruction of spatial order was attempted from "periphery". In practice, however, deconstruction had begun. Of course, urban morphology made a difference under the new order. The Japanese attempted to introduce the imagery of Western colonial imperialism to Taiwan's urban spatial system, mixing elements of two (or three) very different lands and people. Such imagery had to be combined under one state system, while also attempting to eliminate social factors through spatial segregation. This contradictory relationship resulted in the complexity of Taipei's urban space (Fig. 9).
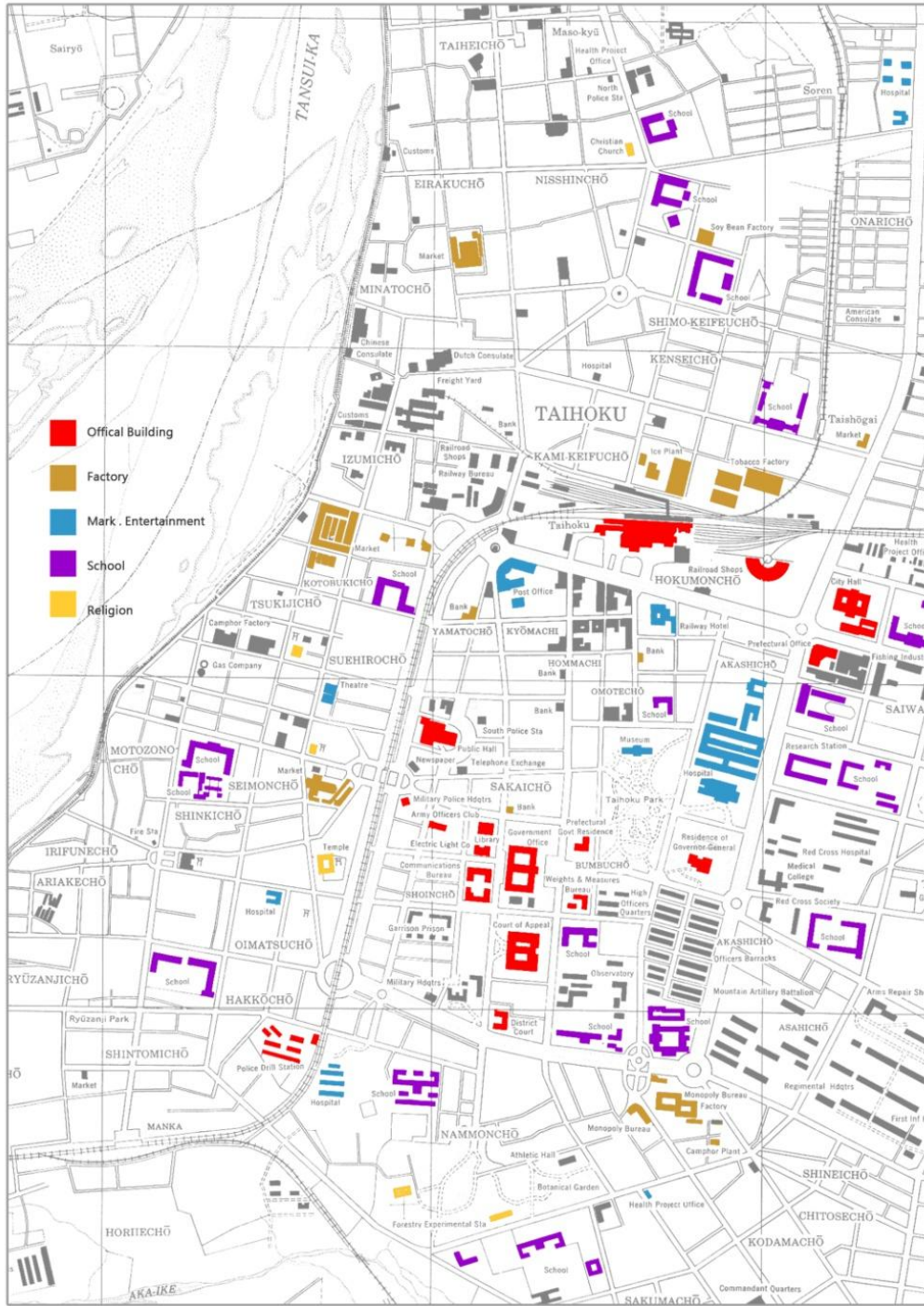
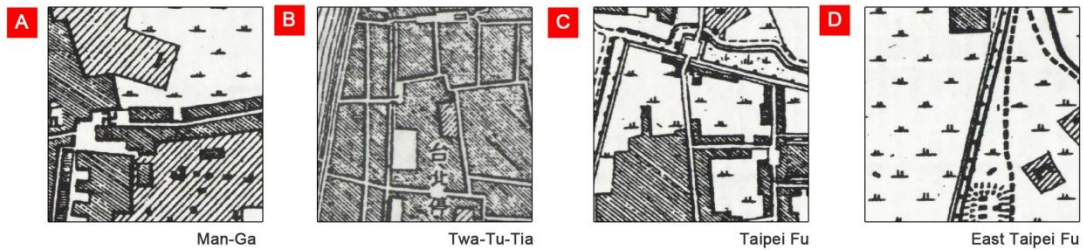**Figure 8.** *The edge of three settlements began to create a new spatial form or typology. The colonial government expanded the role of spatial rights with its new system of knowledge and spatial institutions. However, to combine and distinguish the self from that which is alien or 'the other', reconstruction of spatial order was attempted from periphery. In practice, however, deconstruction had begun.*
Source: Redran map of Taipei from the Army Map Service (AMS) in 1944. Prepared by Po Ju Huang

1895's Taipei map

A — Man-Ga
B — Twa-Tu-Tia
C — Taipei Fu
D — East Taipei Fu

1945's Taipei map
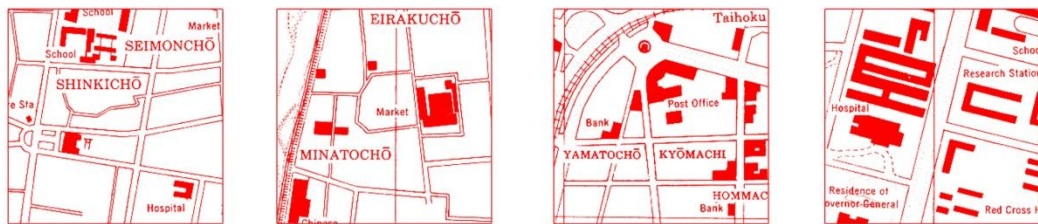
Figure 9. *The colonial government expanded the role of spatial rights with its new system of knowledge and spatial institutions. However, to combine and distinguish the self from that which is alien or "the other," reconstruction of spatial order was attempted from periphery.*
Source: Redrawn map of Taipei from the colonial Japanese government in 1895 and Army Map Service (AMS) in 1944. Prepared by Po Ju Huang

Complex and disoriented narrative prose

The construction of the "diasporas typo-morphology" demonstrates the colonial power of the Japanese government to shape the urban space for objective purpose and form a peripheral typo-morphology. Rather than being allowed to house forgotten collective memories or to become a decaying space, the new area with new typo-morphology served as a place for both behavioral correction and reciprocal relationship. This unique colonial city of Taipei is uncertain, open and flowing, and its purpose is not representative but resonant; the Japanese government released the first Taipei urban planning in 1937. Local urban planning by the advanced standards of Western countries pursues equitable distribution of the overall planning in order to erase the gap between the local and construct the hypothesis of a homogeneous city by ignoring people's 'sense of place'. By removing the formal political symbols as temple institutes and old city walls, and replacing them with new typology like museums, assembly halls, and banks, interweaving new and old, results in a partially disintegrated localised society which creates complexity.

Overemphasis on modern scientific rationalism, however, created novel differences by introducing new standards. During the process of spatial practice, standardised modification would be impossible to complete, and only highlight the complexity that populations and societies possess in colonial cities. Looking at large-scale urban adaptations from a spatial point of view, one clearly sees new urban blocks generally mixed in with old alleys (Fig. 10).

Figure 10. *During the process of spatial practice, standardised modification would be impossible to complete, and only highlight the complexity that populations and societies possess in colonial cities. Looking at large-scale urban adaptations from a spatial point of view, one sees new boulevards mixed in with old alleys.*
Source: Redrawn map of Taipei from the colonial Japanese government in 1895 and Army Map Service (AMS) in 1944. Prepared by Po Ju Huang

In nature a hybrid is not a single species or breed but a combination. Similarly, hybrid culture is not a single culture. When one's attention is not focused on pure culture, one is less prone to be influenced by so-called cultural purists. From another perspective, tolerance opens the way for hybrids. The hybrid is a deep cultural mix, not just the juxtaposition of different cultures, and it focuses on the parallel coexistence of different cultures in an area along with a different culture's right to exist and develop its identity.

Conclusion

Influenced by Western centrism and globalisation, local discussions around typo-morphology looks beyond the centre for an understanding of the periphery. As we begin to look out from the center to the periphery, the relative direction of research shifts from 'unity' to 'diversity'. This is precisely the effect of post-structuralism on various trends in theoretical background, generating new theoretical gaps and a new spatial imagination, which appear to originate from such a closed system of spatial science and a structural world.

Starting from the era of Japanese colonial rule, Taipei was laid out in such a way as to create a modern urbanism that is very different from that of the West. While people have freedom to come and go, a sense of connection to a local identity has been stripped away. While they can find any space in the city, their stay is usually temporary. This creates a new concept of dwelling- space of exiles who move in and out easily but are never connected by a sense of 'one place'.

Taipei has gradually become a modern city that has abandoned its history and the sense of place in favor of creating space for development, with the global style and universal typology diversity has been sacrificed at the expense of the city's vitality. The colonial process attempted to standardise space, eliminating diversity and complexity, while sacrificing energy and discourse. However, the customary

process is not like that. The colonial city remains diverse and complex, but also covertly includes the updated standards of the time, and it is nonetheless a more complicated process of spatial construction and deconstruction.

Taipei generated multiple two-way and short-interlude migration processes under colonialism, creating a peripheral cultural diaspora and complexity in the urban setting. It differs from the American postmodern city described by Soja as "[u]sing the city as subject to integrate diversity and difference, it is a space that is both diverse and contradictory, and it is also an extreme open space, with multiple identities" (Soja 1999, p. 276).[1] However, it is only a form of centre-style spiral diaspora. During the colonial and anti-colonial process, Taipei established a peripheral anti-centre-style diaspora and propagated the continuation of both societal behavioral practices and spatial practices. Therefore, typology is not fixed, but variable, continuously disintegrating and reappearing. This concept of typology is what Ricoeur (1961) described as "the foundation of the cultural creative core, something I called the core of humanity and sacrosanct, that our civilization gets to interpret life".[2]

This typo-morphology can be defined as a 'living space' where the inhabitants or users have some control over it. Therefore, emphasis should be placed on the fact that though planners follow a narrow ideal of scientific and architectural standards, residents have the power to reshape the space and give it new meaning. However, as Lefebvre (1991, p. 391) asserted, this space is liable to be eroticised and restored to ambiguity.

Endnotes

[1] Soja describes 'thirdspace' in the following way: "Thirdspace [...] is portrayed as multi-sided and contradictory, oppressive and liberating, passionate and routine, knowable and unknowable. It is a space of radical openness, a site of resistance and struggle, a space of multiplicitous representations, investigatable though its binarized oppositions bot also where il ya toujours l'Autre, where there are always 'other' spaces, heterotopologies, paradoxical geographies waiting to be explored. It is a meeting ground, a site of hybridity and mestizaje and moving beyond entrenched boundaries, a margin or edge where ties can be severed and also where new ties can be forged. It can be mapped but never captured in conventional cartographies; it can be creatively imagined but obtains meaning only when practiced and fully lived (1999, p. 276)."

[2] Paul Ricoeur (2007): "The phenomenon of universalization, while being an advancement of mankind, at the same time constitutes a sort of subtle destruction, not only of traditional cultures, which might not be an irreparable wrong, but also of what I shall call for the time being the creative nucleus of great civilizations and great cultures, that nucleus on the basis of which we interpret life, what I shall call in advance the ethical and mythical nucleus of mankind. The conflict springs up from there. We have the feeling that this single world civilization at the same time exerts a sort of attrition or wearing away at the expense of the cultural resources which have made the great civilization of the past."

References

Cohn, B. (1996) *Colonialism and Its Form of Knowledge: the British in India* (Princeton University Press, Princeton).

Foucault, M. (1970) *The Order of Things: An Archaeology of the Human Sciences* (Originally published 1996) (Vintage, New York).

Hsiu-Shen C. (2008) "Taiwanese Modernity and Its Culture of 'Native Place' Coping with the Thoughts of Japanese 'Overcoming Modernity'", *Journal of Humanities* 7.

Murdoch J. (2006) *Post-Structuralist Geography: A Guide to Relational Space.* (London, Sage, London).

Lardner, D. (1968) *Railway Economy: A Treatise on the New Art of Transport, its Management, Prospects & Relations* (A. M. Kelley, New York).

Said, E. (1978) *Orientalism* (Penguin, London).

Schivelbush, W. (1986) *The Railway Journey: The Industrialization And Perception of Time and Space* (University of California Press, Berkeley).

Shao-Li L. (2005) *EXHIBITING TAIWAN: Power, Space and Image Representation of Japanese Colonial Rule* (Rye Field Publishing, Taiwan).

Shuo-Bin S. (2010) *Invisible and Visible Taipei* (Socio Publishing, Taipei).

Soja, E. (1996) *Thirdspace: Journeys to Los Angeles and Other Real-and-imagined Places* (Blackwell, London).

Ricoeur, P. (2007) "Universal Civilization and National Cultures", in Canizaro, V.B. ed., *Architectural Regionalism-Collected Writings on Place, Identity, Modernity, and Tradition* (Princeton Architectural Press, New York).

Edge form design between natural and artificial: a case study of the Northern New Town of Nanchong, Sichuan

Enqi Wang
College of Architecture, Southeast University, Nanjing, China
Email: wangenqi7@yeah.net
Xin Wang
College of Architecture, Southeast University, Nanjing, China
Email: wangxinmj87@163.com

Abstract. *In recent years, cities in Chengdu-Chongqing Region of Southwest China have witnessed a remarkable boom that has triggered the process of urbanisation, in which the edges of those cities are being extended considerably. Due to the diversity and complexity of the landforms in this region, the balance between the natural terrain and artificial construction has become sensitive. In view of this, 'edge form design', a means to properly locate and shape the edges of new urban areas has manifest as a typical approach, is explored widely and applied effectively. To illustrate this approach, the paper takes the Northern New Town, a newly urbanised area located over complicated terrain in Nanchong City, as an example. After a brief introduction of the project background, the paper offers a demonstration of the process of edge form design and of the types of urban edges with corresponding open spaces.*

*Keywords: edge form design, new urban area, urban design method*

Project background

The main city of Nanchong used to be situated in the relatively concentrated plain regions along the riverside of Jialing River. In the past few years, owing to the upgrade of the city and population growth, land was in short supply. Land use became an obstacle for the further development of Nanchong. The construction of new urban areas is thus imperative. In 2010, the Northern New Town was prioritised as a new urban area of Nanchong for the two considerations below (Fig. 1):

1. *Natural conditions:* Compared with the mountainous areas, the terrain here is features tablelands and low hills, which could ease the difficulties of the transformation from original land into construction land.
2. *Artificial aspects:* This area is in the vicinity of the main city. Additionally, a new railway station on the Lanzhou-Chongqing line was about to be set up and this would grant the area an opportunity to become a new gateway of Nanchong.

On the basis of the estimated population and the predetermined land use in the Northern New Town by the government of Nanchong, the design proposed a feasible approach to form a framework of the new urban spaces that balanced between the natural landscape and the artificial construction. Properly locating and shaping the edges of the new town emerged as a critical issue.
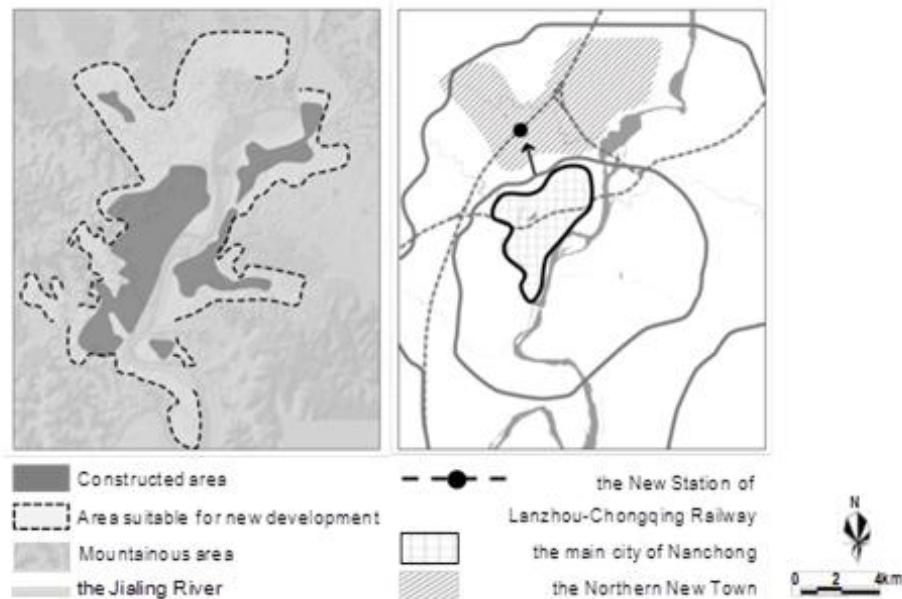
Figure 1. *The Natural Factors and the Artificial Factors for the Site Selection of the Northern New Town*
Source: Prepared by Enqi Wang and Xin Wang

The Process of Edge Form Design

Urban edges should be discussed based on different scales: from the holistic perspective to the detailed one. The process of edge form design tends to be staged in three phases, namely site selection, transformation and optimisation. The design at these stages addresses different issues – from general to specific and from abstract to concrete, thus making it varied in its main tasks and techniques (Fig. 2).
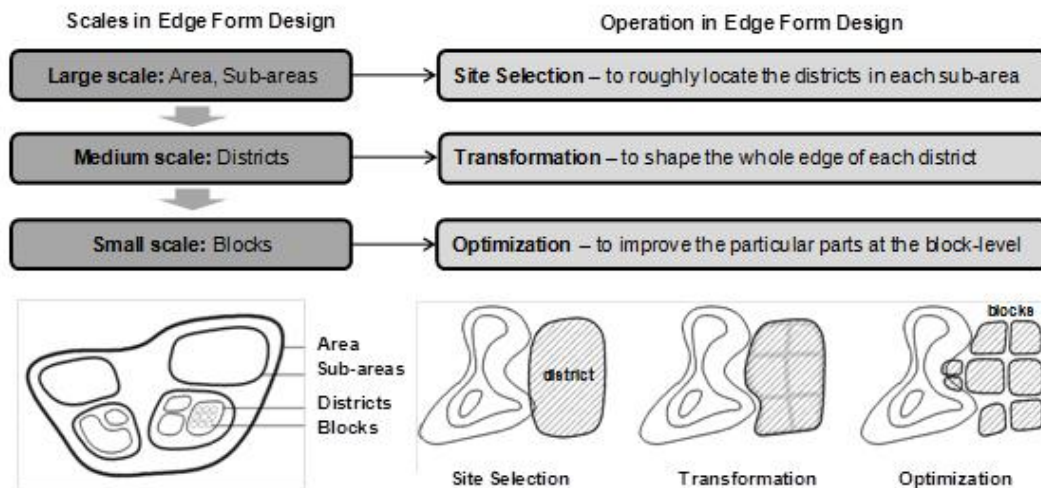
Figure 2. *Scales and Operations in Edge Form Design*
Source: Prepared by Enqi Wang and Xin Wang

Large-Scale: Site Selection – to roughly locate the districts in each sub-area

In order to form the overall framework and the spatial configuration between the natural landscape and artificial construction, the main task of the large-scale edge form design is to roughly locate the districts in each sub-area according to the external edge conditions, as it is shown in the design case of Nanchong. Two steps are followed. First, an overview of the external conditions and the dividing factors inside of the Northern New Town is required. This is developed through data analysis and on-site survey. As a whole, it is obvious that the area is bounded by Jialing River to the east, Qinglong-Mountain to the west, the First-

Circle Highway to the south and mountains and farm lands to the north. These are varied edge conditions for this area. Moreover, Lanzhou-Chongqing Railway and Yingxi-Jingxi River split the new urban area into several parts. After weighing the overall factors, the Northern New Town is divided into four sub-areas (Fig. 3) to reserve spaces for ecological and infrastructural corridors. By limiting the construction area to a comparatively compact scale, the aim is to facilitate the realisation of the functional configuration and the development of the supporting infrastructure in each sub-area.
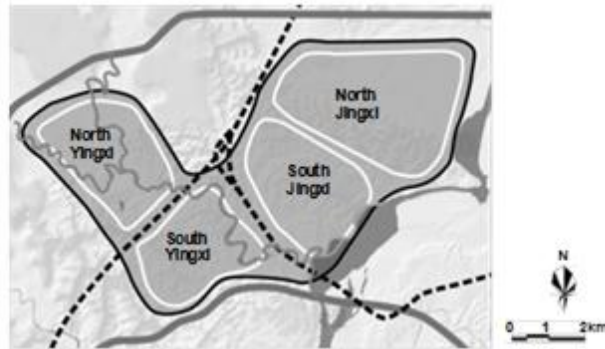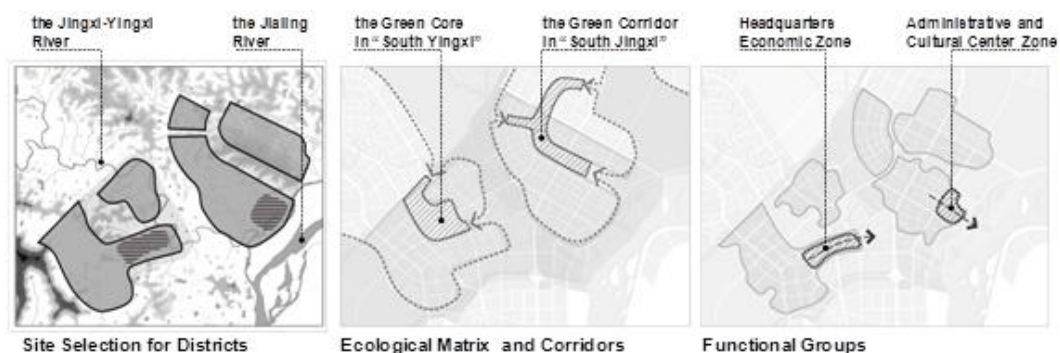

Figure 3. *Four Sub-Areas in the Northern New Town*
Source: Prepared by Enqi Wang and Xin Wang

Second, based on the analysis in Fig. 3, the general edges for districts in each sub-area are set and this completes the site selection phase of each district. In the new urban area, the 'Administrative and Cultural Centre' and the 'Headquarters Economic Zone' enjoy the priority in site selection and edge form design as these are the most important functional districts.

In South Jingxi sub-area, the 'Administrative and Cultural Centre' is adjacent to the natural edge of Jialing River which offers an excellent river-facing view. As this district sits on a north-to-south gentle slope, it holds a geographic advantage for development. In the land use planning, the mountain ridge zone with the dense vegetation to the north is reserved as the green corridor in this sub-area, which joins the Jialing River ecological zone.

In South Yingxi sub-area, 'Headquarters Economic Zone' is located on the west of Yingxi River and extends westwards to the 'High-speed Rail Station Region'. In the land use planning, the hills to the north are reserved as the green core in this sub-area and are connected to the main ecological corridor along Yingxi River.

The overall spatial configuration, which comprises ecological corridors at different levels and various functional groups, can be thus defined by the two steps above. Then, the balance between the Natural and the Artificial is achieved at the initial stage (Fig. 4).
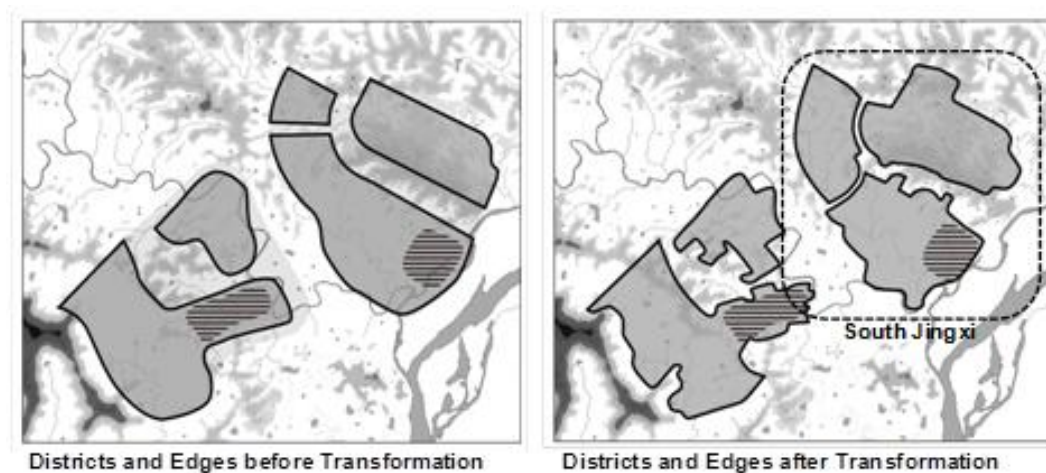

Figure 4. *Site Selection for two Sub-areas in the Northern New Town*
Source: Prepared by Enqi Wang and Xin Wang

Medium-Scale: Transformation – to shape the whole edge of each district

The main task in this stage is to shape the whole edge of each district in accordance with the overall spatial configuration, and then, to form the framework of each district. Edge form design at this stage needs to be discussed in relation to specific requirements for land use and terrain conditions, while the conflict between the natural and the artificial increases. While the city is required to be convenient and comfortable to live in, it must also reserve its organic and ecological advantages.

In South Jingxi sub-area, the ridge zone of Daying Mountain extends from west to east, where steeper slopes and wild vegetation abound. In the overall planning, a green corridor has been reserved in the central parts of this sub-area. However, the uniform road grid divides the natural terrain roughly, and the planned location of the green corridor deviates from the ridge zone and vegetation. Thus, edge transformation of districts in this sub-area starts with the edge adjustment for the green corridor.

First, there should be a clear view of the alignment between the overall planning and natural conditions by overlapping the land use maps with the topographic and vegetation maps accurately. Second, the ridge zone with its rich vegetation should be retained within the range of the green corridor, which is not suitable for construction and requires preservation for its ecological values. Third, the green corridor must fit with the natural terrains properly, and this requires the adoption of multiple methods to adjust its edges; for example, by curving the low-grade road on its north side, or by adding small patches along the high-grade road on its south side. Finally, hard edges defined by road grids can be turned into soft ones that are dominated by natural landforms (Fig. 5, Fig. 6).

Figure 5. *Edge Transformation for two Sub-areas in the Northern New Town*
Source: Prepared by Enqi Wang and Xin Wang

Small-Scale: Optimisation – to improve the particular parts at the block-level

Small-scale edge form design, as the extension of the medium-scale one, is discussed at the block-level in each district. As the city's configuration of ecological corridors, public spaces and municipal infrastructures have taken shape, the edge form of urban blocks does not make remarkable differences to the overall framework. On some important spots, however, the edge form between the artificial construction and the natural environment may still bear some significance.
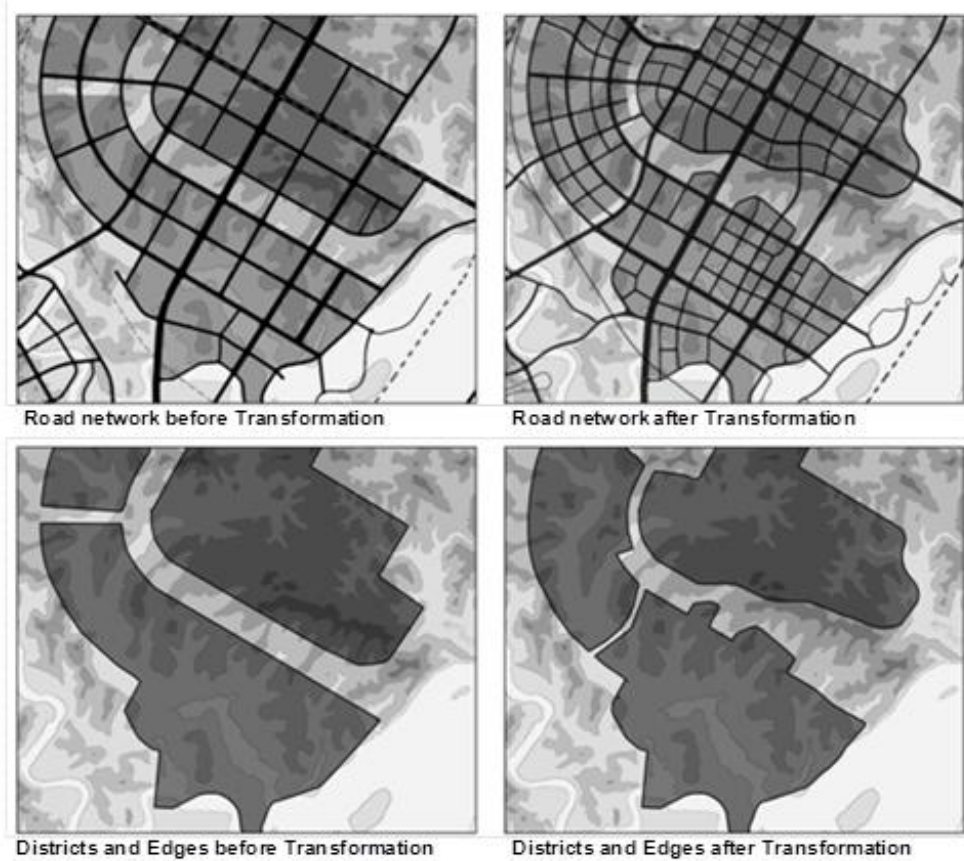
Figure 6. *Edge Transformation for "South Jingxi" Sub-area*
Source: Prepared by Enqi Wang and Xin Wang
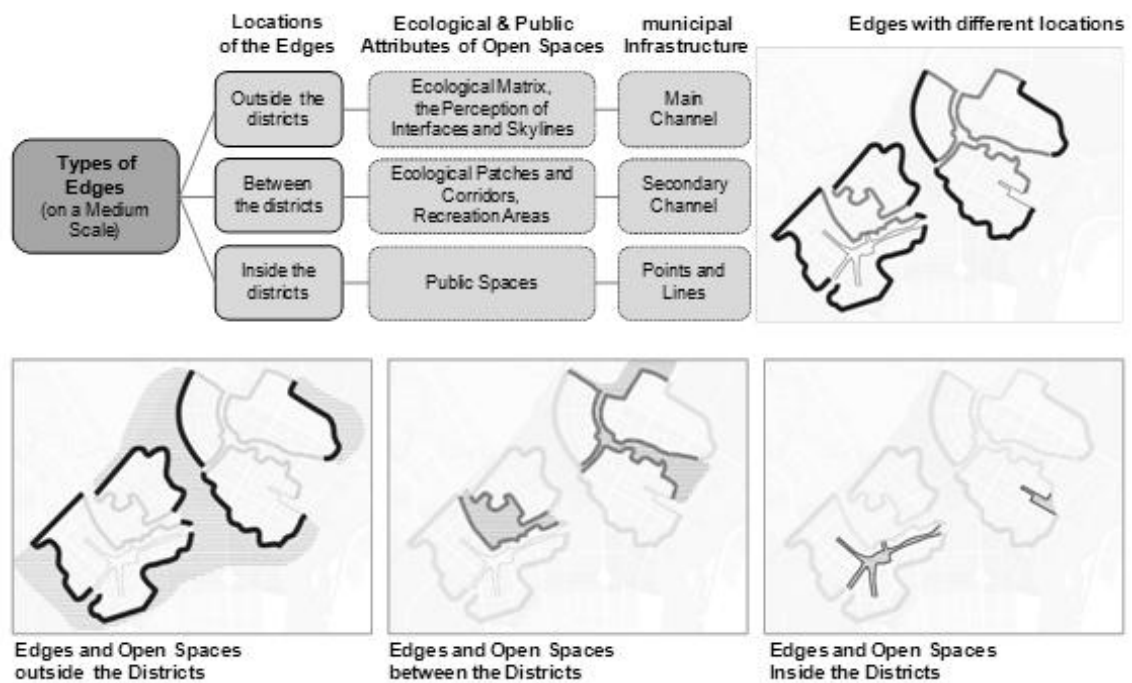
Figure 7. *Three types of Edges and corresponding Open Spaces*
Source: Prepared by Enqi Wang and Xin Wang

Types of edges with corresponding open spaces

Edge form is the most important factor that limits and establishes the order of external and internal urban spaces. Different types of edge forms lead to different basic attributes and functions of urban spaces. In the process of edge form design, the edge zones are neither negative nor indefinite, but zones of multiple uses that embrace infrastructure, ecological corridors and public spaces. This part will take the medium-scale edge form design as an example, to discuss how to create, shape and promote the new urban spaces by developing the edge form. According to the varied locations of district edges, we can define three types of edges with corresponding open spaces, namely edges and open spaces outside, inside and between the districts (Fig. 7).
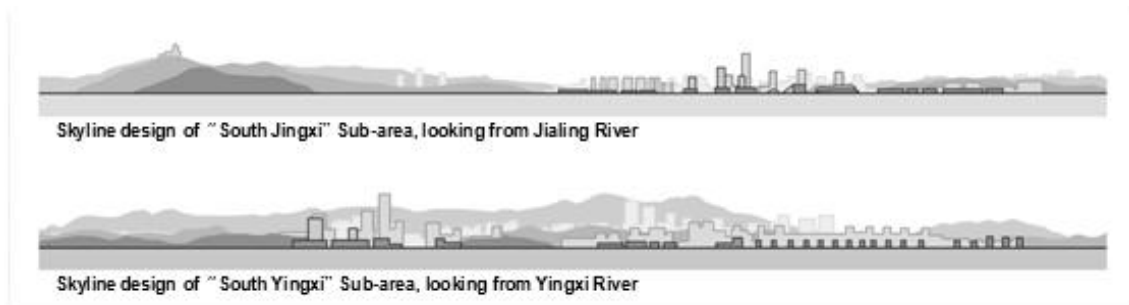
Edges and Open Spaces outside the Districts

The outer open spaces, defined by edges outside the districts, are generally the ecological matrix or corridors outside of the urban areas. These spaces contain semi-natural agricultural areas or natural areas with large lakes, wide rivers, and continuous mountains in them, such as the Jialing River on the east side and the Qinglong-Mountain on the west side of the new urban area.

In terms of infrastructure, this type of open space usually contains part of the infrastructure corridors. For example, there are high-speed highways, municipal electricity and gas pipelines on the south side of the new urban area.

Looking into the urban area from gateways in the outer open spaces, we can have a perception of the overall form of the new urban area, especially the interfaces and skylines of the city, which are closely related to the form of urban edges. In general, interfaces and skylines for cities with flat terrains are mainly defined by the outer edges, and the height distribution of urban areas. While interfaces and skylines for cities with complicated terrains are superposed and interlaced by the multiple skylines at various distances or heights, combined with the natural mountain outlines.

In the design of the Northern New Town, the skyline design is important because of the high-level of sight exposure of Jialing River and Yingxi-Jingxi River. The key is to design the edge form between the high-rise building zone and the natural mountains in the process of transformation and optimisation (Fig. 8).

Skyline design of "South Jingxi" Sub-area, looking from Jialing River

Skyline design of "South Yingxi" Sub-area, looking from Yingxi River

Figure 8. *Skylines design in the Northern New Town*
Source: Prepared by Enqi Wang and Xin Wang

Edges and Open Spaces inside the Districts

The internal open spaces, defined by edges inside the districts, are more likely to undertake the demands for public activities, such as public green lands, urban squares or a combination of the two. As these spaces are important places for public use and leisure, the space form and landscape design should take the residents' convenience into further consideration. A high quality public space usually has an agreeable scale, a harmonious spatial proportion and convenient service facilities. In those districts with complicated terrain, the organic combination of urban space and natural topography contributes significantly to the spatial quality.

In the design of Northern New Town, the main squares in the 'Headquarters Economic Zone' and the 'Administrative and Cultural Centre' serve as good examples. Both cases are similar in handling the relations between the natural terrain and public space, while they differ from each other depending on the specific conditions (Fig. 9).

Master plan of the "Headquarters Economic Zone"

Master plan of the "Administrative and Cultural Center"

The frameworks of Landscape & Open Space

The frameworks of Landscape & Open Space
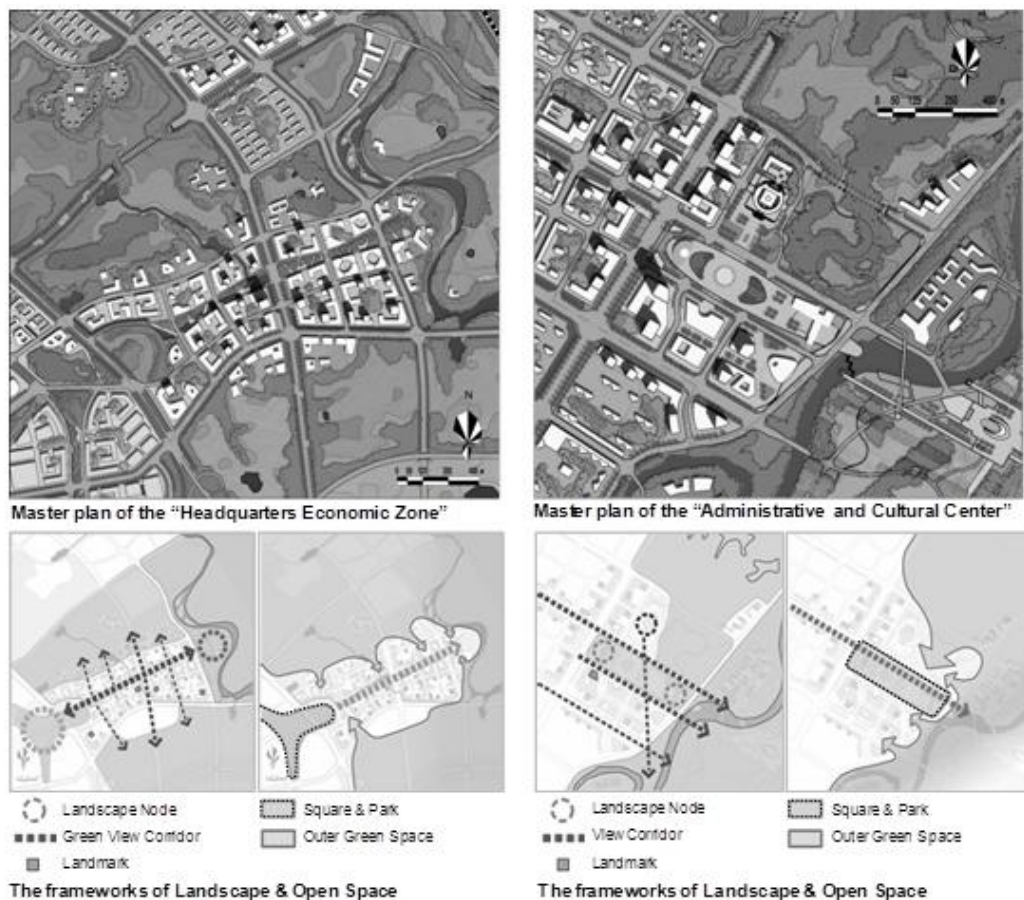
Figure 9. *The frameworks of Landscape and Open Space in the two Public Districts*
Source: Prepared by Enqi Wang and Xin Wang

In terms of infrastructure, this type of urban space could be designed for connectivity with roads, rail transit lines and stations. Due to the relatively heavy disturbance of artificial constructions, the public attributes of these spaces is much stronger than ecological sites. Consequently, these spaces are corridors at the lowest level in the ecosystem.

Edges and Open Spaces between the Districts

The open spaces, defined by the edges between the districts, could be important ecological corridors connecting different ecological matrix and patches, or an extension of the internal public spaces for the residents' leisure activities, many of which are eco-leisure parks with double attributes. Two typical cases are 'Da Ying-Mount Eco-leisure Park' and 'Yingxi Central Eco-leisure Park' in the Northern New Town.

As to the infrastructure, this type of open space contains sub-level corridors for municipal electricity and fuel gas facilities, whose distribution should be planned appropriately so as not to create a disturbance to eco-leisure parks. Roads in eco-parks can be elevated or tunneled to keep the continuity of the eco-environment.

Conclusion

Open spaces that are framed by urban edges with different scales and varied locations would have their own characteristics. The common principle is: from the outside to the inside, the ecological attributes of open spaces becomes weaker while the public activity attributes increase. Therefore, in practice, we must target the key edges with the most appropriate scale in mind. For instance, when discussing ecological and environmental problems, we should first target the large-scale edge form design to form a continuous ecological framework. While talking about human activities, we should create rich and vibrant public spaces through the small-scale edge form design.
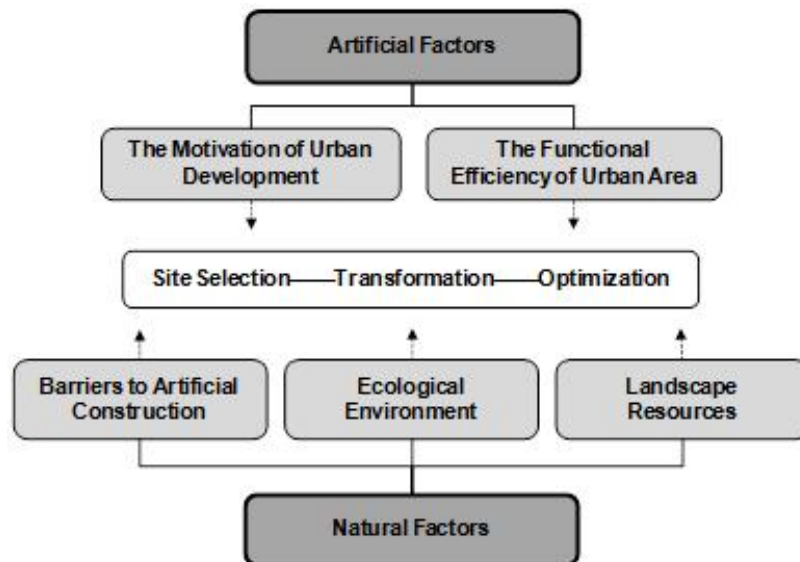
Figure 10. *Effects of the Natural and the Artificial in the process of Edge Form Design*
Source: Prepared by Enqi Wang and Xin Wang

From the perspective of the design process, the artificial factors and the natural factors have always been two forces competing with each other, and their effects for edge form design are constantly changing (Fig. 10).

1. In the process of site selection, the demands of local social and economic development are motivations which decide the developing goals and the land use for each public or residential district. Natural factors are the most important and direct constraints and resources, which restrict the casualness of the site selection.
2. In the process of transformation and optimisation, the natural terrain is the main basis for edge transformation. The functional efficiency of cities that calls for modernisation, industrialisation and digitalisation may work as a key barrier to the transformation process.

After a close study of the designed case for Nanchong, a conclusion tends to be clear that a well planned urban form with its own identity must be a result of discreetly balancing and weighing all the dilemmatic demands – natural and artificial – at every stage of the design. The balance reached should be contingent on the holistic mastering of the background of the project together with the analysis and evaluation of every detailed element. It is through this kind of balance that the characteristics of the urban form would have a good chance to be discovered, established and preserved.

References

Hough, M. (2004) *Cities and Natural Process: A Basis for Sustainability* (2nd ed.) (Routledge Press, London & New York).
Lynch, K. (1960) *The Image of the City* (the MIT Press, Cambridge, MA.).
Lynch, K. (1981) *A Theory of Good City Form* (the MIT Press, Cambridge, MA.).

Lynch, K. (1984) *Site Planning* (the MIT Press, Cambridge, MA.).

McHarg, I.L. (1995) *Design with Nature* (John Wiley & Sons, Inc. Press, New York).

Sternberg, E. (2000) 'An Integrative Theory of Urban Design', *APA Journal* 66, 265-278.

The new urban conditions to answer old demands of the urban life

Stael de Alvarenga Pereira Costa

School of Architecture, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil
Email: staelalvarenga@gmail.com

Jaqueline Duarte Santos

School of Architecture, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil
Email: jaquelineduarte.arquitetura@gmail.com

Maria Manoela Gimmler Netto

School of Architecture, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil
Email: manoelanetto@yahoo.com.br

Abstract. *In the introduction to their book,* The death and life of urban block, *Panerai, Samuels, Castex and Depauli (2004) stated that if they could define the subject matter of their work in one word it would be 'agony'. 'Agony' was thus used to refer to the transformation of the urban block which had previously been considered the typical element of classical European cities. The consequence, according to the authors, was a loss of indigenous quality and the undermining of the entire notion of the Xxth city. Since raising these issues 38 years ago, new urban configurations have resulted in the joining of plots and blocks onto a single, large parcel of land. The tendency has been to build such configurations on the outskirts of the city so as to provide land for new facilities that require huge spaces in order to perform their functions. Although the authors considered that this could define the 'agony' of the traditional city forms they are products of new urban conditions and, therefore, responses to urban demands and contemporary requirements. When surveying the new urban configuration, the transformation of the traditional forms of blocks and plots, the urban redevelopment programs in city centres and, above all, the increasing number of housing suburbs, can all be recognised. Despite the fact that they have increased in number and density, what can be observed is that they are not new constructions. Reports on over-occupation and redevelopment of urban centres can be traced back centuries. This paper intends to present the new urban conditions by making a comparative study of London, UK and the Belo Horizonte, Brazil.*

Keywords: Logistics, urban sprawl, new urban configuration, comparative studies, London, Belo Horizonte

Introduction

In *The Death and Life of the Urban Block,* Panerai et al. warned about the continuing disappearance of the traditional European morphological feature, the urban block. According to Panerai and his colleagues, an "agony" of this traditional urban element, which had been under profound transformation, could be observed. By presenting examples of several urban interventions they supported their critique by showing how gradually the idea of the suppression of urban blocks was introduced into the urban scene. The results of this phenomenon were characterised as, according to the authors, long blocks, of almost non-parcelled land, that can be found in several big cities contemporaneously (Saunders, 2005).

Such spaces are further characterised by great extensive tracts of land with only two sides being aligned to arterial roads. This is in stark contrast to the previous single plot areas surrounded by networks of streets. The construction space is destined to receive facilities that support functions going beyond local

and urban demands. Consequently, the area starts to perform an almost regional function and spreads beyond the municipal boundaries. Such spaces are allocated for warehousing, the headquarters of food companies, industry or cultural production infrastructures, such as TV studios, or even administrative centres. The most striking characteristic is their location which has often been transferred to the borders of the main city or, in some cases, to another city which forms part of the greater metropolitan area. This is in historical contrast to a location within the traditional city centre areas (Santos, 1994).

Some authors (Santos Jr, 2009) consider these spaces to be a product of globalisation and one in which logistics, while streamlining the production and distribution processes, is still territorially identified with the presence (or absence) of installed infrastructure, notably targeting systems and installations responsible for the intermodal movements of goods, such as ports, airports, railroads etc. Thus, he concludes that the industrial role of logistics is a strategic component which stands out and becomes increasingly important within these new processes. This phenomenon, one understood as an internal strategy to rationalise the process of industrial production, can now be understood as representing the dominant matrix of the contemporary economy. Consequently, the demands and requirements of globalised logistical organisation have come to determine the transformation and have contributed heavily to the redesign of urban areas; the visible result being dispersion and urban sprawl.

This paper conclusively demonstrates that the fragmentation and dispersal of space and territory are dominant in the transformation process to such an extent that new and large urban infrastructure is given priority in the aggregation of the metropolitan territory. Urban infrastructure, in this sense, has the basic function of reorganising urban systems and subsystems, thus promoting profound changes in the structure of the metropolis.

In contrast to these areas located on the outskirts of big metropolitan areas there are vacant and abandoned plots within the traditional urban forms in which the previous, now displaced facilities, used to be located. These are generally left free for new developments. This practice was observed in 1960 at Alnwick by Conzen when he classified the process as "urban fallows", thus making an analogy to a procedure dating back to agricultural practices in ancient times.

These spaces are eventually occupied by new mixed purpose housing schemes, long blocks surrounded by parking space provision, open spaces and recreational sites, all privatised, and occupying vacant land with extensive areas that are strikingly inharmonious with the traditional morphological features. They occupy the entire block and a traditional pattern of plot subdivision is absent. Thus the whole space turns into an extensive plot. Other features of the urban sprawl include the condominiums and mansions of the wealthy classes and housing for the poorest strata of the population. However, although contrasting socio-economically, both these tendencies can be identified as the same extensive products of the new urban conditions.

The consequences of this trend have impacted on both traditional urban form and on the surrounding landscape. The continuous spread of urban space into the surrounding countryside has however also been reported in literature since the 19th century. It has also led to heated discussions among many scholars. Concerns about city sprawl and unplanned growth have also dominated discussion in planning forums during the last decades of 19th century.

Those in favour of urban expansion usually argue for the development of a competitive city placed in a highly dynamic environment, appropriate for supplying developers with the right to revitalise commercial space and turn obsolete industrial zones into new commercial sites, (Wilson and Wouters, 2003). Troutman (2004) sets out further evidence supporting urban expansion, which he cites as being based on the social aspirations of the population for suburban living as a preferable alternative vision of the good life.

Anti-sprawl discourses have also played a systematic role in urban planning practices since the beginning of the 20th century, when the first city movements started to emerge. The balance between pro-sprawl

(new cities, suburbs) and anti-sprawl (urban renewal) moved decisively in favour of the anti-sprawl movement in the 1980s and thus impeded urban sprawl by advocating the renewal of inner cities and city centres. This phenomenon was witnessed mainly in England, although examples are also found in France. Despite the severe criticism Jacobs (1962) made of urban sprawl in the United States, one can still identify the continuation of the tendency in the form of residential suburbs or the development of commercial corridors alongside the suburban road networks which accommodate vast facilities, industry or neighbouring organisms, such as malls and warehouses. Clearly, according to Conzen's statements, they perform a role as units of a fringe belt.

An intriguing question that has arisen from the tendencies described above is whether or not the original inner fringe belts are, in practice, being transferred to the more distant metropolitan fringe areas. In order to provide an answer this paper will examine the new urban conditions witnessed in the Brazilian city of Belo Horizonte, built to be state capital of Minas Gerais 115 years ago. The second objective is to present the characteristics of the current urban conditions that are occurring in London. Thus, a comparative case study, designed to ascertain whether or not such tendencies are really new or are simply cyclical movements seen since ancient times, will be provided.

The contemporary phenomena surveyed in two different Case studies – London and Belo Horizonte

This case study uses two different cultural contexts to show how logistical imperatives have performed the same role by projecting traditional urban features to the outskirts of the cities. The major concern facing planners has been related to whether or not there is a real need to locate such installations in the new spaces and to thus leave the vacant areas left behind to be occupied by new urban features. Important functions that could be previously identified as an integral part of the urban scene have long gone. In contrast, contemporary logistical requirements dictate the type of development found in the outer spaces of the city and these areas are thus characterised by the same stereotyped uses with similar shops and houses. Consequently, the city loses its original character, vibrancy and diversity of functions.

Two different urban locations will be used as examples of the phenomena: Covent Garden Market in London, UK and the original warehousing and wholesaling area in Belo Horizonte, Brazil. Both cases belong to a distinct cultural background and were founded in different eras with the consequence that they exhibit distinct social, economic and political contexts. Despite these differences they present a similar process as can be seen in the following section.

Covent Garden – London

The area of London where the origins of Covent Garden market can be found was acknowledged in the walled city of Londinium in AD 410. The Saxons established a trading port in the place occupied now by Fleet Street and which covered the areas where the market once stood. The history of Covent Garden has been mapped since 1630 when it was used literally as the garden of a convent which belonged to Westminster Abbey. The main features of the area were preserved until the 17th century (Richardson, 2003).

Since this time, it has been the object of planning policy experiments, the first of which was carried out at the instigation of the Fourth Earl of Bedford who hired Inigo Jones to draw up the schemes for the first public square in London. Inigo Jones (1573 – 1652) was both keen on classical elements and influenced by the architecture of the Italian Renaissance, especially Palladio's designs and projects, when visiting that country. On his return to England, he introduced this style into his practice adopting it in royal buildings and residences (Spreiregen, 1973). He borrowed Palladio's ideas, proposing a grid pattern to locate Covent Garden square inside a set of winding streets. In this project he introduced uniformity into the urban landscape by building similar houses surrounded by arcade houses which belonged to the upper classes. The latter took exception to the character of the public spaces and complained about the lack of privacy that resulted from the square beneath their windows (Richardson, 2003). After it was

constructed, the upper classes vacated the area and were replaced by tenants who belonged to the artistic classes, consequently giving the area a bohemian atmosphere.

The image today associated with the fruit and vegetable market commenced in the 16th century. However, during the great fire of London in 1666, the market was destroyed. Recovery was swift and the public character of the market was enhanced by the construction of theatres, public houses and the emergence of a flower market. The area has always been associated with theatres, being the home of several buildings such as the Royal Theatre which was established there in 1660, with about 10 other theatres being established around the market in the 20th century. Further enhancement was provided by the addition of an assortment of small businesses such as car dealers, publishers and printers. While all of them contributed to the vitality of the place, it also it brought traffic congestion to this part of London. In the middle of the 20th century it became evident that the area could no longer sustain the amount of activities in just one place, so the idea of relocating the market to the outskirts of London arose (Markus, 1979).

The main project envisaged not only the relocation of the old market but also the development of an urban renewal project encompassing a hotel, conference and shopping centre as the main activities to be located in the old market place. Strong reaction by local residents and the public in general prevented this project from being realised. Consequently, the market building was preserved to accommodate small shops, bars, public facilities and niche businesses. The renewal of this part of London brought about the replacement of the old market and gave rise to several new facilities which consolidated the image of the place as a touristic area designated for theatres and amenities. In a way it reinforced the character of the area and turned it into a successful public space according to Bentley's rules (1999). It is possible to see in the following graphic examples that the transformation of urban features, such as blocks and plots, did not occur.

Fig. 1 and Fig. 2 show that the relationship between the built and open space was maintained despite the change in land use. Thus, the assertion of Conzen (2004) that the urban plan is the last feature to be transformed within the urban scene is confirmed by this example.
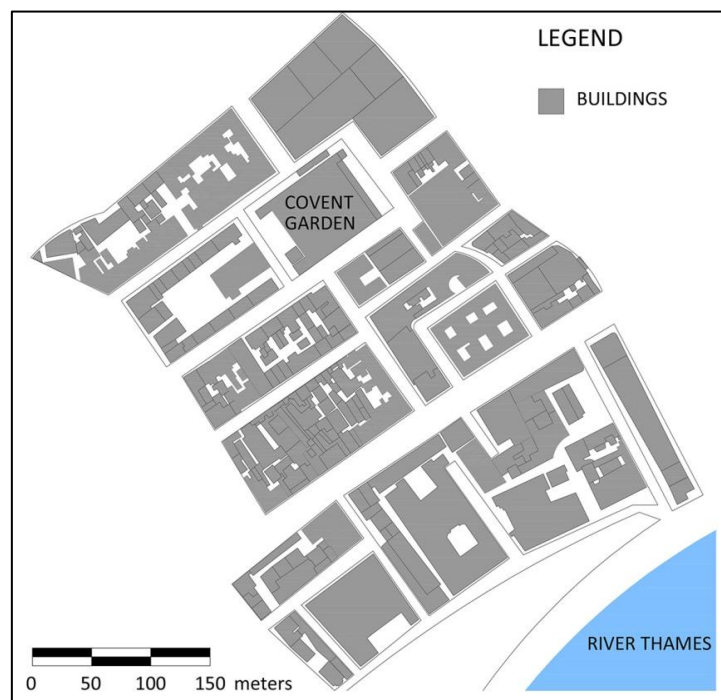
Figure 1. *Covent Garden Market and the surrounding area – buildings*
Source: Prepared by Pereira Costa at all, Landscape Laboratory, EQ-URMG, 2013
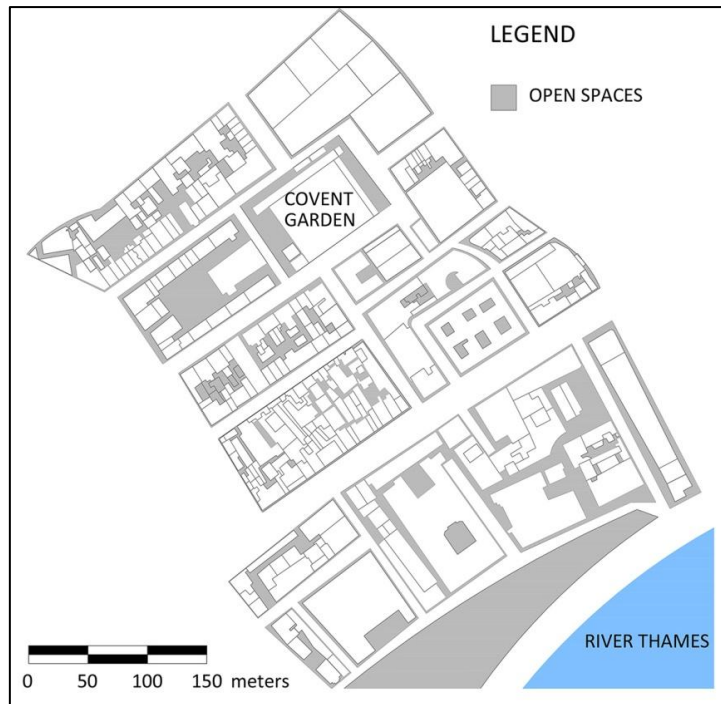
Figure 1. *Covent Garden Market and surrounding area – open spaces*
Source: Prepared by Pereira Costa at all, Landscape Laboratory, EQ-URMG, 2013

The surrounding area has also witnessed a new kind of urban phenomena – the overcapacity of activities. This phenomena, recognised by Jacobs (1962) in the Broadway area in New York, is characterised by the spread of already successful activities from the core to the surrounding areas. Such activities are driven by the search for increased profits and, consequently, the new activities lead to the extinction of the old. In the case of Covent Garden, the shopping activities, represented by department stores and retail chains, have tended to migrate towards the main surrounding areas leading to the expulsion of the small shops and niche businesses. As a result, the character of the place has been lost and has taken on the appearance of an adjunct to Oxford Street.

New Covent Garden, located in southwest London, was constructed on a plot of land which had previously been neglected for decades (Powell, 2001). The new market constitutes one of the largest fruit, vegetable and flower markets in the UK. The replacement market, named New Covent Garden, has created over 200 businesses, employing around 2500 people. The market supplies 40 percent of fresh fruit, flowers and vegetables to London and the surrounding areas (Sheppard, 1970).

Intriguingly, one wonders how this new construction, designated to perform a single function in a closed space, affects the surrounding space. The question arises as to whether the development has brought the positive characteristics of the old market, such as theatres and other amenities. It would also be interesting to observe if other niche business have been attracted by the new market. In short, clarification is needed as to whether the relocation of the old market has brought with it the successful surrounding spaces that used to attract the public, or whether it is to the contrary as a closed feature performing a single function. It is thus necessary to compare the two spaces in order to balance the positive and negative results of the public policies that have supported such changes. The construction of the new venture led to the creation of new jobs and access facilities for wholesalers. However, it did not promote the vitality and diversity of uses, as in the original market, in central London. Public access was also poor, since access via subway was distant. It is thus clear that the new venture did not contribute to the revitalisation of the adjacent space in the first years of its implementation (Littlefted, 2012).

It is therefore necessary to compare the two spaces in order to balance the positive and negative results of the public policies that have supported such changes, in order to analyse and propose improvements, as in the case of Belo Horizonte.

Belo Horizonte: a case study of the warehousing and wholesaling area of the city

The second case study addresses the Brazilian city of Belo Horizonte, designed to be the state capital of Minas Gerais, at the end of the 19th century. As a planned city, Belo Horizonte was expected to grow within its boundaries to accommodate a total of 200,000 inhabitants (Barreto, 1996), and to follow the design proposal for its development. This model planning strategy was consequently appropriated by several other cities. Thus, the main policy, designed to create a capital conducive to regional development and first applied in Belo Horizonte in 1897, was successfully followed by other capitals, such as Goiania in 1930, Brasilia in 1960, and Palmas in 1980 (Del Rio, 2008).

However, Belo Horizonte has spread in an unplanned manner towards the rural areas at an extremely fast pace due to both individual decision-making and political inputs. This work concentrates on the recent form of this metropolitan centre in 2013, the latter being viewed as a product of both private and public action. The main aspects of the evolution of this current form will be highlighted in an attempt to present the governmental policies and goods produced, taking into account the influence of modern logistical demands.

Planning concepts of Belo Horizonte

Belo Horizonte was constructed on the site of a small village, Arraial do Curral del Rey, which was demolished to make way for the new state capital. The overall planning concept was supported by a positivist ideology that considered the application of technology to be an integral part of a strategy for solving the problems of nature. The importance of such concepts may be observed in the design process which utilised frameworks and orthogonal grid patterns (PLAMBEL, 1986), these being imposed upon the higher regions of the city. In these areas streams were also conducted into covered channels. Belo Horizonte's planning design was conceived as a grid pattern subdivided into three major zones – rural, suburban, and urban. Each of these was supposed to take on different purposes, and initially occupied a total urbanised area of 1200 hectares. The initial strategy stipulated that the occupation of the urban zone should follow the north-south axis where the public buildings were constructed. The area that surrounded the commercial axis was located near the railway station so that goods could easily be transported to the warehouses.

The wholesale area of Belo Horizonte was consolidated during the formative stages of the city and was considered as an essential component in the city's development. The buildings were constructed on plots located within the urban zone, structured in the form of 120 m long, orthogonal blocks subdivided into 10 plots.

Most of those working in this wholesaling/warehousing area were the descendants of the Lebanese community, and the area received the nickname of 'Rua dos Turcos', due to the Brazilian custom of referring to people of Arabic background as 'Turks'. This nickname also acknowledged the commercial skills of members of the community who soon became prosperous businesspeople by transforming a single business activity into an important segment of commercial trade for both city and state. Due to its success, the area attracted additional enterprises to complement the core businesses. A brewery was located between the warehouses and, as the area attracted traders from the whole of Minas Gerais state, a set of facilities, such as small hotels, inns, restaurants, dancing clubs and universities, sprang up. The area thus became known as the bohemian quarter of the city (Barreto, 1996).

The warehouses of wholesale trade area were built on the alignment of the lots and have up to two floors with high ceilings. The facades area all inspired by the eclectic features and subdivided into three main parts: the base, the main body and the parapet. These are all decorated with classical elements. The

distribution of similar type on both sides of the track creates uniformity and rhythm, since there is a ratio between the voids and built-up areas, represented by the masonry of the building and the openings (doors and windows). The rhythm created by existence of the voids and built parts of the buildings creates a harmonic urban landscape.

The development of the wholesale area

However, at the same time, the downtown area began to receive governmental funding and support for the verticalisation of the region, a move also backed by local government and developers. This, in turn, influenced policy-makers to create legislation concerning urban land so as to give incentives to develop the region. The value of real estate increased considerably, bringing about a rapid transformation of the surrounding urban fabric, which in turn led to the construction of a large number of high-rise buildings. The additional consequence, beyond the increase in land values, was further heightened by the amount of traffic congestion, the streets no longer being able to provide space for trucks and the loading of heavy goods.

In the area of trade wholesalers, one can observe increased amount of built spaces. However the ongoing process is to turn them into parking and vacant land to be revitalised.

In this way, it is observed that the two areas were structured by ideals of Italian architecture, being Convent Garden a classically and the wholesale site an eclectic inspiration.

The new area designated to the wholesalers' activities settled along an interstate highway and turned into an input factor to attract new industries, services and low-income housing etc.

The state government consequently supported policies designed to encourage the growth and expansion of the wholesale area by relocating it to the outskirts of the city where, due to the extensive land available, the new facilities were able to meet both local and national food production needs. An important new commercial centre in the region has become consolidated and access is restricted to local and state purchasers, with the general public having no right of entry.

Figure 3. *Guaicurus Street in Belo Horizonte, 1942*
Source: Prepared by Pereira Costa at all, Landscape Laboratory, EQ-URMG, 2013

Figure 4. *Guaicurus Street in Belo Horizonte, 2009*
Source: Prepared by Pereira Costa at all, Landscape Laboratory, EQ-URMG, 2013

In contrast, although the old area remains fully occupied during the day, at night, the dereliction and decay of the urban fabric becomes more apparent. The brewery has been redeveloped and is now a popular, but rather rundown shopping centre dedicated to selling electronic gadgets. The warehouses are utilised as car parks and the prevailing image is one of decay, associated with the dying moments before revitalisation. Currently, the renovation of an old hotel which has suffered a series of infrastructure interventions is receiving mainly public investment due to Belo Horizonte being a World Cup host city (EAUFMG, PIAU, 2012). Among the projects planned by the city of Belo Horizonte Council is a newly designed central urban operations area, which covers the former warehousing site. The old fabric and the traditional buildings will soon be replaced by high-rise projects.

Considerations on contemporary demands for new urban conditions

The expansion of areas into the outskirts and countryside requires the provision of road networks and urban infrastructure. In fact these facilities both precede the construction of great building projects and act as a prerequisite to their implementation. It may be noticed, though, that both new projects were installed in remote locations, large enough to accommodate the logistical demands of road and rail traffic but without easy access for the general public.

The new Covent Garden was located in a derelict area; one of the causes that new market did not contribute to the revitalisation of the site. However in recent years it has been considered along with the U.S. Embassy as an anchor input to integrate the project of the revitalisation of the Nine Elms Corridor which will compliment Battersea Power Station. The whole enterprise has been structured on the basis of sustainability through the use of alternative energy for heating, cooling and carbon sequestration.

We conclude that when it used as a part of a larger enterprise, with the extension of two subway lines, the urban quality, previously nonexistent, can happen in premises suitable for the 21st century and in ways that supports sustainability.

The expansion of Belo Horizonte confirms the previously stated hypothesis explored in this paper. Further evidence of this phenomenon in the city can also be observed in the construction of a dual carriageway which connects the main centre to the northwest region. The provision of such a project, in an unoccupied area, has been designed to attract key logistical enterprises on both sides of the carriageway and the surrounding areas have started to accommodate various industries and peripheral housing schemes.

In order to provide answers to the demands of these new urban areas, both local and national governments need to demonstrate a more holistic approach (Spirn, 1995). This should include a greater awareness of environmental issues in areas which are intrinsically, environmentally fragile being that such new developments often cut through the traditional city green belts and are characterised, here in Brazil, by conspicuous land erosion. Thus, it is essential that alongside such developments there are water reutilisation systems, carbon capture programs, characterised by tree planting projects and green corridors, as well as, street lighting which utilises solar energy – a resource that Brazil has in abundance but unfortunately under-exploits.

Regrettably many political authorities have not taken into account the most evident negative impacts. Decisions have often been taken which are only designed to meet the constant needs for low-income housing provision and the implementation of logistical centres. Developments in the north and south of the metropolitan areas of Belo Horizonte are characterised by long corridors of housing occupation, without a centre or sense of community. Such areas are crying out for the establishment of new poly-nuclear cities and villages with several centres designed to perform poly-nuclear functions.

It appears from the examples presented that logistics demand great extension of new spaces and various forms of access. It is also a fact that the demands and consumption of general population will require the promotion and increase of these developments on the outskirts of large cities. The examples presented show that there are alterative solutions for their case, with the integration of mixed activities that can promote quality of life with social interaction.

The new urban reality thus demands discussion and deliberation on the efficacy of the social and political actions that have been and are being taken in relation to the day-to-day life, operations and planning of our cities. The examples presented in this paper hope to contribute to this debate by highlighting a tendency in urban development which has been predominantly a product of the 20th and 21st century economics.

Acknowledgements

References

Barreto, A. (1996) *Belo Horizonte, memória histórica e descritiva*; história antiga e história média. 2nd. ed. (Fundação João Pinheiro, Centro de Estudos Históricos e Culturais, Belo Horizonte).

Barreto, A. (1936) Belo Horizonte: *história antiga de Belo Horizonte.* (Rex, Belo Horizonte).

Bentley, I., Alcock, A., Murrain, P., McGlynn, S. & Smith, G. (1999) *Entornos Vitales* – Hacia un diseño urbano y arquitectónico más humano. Manual práctico. Editorial Gustavo Gili. (S.A.Barcelona).

Conzen, M.R.G. (1960) *Alnwick. Northumberland: A Study in Town-Plan Analysis*, Publication 27 (Institute of British Geographers, London).

Del Rio, V. E. (2008) *Beyond Brasília- Contemporary Urbanism in Brazil*. Del Rio, V. E & Siembieda, W. (eds) (The University Press of Florida, Gainesville).

Escola de Arquitetura/UFMG (2012) *Plano de Curso de Planejamento Integrado de Arquitetura e Urbanismo*. PIAU. UFMG, Moodle/UFMG.

Jacobs, J. (1962) *The Death and life of great American cities* (Jonathan Cape, USA).

Littlefted, D. (2012) 'London Re (Generation)', *Architectural Design,* January/February, Profile no 215. London.

Markus, T.A. (1979) *Building conservation and rehabilitation* (London, Newnes-Butterworths).

Panerai, P., Samuels, I., Castex, J. & Depaule, J.C. (2004) *Urban Forms: The death and life of urban block.* (Architectural Press, Oxford).

PLAMBEL (1986) Superintendência de Desenvolvimento da Região Metropolitana de Belo Horizonte, *A Estrutura Urbana da Região Metropolitana de Belo Horizonte*. Belo Horizonte: Secretaria do Estado do Planejamento e

Coordenação Geral, v.1.

Powell, K. (2005). *New London Architecture* (Merrell Publishers Limited, London).

Richardson, J. (2003) Covent Garden Life Ltd.1999-2003. *Group Booking.* Party Planner. London. In: http://www.coventgardenlife.com/info/history.htm

Santos Jr, W.R. (2009) A configuração atual, os conflitos e as potencialidades das transformações sócio espaciais na Região Metropolitana de Campinas, in 53 º *ICA Congresso Internacional de Americanistas,* Ciudad de México. 53 º ICA Congresso Internacional de Americanistas (Universidad Iberoamericana. v. CD, Ciudad de México México).

Santos, M. (2004) *O espaço dividido*: Os dois circuitos da economia urbana dos países subdesenvolvidos, 2ª ed (EDUSP, São Paulo).

Saunders, W.S. (2005) *Sprawl and suburbia* (University of Minnesota Press, Minneapolis).

Sheppard, F. H. W. (1970) British history on Line. *Covent Garden Market*. Survey of London, v. 36, 129-150 (http://www.british– history.ac.uk)

Spirn, A.W. (1995) *O jardim de granito*: A natureza no desenho da cidade (EdUSP, São Paulo).

Spreiregen, P. D. (1973) Compendio de Arquitectura Urbana. Segunda Edição. Editorial Gustavo Gilli. (S.A. Barcelona).

Troutman, P. (2004). 'A growth machine's plan B: legitimating development when the value free growth ideology is under fire', *Journal of Urban Affairs* 26, 611- 622.

Wilson D. & Jared W. (2003) 'Spatiality and growth discourse: The restructuring of America's rust belt cities', *Journal of Urban Affairs* 25, 123- 138.

REGIONAL CENTRES

cities and towns with local importance, at the edge of national or regional urban networks

Correlation analyses between underground spatial configuration and pedestrian flows by space syntax measures: a case study of underground mall complex in Nagoya Station

Kouhei Okamoto
Nagoya Institute of Technology, Nagoya, Japan
Email: kouhei2125@yahoo.co.jp
Toshiyuki Kaneda
Nagoya Institute of Technology, Nagoya, Japan
Email: kaneda@nitech.ac.jp
Akira Ota
Tokyu Land Corporation Ltd, Nagoya, Japan
Email: wizvib@gmail.com
Rim Meziani
Abu Dhabi University, Abu Dhabi, UAE
Email: rim.meziani@adu.ac.ae

Abstract. *Since the early stages of space syntax studies, the relationships between spatial configuration and pedestrian numbers have been analysed, and are mainly discussed in the context of natural movement. This natural movement has an ideal assumption that no attractive facility (attractor) exists in the space. Desyllas et al. also analysed the spatial configuration factor positively from a London downtown survey, finding that the actual downtown does not satisfy this assumption. By contrast, Ota et al. reports the connectivity measure as a characteristic of spatial configuration works positively but the secondary factor is weaker than attractor factors from their analysis on Sakae-South (West part of CBD) in Nagoya where a fleet of large department stores stands. In this paper, we analyse the relationships between several space syntax measures and the sliced volume of pedestrian flow at major lanes in the case data of Nagoya Station Underground Malls where there is the potential slope of the accessibility to stations. Both the closed underground space case and underground/ground two-layered connection case are studied statistically. In particular, the results of the layered connection case suggest that the local integration value of a space syntax measure works as a positive complementary determinant to the strongest accessibly measure for explaining the lane flows of pedestrians, though it still remains as the secondary factor.*

Keywords: space syntax, natural movement, underground mall, pedestrian flows, multi-regression analysis

Research background and objectives

From the beginning of space syntax (SS) theory study (Hillier and Hansen, 1984), there have been several analyses of the relationship between spatial configuration and pedestrian flows, especially by using the theory's proposed measures. For example, Hillier et al. (1987) researched the correlation between the integration and encounters (number of people recorded per 100 m/minute moving on the same axial line as the observer) in two areas of differing character – Barnsbury in inner north London as an urbanised area and Golders Green in London as a suburban area. The result of their analyses showed the best correlation coefficient of 0.800, 0.803 in each area. In Hanazato et al. (1991), the analyses of residential areas in Tokyo, Japan also achieved the result of a high correlation coefficient of 0.883.

After that, Hillier et al. (1993) proposed the concept of 'natural movement'. Their approach was based on the assumption that in open spaces with good visibility, or spaces with a high degree of centrality, some tendency of the visitors' towards crowding can be found. In order to discuss pedestrian movement rather than focus on an attractor factor, such as facilities attracting customers, they addressed an underlying spatial configuration factor. They described the movement motivated by spatial configuration as 'natural movement', claiming that natural movements were stipulated by the integration value described in SS theory, and they conducted case study analyses.

For example, the percentage of natural movement in an area will increase if the streets do not have rows of similar-size stores with prominent attractor facilities as found in a typical shopping street or complex. Multi-regression analysis (MRA) was used to explain office rents and pedestrian flows in the midtown areas of Berlin (Desyllas, 2000) and London (Desyllas et al., 2003). For example, they employed measures based on SS theory as candidate factors to explain pedestrian flows in London downtown, and discussed their explanatory intensities. The results of their analysis showed the following four factors, although they did not show the degree of influence of each factor:

1. Visibility
2. Accessibility to an underground station
3. Number of floors and the purpose of each building on a street
4. Pavement width (or capacity).

Based on the above research, the factors of pedestrian flows in the Sakae-Minami district in Nagoya City, reported by Ota et al. (2008), were analysed. The Sakae-Minami district, located to the southeast of Sakae Station, is a commercial district some 25 hectares in area, bounded by Hirokoji Street in the north and Wakamiya Main Street in the south. Otsu Street, running north-south and stretching the full length of the district, is lined with department stores. The data was collected on a sunny autumn national holiday in 2005. Some of the authors conducted MRA to explore factors to explain the characteristics of all-day pedestrian flows for each street (from 10:00 to 21:00, N=61). In this factor analysis, the following candidate variables were used, except for multicollinearity:

1. Connectivity measure (CNT, to be explained later) of SS theory
2. Accessibility (walking distance to an underground station)
3. Commercial use floor-area ratio
4. Office use floor-area ratio.

As a multiple correlation coefficient of 0.611 was then obtained, this expression was adopted. Based on the strength of the standard partial regression coefficient, explanatory factors were listed as follows: accessibility (-0.340), commercial use floor-area ratio (+0.260), office use floor-area ratio (+0.184) and visibility measure (+0.139). However, the first factor and the third factor showed a significant difference at a level of 10 percent, but the visibility measure showed no significant differences.

The results show that the natural movements, known as visibility measures in Space Syntax, are not a strong factor in this district, which is characterised by many department stores representing important attracting points. Yet, this factor must be considered as an explanatory one. Hence, this study aims to explore the implication of this factor in the space syntax theory by analysing the relationship between the measures of this theory and the pedestrian flows surveyed in the underground mall complex of Nagoya station.

Case study: the underground mall complex of Nagoya Station

Spatial characteristics of Nagoya Station area

The JR Nagoya Station is on the JR Tokai and Aonami Lines, and Nagoya City Subway system. Together

with the adjacent Kintetsu and Meitetsu railways, it is the largest terminal station in the Chubu Region; a daily average of about 1.14 million passengers uses the station (2008). The underground mall complex extends to the east along the Subway Sakura-dori Line, and stretches north and south along the Higashiyama Line (Fig. 1).

The current underground mall complex at Nagoya Station is well known as one of the largest classes of underground malls in Japan. The whole floor area of this underground mall is approximately 83,345 m². There is a competitive relationship between Sakae underground mall of 83,199 m² at another Nagoya CBD core to Tokyo Shinjuku underground mall measuring 104,505 m² and Osaka Nagahoribashi underground mall measuring 81,818 m².
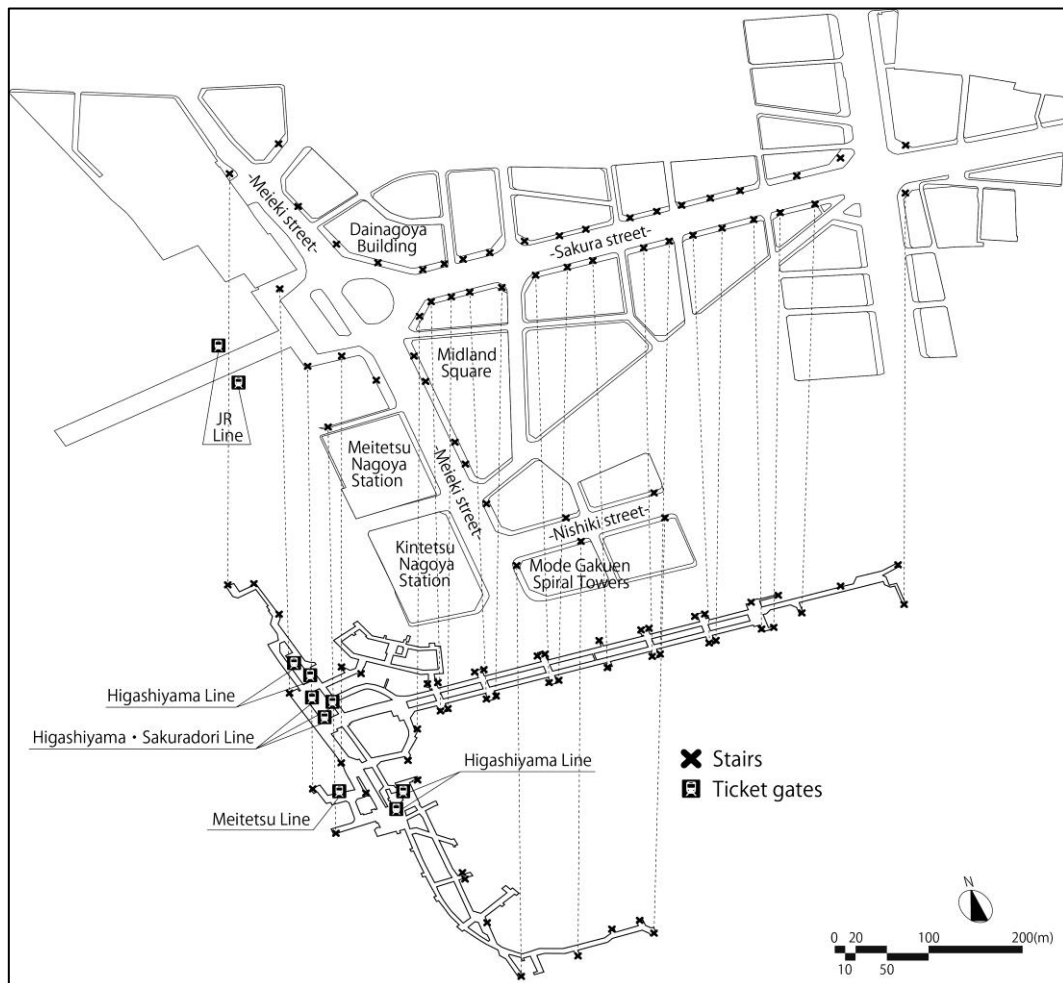

Figure 1. *Study area – Nagoya station area and underground mall complex*

A brief history of the underground mall complex formation

After the World War II damage reconstruction projects were completed successfully, Higashiyama subway line was constructed along Nagoya Station. At the same period, the project called Nagoya underground mall was constructed by private initiatives, along with this subway line. The early stage plan was merely a public pathway for commuters and transferring passengers to reduce the congestion of pedestrians and vehicles on ground. However, small-size shop and service tenants were also formed along both sides, gradually it became very popular for citizens, and evolved into a mall complex. When the underground was opened, the spatial configuration was simple. During the last half century, it has grown into a mall complex, and, for guest visitors entering the underground, it is difficult to recognise where they are (Fujikawa, 2007).

The current mall complex functions not only as a pathway for commuters in the morning rush hours but also as a shopping space for many customers visiting adjacent department stores, as well as free-walking visitors.

In this study, which covers about 53,000 m², the focus is on the main part of the mall complex which includes several malls (Fig. 2) that opened in the late 20th century:

- Sun Road Mall, Shimmei Food Mall, Meichika Mall (all have opened since 1957)
- Dainard Mall, Miyako Mall (both since 1963)
- Unimall (since 1970)
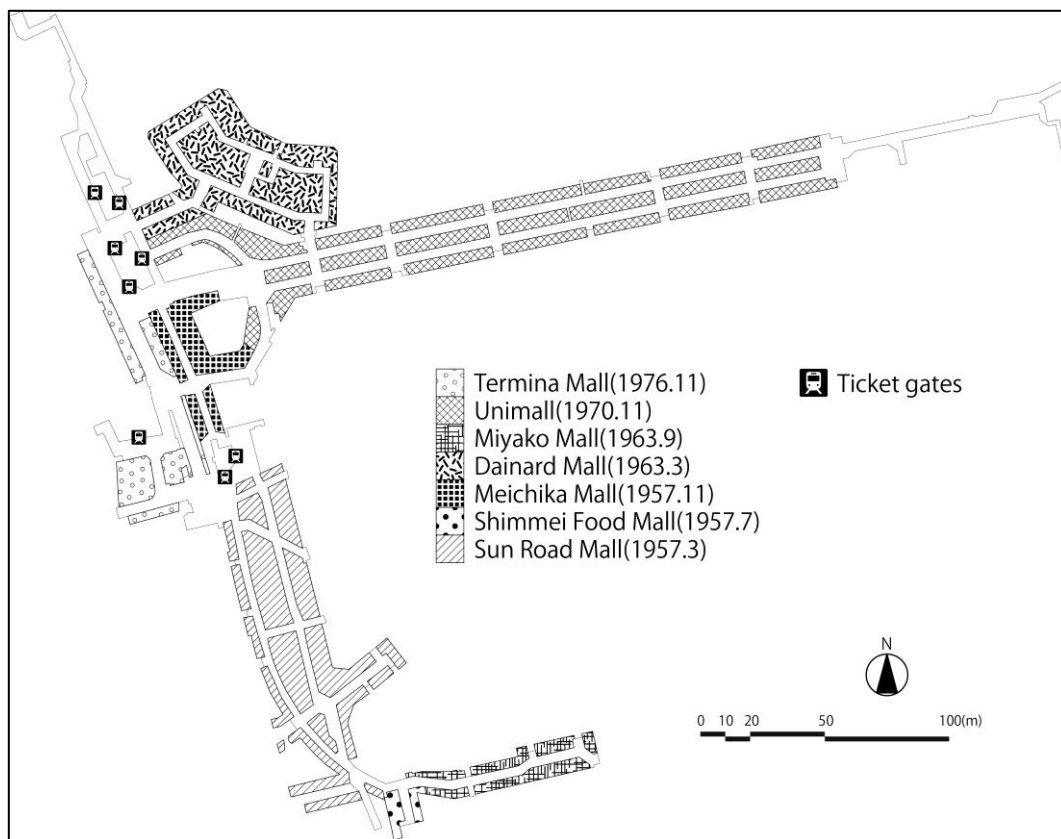- Termina Mall (since 1976).

Figure 2. *Transition of constructing the underground mall complex of Nagoya station*

Pedestrian flow survey in the Nagoya station area: Methodology

Throughout September and October 2012, the number of actual pedestrians in the Nagoya Station were counted at the survey spots shown in Fig. 3. The non-rush hours of 13:30 to 15:30 on a weekday were chosen. In this time zone, there are many mall visitors without commuters. The underground 50 spots were surveyed for random five minute periods and the sum total of cross-sectional pedestrian flows in both directions was calculated. In addition, for the coupled case, the same information was gathered for 30 spots above the ground floor. Fig. 3 also shows the results.
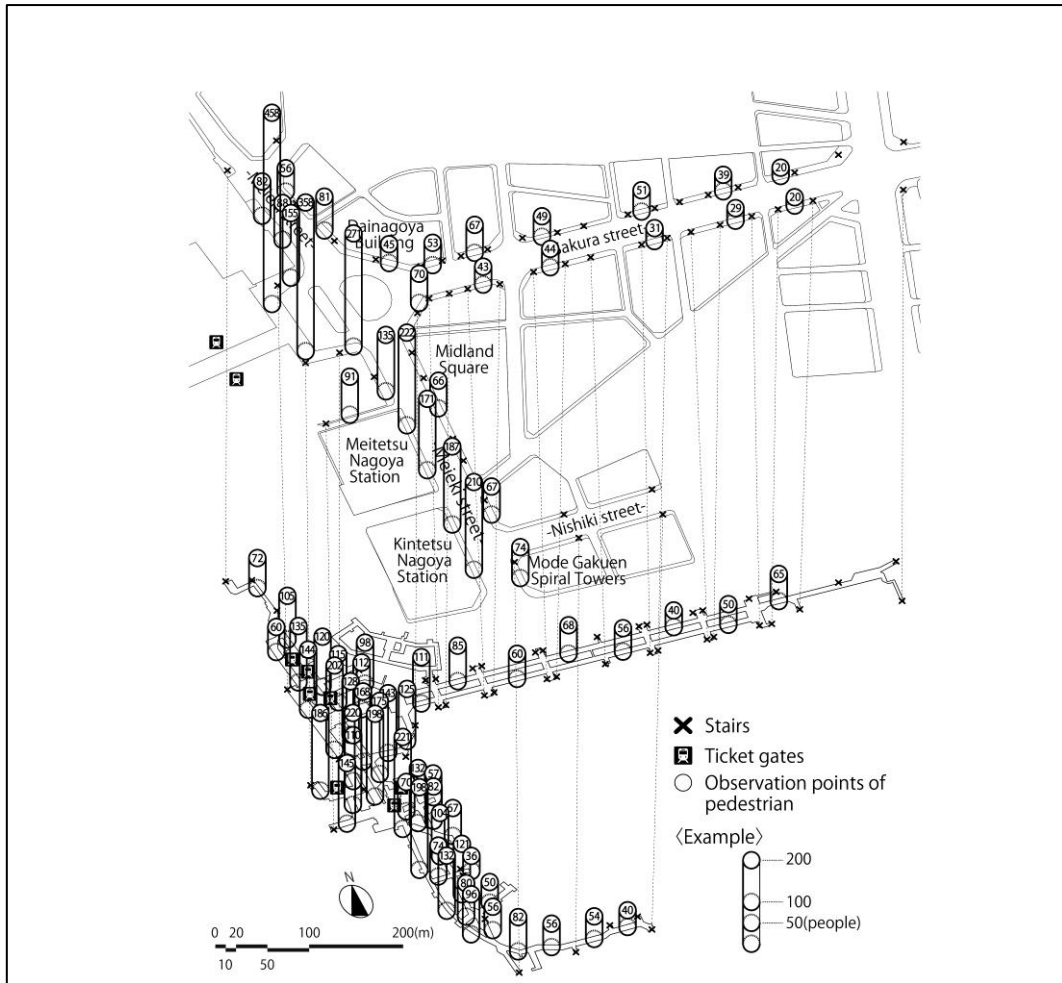
Figure 3. *Observation of pedestrian numbers in ground/underground spots*

Application of SS theory and measures to analyse the relationship between the pedestrian flows and the spatial configuration of the study area

SS theory and measures

This research used visibility graph analysis measures taken from SS theory. The target area was divided into grids, and a focus was given to the link between the central points of the grids to define each quantitative measure. The following four measures were studied:

1. Connectivity (CNT)
2. Visual Step Depth (VSD)
3. Shortest distance (Metric Shortest Path Length: MSP)
4. Integration Value (IV).

CNT is the total number of grids directly visible from a grid; a higher value indicates a broader visible area from the grid (Fig. 4(a)). MSP is the shortest physical distance between two specified grids (Fig. 4(b)). VSD is the least number of steps between two specified grids; a 'step' is any visual direction change made when moving from one grid to another grid. This means that when a pedestrian walks to an edge of their visible field, this is one step; when they change their visual direction and walk again to an edge of their new visible field, this is a second step (Fig. 4(c)). In VSD, the distance concept is abstracted into 'visual step-based'. For both MSP and VSD, measure values from the closest ticket gate are used (Fig. 4(b) and (c)). IV indicates the degree of integration of a grid in the area. A higher value of IV indicators shows higher degree of 'centrality' in the visual step-based context. Moreover, the IV has two variations: global

(GIV) and local (LIV). GIV is the calculation for the whole area and LIV has the calculation limit to r steps. In this research, an area up to three steps was calculated for LIV (Fig. 4(d)).
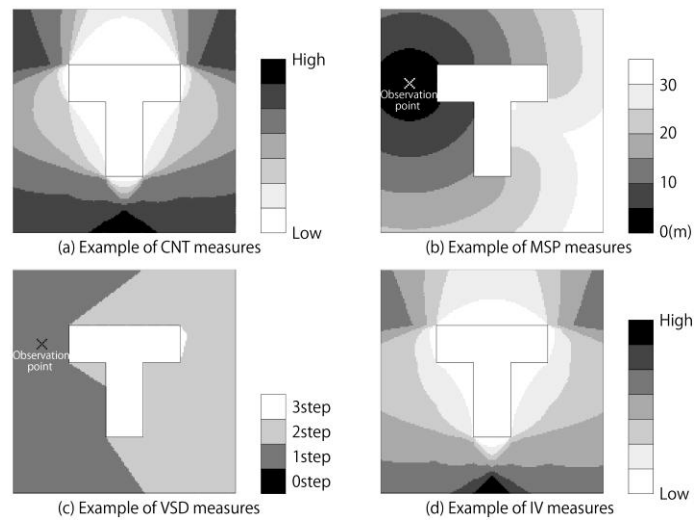
Figure 4. *Examples of Space Syntax measures (CNT, MSP, VSD and IV)*

To find the IV, the relative asymmetry (RA) first needs to be found (Expression 1). RA represents the relative depth (Depth) of each grid when viewed from the whole area. A higher value indicates that a particular space is in a deep and complex location, and when a pedestrian moves, they must walk through many spaces. Mean depth (MD) is an average of Depths from a grid to all other grids. In addition, k indicates the total number of grids. Next, using the RA, comparing target areas with different scales, a real relative asymmetry (RRA) value is found (Expression 2). This value is standardised by a correction coefficient D_k determined by only *k* (Expression 3). The reciprocal of this value is an IV (Expression 4).

The following equations show how to calculate RA, D_k, RRA and IV:

$$RA = \frac{2(MD - 1)}{k - 2}$$
(Expression 1)

$$D_k = \frac{2\left\{k\left[\log_2\left(\frac{k+2}{3}\right) - 1\right] + 1\right\}}{(k - 1)(k - 2)}$$
(Expression 2)

$$RRA = \frac{RA}{D_k} = \frac{(MD - 1)(k - 1)}{\left\{k\left[\log_2\left(\frac{k+2}{3}\right) - 1\right] + 1\right\}}$$
(Expression 3)

$$IV = \frac{1}{RRA}$$
(Expression 4)

Measure values in the underground mall complex of Nagoya station

Recently several studies trying to analyse the multilevel space configuration were reported (Afroza et al., 2007; Ueno et al., 2008; Hoolscher and Broosamle, 2012). So, this research analysed two cases: the closed case and the coupled case. The closed case is specified to only a closed area located in the underground floor while the coupled case connects the underground floor to the ground level. A grid was defined as 1 m each. DEPTHMAP was used as the analysis software. We connected each of the 51 stairs between the underground floor and the ground level as one step, regardless of difference of the stair configurations. Here, we analyse the explanatory factors for the pedestrian numbers in 50 spots underground. Section 4 deals with the closed case in that all of the measures are composed under the assumption of underground space only. Section 5 deals with the coupled case and considers not only underground but also ground through the 51 stairs connections. Fig. 5, 6 and 7 show the spatial distributions of the common measure values in both cases.
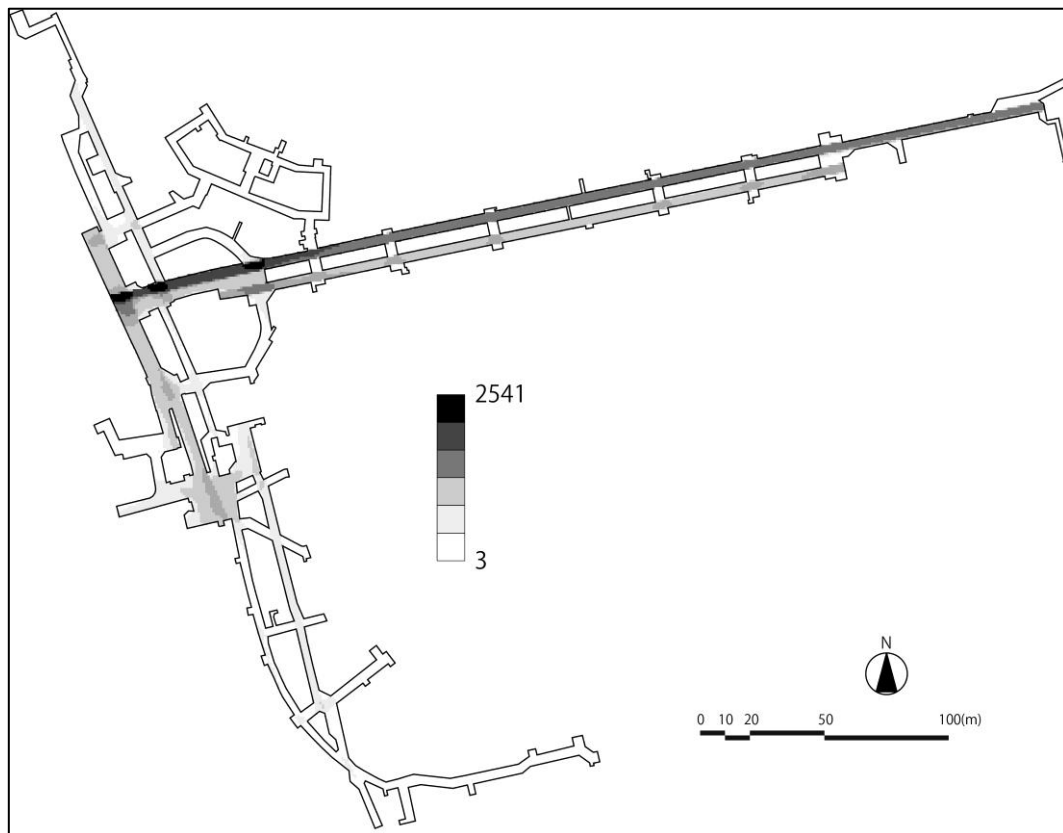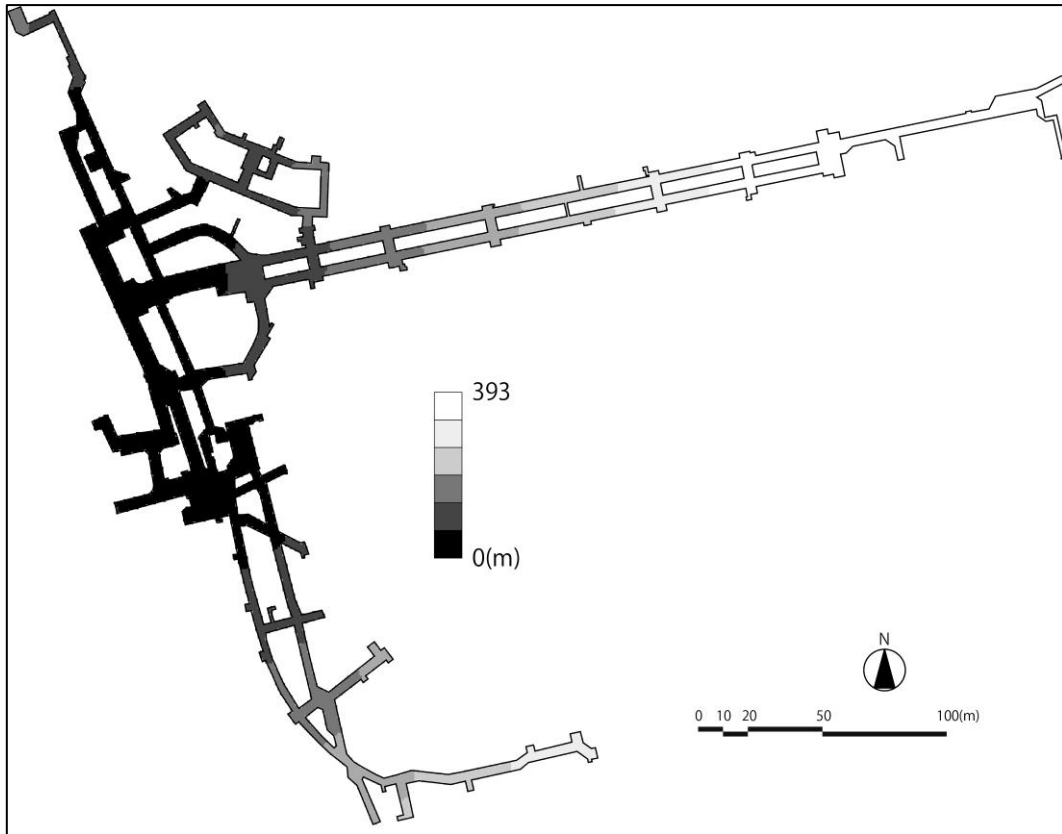

Figure 5. *Spatial distribution of CNT measure values*

Figure 6. *Spatial distribution of MSP measure values*
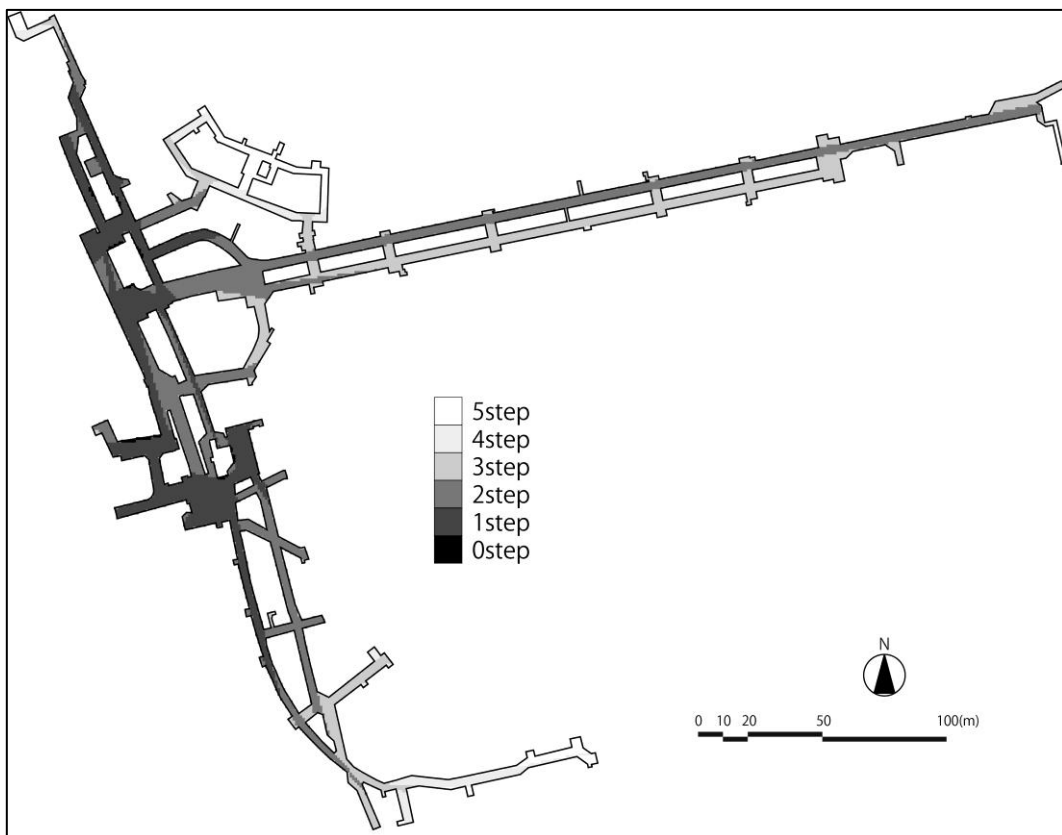
Figure 7. *Spatial distribution of VSD measure values*

Correlation analyses in the closed case

Correlation matrix of the closed case

For the closed case, correlation analysis was conducted using six measures: the number of pedestrians, CNT, MSP, VSD, GIV, and LIV. Fig. 8 and 9 show the spatial distributions of GIV and LIV (r=3) measure values in the closed case. Table 1 is the correlation matrix of the closed case. According to the table, a high correlation with pedestrians was found in the order of MSP (-0.598), VSD (-0.486), and GIV (+0.340). In contrast, CNT (-0.052) and LIV (+0.064) did not show any correlation on their own, although the existing research reported a great correlation with the number of pedestrians for LIV.

Therefore, CNT and LIV have been excluded from explanatory factor candidates. However, we doubted that the intensity order of MSP, MSP and GIV factors are only apparent, so next we conducted (multi-) regression analyses.
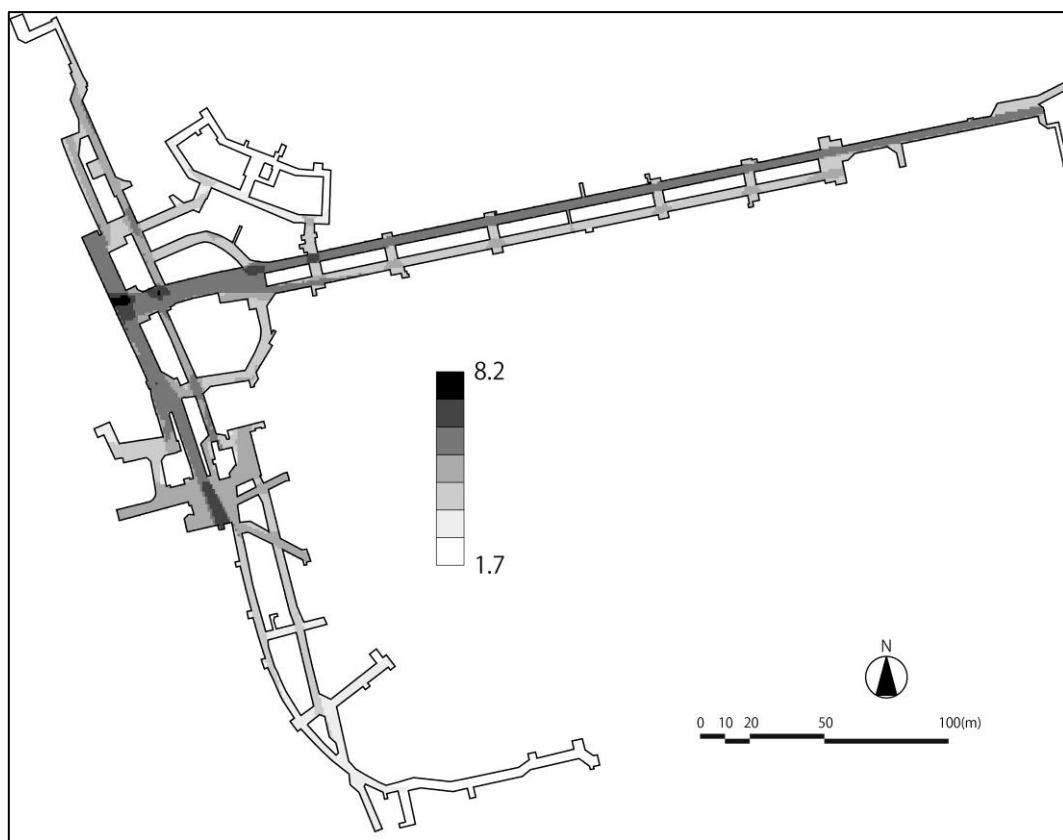
Figure 8. *Spatial distribution of GIV measure values in the closed case*
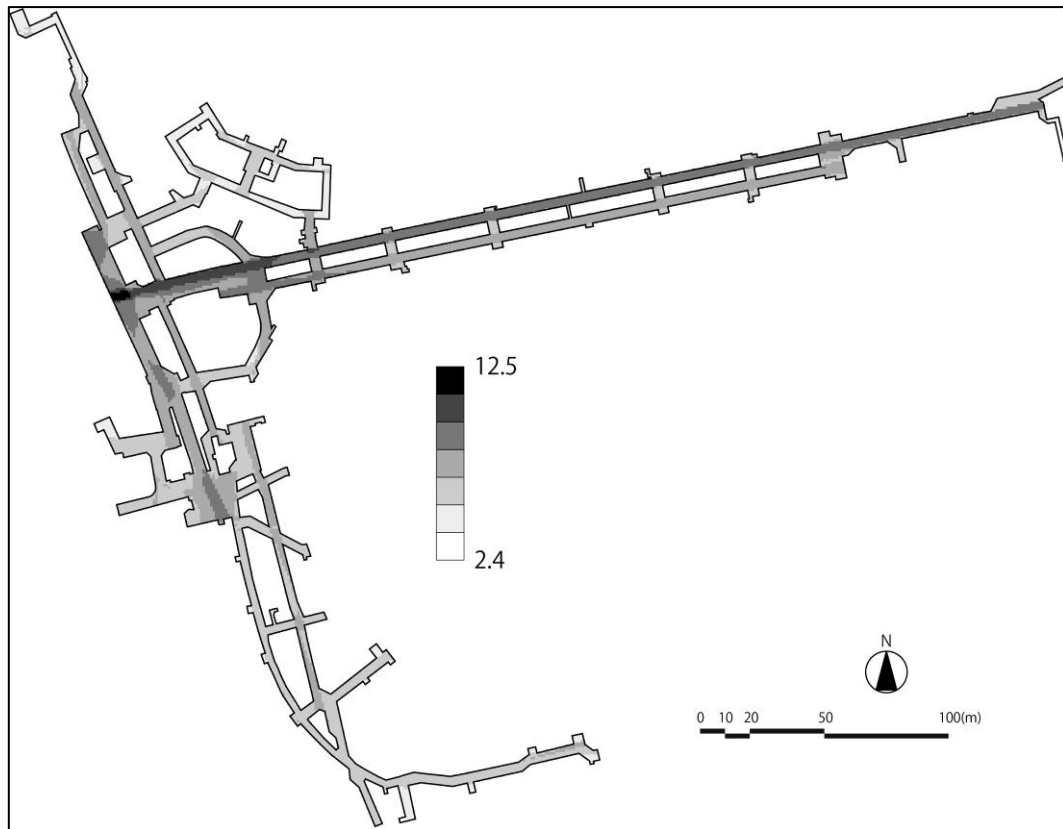
Figure 9. *Spatial distribution of LIV (r=3) measure values in the closed case*

Table 1. *Correlation matrix among SS measures in the closed case*

	Pedestrians	CNT	VSD	MSP	GIV	LIV
Pedestrians	1.000	——	——	——	——	——
CNT	-0.052	1.000	——	——	——	——
VSD	-0.486	-0.097	1.000	——	——	——
MSP	-0.598	0.319	0.617	1.000	——	——
GIV	0.336	0.670	-0.658	-0.248	1.000	——
LIV	0.064	0.869	-0.305	0.140	0.814	1.000

Regression analysis and discussion of the closed case

Table 2 shows the regression analysis results of three models in the closed case. As a regression model (3), multiple-regression analysis was conducted using two explanatory variables, MSP and GIV. A correlation coefficient of these two explanatory variables was -0.248, and it can be assessed that no issue of multicollinearity arises. At this time, the intensity of correlation coefficient improved from 0.598 of Model (1) (MSP alone) to 0.628 of Model (3) (MSP and GIV). The result of AIC test also selected Model (3) of the least AIC value from the three candidate models. When the intensity of the standardised coefficients of MSP and GIV were compared, we can find that MSP (-0.548) had a greater influence than GIV (+0.200). In a significance test, a significant difference at a level of 1 percent was obtained for MSP and 10 percent for GIV.

Therefore, we can conclude the primary factor as MSP (physical distance) and secondary factor as GIV (visual step-based centrality) in the closed case.

Table 2. *Regression results of models in the closed case*

			Single-correlation coefficient		Standardized partial regression coefficients	AIC	Significance test	
			Multiple-correlation					
(1)	Single-regression analysis	MSP	-0.598		-0.598	516.147	✳✳✳	
(2)		VSD	-0.486		-0.486	524.760	✳✳✳	
(3)	Multiple-regression analysis	MSP	0.628	-0.598	-0.548	515.129	✳✳✳	✳✳✳
		GIV		0.336	0.200			✳

(✳✳✳: significant difference at a level of 1%、✳✳: 5%、✳: 10%)

Correlation analyses in the coupled case

Correlation matrix of the coupled case

For the coupled case, five measures were used to analyse correlation: the number of pedestrians, CNT, MSP, VSD, and LIV. Fig. 10 shows the spatial distribution of LIV (r=3) measure values in the coupled case. Table 3 is the correlation matrix of the coupled case. According to the table, similar to the closed case, a high correlation with pedestrians was shown in the order of MSP and VSD. Similar to the closed case, CNT (-0.052) and LIV (-0.088) showed fewer correlations to the number of pedestrians. However, we doubted these values are only apparent, so next we tried (multi-) regression analyses in the coupled case.
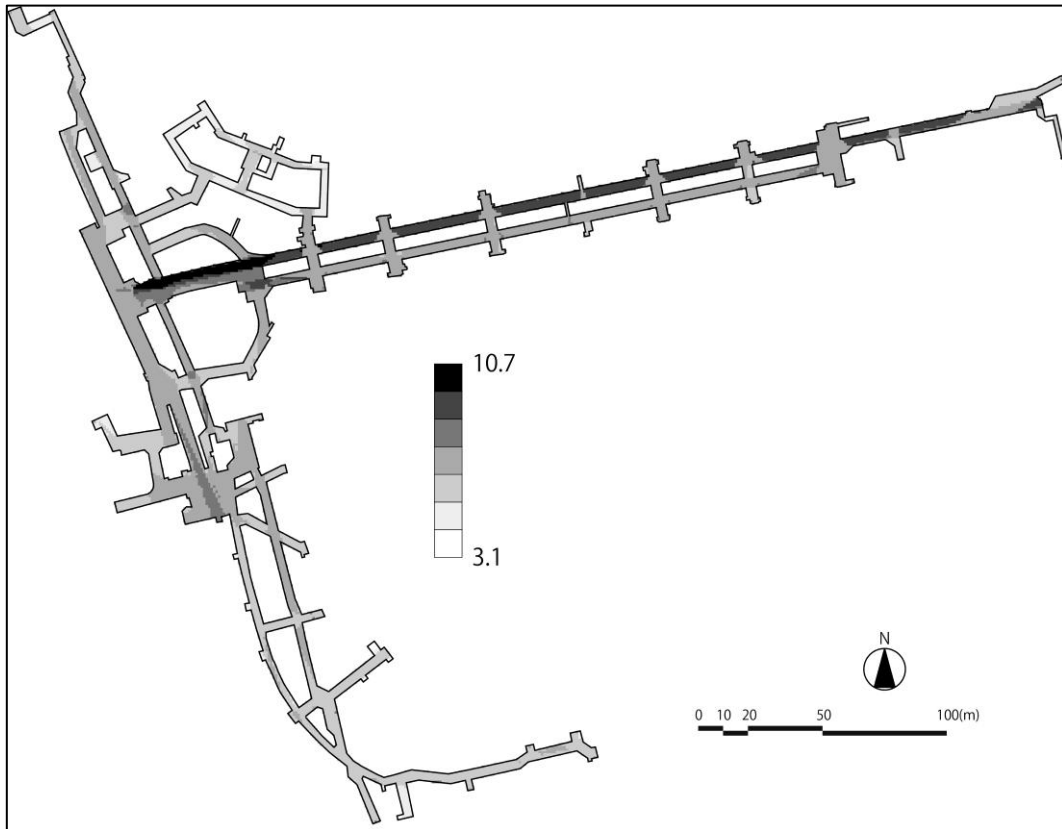
Figure 10. *Spatial distribution of LIV (r=3) measure values in the coupled case*

Table 3. *Correlation matrix among SS measures in the coupled case*

	Pedestrians	CNT	VSD	MSP	LIV
Pedestrians	1.000	—	—	—	—
CNT	-0.052	1.000	—	—	—
VSD	-0.486	-0.097	1.000	—	—
MSP	-0.598	0.319	0.617	1.000	—
LIV	-0.088	0.902	-0.246	-0.243	1.000

Regression analysis and discussion of the coupled case

Table 4 shows the regression analysis results of three models in the coupled case. As a regression Model (4), multiple-regression analysis was conducted using two explanatory variables, VSD and LIV. A correlation coefficient between these two explanatory variables was -0.246, and it can be assessed that no issue of multicollinearity arises. At this time, a multiple correlation coefficient improved from -0.486 (Model (2), VSD alone) to 0.531. When standardised partial regression coefficients of VSD and LIV were compared, both values were negative. However, it can be assessed that VSD (-0.540) had a greater influence than LIV (-0.221). In a significance test, a significant difference at a level of 1 percent was recognised for VSD, and 10 percent for LIV. However, compared to Model (2), Model (4) had an improved intensity of correlation coefficient from 0.486 to 0.531, but the value did not exceed the correlation coefficient 0.598 of Model (1). The result of AIC test also selected Model (1). We had already confirmed that the combination of MSP and LIV is not improved Model (1). So in this case, we concluded the primary factor is MSP (physical distance), although the combination of MSP and LIV (visual step-based distance and centrality) is also hopeful.

Table 4. *Regression results of models in the coupled case*

			Single-correlation coefficient		Standardized partial regression coefficients	AIC	Significance test	
			Multiple-correlation					
(1)	Single-regression analysis	MSP	-0.598		-0.598	516.147	***	
(2)		VSD	-0.486		-0.486	524.760	***	
(4)	Multiple-regression analysis	VSD	0.531	-0.486	-0.540	523.613	***	***
		LIV		-0.088	-0.221			*

(＊＊＊: significant difference at a level of 1%、＊＊: 5%、＊: 10%)

Conclusion

This research aims to study the correlation between the Space Syntax theory measures and the pedestrian flows in the underground mall complex of Nagoya station. To achieve this, 50 spots were analysed.

The implications from the findings of our analyses in Nagoya underground mall complex can be summarised as follows:

- The primary factor of the pedestrian flows can be seen as the physical distance to ticket gates (MSP) in the both cases. This is supported by the results of AIC tests.
- The visual step-based distance (VSD) also can be recognised as the primary factor substitutively in the both cases (from the results of t-value significant test), but slightly weaker than MSP.
- The visual step-based centrality (GIV or LIV) can work as the secondary factor in each case (like as Model (3) and Model (4)). It suggests the power of shape exists in our ground mall complex study.

References

Afroza, P., Arlen, M. Y. & Beisi, J. (2007) 'Multilevel pedestrian movement: Does visibility make any difference?', Proceedings of 6th International Space Syntax Symposium (International Space Syntax Symposium, İstanbul), 1-16.

Christoph, H., Martin, B. & Georg, V. (2012) 'Challenges in multilevel wayfinding: a case study with the space syntax technique', *Environment and Planning B', Planning and Design* 39, 63-82.

Desyllas, J. (2000) 'The Relationship between Urban Street Configuration and Office Rent Patterns in Berlin', PhD thesis, (Bartlett School of Graduate Studies, University College London, London).

Desyllas, J., Duxbury, E., Ward, J., & Smith, A. (2003) 'Pedestrian Demand Modelling of Large Cities: An Applied Example from London', UCL CASA Working Paper Series Paper, 62.

Fujikawa, H. (2007) *A Birth Story of Nagoya Underground Mall* (C&D publication, Japan) (in Japanese).

Hanazato, T., Lee, K. L. and Takahashi, T. (1991) 'An Introduction to Space Syntax Theory: Part 4. A Case study in Yanaka and Hongo', Summaries of technical papers of Annual Meeting Architectural Institute of Japan, Architectural planning and design rural planning (Architectural Institute of Japan, Japan) 223-224.

Hillier, B., Burdett, R., Peponis, J. & Penn, A. (1987) 'Creating Life: Or, Does Architecture Determine Anything?', *Architecture et Comportement/Architecture and Behaviour* 3, 233-250.

Hillier, B. and Hanson, J. (1984) *The Social Logic of Space* (Cambridge University Press, Cambridge).

Hillier, B., Penn, A., Hanson, J., Grajewskig, T & Xu, J. (1993) 'Natural movement: or, configuration and attraction in urban pedestrian movement', *Environment and Planning B* 20, 29-66.

Ota, A., Meziani, M., Sugiura, Y. and Kaneda, T. (2008) 'Factor Analysis of the Pedestrians Number in a Downtown Area Using Visibility Indicators – A Case Study of the Sakae-South District, a Downtown Area of Nagoya', in Lucas, R. and Mair, G. (eds.) *Sensory Urbanism Proceedings 2008* (The Flaaneur Press) 158-164.

Ueno, J., Nakazawa, A. and Kishimoto, T. (2009) 'An Analysis of Pedestrian Movement in Multilevel Complex by Space Syntax Theory – In the Case of Shibuya Station', Proceedings of the 7th International Space Syntax Symposium, Ref 118-1-18.

The new order of dwelling as morphological restructuring of Taiwan shophouse, with a case study on Tainan

Shu-Li Huang

Graduate Institute of Urban Planning, National Taipei University, Taiwan
Email: zizi0815@ms51.hinet.net

Chaolee Kuo

Graduate Institute of Urban Planning, National Taipei University, Taiwan
Email: chaoleek@gmail.com

Abstract. *The meaning of dwelling, for a long time, has been the central issue of discussion on modernity and urban regeneration encountering the old settlements in Tainan. However, conservation law not only freezes the urban form but also accelerates the fading meaning of urban dwelling. What is the form in the meaning of 'dwelling' in the urban old settlements? From the perspective of morphology on physical and social spaces, we found that the problem of spatial structure of the old settlements in Tainan today is that the transformation of physical space cannot be concomitant with the shift of social space. The issues of 'dwelling' and 'dwelling display', emerging from the question of spatial structure, lead the work to reviewing the Old Settlement Preservation Law. We try to interpret how 'dwelling' is completely eliminated from the preservation process of shophouse form by external forces? First, we think the shophouse morphology not only evidences the disintegration of the feudal system in China, but also the emergence of marginalisation. Therefore, the shophouse morphology has its expositions value for the issue of deconstruction and marginalisation. Second, we find the shophouse morphology in Taiwan is more relaxed than in China. We question how to change the shophouse morphology in the process of modernisation? Finally, the research returns to the basis of morphology to understand the process of shophouse transformation from family dwelling to urban dwelling as well as the relationship between urbanisation and dwelling.*

Keywords: new order of dwelling, morphological, restructuring, Taiwan shophouse, Tainan

Introduction

In *Building Dwelling Thinking*, Heidegger believed that the coexistence of people and the environment to achieve balance is important for defining how 'build equals dwelling'. He united the four elements of 'Universe, Land, God and Human' into one entity. This has become a foundation for Chinese traditional residential research (Ji, 1992). How has the difference between traditional dwelling and modern dwelling displayed the separation among 'dwelling', 'build', and 'human'?

Cacciari (1980) asserted that dwelling behaviour in modern cities focuses on subjectivity and individual living which resulted in the broken relationship between dwelling and building. Modern dwelling is meaningless and building represents the exhaustion of modern living. In his book *Architecture and Nihilism: On the Philosophy of Modern Architecture*, Cacciari (1993) rejected the possibility of dwelling in cities. However, we can challenge Caccari's idea of 'non-dwelling' through the case of Tainan due to the specific historical context of migration and colonisation in Taiwan.
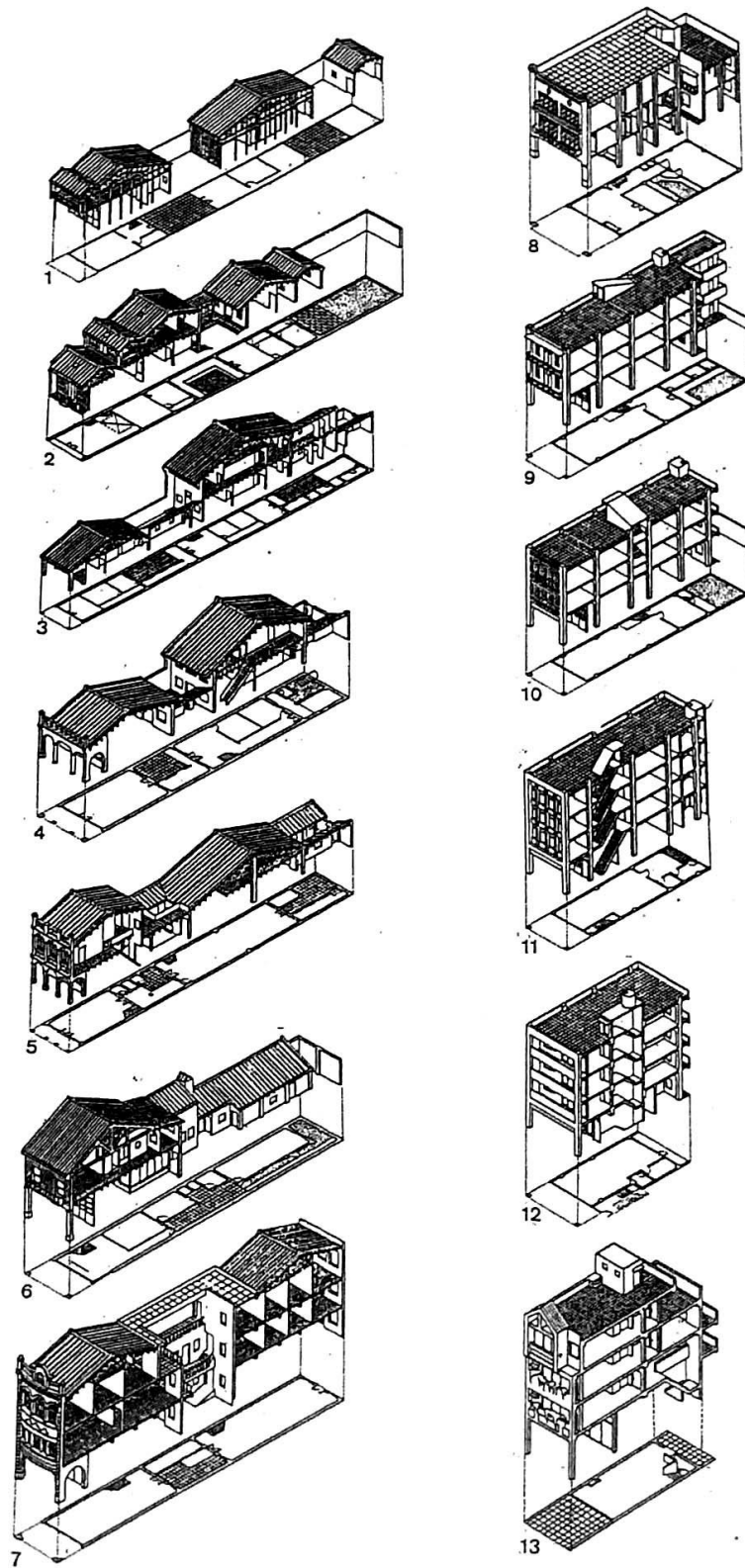
Figure 1. *The Constellation of Taiwanese Shophouse (1660-1992)*
Source: Kuo, C. (1992), 'Identity, tradition and modernity, a genealogy of urban settlement in Taiwan: including a case study on shop house morpho-typology in Lukang', Leuven

When we focus on Taiwan's urban development, we find that Taiwanese traditional town and urban dwellings in the era of 19th century Qing Dynasty were different to the western individual ones in that they integrated all the requirements through its family compound. This allowed the influence of a family

compound to extend to the level of society and establish a strong kinship-dwelling relationship (Chen, 1990). With the ceding of Taiwan from the Qing Empire to Japan, the importance of family dwelling was not maintained due to the implementation of urban renewal under the early colonial modernisation instigated by the new ruler. The Japanese Governor, Kodama Gentaro, enacted regulations for Taiwan's residential buildings for the Chief of Civil Engineering Activities (Ide Kaoru, 1879-1944), defining new types of urban housing as hygienic, clean, bright and functional (Fig. 1). From the perspective of the Governor, dwelling is not only an inheritance from western modernisation, but also a colonial discourse and authoritative framework for colonisation. During the Japanese ruling era (1895-1945), urban planning in Taiwan started to introduce land use control. Functionality and rationality became the goal for architecture and urban planning; this resulted in new diverse types of urban buildings.

Is the evolution from the traditional Chinese integrated 'family dwelling' to the segregated, modernised urban dwelling advancing towards the concept of 'non-dwelling' as promoted by Cacciari? The paper focuses on 'shophouses' to discuss the transformation on the typo-morphology and dwelling behaviour during rapid urbanisation. According to the transition diagram of shophouse typo-morphology in Taiwan (1960-1992) suggested by Kuo (1992), it is possible to not only analyse the detail of architectural replacement with the needs of the times, but also discuss the morphological changes and dwelling behaviour patterns of urbanisation. The paper especially focuses on the key issue of 'dwelling'. In the first instance, we try to ascertain a clear relationship between modern urban development in Taiwan and the influence from China and Japan rule. In the second instance, we can detail the relationship between compounds and divided dwelling orders to understand the impact of westernisation.

Chinese dwelling tradition and the family compound

### Modernisation of Chinese dwelling

Under the idea of Confucianism, traditional Chinese feudal cities established a society with strict manner-oriented rules to display extreme stability in terms of urban space planning (Qu, 1984). The early courtyard houses within the feudal cities and emerging shophouses followed the end of 'market block' after the Song Dynasty, 12th century. They all inherited the tradition of 'compound family dwelling'. It is clear from history that Taiwan is a unique island. It is located in a marginal area of Chinese territory, although the majority of its early immigrants were from China. Its dwelling morphology was not entirely the same as its origin, but rather that of mixed cultures with multiple changes and localisation. It is also the first place to receive western modernity and colonial cultures.

Before Chinese massively immigrated in the 17th century, there were few traces of commercial activities along the costal harbours. The population, including Japanese, Portuguese, Spanish, Dutch, Han Chinese and indigenous tribes, arrived from as early as the middle 16th century to early 17th century (Tang, 2001). Thereafter, the Dutch ruled the island for 38 years (1624–1662), followed by Cheng's rule for 19 years (1662-1683). Taiwan was included in the Qing Dynasty's territory for the next 212 years (1684-1895). It was then handed over to the Japanese colony for 50 years. Due to this cultural hybridity and complexity, the island is the ideal site to study the modernisation of Chinese dwelling culture and help us discover the biggest challenges met by the West.

Periphery structure of the empire: displacement of family compound

Taiwan was officially included in the Qing's territory in 1684 and government council was set up in Taiwan (now Tainan). Its marginal location made it difficult to maintain control. Lacking imperial authority on the island, the ruler's 'passive ruling' is indicated by multiple orders restricting immigration and promulgation of 'Interdict Restriction for Moving to Taiwan'. Chen (1990, p. 59) believes Qing Dynasty did not treat Taiwan as important; it was a symbol of a feudal 'Agriculture Empire' gaining control and, at best, an extension of Chinese overseas expansion. It is a marginal society without culture and education. Taiwan County Government was at the end of Qing Empire's administration and had limited power. Its local management and execution of obligation by quasi-officials relied on local heads and gentries.

The cultural foundation for marginal places was soft and it was difficult to execute the Empire's authority and orders thoroughly. During the process of localisation of Han immigration, original Chinese family blood-related modes of society (the perception of one's origin by ethnic groups) gradually shifted to new organisations connected by their geographical areas (by local leaders, worship circle, religious organisations, and market networks) (Chen, 1990, pp. 77-78). For example, the development of early Tainan shophouses was led by the so-called 'San-Jiao' (that is, three guild merchants being Northern Guild, Southern Guild and Sugar Guild) combined with trade, kinship and religion. It not only integrated relationships between politics, trade, temple, and individual dwelling, but also formed a unique marginal spatial structure – the street community.
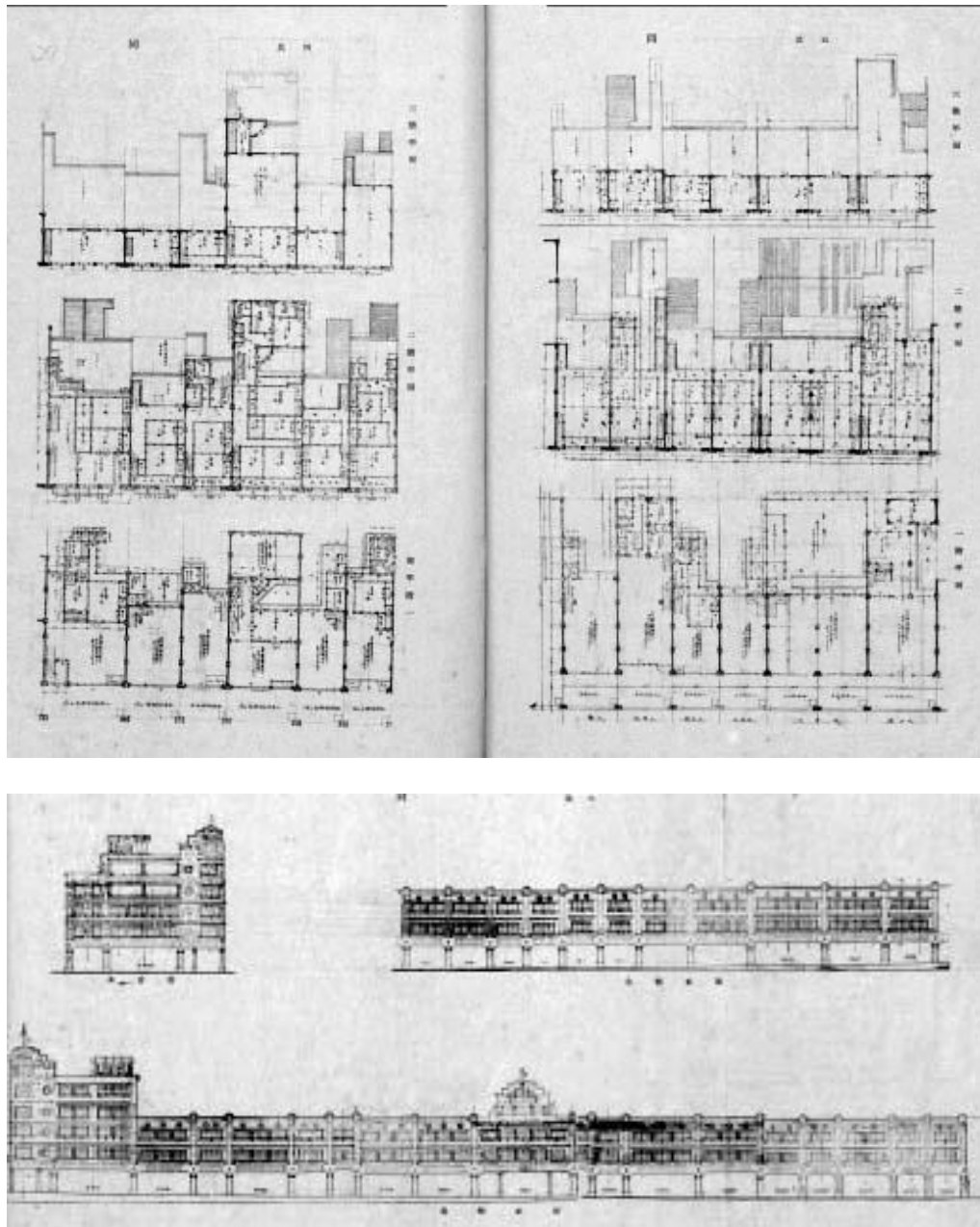
Figure 2. *Suehirocho Shophouses, 1930*
Source: 'Taiwan Architect Journal', First Edition, no.6: p5-6, 22-28 (in Japanese)

In the case of Shen-Non streets area, Tainan's five main roads were mostly comprised of the members of 'San-Jiao' unions. Its street typo-morphology developed into a compound mode of 'shop in front, dwelling at back' or 'shop at the bottom, dwelling at top' while new worship circles (or the religious sphere) were formed to praise different gods from various industries. The new typo-morphology and social

relationships were formed. The spatial structure is not a denial of traditional Chinese dwelling based on blood-relationships, but rather the morphology was more socialised and suitable for immigrant society as a result of integration, expansion and changes to the stability of immigrant families.

This organisations and worship circles based on geographically oriented non-blood relationships became a 'hidden order' for managing the immigrant society. It exposed the marginal politics and deemed shophouse typo-morphology within the cities during the time as a norm and rational knowledge. It resulted in the displacement of street dwelling structure during the late 19th century, a unique Taiwanese urban dwelling that differed to the traditional Chinese one (Fig. 2).

Modernity and urban dwelling

Japanese colonialism and hybrid typo-morphology
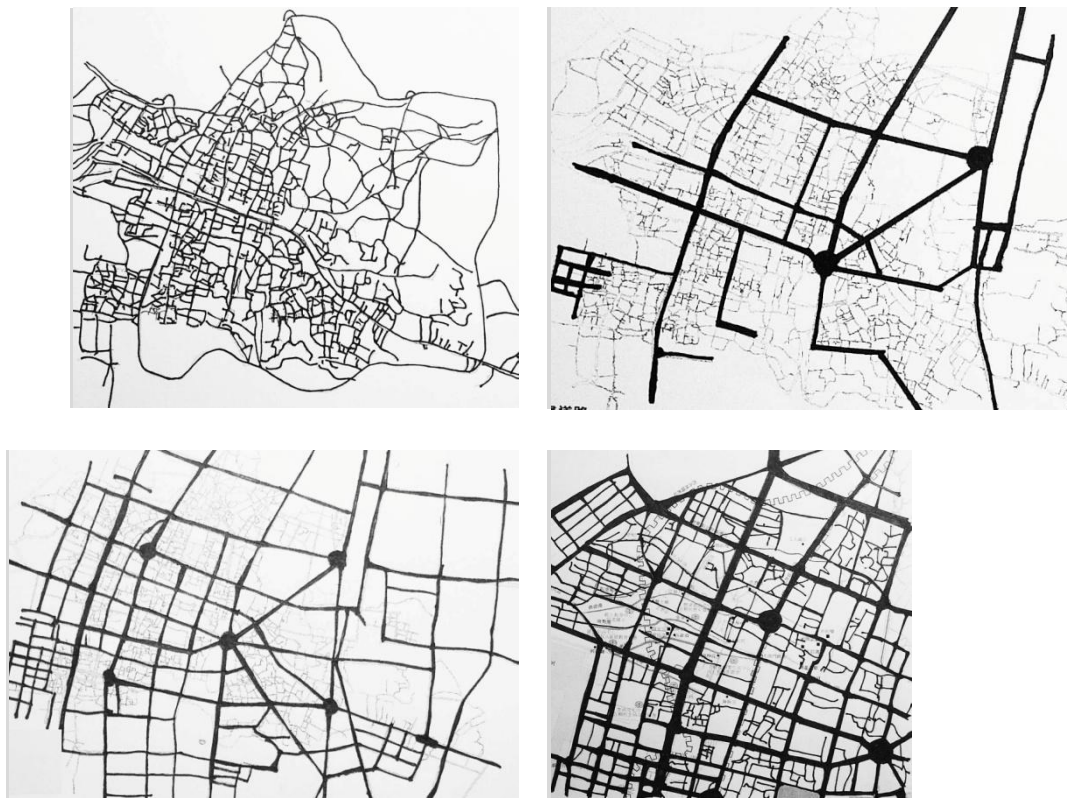
Figure 3. *Urban Street Structure Development, Tainan: 1808 (Qing Dynasty), 1911-1920 (The Japanese Ruling Era), 1941-1945 (The Japanese Ruling Era), 1945-2012 (Republic of China)*
Source: S. Huang

After 1895, under the influence of Japanese colonisation, Taiwan was entering a non-Han ruling colonisation era, but it was also a time when actual urban spaces were subject to comprehensive modernisation for the first time. In order to promote its economic interests and colonial authority, the Japanese Head of Administration, Goto Shinpei (1857-1929), seeking to transform Taiwan into a 'modernised model', began to use colonial knowledge by applying management psychology and the concept of biological operation to colonial governance in Taiwan (Yanaihara, 1929; Lo, 2004). As with Foucault's interpretation of disciplines (Foucault, 1992), colonial government purported to control its complicated colony through rationality and establish a real 'representation' of colonial knowledge through the execution of a categorised plan, analysis and education. For instance, the 'Taiwan Housing Construction Regulations', promulgated in the 1920s, offered the arcade requirement in all local cities.

Under the regulations for comprehensive urban renewal, all material spacing for cities would be transparent and unified. Therefore, the new street morphology for the renewed cities not only promoted

the improvement of urban hygiene and modernisation, but also represented modern 'knowledge rational'. Given the importance of urban private and public hygiene, standardisation of buildings and ideal commercial streets for urban development during colonisation, we can see that the marginal culture structure, which originated from Traditional China, had been torn apart by Japanese westernising orders and resulted in a hybrid typology that is 'not Chinese, not Western, and not Japanese' (Fig. 3).

Functional-divided urban dwelling

Due to the execution of '1905 Tainan City Renewal Project' during the Japanese-ruling era, Tainan's urban structure gradually changed from complication to an orderly geometric pattern. This realised the ideal image of a modern city by the coloniser through the construction of 'Suehirocho Project' in 1930. This example not only created street scenes that were never seen before (for example Art Deco and Modernism), but also signifies the insertion of concepts for a capitalist city. This presented a richer typology such as arcade shophouses, flats, train stations, interior arcade, banks, shopping centres, police stations, and municipalities.

In relation to Tainan urban dwelling, 'fan' was defined in the traditional Chinese dwelling concept during colonisation – the Chinese concept 'fan' is the room, the space unit as well as the family unit that rules for patrilineal, generations, subordinates expansions and divisions. The wide spread of the 'nuclear family' type of dwelling unit was a sign that the 'traditional family business' characteristic was fading. It was replaced by major Japanese businesses and unions with commercial ties. The study argues that it is the dividing point for traditional Chinese 'compound dwelling' and western modern 'functionalism dwelling' (Fig. 4).
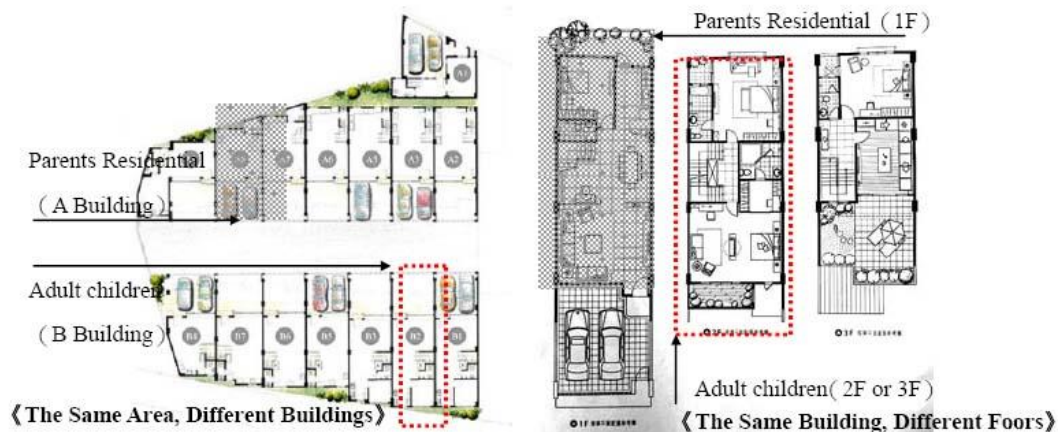

Figure 4. *Two Modern Dwelling Forms, Tainan: 'The Same Area, Different Buildings' and 'The Same Building, Different Floors'*
Source: S. Huang

Conclusion: the possibility of urban dwelling

Taiwanese dwelling began with the tearing apart of the Chinese traditional concept of family compound; the power of 'marginal' enhanced a non-traditional Chinese Imperial authority verification. In the Japanese colonial period, a new typo-morphology was introduced in the Suehirocho Project with the rise of urbanisation and rationalisation. However, in essence it is a project for the petty bourgeoisie, not for the urban poor. For Japanese rulers, however, it symbolised imperialism and colonial productivity instead of Western social modernity and social housing.

Looking for the key points within the Tainan street typo-morphology, Taiwanese urban dwelling was a mixture of a verified marginal family system and power of modernisation, which resulted in two main categories of 'compound' and 'divided'. The latter slowly shows the signs of 'non-dwelling' of modern cities. It is worth noting that even though local new dwelling appears western style and seems like a

departure from old street relationships, it exhibits some disagreement and amendments to Caccari's idea of 'non-dwelling'. For example, the main focus for current Tainan property developers is still the idea of 'nuclear family first, then compound family', including offering 'parents' room' in a flat and 'mother-son units' which are close to each other in nearby buildings. New types of dwelling orders not only shape the individual through an independent living unit, but also create a form of reliance on family relationships by an individual.

Based on this exploration, we can understand that modern Taiwanese living functions cannot be fully explained by Cacciari's idea of 'non-dwelling' and secretly contain the elements and intimacies of kinship relations in the adaptation process of shophouses to conform to social needs. Taking 'compound dwelling orders' and 'divided dwelling orders' as examples, we find that every shophouse of a generation has defined and interpreted 'dwelling' in its own unique way. The typo-morphology of shophouses that may seem independent within a generation actually knits a sustainable idea for the dwelling orders for the next generation.

References

Cacciari, M. (1980) 'Eupalinos or Architecture', *Oppositions* 21, 106-116.

Cacciari, M. (1993) *Architecture and Nihilism: On the Philosophy of Modern Architecture* (Yale University Press, New Haven)

Chen, C.N. (1990) 'Establishment and Transformation of Taiwan Han Immigration Society' in *Basic Concept for Family and Society: Taiwan and Chinese Society Study* (Linking, Taiwan) 57-96 (in Chinese).

Chen, C.N. (1990) ''Fang' and Traditional Chinese Family Structure: Chinese Family Study from Western Anthropology' in *Basic Concept for Family and Society: Taiwan and Chinese Society Study* (Linking, Taipei) 131 (in Chinese).

Chen, C.N. (1987) *Traditional Chinese Society in Taiwan* (Yunchen, Taipei) (in Chinese).

Fei, S.T. (1993) *Origin China, Rebuild Origin* (Fongyun, Taipei) (in Chinese).

Heynen, H. (2012) *Architecture and Modernity: A Critique* (Taiwan Museum, Taipei) (in Chinese).

Ji, T. N. (1992) *Introduction to architectural phenomenology*. (Guigaun, Taipei) (in Chinese).

Kuo, C. (1992) *Identity, Tradition and Modernity-A genealogy of urban settlement in Taiwan : including a case study on shop house morpho-typology in Lukang,* PhD dissertation (Katholieke Universiteit Leuven: Leuven).

Lo, J.F. (2004) *Japan Empire in Taiwan: Analysis for Japanese Invasion Economic Aggression in Taiwan* (Yuanlio, Taipei) (in Chinese).

Foucault, M. (1992) *Discipline and Punish the Birth of Prison* (Guaguan, Taipei) (in Chinese).

Qu, T. Z. (1984) *Chinese Law and Chinese Society* (Liren, Taipei) (in Chinese).

Tang J. T. (2001) *Taiwan during the Age of Discovery* (Owl, Taipei) (in Chinese).

Yanaihara, T. (1929) *Taiwan under the Japanese Imperialism* (Tokyo UP, Tokyo).

PUSHING THE EDGE

new technologies and new techniques

Hybrid place: blurring the edge between the digital and physical layers of urban environments

Glenda Caldwell

School of Design, Creative Industries Faculty, Queensland University of Technology, Brisbane
Email: g.caldwell@qut.edu.au

Abstract. *The purpose of this paper is to investigate the edge condition between the digital layers and the physical layers of the city and how tangible expressions of the interrelationships between them create and define new experiences of place, creating* hybrid place*. To date, there has been discussion about and investigation into understanding the importance of place, similarly into defining hybrid space. This paper explores principles of place and space to question how they can be applied into defining and proposing the notion of* hybrid place *in urban environments. The integration of media spaces into architecture provides infrastructure for the development of* hybrid place*. The physical boundaries of urban spaces become blurred through the integration of media such as computer technologies connecting the physical environment with the digital. Literature and case studies that reflect the current trends of use of technology by people in space and place within urban environments are examined.*

Keywords: Hybrid place, digital fabrication, creative catalyst

Architecture can be seen as a way to give form and pattern to the social life of a community (Sinclair and Stohr, 2006). The purpose of this research is to investigate the connection between the digital layers and the physical layers of the city and how tangible expressions of the interrelationships between them creates and defines new experiences of place, creating *hybrid place*. To date there has been discussion about and investigation into understanding the importance of place, similarly into defining hybrid space. This paper will examine these principles to question how they can be applied into defining and proposing the notion of *hybrid place* in urban environments.

The problem

Place, space and hybrid space have been defined and discussed from a range of perspectives. However, what is yet to be explored is the notion of hybrid place. Ubiquitous computing, mobile devices, the web 2.0 and other new technologies have become a part of our daily lives including the ways in which we work, play and learn. The world we live in is composed of a constant flutter between the physical and digital spaces we experience with our multiple senses and it is the memories and meanings that we attach to these spaces that create place. It is understood that place can occur either in digital or physical environments, but why not in both simultaneously?

Key principles of hybrid place

The four main factors that inform this research fall under the categories of people, place, space, and technology. This literature review investigates the current trends within the use of technology by people in space and place. The use of technology weaves the different disciplines of architecture, urban design, media design, interaction design, and urban informatics together to create opportunities for social interaction to occur within the digital and physical layers of the urban environment.

Space and place

Dourish has written two key papers that provide the foundation for this literature review. Initially it is important to understand that space is three-dimensional and provides the structure or the area for objects to exist and for things to happen (Harrison and Dourish, 1996). The "affordances of space" or the interactions and actions that are available through space are different from person to person. Space can exist both in physical and digital environments, together or separately.

It is out of lived experiences and through applied meaning that people as groups or as individuals change spaces into places (Carmona et al., 2010). Within the fields of urban design and architecture there is discussion about the creation and understanding of place (Jackson, 1994; Trancik, 1986; Arefi, 2004). When discussing place phenomenology is often drawn upon as it refers to the phenomena that influence the experience of human consciousness; this human experience creates the understanding of place (Carmona et al., 2010).

Harrison and Dourish (1996) recognise that people also establish meanings and memories within digital space, and acknowledge that the notion of place is also critical to the development of technology in interaction design. It is the use of space by people – their memories, their history and meanings – that create the experience of place (Harrison and Dourish, 1996). People are the essence of place. From their research within interaction design, Harrison and Dourish (1996) state that the critical factors contributing to the creation of place rely on the ability for users to participate, adapt and appropriate. These factors are useful in the development and measurement of place within this research.

Hybrid space

Harrison and Dourish (1996) define hybrid space as "one which is comprised of both physical and virtual space, and in action is framed simultaneously by the physical space, the virtual space and the relationship between the two" (p. 72). In Dourish's paper from (2006, p. 8) he re-examines the role of technology in the creation of space and place and states, "is it time, perhaps, to re-space place. More importantly, it is important to see both as critical aspects and products of the circumstances of interaction." Dourish acknowledges hybrid space, and that place can occur in either physical or virtual space, although he does not investigate the potential for place to occur in both simultaneously.

Souza e Silva (2006) continues to build on this idea of hybrid space while specifically examining the use of mobile technologies as interfaces between the digital and physical environments. Souza e Silva (2006) states, "[h]ybrid spaces are mobile spaces, created by the constant movement of users who carry portable devices continuously connected to the Internet and to other users". Through the use of mobile technologies one is continually connected to the Internet while navigating through the city, therefore the space in which the user exists becomes hybridised. Souza e Silva conceptualises hybrid space on three trends: "hybrid spaces as connected spaces, as mobile spaces, and as social spaces" (p. 261). From Souza e Silva's definition of hybrid space, one can understand that it is created by the merging and blurring of borders between physical and digital spaces due to the use of mobile devices. However, it is not constructed by technology, "it is built by the connection of mobility and communication and materialised by social networks developed simultaneously in physical and digital spaces" (2006, p. 266). Therefore the mobile technology assists in connecting people with one another in digital and physical spaces. Although Souza e Silva's research is extensive in discussing hybrid space, it does not address how these connections affect people's experience of place.

Media space and media architecture

Harrison and Dourish (1996, p. 70) describe media spaces as integrating "audio, video and computer technology to provide a rich, malleable infrastructure for workgroup communication across time and space". In media spaces people have a tendency to appropriate space, and give them personal meaning,

creating memories out of the media space, therefore experiencing place (Harrison and Dourish, 1996, p. 70).

The discipline of architecture focuses on designing the physical infrastructure of the built environment in response to the needs of society, reflecting culture through materials and forms. The integration of media spaces into architecture provides infrastructure for the development of hybrid space. The physical boundaries of the built environment become blurred through the integration of media such as computer technologies connecting the physical environment with the digital. Media architecture has the potential to combine digital and physical spaces by materialising information through interactive public screens, 3D projection mapping, amplified or augmented reality, digital fabrication and other technologies, which inform hybrid space. The question remains, how does media architecture inform the creation of hybrid place? Further, how do media and architecture come together to affect the experience of people within space to create hybrid place? A couple of examples will be explored in more detail.

Digital fabrication within architecture

There is the potential for architectural design to become socially responsive and interactive through the use of digital tools and digital fabrication methods to translate digital information into tangible formats and hybrid space (Foth et al., 2011).

Iwamoto (2009) states that "[a]rchitecture continually informs and is informed by its modes of representation and construction, perhaps never more so than now, when digital media and emerging technologies are rapidly expanding what we consider to be formally, spatially, and materially possible". Digital fabrication is a method of creating physical outputs from digital data, relying on computer driven tools. The machinery, tools and processes within digital fabrication stem from aerospace, naval, and automotive industries (Kolarevic, 2003). Since the late 1990s the architectural discipline has been conducting applied design research relying on digital fabrication methods. Digital fabrication has been described as revolutionising design through the ability to test and experiment with complex forms and concepts (Iwamoto, 2009). Time and material intensive approaches to design can be reduced through the use of digital fabrication tools by eliminating steps from design to production (Sass, 2007).

Fabrication processes are described as subtractive or additive methods (Seely, 2004). Computer Numerical Control (CNC) methods create physical objects through the removal of material. Alternatively rapid prototyping processes fabricate objects by adding and building up layers of materials (Seely, 2004). The wide range of digital fabrication tools combined with traditional construction methods have stimulated the architecture discipline to explore formal and material possibilities while promoting the process of making. The output of digital fabrication tools is limited to the scale of the equipment and the materials that are used ranging from representation models to the creation of 1:1 building components. Digital fabrication methods have been appropriated within the architecture discipline as a means to convey digital information through physical and tangible artifacts.

Digital fabrication: from bits to atoms

Since 1997, Ishii (Tangible Media Group, MIT) has conducted considerable research in bridging "the gap between cyberspace and [the] physical environment by making digital information (bits) tangible" (1999, p. 23). Ishii's focus has been on bringing the immaterial bits of the digital space into the physical space through developing the physicality of digital interfaces as the connection between digital and physical spaces, known as Tangible User Interfaces (TUIs) (Souza e Silva, 2006, p. 265).

The main challenge in Ishii's research has been the seamless transition of the physical affordances of objects and their physical properties into the digital environment. The purpose of TUIs is to allow digital information to be physically manipulated by the user's hands, allowing a haptic interaction. The physical forms become controls and representations of the digital information (Ishii, 2008, p. 16). The materials and objects that Ishii has utilised in his research are relatively low-tech and familiar to the everyday user,

such as modeling clay, blocks of wood, plastic bottles. The objects are connected to the interface and manipulate the digital information.

Typically in architectural applications of digital fabrication the digital information informs the physical output and creation of physical objects or prototypes. There is much that can be learned from Ishii's research, which can be explored further by questioning how TUIs have affected the experience people have within the digital or the physical space, and whether TUIs have a role to play in the development of hybrid space or hybrid place.

Trends in digital fabrication

In discussing a future in which there will be personal manufacturing machines, MIT's Gershenfeld says,

> like the earlier transition of mainframes to PCs, the capabilities of machine tools become accessible to ordinary people in the form of personal fabricators (PFs) … [The] implications are likely to be even greater because what's personalized is our physical world of atoms rather than the computer's digital world of bits (Mota, 2011, p. 279).

Digital fabrication machines and tools turn digital information (bits) into atoms through the subtraction or addition of materials to create physical objects from digital information and designs. A benefit of these fabrication tools is the ability to create one-of-a-kind parts, which can be individualised and personalised. Due to the additive nature of some of the tools, minimal waste is created.

As the cost of digital fabrication tools has significantly decreased, it is becoming more accessible to a larger part of the population. In 2001, 3D printers tended to cost US $45,000, in 2011 personal 3D printers cost between US $1000 and US $10,000 (Mota, 2011, p. 280). Based on this continuing trend, it is thought that 3D printers will become part of every household, similar to laser printers. While many factors contribute to the significant cut in costs for 3D printers, including the development of technology and materials, one of the most important factors is the exchange of information surrounding the use and development of these tools. Knowledge sharing across the globe via social networks and community groups within the digital and physical space has supported the development of digital fabrication tools. Two of these community groups are MIT's FabLabs and Hackerspaces.

The MIT FabLabs begun out of the Center of Bits and Atoms as a workshop aimed at providing self-replicating tools to communities. Currently there are 89 FabLabs in 23 countries (see http://fab.cba.mit.edu/about/labs/). Hackerspaces are informal learning spaces that are community operated and promote collaboration. Hackerspaces are a direct response to the needs and interests of the community who participate within them, most of which will incorporate digital fabrication machinery and tools within their workshop space (Mota, 2011, p. 280). Mota attributes the success of digital fabrication to the Do-It-Yourself (DIY) movement, which is based on self-improvement through the development of new skills and knowledge (2011, p. 283), proposing that

> Access to tools capable of turning digital designs into physical objects, coupled with the ease with which digital files can and are being modified and circulated, is bringing a third dimension to the practices of sharing, mashup and remix, and giving everyone the opportunity to not only reinvent and shape the world of bits, but also the world of atoms. The next decade will tell if indeed, as Doherty suggests, more than consumers, we are makers (Mota, 2011, p. 286).

Similar to the notion that digital fabrication has returned craft to architects and designers; digital fabrication along with the affordances of digital space and networks is increasing expression of personal creativity and the power of making throughout communities across the globe.

Digital fabrication and the internet

Social media is a powerful and pervasive trend not just in media and communications but also in associated fields such as architecture and urban design. Social media and Web 2.0 services along with the development and wide uptake of smart mobile devices have changed the way that people live and communicate (Kolbitsch and Maurer, 2006). Web 2.0 technologies have provided for the creation of communities revolving around access to information regarding digital fabrication ranging from wikis, blogs, podcasting, file sharing and social networking (Kolbitsch and Maurer, 2006). The power behind these tools lies in two areas. First, the vast amount of the population who interact with social media, as Qualman points out, "[i]f Facebook were a country it would be the world's 3rd largest and 2x the size of the U.S. population" (2012). Second, the fact that social media allows for more individuals to participate and have a voice in the ample area of the internet (Foth et al., 2008).

The critical factor to the success of emerging technology within the web is the bottom up approach where users become the creators. This is a fundamental shift in thinking which encourages innovation within the development of new content (Kolbitsch and Maurer, 2006). How can this similar approach where the experience is created by the user, be utilised in the design of hybrid place?

Hybrid place

As discussed previously, the use of digital fabrication tools provides methods for creating physical atoms from digital bits. Would it be possible for digital fabrication to be the method in which to capture and materialise digital environments that would inform our working, playing or learning parts of life? Can place be redefined based on the interaction and experience of both the digital and physical world, creating hybrid place? The opportunity for digital fabrication is not only in the translation of digital information into physical objects, it is the empowerment of individuals to express themselves. The individual creates the digital information in order to create the physical artifact through different digital fabrication methods. Through this process the individuals are expressing themselves and contributing to the overall experience of a space. The creative process from digital to physical is memorable and powerful allowing the user to contribute to the shift in meaning of the space into a hybrid place.

Exemplars

Two case studies are discussed in this paper serving as examples of how media and architecture come together to create hybrid places.

The Russian Pavilion

The Russian Pavilion at the Venice Biennale 2012 uses QR code technology as links between the digital and the physical environments of the exhibition. The QR codes covered all the walls, floors, and ceilings of the pavilion. Participants use tablet computers to read the QR codes linking them to a central website that explores ideas for a new Russian City for science (Etherington, 2012). This pavilion was awarded a special mention by the Jury of the Architecture Biennale (Basulto, 2012) signifying that it was acknowledged as a good piece of design and highly regarded by the architecture community. The pavilion is unique in its design, the aesthetics created by the QR codes on all the surfaces, the content of the exhibition, and the experience of the users.

Sergei Tchoban and Sergey Kusnetsov, of the design practice called SPEECH Tchoban & Kuznetsov, curated the exhibition. When discussing the design idea behind the pavilion, the curators said, "[i]n our pavilion we have tried to find an architecture metaphor for connecting the real and the virtual. People today live at the intersection of on-and off-line; 'our common ground' is becoming a cipher for infinite mental spaces," (Etherington, 2012). The commissioner of the pavilion stated, "[w]e have created a space that is physical and virtual at the same time" (Alice, 2013). From these quotes the design intention is very clear where the purpose of the pavilion was to combine media and architecture to explore how these digital and physical

environments inform each other. The special mention award and the media attention received by this pavilion indicate that society recognises the value and opportunities for architecture to actively explore the connection between digital and physical environments.

Although the link between the digital and the physical environment of the pavilion is incredibly clear what is lacking in this exhibition is the ability for the user to participate or contribute to the creation of place. In Fig. 1, one can see that the room is filled with visitors however they are all focusing on the tablet computer and there appears to be a lack of face-to-face interaction among them. According to the critical factors for assessing place, as described by Harrison and Dourish (1996), the Russian Pavilion does not allow users to adapt or appropriate the content of the exhibition. Users participate but not in an active way, they are merely observing and learning from the content however they are not contributing to it.

Although the experience of engaging with the pavilion is possibly memorable to the users due to its unique design, the experience of place is questionable. How much meaning would the people attach to the pavilion when the face-to-face interaction is not promoted? The use of the technology evidently serves the purpose to connect to online content important to the exhibition. However, the use of the technology can be seen to detract from the human experience within the pavilion. The opportunity for the individual to contribute to the experience of the space and place is relatively limited and could have been explored further in this pavilion.

Shadowgram by Ars Electronica Futurelab

In 2010 the Ars Electronica Futurelab in Linz, Austria developed *Shadowgram* (Fig. 1) as a way of combining the creation of a tangible object with the notion of social brainstorming. Social brainstorming, a term developed by this group, describes the dynamic process of stimulating creativity and inspiration from other people (Gardiner et al., 2011). The process of creating a shadowgram allows users to pose in front of a camera to take an image of their shadow. The shadow is then cut out of adhesive vinyl producing a sticker to be placed on the wall of the installation. Users have the opportunity to attach a speech bubble to the shadow and write a comment. The intention for the comments is to create dialogue between the local communities.

Figure 1. *Users create a shadowgram*
Source: Ars Electronica Futurelab

Social fabrication, another term developed by the Futurelab, has been defined as "a type of fabrication for shared creation with others in public spaces" (Ogawa et al., 2012, p. 58). The purpose of this concept is to promote communication within society through the illustration of individual or collective perspectives. These terms come together to define the notion developed by the Ars Electronica Futurelab as the

Creative Catalyst, where creativity is produced through the participation of individuals and the content is generated by the people, "the output has significance for individuals and for the collective" (Ogawa et al., 2012, p. 58).

Researchers from the Carnegie Mellon University, Willis et al. (2011) have defined interactive fabrication, which incorporates real time input by the user to directly produce fabrication by sound or shape. The purpose of interactive fabrication is to bring back the craft power to the user providing new creative opportunities. Fundamental to these alternative fabrication methods is the interaction of the user for creative expression.

When assessing the creation of place in *Shadowgram* against the principles mentioned by Harrison and Dourish (1996), it is understood that the users actively participate in the adaptation and appropriation of place through the creative catalyst process. *Shadowgram* allows users to participate in the creation of hybrid place by connecting the digital with the physical layers of the built environment. The purpose of *Shadowgram* is to encourage interaction between users while allowing them to express a part of themselves. This installation promotes the unique potential of digital fabrication where the digital content created by the individual and the physical artifact that occupies the space is a personal expression of that person. It is the connections that are facilitated between the participants through every part of the process, and these create a memorable experience in both the digital and physical space, therefore exemplifying hybrid place.

What can be learned from these examples? The Russian Pavilion is a provocative step towards blurring the edges of digital and physical space. The architecture provides the infrastructure for the digital layers of the environment to be accessed and experienced. In order to make the overall experience more meaningful to the participant, opportunities for the participants to express themselves or contribute to the overall experience could be explored further. The success of *Shadowgram* can be attributed to the fact that people had the ability to create something that reflected them while contributing to a larger discussion that was relevant and of interest to the broader community.

Conclusion

Although the case studies discussed in this paper are of a small scale in relation to urban environments a few critical factors can be highlighted which can be scaled up to affect design on multiple levels. The experience of place can occur anywhere in any space. The use of technology in our everyday lives is continually evolving and becoming more ubiquitous. The Russian Pavilion makes a strong and clear statement acknowledging that the digital environment cannot be ignored and should be included in the design of our physical environments. While accessing digital information can be informative, it can also restrict the purpose of architecture and design, which is to create spaces for the experience of people.

The proposition of hybrid place is to embrace the affordances of technology to improve the overall human experience within built environments. The technology can be used to promote interaction among people, allowing for the expression of individuals and creativity. Screen based media architecture is evolving to become increasingly interactive. However the screens are currently limited to 2-dimensional interaction. Although augmented reality is an exciting development that can continue the blurring between digital and the physical environments, it is only capturing the phenomena of a purely visual sense. The creation of tangible artifacts through digital fabrication methods promotes the process of making, individual expression, and includes a multidimensional and sensory experience.

Based on the work by Lentini and Decortis (2009), who established a framework for determining the potential for technological devices to support experiences of place, of particular interest for the future of this research is: the encouragement of the physical exploration of the environment, the enabled discovery of the environment through the senses and the empowerment of users through responsibility and value that "elicit[s] face-to-face interactions and favour rich collective experiences between users" (p. 414).

The intention of this research is to develop the concept of social and interactive fabrication further. This can be done by producing a small installation within a large Australian university to act as a "Creative Catalyst", to promote a collective creativity experience through the process of making. Digital fabrication technology such as 3D printing and laser cutting while questioning the experience and definition of hybrid place will be explored. Similar to the work of Lentini and Decortis (2009) the aim of the installation will be to promote face-to-face interaction of people through the use of technology and therefore combining the digital and physical layers of the urban environment. The involvement of users through creative collective and face-to-face interactions provokes opportunities of hybrid place by providing memorable experiences.

Acknowledgements

References

Alice (2012) *Russia's Futuristic QR Code Covered Pavilion* (http:/ s/blogs/russia-pavilion-venice-architecture-biennale) accessed 12 April 2013.

Arefi, M. (2004) 'The pedagogy of the American city: revisiting the concepts of place, non-place, and placelessness', *Urban Design International* 9, 103-117.

Basulto, D. (2012) *Venice Biennale 2012: Awards ceremony, big winners: Alvaro Siza, Japan and Urban Think Tank* 29 (http://www.archdaily.com/268392) accessed 16 April 2013.

Carmona, M., Heath, T., Tiesdell, S. & Oc, T. (2010) *Public places-urban spaces* (Architectural Press).

Dourish, P. (2006) 'Re-space-ing place: place and space ten years on', in *Proceedings of the 2006 20th anniversary conference on Computer supported cooperative work*, ACM, 299-308.

e Silva, A. S. (2006) 'From Cyber to Hybrid', *Space and culture* 9, 261-278.

Etherington, R. (2012) *Russian Pavilion at the Venice Architecture Biennale 2012* (http://www.dezeen.com/2012/08/29/russian-pavilion-at-venice-architeture-biennale-2012/) accessed 12 April 2013.

Fab Lab List (2012) (http://fab.cba.mit.edu/about/labs/) accessed 14 August 2012.

Foth, M., Choi, J. H. J. & Satchell, C. (2011) 'Urban informatics', in Proceedings of the ACM 2011 conference on Computer supported cooperative work, ACM, 1-8.

Foth, M., Choi, J. H. J., Bilandzic, M., & Satchell, C. (2008) 'Collective and network sociality in an urban village', in Proceedings of the 12th international conference on Entertainment and media in the ubiquitous era, ACM, 179-183.

Gardiner, M., Lindinger, C., Haring, R., Hörtner, H., Ogawa, H. & Ogawa, E. (2011) 'Social brainstorming via interactive fabrication', in Proceedings of the 8th International Conference on Advances in Computer Entertainment Technology, ACM, 76.

Harrison, S., & Dourish, P. (1996) 'Re-place-ing space: the roles of place and space in collaborative systems', in Proceedings of the 1996 ACM conference on Computer supported cooperative work, ACM, 67-76.

Ishii, H. (2008) 'Tangible bits: beyond pixels', in Proceedings of the 2nd international conference on Tangible and embedded interaction, ACM, xv-xxv.

Iwamoto, L. (2009) *Digital Fabrications: architectural and material techniques* (Princeton Architectural Press, New York).

Jackson, J. B. (1996) *A sense of place, a sense of time* (Yale University Press).

Kolarevic, B. (2003) *Architecture in the digital age: design and manufacturing* (Taylor & Francis).

Kolbitsch, J. & Maurer, H. (2006) 'The transformation of the web: How emerging communities shape the information we consume', *Journal of Universal Computer Science* 12, 187-213.

Lentini, L. & Decortis, F. (2010) 'Space and places: when interacting with and in physical space becomes a meaningful experience', *Personal and Ubiquitous Computing* 14, 407-415.

Mota, C. (2011) 'The rise of personal fabrication', in Proceedings of the 8th ACM conference on Creativity and cognition, ACM, 279-288.

Ogawa, H., Mara, M., Lindinger, C., Gardiner, M., Haring, R., Stolarsky, D., Ogawa, E. & Hörtner, H. (2012) 'Shadowgram: a case study for social fabrication through interactive fabrication in public spaces', in Proceedings of the Sixth International Conference on Tangible, Embedded and Embodied Interaction, ACM, 57-60.

Qualman, E. (2012) 39 Social Media Statistics to Start 2012 (http://www.socialnomics.net/2012/01/04/39-social-media-statistics-to-start-2012/) accessed15 August 2012

Sass, L. (2007) 'Synthesis of design production with integrated digital fabrication', *Automation in construction* 16, 298-310.

Seely, J. C. (2004) *Digital fabrication in the architectural design process* (Doctoral dissertation, Massachusetts Institute of Technology).

Sinclair, C. & Stohr, K. (Eds.). (2006) *Design like you give a damn: Architectural responses to humanitarian crises* (Thames & Hudson).

Trancik, R. (1986) *Finding lost space: theories of urban design* (Wiley).

Willis, K. D., Xu, C., Wu, K. J., Levin, G. & Gross, M. D. (2011) *Interactive fabrication: new interfaces for digital fabrication*, in Proceedings of the fifth international conference on Tangible, embedded, and embodied interaction, ACM, 69-72.

Pushing the urban edge: high speed public transports as future shapers of cities

Todor Stojanovski

Department of Transport Science, KTH Royal Institute of Technology, Stockholm, Sweden
Email: todor.stojanovski@abe.kth.se

Abstract. *Throughout history, cities have relied on transport to sustain their urban life. The different transportation technologies and the need for undisturbed flows of goods and people shaped cities. The omnibuses, steam trains and electric trams revolutionised transport in the 19th century only to be overtaken by petroleum driven cars and buses in the 20th century. Many argue that there is an emerging public transportation renaissance in the 21st century. High speed trains and sophisticated super buses are new transportation technologies that have the potential to push urban edges over 100 km from their historical centres. The major challenge in cities is to introduce new public transportation systems and integrate them with the urban form. This article looks at the history of Swedish cities and their adaptation to transportation technologies. The future of public transportation infrastructures and their integration with cities is discussed via permeability and barrier effects, attractiveness cores and desirability. There are different transportation infrastructures that historically pushed the urban edges and unfolded consistent patterns of mobility as well as urban form and structure. These regularities reveal possibilities and obstacles important for urban designers, planners and developers.*

Keywords: urban form, urban structure, public transportation, Swedish cities, integration

Introduction

High-speed rail (HSR), bus rapid transit (BRT) and light rail transit (LRT) in Sweden are discussed as attractive and speedy future public transportation systems that are more efficient and contribute to more sustainable patterns of mobility. The ambition is to make the private car only one option for urban transport, rather than a necessity (EC, 1990, pp. 30) by creating integrated, multimodal transport systems which fully exploit the potential of public transportation (EC, 1997, pp. 11-2). The model of the postmodern metropolis depicts urban networks of sustainable compact cities and neighbourhoods that are interconnected with high-speed public transportation systems into polycentric urban regions.

The major challenge in cities is to introduce new public transportation systems and integrate them with the urban form. Cities have historically integrated the transportation systems that were preferred in different ages (Whitehand, 2001). A neighbourhood that developed in times dominated by public transportation was integrated with the public transportation which functions there even today. The automobiles and parking lots on the other hand dominate in the modern suburbs that were explicitly designed for the private car and individual mobility. Many Swedish towns and cities embraced the private car as a vehicle of modernisation in the 20th century. In return, it trigged innovation, new forms of industrialisation and doing business, incredible economic growth and prosperity. The automobile brought convenient and mobile lifestyles to many. Swedish modernism produced a consistent pattern of decongested historical urban cores transformed in business hubs or central business districts (CBDs), clone towns and tourist attractions, sprawled suburbs, suburban shopping centres, factory outlets and edge cities on the periphery. The urban life in the metropolitan archipelagos of many sprawled Swedish towns and cities would malfunction without cars and petroleum imports. The lavish lifestyle and

prosperity in the suburbs is threatened today by an apocalyptic vision of a future with depleted oil wells and junkyards of rusting automobiles.

The historical urbanisation and integration of transportation systems is very important in understanding the effect of transportation on cities and the consistencies in urban form that result from different public transportation systems. This knowledge is valuable to urban planners, designers and developers faced with the challenge to introduce new public transportation systems and integrate them with existing urban forms. It is also an endeavour that ultimately tangles the traditional concepts of urban form and modern urban flow, where the form is rigid and the flow is dynamic. What can we learn from the history and periods of urbanisation to broaden the prospect of introducing a more efficient public transportation system in Swedish urban regions? Where are BRT, HSR or LRT positioned in the postmodern trends of urbanisation? How did cities historically integrate public transportation? What are the principal differences between public transportation systems? How far can high-speed trains (HSR) and super buses (BRT) extend the urban edges? What will happen to the other smaller cities that are out of the HSR urban networks? What will happen to the other parts of the cities that are not attractive to developers and where the postmodern metropolis model is inapplicable?

Cities through urban form and flow

### Cities as "extraordinary agglomerations of flows"

Cities are "extraordinary agglomerations of flows" today, not only of people on the move, but as other forms of mobility like flows of information, capital, values, norms and lifestyles (Ash and Thrift, 2002, pp. 42). The physical flows in cities are enabled and hindered by transport infrastructures and systems. The concept of systems of movement was introduced by Mitchell and Rapkin in the book, *Urban traffic – A function of land use*. The urban flow was a function of *land use* that was differentiated by the major activities of establishment based on the land. The term 'land use' refers to buildings or other improvements on land, to the occupants or users of the land, to the major purpose of the occupancy of the land or to the kind of activities on the land (Mitchell and Rapkin, 1954, pp. 13). It triggered a tradition of looking at cities as urban systems. Lynch and Rodwin (1958) used the systems theory for a concept of urban form. The physical form of cities was described through the *flow system*, excluding the flow itself and distribution of *adapted spaces*. Within the *urban system* there are *activities* that occur and recur in *adapted spaces* and are linked by *communications* through *channels* (McLoughlin, 1969). Land use is defined by *urban activity* and the interaction with transportation was a feedback cycle between the transportation system and the land use (Wegener, 1994). The concept of feedback loop was introduced in the book, *Urban Dynamics* (Forrester, 1969).

The movement of physical flow of people in a transportation system is channeled within a network, along the line or it is free within an area. Public transportation systems are linear, but they can achieve network effect by temporal coordination in the transfer points from one line to another line. The private car is deployed in a predominantly network-based system. There is an instant network effect because within the network every destination is accessible from every origin. Cycling is a hybrid system that shifts between a network and area on streets and squares. Walking is an area system, but Lynch (1960) argues that the movement in cities is through consistent paths, by 'wayfinding' and orientation to landmarks. There is a mental map of networks of paths within an area. The transportation modes also change perception of reality. Driving triggers a 'flow' mode of thinking (Csikszentmihalyi, 1990). The drivers neglect the spatial and the urban environment to focus on the flow, traffic signs, turns and stops. Walking evokes a sense of space and orientation in space. Then the quality of the urban environment and what is going around matters. Public transportation is a hybrid system that shifts between 'flow' and 'sensing space' mode. Groups of people evoke the flow mode. Public transportation also includes walking and it is a mobile space where the 'sensing space' mode comes out.

Representations of form and flow at urban scale

The representations of physical space and flows of cities vary from algebraic formulas or topology and matrices, to geometric symbolical diagrams and accurate drawings and maps. The representations on paper include two principal viewpoints on cities (Cecchini and Rizzi, 2001): within or inside the city (perspective), or from the top (plan). The classical representation of the urban form includes patterns of streets, plots and buildings that are shaped by the society and its economy (Conzen and Conzen, 2004). In another conceptualisation the urban space is defined by a pattern of buildings, streets and squares (Krier, 1979; 1984). In space syntax there are specific viewpoints in urban space, from which the city is observed, that turn into axial spaces and shape convex spaces and isovists. The axial spaces are represented by centroids in graph diagrams and axial lines on maps (Hillier et al., 1984). The physical flows in cities are represented within the edges of streets from the classical representation of the urban form, by topology of spaces and graphs; for example, in space syntax and hierarchy of flows that is widely used in transportation engineering and planning (Marshal, 2005a, pp. 16).

Within the framework of urban systems, space and flow, Lynch (1960, pp. 47-8) defined five elements: paths, nodes, districts, edges and landmarks. The transportation systems are *paths* and *nodes* that produce a barrier effect or *edges*. In the context of public transportation there are also *desirability cores*. These show the actual peaks in attractiveness in relation to the exits from the public transportation stop, or the actual dispersal and grouping patterns of passengers in public spaces around the exits of the stops. I use *paths*, *nodes*, *districts* and *desirability cores* in the *districts* as elements to map the shape of the morphological interrelationship between urban areas and transportation infrastructures (Fig. 2).
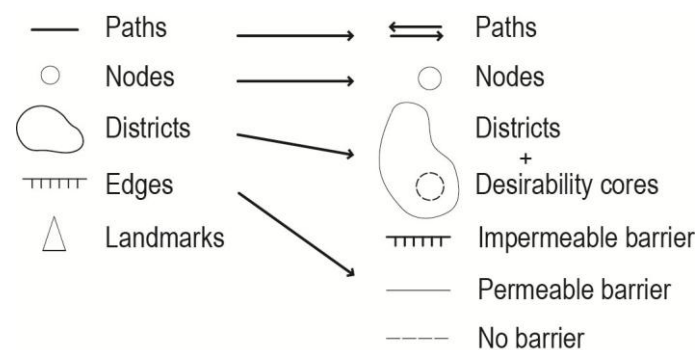
Figure 1. *Modification of the elements by Kevin Lynch urban to describe the morphological overlay of urban areas and transportation infrastructures.*

The urban structure or regional perspective

The city revolves around central places and directions. The urban flows concentrate around one or many central points, elongate along directions or interweave on intersections of directions. These regularities are captured by the three classical urban models: concentric rings, sectors and multiple nuclei (Harris and Ullman, 1945; Ehlers, 2011). The importance of transportation is visible in all of them. The urban rings extended by increasing speeds of transports; the cities elongated along transport axes or grew around nuclei at transport foci or breaks of transport. The transportation systems have scaling, agglomeration, elongation or dispersal territorial effects. They can agglomerate nuclei. They can expand one nucleus by scaling, or elongate it in a corridor or ribbon. They can scatter urban nuclei. The principal public transportation technologies historically unfolded consistent urban structures (Fig. 2).
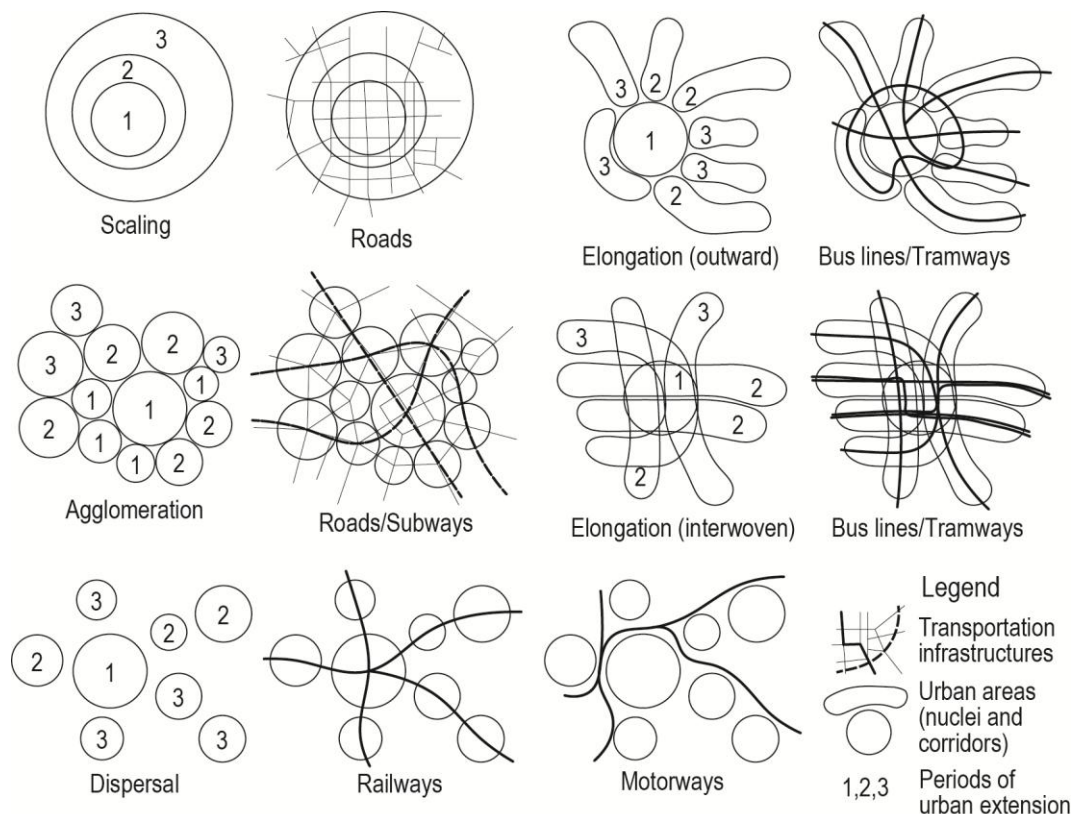
Figure 2. *Structure of urban areas in one region shaped by different transport technologies.*

Public transportation and cities

The principal public transportation technologies

Public transportation dominated the industrial society. Four principal technologies emerged and shaped the cities during the industrialisation in the 19th century:

1. Public transportation *on streets* (buses and trams)
2. *Completely segregated, either elevated or on the ground* (buses or trains on heavy railways or busways, HSR or BRT)
3. *Underground* (buses or trains in tunnels)
4. *Partially segregated d on ground, which was a hybrid of the previous three technologies* (buses and trams on light railways or busways, LRT or BRT).

The common distinction in transport, *light* versus *heavy,* was borrowed from transportation engineering and planning. *Heavy* means always *complete* or *full, segregated* from a street regardless if it is a bus or rail system. The traditional meaning of heavy and light in transportation planning and engineering designates volumes of traffic. The segregation allows for heavier volumes of traffic.

Each public transportation technology has a consistent effect on the urban form and pattern of *desirability cores* in urban space. These *desirability cores,* as amoebic nuclei or corridors, exist as historical artifacts in many European metropolises. The *public transportation on streets* accelerated urban life and enabled elongation and interweaving of the cities. They created urban corridors along the bus lines and tramways. The *fully segregated public transportation* orchestrates discontinuity of urban fabric and regional existence by temporal convergence of distant urban areas. The railways dispersed and fragmented the city in its region. The public transportation underground strengthened the polycentric agglomeration of the existing cities; subways fused urban nucleuses in a network similar to boulevards in the

industrialising European cities, although without disturbing the city above. These regularities are referred to as:

1. The *elongated and interwoven city of buses and trams*
2. The *city of pearls along heavy railways and busways* (HSR and BRT)
3. The *networked city of subways*
4. The *compact city along light railways and busways* (LRT and BRT).

Today, in reality, there are no exclusively or distinctively *elongated and interwoven cities*, *cities of pearls*, *networked cities* or *compact cities* as per the classification above. Rather, the cities are combinations that overlay and coexist simultaneously. Large European cities, like London, Paris, Berlin, Copenhagen, Stockholm or Helsinki, are examples of *public transportation metropolises* that have continuously integrated new public transportation infrastructures and technologies throughout their histories. Stockholm is an example where there is a regional hierarchy: the subway and heavy railways structure *networked city* and *city of pearls* in its region, while the buses *elongate and interweave* the urban core.

The elongated and interwoven city by public transportation on streets

The *omnibuses*, *cable cars*, *horse cars*, *trams* or *streetcars*, *motorbuses*, *trolleybuses* or *trolleys*, are *public transportation on streets*. They are all modifications of the same technology. Speed did not change the transportation system dramatically with different propulsion systems. Hindered by the traffic on the streets, they are slow transportation modes reaching an average speed of 10-20 km/h. The length of the lines is limited to roughly 10 km which is the limit of the radius of the *elongated and interwoven city* of the buses and trams. The *public transportation on streets* unfolds *urban corridors*. The lack of speed of the *public transportation on streets* is completed by lack of barrier effects.

The city of pearls along fully segregated public transportation

The *fully segregated public transportation* system orchestrates discontinuity of urban fabric and regional existence as temporal convergence of distant places. The railways spread a pattern of *urban nuclei* in regions and usually use the shortest distance, by almost direct lines, to travel between them. The *trains* reach over 500 km/h today. HSR operate at average speeds of around 200 km/h. With these speeds, theoretically, the *city of pearls* can extend over 100 km. The urban radius of the *city of pearls* is set to 60 km, roughly corresponding to the lengths of the suburban railway lines in the large European cities (Pendeltåg, RER or Overground lines in Stockholm, Paris or London). The heavy railways and busways produce strong barrier effects and the *desirability cores* depend on the exits from the bus and train stations.

The city networked city above the public transportation underground

The *public transportation underground* strengthens the agglomeration of historical cores by offering quick getaways within or to the suburbs. With speeds of more than 30 km/h they can open, fuse or establish *urban nuclei*. If we consider the average speed of subways in European cities, the radius of a *networked city* can reach 20 km, but the theoretical size of a *networked city* is practically comparable to the *city of pearls*. There are no barrier effects and the *desirability cores* depend on the location and exist from the subway.

The compact city along partially separated public transportation.

The *partially separated public transportation* makes a trade-off with the barrier effect of the public transport infrastructure and the attractiveness of the *urban corridors*. LRT and BRT achieve an average speed of 20-30 km/h on partially segregated busways or railways. The speed of the buses and trams is higher than on *public transportation on streets*, but it is not possible to achieve high speeds and high frequencies and have a closed system because of the conflicts at intersections.

Representations of public transportation systems

The urban form and flow perspective

The public transportation technologies are represented as *paths*, *nodes* and *desirability cores* on map by using the modified elements by Kevin Lynch (Fig. 1) or conceived as models for urban design (Fig. 3). The *desirability cores* depict continuous space as a *serial vision* of photographs (Cullen, 1961). It is a *district within a district* phenomenon, in the sense of the elements by Kevin Lynch, inspired by the research on urban patterns by Stephen Marshall (Marshall, 2005b; Marshall and Gong, 2008).
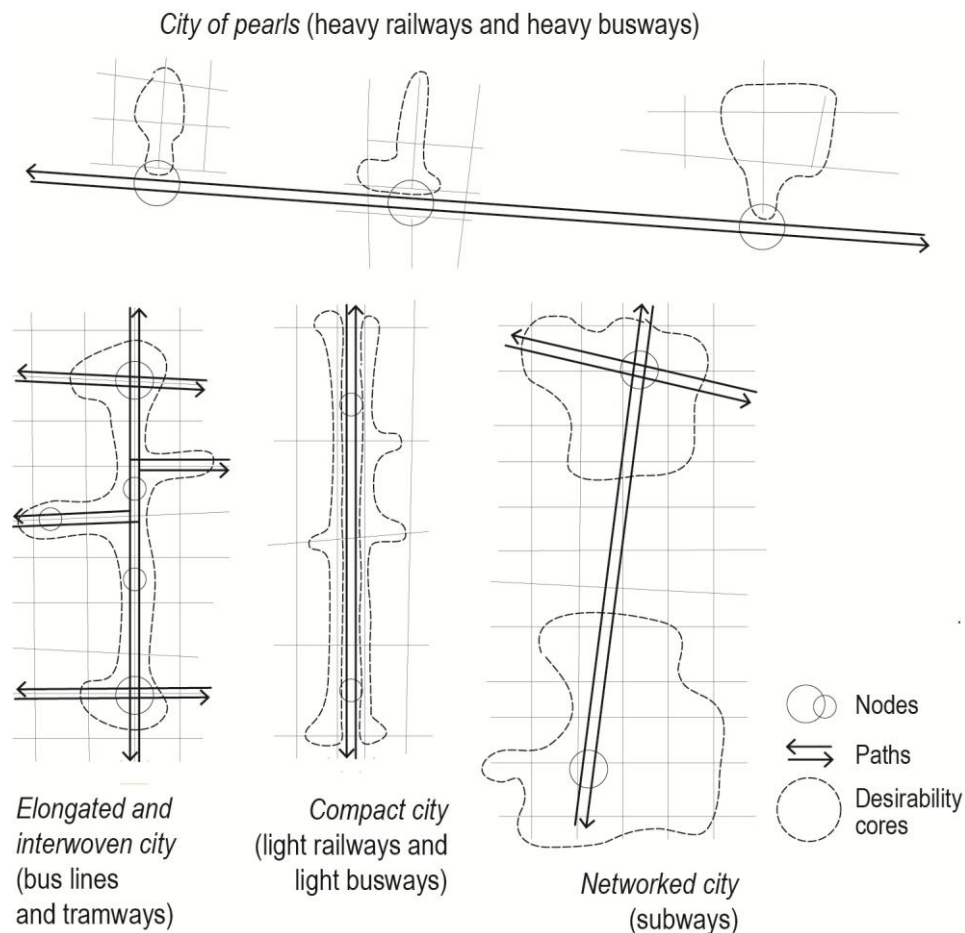
Figure 3. *Attractiveness cores in urban space unfolded by principal public transportation technologies*

The *desirability core* starts when a person changes transportation mode to walking and steps out on a public transportation stop. The exit door of a bus, tram or train is a starting vantage point in the space of a walk through the *desirability cores*. The *desirability cores* have stretchy borders. They can shrink or extend depending on the design of the urban environments. They can elongate in *isovist* shape if it continues in an attractive urban environment that does not disturb the *serial* of urban images. For example, flows and crowds of people trigger a subconscious 'flow' mode of thinking and movement of a person, extend the line of sight and add a sequence of new prospects and overlaying *isovists*. An *isovist* is the set of all points visible from a given vantage point in space with respect to the obstacles and voids in the line of sight in one environment. The shape and size of an *isovist* is liable to change with position of the observer (Benedikt, 1979). The *isovist* concept has been further developed within space syntax into convex and axial space: space delimited by edges of buildings and possible paths or axial lines between buildings (Hillier et al., 1984). The crowds, invisible exits and entrances in attractive urban environment fuse convex and axial spaces. The principal transport infrastructures unfold consistent patterns at urban scale that can be represented as morphological models (Fig. 4).
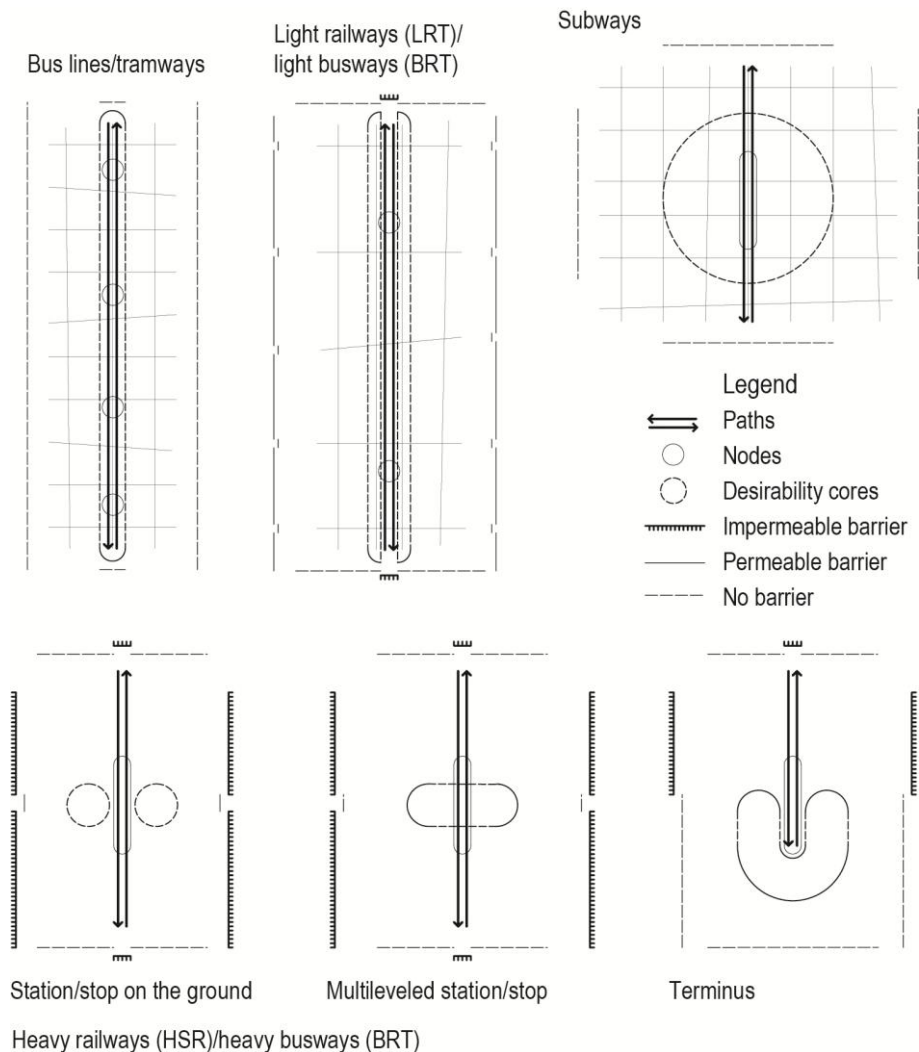
Figure 4. *Morphological model of attractiveness cores and barrier effects of the principal public transportation technologies*

The urban structure perspective

The effect on the city depends on the hierarchy of the traffic flow and the capacity of the transportation system. The highly prioritised and recognisable traffic flows, as motorways or easily identifiable lines in public transportation, have effect on the structure of urban areas. Traffic flow and capacity are complex concepts in transportation planning and engineering. I simplified their dynamics by considering a single variable, an average speed that defines maximum distance reached by a public transportation line. Motorised transport allows for convergence of space and time and the blurring of urban boundaries. Urban life is more a variable of time, than distance, experienced by mobility before propinquity (Webber, 1964). There are constraints in mobility and temporal invariants in travel behavior (Marchetti, 1994). The travel time budget is the time that we spend traveling during one day and the empirical research of travel behaviour shows that it varies between one and two hours per day (Zahavi, 1974). The invariant of one hour travel time per day is known as the Marchetti constant and it is considered to be a determinant for the historical change of urban boundaries. The distance from the urban centre to its periphery is defined by the speed of transportation (Von Thunnen, 1826/1966; Marchetti, 1994). The principal transport infrastructures unfold consistent patterns of cities at regional scale that have different ranges (Fig. 5) and urban structures (Fig. 2).
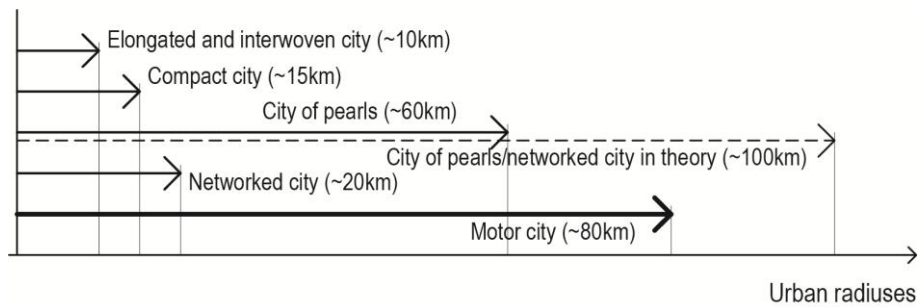
Figure 5. *Urban radiuses of the transport technologies*

A retrospect to the Swedish urbanisation

Urbanisation of fringes extending outward

The towns and cities in Northern and Western Europe expanded outward in distinctive fringe belts characterised by different periods of urbanisation (Whitehand, 1967; Whitehand and Morton, 2003). Swedish urbanisation was no exception to the pattern. Each fringe became a front of urban development preconditioned by innovations in business and industry, technology and society. In each period, society was equipped with more advanced communication, information and transport, manufacturing and building technologies that shaped cities, lifestyles and mobilities. There are four distinct periods of societal changes that triggered waves of urbanisation at the fringes. They are referred more generally as traditional, industrial, modern and postmodern cities (Fig. 7). In a Swedish context these eras are characterised as pre-industrial, industrial, welfare and knowledge society (Engström and Cars, 2008). The consistencies are visible if neighborhoods from different ages are presented in respect to the distance from the traditional urban cores. The analysis of 55 neighborhoods in the small Swedish city of Karlstad shows that there are not only regularities in respect to distance, but also to urban density as the number of inhabitants and workplaces per hectare (Fig. 7). These results reflect the research undertaken by Rådberg (1988; 1996; Rådberg and Friberg 1997).
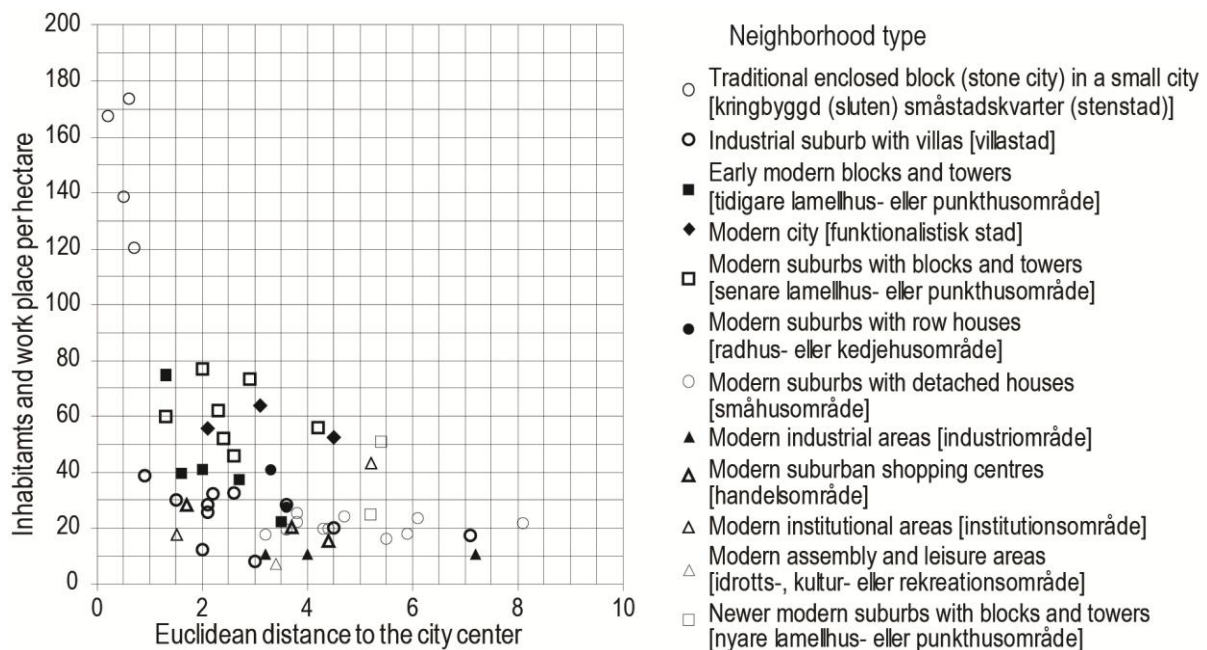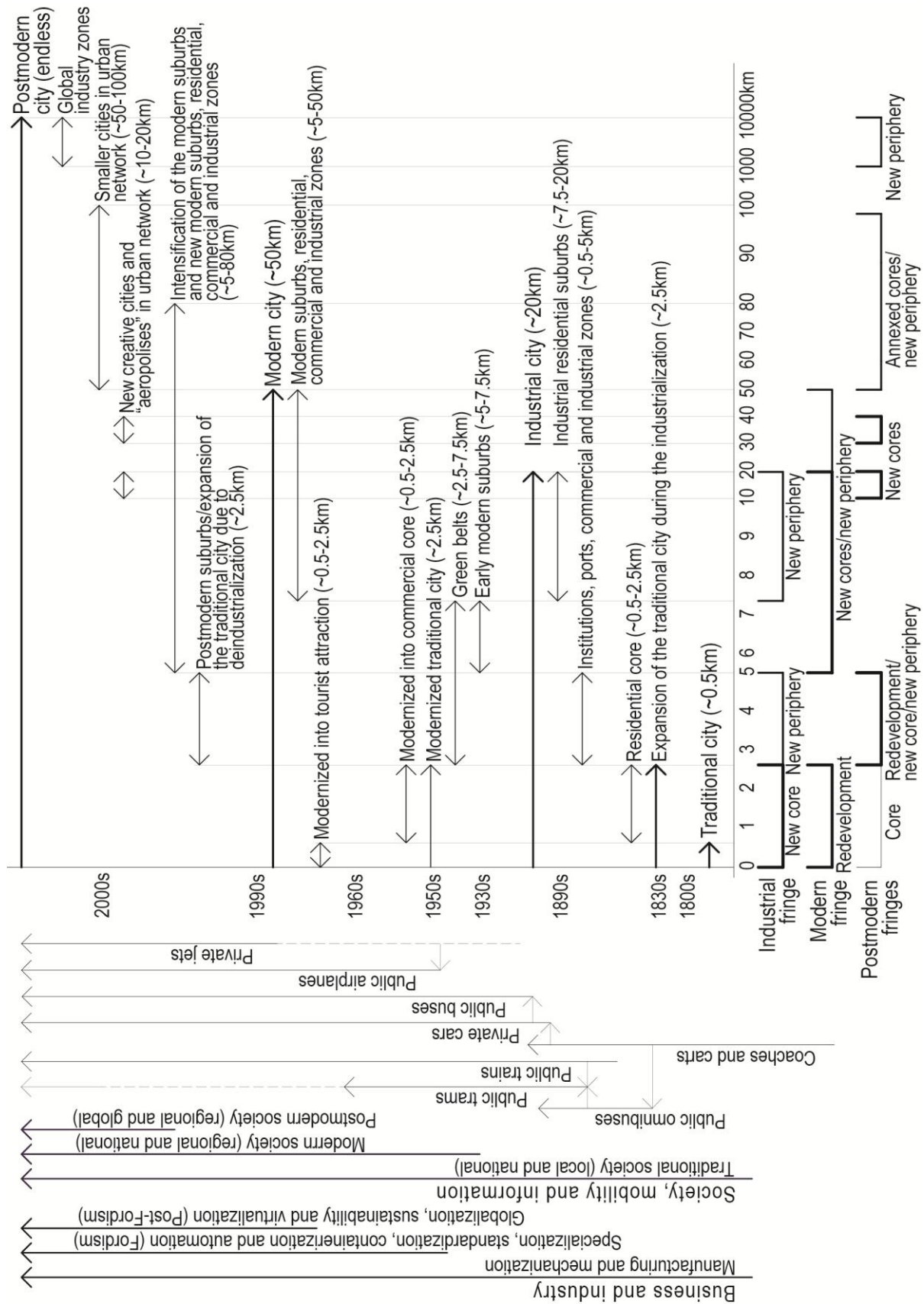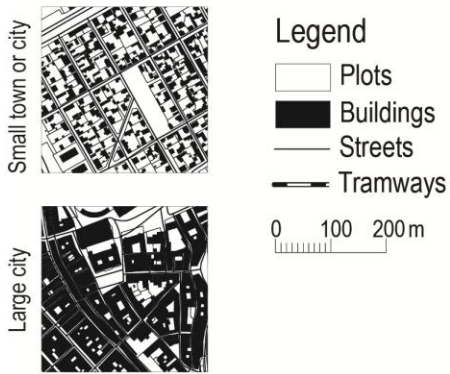

Figure 6. *The longitudinal extension of the urban fringes in respect to the network and Euclidean distance from the traditional urban core by using the Swedish typology of neighborhoods.*
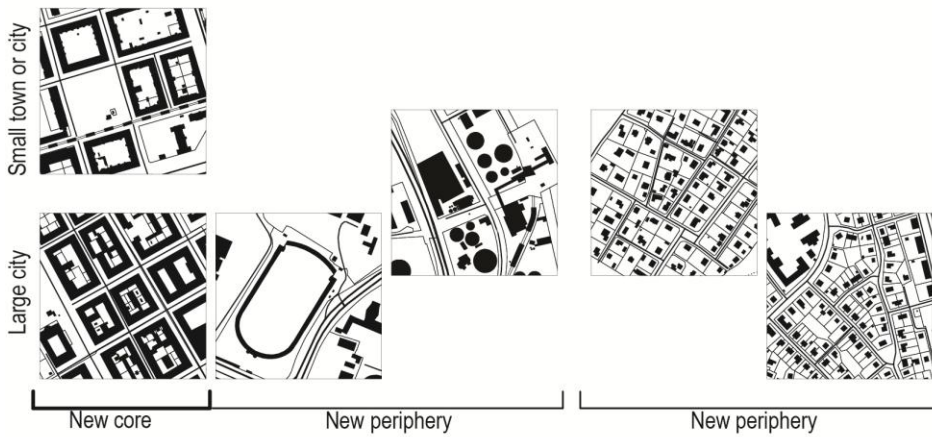
Figure 7: *Diagrammatic representation of Swedish urbanisation from the traditional city, industrialisation, modern city to postmodernism in regard to transportation technologies (expanded from Cars and Engström, 2008) and the urban forms of its cores and peripheries (continues on next page).*
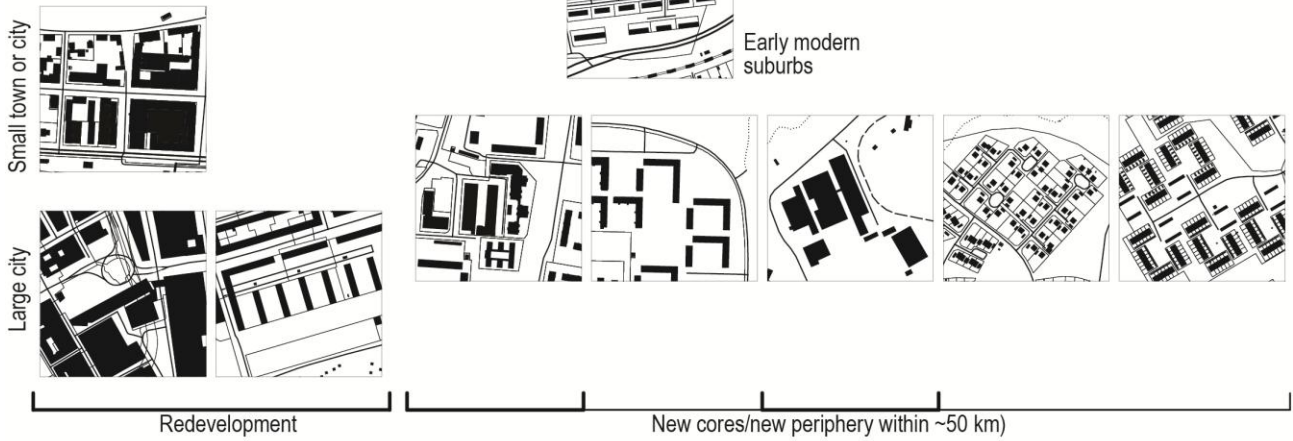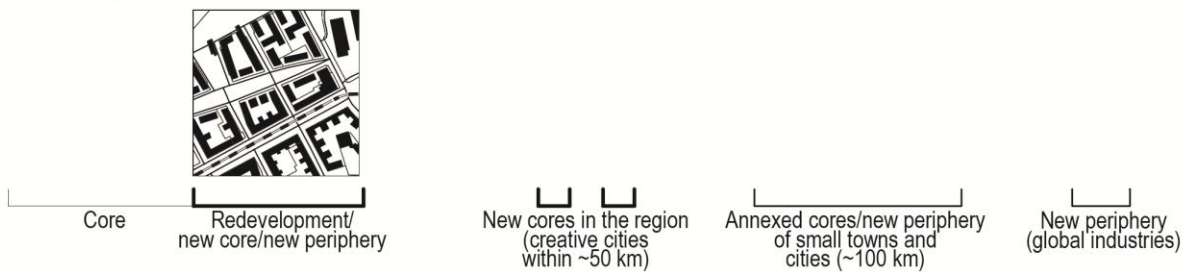
Traditional city

Small town or city

Large city

Legend
☐ Plots
■ Buildings
— Streets
▬ Tramways

0 100 200 m

Industrial city and its fringes

Small town or city

Large city

New core   New periphery   New periphery

Modern city and its fringes

Small town or city

Early modern
suburbs

Large city

Redevelopment   New cores/new periphery within ~50 km)

The fringes of the postmodern city

Core   Redevelopment/   New cores in the region   Annexed cores/new periphery   New periphery
              new core/new periphery   (creative cities   of small towns and   (global industries)
                                       within ~50 km)   cities (~100 km)

While Swedish societies do not follow each other, there are modernisations, returns to traditions and mixing in different parts. It is a dynamic process of development, decay and refurbishment. There are models within the model with the emergence of new urban cores in the modern age. Each new modern urban core resets its position in the model (Fig. 7).

Traditional society and its urban cores

Swedish urbanisation has a long tradition of urban planning. Even the *traditional cities* developed according to urban regulations and laws. They were growing densely on small hills, rivers and waterfronts as wooden cities or *trästäder*. The increasing densities in the wooden cities caused disastrous fires in the 17th century. The risk of fires demanded better regulation, division of the city by wider streets and new stone buildings as in the traditional urban core of Stockholm. The Swedish stone cities or *stenstäder* based on a rectangular street network emerged. The street in traditional Swedish towns and cities was designed for walking and small cart and carriage traffic volumes. The main streets were 10-12 m wide, like Stora nygatan in Stockholm or Västra hamngatan in Gothenburg, while the side streets were narrower and slightly larger than in the earlier *wooden* or *stone cities*. Traditional Swedish society was predominantly rural. It revolved around communities and agriculture, sustenance and perseverance. The city was a business and trade hub inhabited by merchants, bankers and nobility in a region of villages, mines and industries. Flows on boats and ships on natural waterways shaped the urban life and economy in the traditional Swedish towns and cities. The *traditional* Swedish cities relied on walking, carts and coaches, horses and oxen for transportation until the end of the 19th century (Fig. 7).

The fringes of the industrial society

Swedish industrial society started from the middle of the 19th century. New industrial cities such as Norrkoping and a fringe of factories and industrial zones in Stockholm emerged in the 17th century when Dutch capital entered Swedish iron mining and industry. However, industrial society started much later and in the context of capital accumulation by Swedish industrialists, bankers and entrepreneurs. Industrial Swedish towns and cities were shaped by rapid urbanisation and the transport revolutions of the omnibuses and railways. The business and economy was propelled by Swedish capitalists. The capital accumulated in cities shaped two very different fringes or cityscapes of the industrial city that began to stratify and suburbanise by the end of the 19th century. Two different processes of urbanisation emerged that reflect the praxis of Swedish planning. Sweden was divided in 1868 on *städer* or *cities*, *köpingar* or *market towns* and *landskommuner* or *rural municipalities*. The Swedish *cities* were obliged to draw urban plans and set urban regulation by the Building Act from 1874, whereas the development in *rural municipalities* was not regulated by urban plans. The urban planning and design of the industrial urban cores was largely influenced by the renovation of Paris by Baron Haussmann in the mid 19th century. The industrial urban cores are characterised by patterns of enclosed urban blocks regulated by standardised building heights and widths of boulevards and streets. The main streets and boulevards were 18-30 m wide, like Odengatan and Karlavägen in Stockholm. Rådberg (1988) drawing inspiration from Choay (1969) conceived these two urbanisation trends as separate paradigms or doctrines: *regulation* or *regularism* and *garden cities* or *trägårdstäder*. Another interpretation of the two urbanisation patterns is urban adjustment to two public transportation technologies that dominated and co-existed in that time: buses and trains.

The industrial core regularised, densified and became interconnected by a network of wide boulevards and streets, omnibus lines and tramways, whereas new *neighborhoods with villas* and *garden cities* or *villastäder* and *trägårdstäder* emerged in the Swedish landscape, very much influenced by the American and English railway suburbs. The traditional urban core was surrounded and intersected by a fringe of residences, universities, schools, factories, warehouses and ports. Manufacturing, research and invention took place in a filthy, polluted and congested industrial core. The second cityscape depicted villas in nature. The richer moved to new garden suburbs which were connected to its industrial core by roads or railways, private coaches or public trains.

The industrial urban life in Swedish cities relied either on walking or on public transportation and the cities became incredibly dense and overcrowded regardless of their size. The cities with buses and trams grew faster and evolved urban promenades and corridors while garden cities developed along the tramways or bus lines. The garden suburbs in the cities without tramways or bus lines emerged in proximity to the industrial urban cores, usually separated by a green or blue fringe. Stockholm was the only city in Sweden where the garden suburbs were developed at distance and served by railways as new periphery located in nature. The garden suburbs survive until today and they are as attractive as in the 19th century. The urbanisation during the industrialisation of a constellation of smaller Swedish towns or cities like Karlstad where there was limited development of public transportation (Fig. 8) in contrast to the growth of a large Swedish city like Stockholm with an extensive network of suburban railways and industrial garden suburbs (Fig. 9).
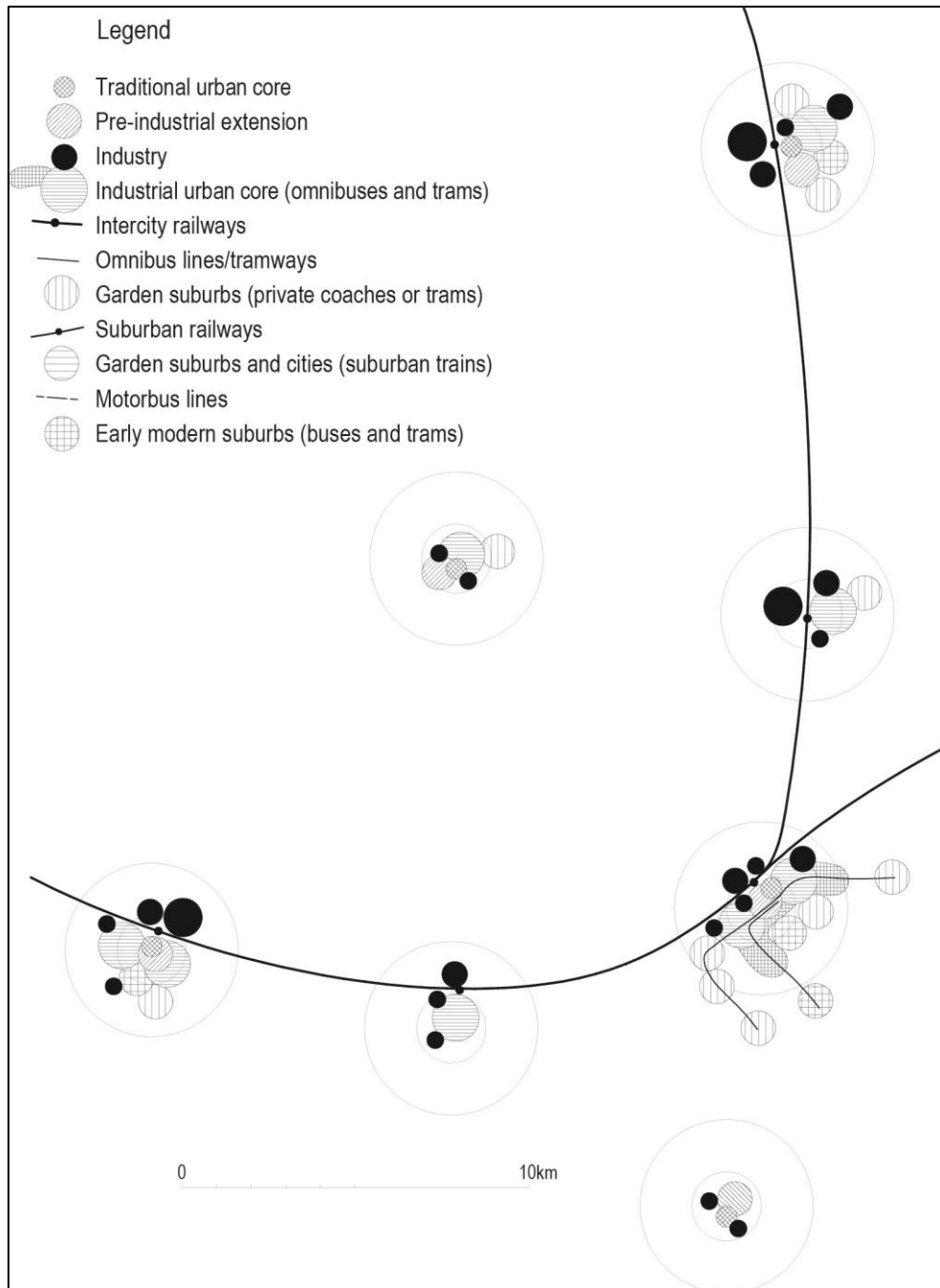
Figure 8. *The constellation of smaller towns and cities during the industrialisation (-1930s)*
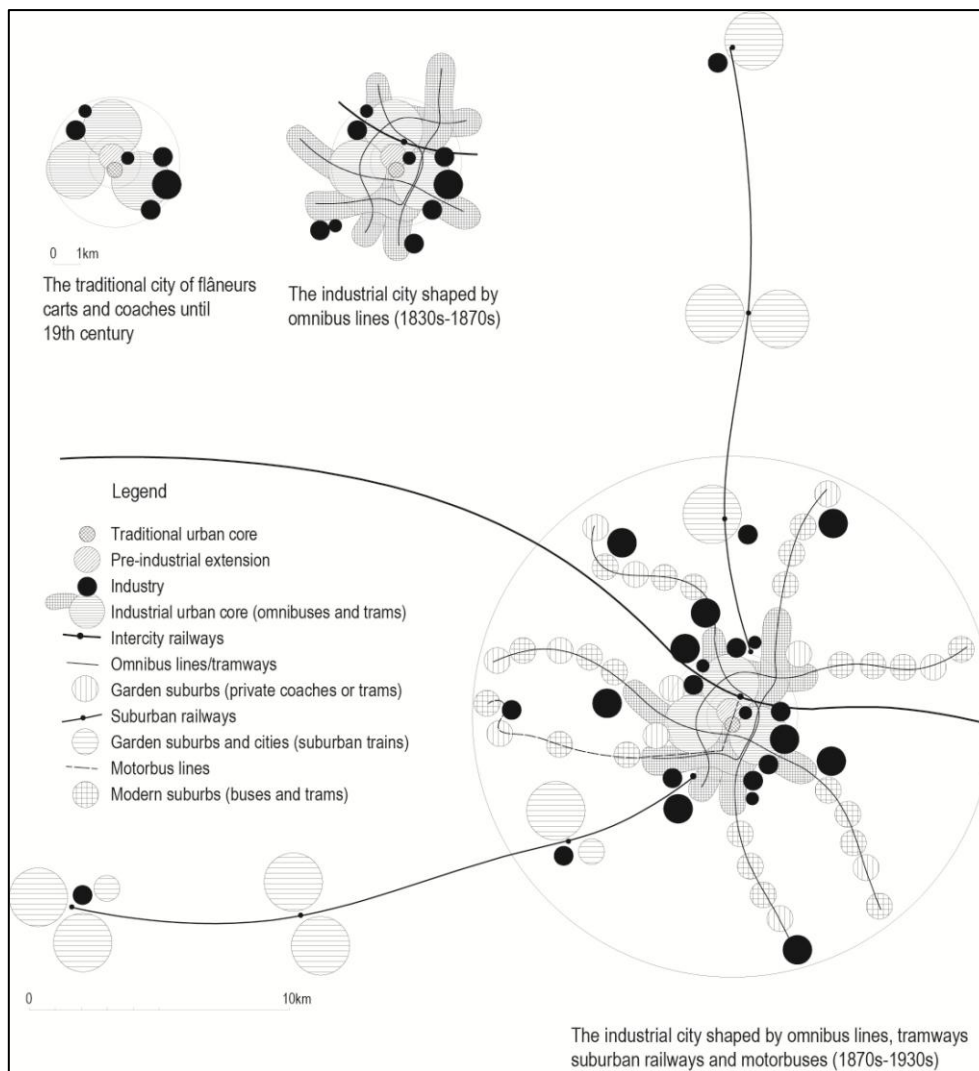
Figure 9. *The urbanisation of a Swedish large city during the industrialisation (-1930s)*

The modern society of cores and peripheries

Industrialisation brought improved sawmills, ironworks and brickworks, and new transport modes: omnibuses from 1830s, steam trains from 1850s, horse trams from 1870s, and electric trams and railways from 1890s. The railways allowed quicker transportation and flows of goods and the Swedish cities boomed. The urban population in almost all cities either doubled or quadrupled from 1840 to 1880. The population doubled from 1880 to 1900 and then again from 1900 to 1940 (SCB, 1969). The industrial city was unpredictable and explosive in its density and congestion, troubled by class conflict, in the Marxist sense, between capitalists and proletarians. The solution in Sweden was the welfare state, driven by capitalism, but highly taxed and controlled by politicians from the left that formed national government in 1932 and dominated the politics of the mid 20th century. The left politicians attained power and capital to invest in social welfare and expand the influence of bureaucracy into the 'public sphere' (Habermas, 1989). The Swedish public sector established a 'system of automobility' in the spirit of Fordism. The private car propelled the Swedish modern society. It became a privilege of the working class and a driver for innovation, industrial development and growth. The new taxes from the industry were invested by the public sector in new suburbs with high standards of living – triggering demand for new cars. The working class in the modern society emerged as wealthy suburbanites copying the lifestyle of the industrial rich.

By the official statistics from SCB the Swedish economy grew four times from 1950 to 1990 while the car traffic increased tenfold. Roughly one million new single family houses were constructed from 1941 to

1990 and almost two million new apartments in multifamily houses from 1946 to 1990. The Swedish population increased by two million inhabitants from 1940 to 1990, while the number of cars increased by four million. The modern suburbs emerged in the 1930s as the solution for improved quality of life and offered an alternative to the polluted industrial city. During the 1950s they were industrialised as ABC city. A means *arbete* (*work*), B *bostad* (*residence*) and C *centrum* (*centre*). The ABC city consisted of dispersed urban areas specialised for work, residence or leisure. It was a Swedish transcript of the recipe for habitation, work, recreation and circulation recommended by Le Corbusier in the 1920s and CIAM in the 1930s and it was executed by architects like Åhrén and Markelius. The urban cores of the 19th century, which relied on walking or public transportation, were depopulated, partly modernised with new architecture and bypassed or pierced by motorways. New modern ABC suburbs emerged everywhere in Sweden. The suburbs were prefabricated and assembled at unprecedented speeds. An extensive network of motorways and roads interconnected the modernised urban cores and the new modern suburbs. The private car allowed for temporal convergence of urban areas into urban regions, blurring the image of the traditional and industrial city. The proletarians and petit bourgeoisie of the *industrial society* quickly motorised and flocked in the fashionable modern suburbs.

During the second half of the 20th century, Swedish cities lost their population densities from the *industrial society*; they decentralised, sprawled and fragmented. Modernisation included removal of the electric trams from the industrial urban cores. By 1970s there were no tram systems left except in Gothenburg and Norrköping. Without trams or suburban railways the smaller cities developed ABC cities along the motorways. They were serviced by buses, but the buses did not perform well on motorways and in the dispersed cities (Fig. 10). The car, bus and truck and the subway or Tunnelbana in Stockholm were preferred transportation modes in Sweden. The ABC cities oriented towards the Tunnelbana in Stockholm, and in the small cities they were located along the motorways. The expansion of a fictional large Swedish city in the 20th century was illustrated by the artifacts in Stockholm (Fig. 11). Stockholm preserved its tradition of suburban railways and regional public transportation network with the Tunnelabana and new suburban railways at higher speeds and capacities. In contrast to Stockholm, Gothenburg invested in trams. The trams in Gothenburg had limited radius of 10 km and could not compete with the private cars on motorways in the urban region. Gothenburg has sprawled along the motorways since the 1940s.

**The global reach of the postmodern society**

Modernity's roots and inspiration are found in the age of enlightenment and exploration and today it extends on a global scale. It revolves around rationality and universality, science, time and standards. It fuses the forces of "world culture", future awareness, cybernetic control and automation based on scientific and technological knowledge (Luke, 1990). Postmodernism emerged as critique of standardisation, mechanised scale and control. It is multifaceted: environmentalism, anarchism, collectivism and conservation stand together with the modern pursuit of individuality, standards and norms, profits and consumption. In the postmodern city the tendency is to mix, but do not abandon the modern. It breaks the modern suburbanite stereotype, but not completely apart from it. The dominating middle class splits in subcultures: suburbanites, urbanites and suburban urbanites. It is not about alienated individuals and actions, but about actors and networks (Latour, 2005). The *knowledge society* is post-Fordist. It revolves around small scale, fantasy and virtual realities, uniqueness, being online, mobile and informed. Inventions like Facebook, Twitter, Spotify start small, then become accepted very quickly and have a global impact. They network people as well as shape lifestyles and sociabilities. The interest to drive and own a driving license is decreasing in many countries. The percentage of driving licenses in the age group from 18 to 30 years in Sweden decreased between 50 percent and 10 percent from 1984 to 2008. A similar trend is visible in the USA, but not in all Northern and Western European countries. In Finland and the Netherlands the trend is opposite (Sivak and Schoettle, 2011).
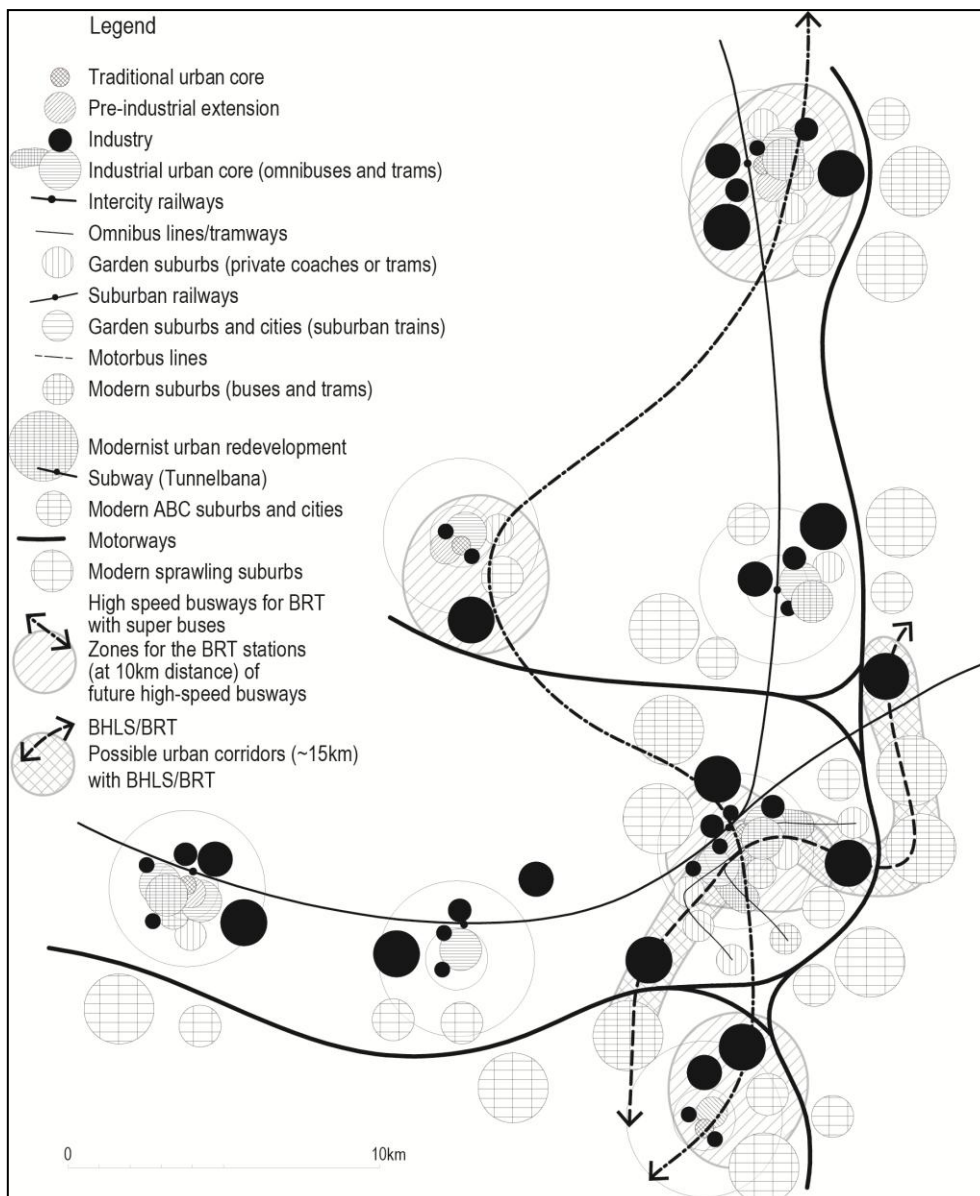
Figure 10. *The urbanisation of a constellation of smaller modern towns and cities (1930s-) with future zones for HSR and BRT*

The emerging knowledge society is a mix of individual and global, standard and uniqueness, innovation and retro, consumption and environmentalism. Since the 1990s, the "'system' of automobility" has developed new global systems of communications that breaks the cybernetic control of modernity. Its urban realm is worldwide, endless and interweaved with digital technology. It is brought into existence by massive globally extended sets of systems and infrastructures (Graham, 2004). The postmodern consumption is a mix of farmers' markets and products "Made in China". New mobilities emerge through shifts between private car and public transportation, including shared cars and private rapid transit, cheap airlines and private jets. The postmodern city of Western and Northern Europe has several fringes or development zones. The first fringe is the abandoned zones of factories, warehouses and ports of the industrial city (Fig. 11). The second fringe is the science edge cities, which are seeds of the emerging knowledge society, are interconnected with central business districts and sky cities or "aeropolises" (Urry, 2007) that are developing next to airports. The third periphery is no longer in the urban regions. It includes zones of fields, factories, warehouses and ports far away that manufacture, transport, store and distribute goods for global consumption (Fig. 7).
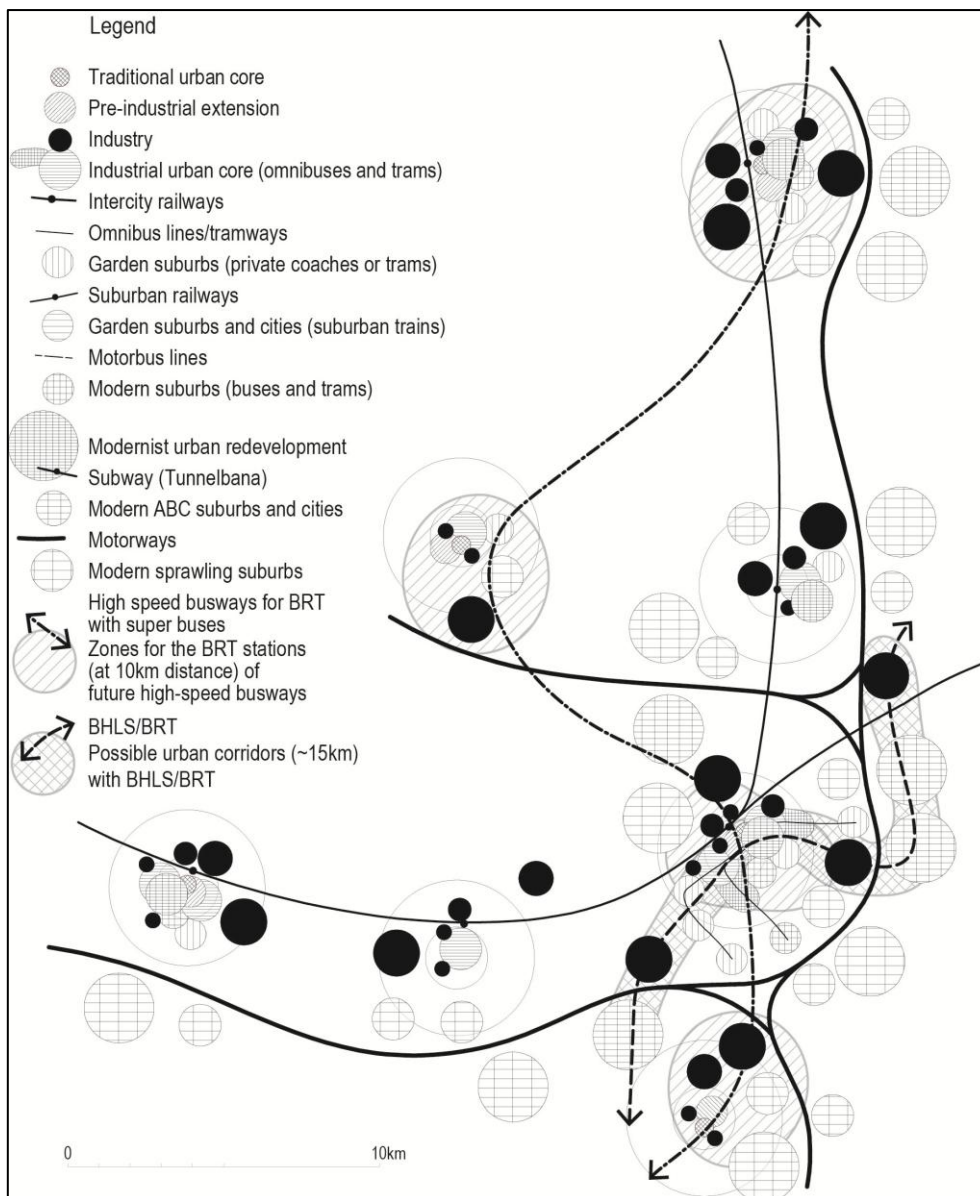
Figure 11. *The urbanisation of a modern Swedish large city (1930s-) with future zones for HSR and BRT*

The introduction of new high-speed public transportation systems in the postmodern Swedish towns and cities

HSR projects and initiatives

In Sweden, as almost elsewhere in Northern and Western Europe, there is a postmodern public transportation renaissance. There are many initiatives, ongoing and finished projects for high speed rail (HSR). In European context HSR is primarily applied for connections between larger cities and airports, but also to enlarge polycentric urban networks. In Stockholm there is already a HSR to the airport and there is a new railway tunnel under construction for more high speed trains on the central station. Adding more frequent HSR service allows commuting at longer distances and in Stockholm there is a regional plan to annex the smaller towns and cities within a radius of 100 km (SLL, 2010). These new high speed connections between Swedish cities are discussed as new urban networks and enlargements of urban regions (Cars and Engström, 2008).

HSR in Europe functions much as the waterways in medieval Europe. HSR connects major cities. The trains bring business, passengers and tourists, but they are isolated from the modern cities and suburbs

where the urban life is comprised of zones of offices and hotels. These postmodern HSR urban centres are business and transportation hubs, depopulated nodes and transfer points. The introduction of high-speed public transportation systems must consider repopulation, not only new offices, shopping centres and hotels around the major train stations served by HSR. Without adding population in the nodes and their *desirability cores* the strengthening of the business and transportation hubs causes urban sprawl at distance. In Netherlands, the train stations in Rotterdam and Utrecht are under major redevelopment. They are strengthened as major urban nuclei on the Thalys network. However, there is a need for a metropolitan HSR network that will serve population centres within the urban regions. Without adding population in the HSR nodes and their *desirability cores* the strengthening of the business and transportation hubs causes urban sprawl at distance that adds extra transfer points.

The bus analogy of the HSR concept is BRT with super buses and busways interconnecting a constellation of small towns and cities into *BRT metropolis*, a replica of the European *public transportation metropolises* with automated super buses running on different bus infrastructures. This concept is not discussed in the smaller towns and cities in Sweden that are business hubs in large urban regions of sprawled modern suburbs dominated by individual mobility. There are regional public transportation authorities in Sweden that offer bus services between small cities, but these services are too infrequent to achieve a sense of an urban network. The bus stations are also vast grey fields of asphalt that are not very attractive for passengers or businesses and the buses are not sophisticated. The buses have the mobility potential to extend the public transportation up to 60 km similar as the trains today. In Stockholm the line 676 is a system of bus stops on the motorway that terminates in Nörtälje. The distance is 67 km and there are 10 stops. The buses drive an average speed of 60 km/h and arrive in Nörtälje in roughly one hour. The line 676 is a candidate for *BRT metropolis* development if bus stops on the motorways develop as urban nuclei following the urban morphology of *paths* and *nodes* that unfold distinctive *desirability cores* and cause barrier effects.

The renaissance of BRT and LRT

The HSR discussions are complemented with development of new sustainable suburbs along BRT and LRT systems on the fringe of the historical urban cores. In Europe BRT is often understood as *quality bus* or *bus with a high level of service* (BHLS). BRT and LRT are entangled in the advocacy for compact city and new urban networks. This advocacy targets the redevelopment of the abandoned industrial fringe and development of new sustainable suburbs on greenfields. BRT and LRT are regarded as urbanity-empowering and more attractive since they do not cause barrier effects like the fully segregated railways or busways. BRT/BHLS and LRT are also forwarded as universal solutions for smaller towns and cities or for new orbital suburbs in the large cities. Douai is a small city in France with a busway that connects the train station in the city in two radial directions. A similar proposal is negotiated in Karlstad in Sweden. A new urban ring is under development in Stockholm with LRT on an orbital public transportation axis. Similarly in Gothenburg the northern part of the urban ring is actuated along an orbital busway. There are new orbital urban corridors or urban fingers extending from the industrial urban cores along the LRT or BRT/BHLS lines in Paris, Amsterdam, Eindhoven, Helsinki and Copenhagen. The compact city model with LRT or BRT/BHLS is widely replicated by developers.

The problem is that LRT or BRT/BHLS are urban systems; they extend to 15 km and are viable solutions for orbital and feeder connections in the large cities to a limited distance. It is not only important to design a sustainable urban form, but also to understand and enable sustainable urban flows from the neighborhood. The Tvärbana, LRT system operating on partially segregated railway in Stockholm, is orbital and there is no direct connection to the city centre of Stockholm by quick regional public transportation system. The inhabitants of Hammarby Sjöstad need to do an extra transfer to the Tunnelbana, the subway system in Stockholm. That caused an ongoing debate to extend a branch of the Tunnelbana to Hammarby Sjöstad. This station will make Hammarby Sjöstad a node in the major urban flows within the region.

Introduction of new public transportation infrastructures

Even though the postmodern knowledge society in Sweden is in its early stages of development, it nevertheless demands multimodal transportation connections and urban networks. HSR, BRT and LRT are speedy advancements of the trains, buses and trams, but they must go beyond industrial or modern application. Urry argues that the "public mobility" pattern of the 19th century will not be re-established in the future. That pattern is irreversibly lost because of the character of the "system of automobility" (Urry, 2004) that "produced and necessitated individual mobility based upon instantaneous time, fragmentation and coerced flexibility". The post-car system "will substantially involve *individualized movement* that automobility presupposes" (Urry, 2007, pp. 285). The private car is a very flexible and convenient transportation system. It can be used for slow and fast transportation, for short and long distances. It is available around the clock. The new public transportation systems have to achieve this availability in order to push the urban edge and produce the required future urban networks of the postmodern city. The public transportation and wired societies are compatible. The IT industry is flirting with the "system of automobility". Google needs people that click or touch and look at the computer or smart phone screen. This is a reason to develop a driveless car. Driving deters potential customers from being online. No one discusses driveless buses on streets and busways or automated BRT. What would that look like? Where can that fit? How will they affect the cities? Just imagine if most of the people live around public transportation modes where the traffic is automated, coordinated and perpetual. Similar conditions of perpetual public transportation exist for example in the European *metropolises*. The mini-metro in Copenhagen, which is basically automated LRT, is one system moving in that direction. With Google's "driveless bus" this is possible on a range of infrastructures.

The postmodern visions of automated BRT or LRT are exciting triggers for discussion about future development and transformation for urban planners and designers than the historical buses and trams. The urban fringes and expansions outward co-exist. The processes of adaptation of urban form and transformation must consider all the fringes in Swedish cities, not only the regional and global fringes of transnational capitalism in today's postmodern society

Conclusion

To achieve sustainability there is a need for a broader view of Swedish towns and cities in respect to their historical urbanisation and future integration with public transportation systems and by considering both form and flow aspects. The model for a postmodern city preferred by the developers in Sweden and around Northern and Western Europe is inapplicable in the industrial urban cores and modern suburbs. The future challenge is not to be immobile, but to be sustainably mobile by using more efficient transportation modes like high-speed public transportation systems. The model assumes walking as in the traditional city, but the modern society is motorised. BRT and LRT on multimodal streets are not high-speed systems. They are not competitive with the private car in the urban regions. The model often fails to contribute to more sustainable mobility in the new neighborhoods. The private car is the unsustainable transportation choice that prevails. The prospect of introduction of more efficient transportation technologies must consider public transportation systems though a postmodern mix of traditional *urban form* and modern *urban flows* via a prism of *fringes of urbanisation* and regional and global business and transnational capitalism that shapes postmodern urbanities.

HSR, BRT and LRT are speedy advancements of the trains, buses and trams. They can extend the urban edges and open urban nuclei at a distance of 100 km or extend the historical urban cores. However, they have to go beyond their industrial or modern application. The postmodern visions of automated BRT or LRT must reach urban planners, designers and developers and contribute to more varied actuations of the compact city. It is important to use methods from urban morphology to design or transform the urban areas for public transportation. The modified elements by Kevin Lynch and introduction of *desirability cores*, flows of pedestrians in urban space, help to represent the effect of public transportation infrastructures on urban areas on a map. The *desirability cores* are also fuzzy hypothetical models of integration of public transportation infrastructures in cities. This is useful information to urban planners,

designers and developers in understanding the potentials and obstacles of different public transportation infrastructures and it is also a framework for discussion with transportation planners and engineers. Other methods like space syntax axial lines and convex spaces are also applicable to analyse and represent *desirability cores*. The *desirability cores* sequence of convex spaces.

References

Benedikt, M. L. (1979). "To take hold of space: isovists and isovist fields", *Environment and Planning B* 6, 47-65.

EC. (1990) *Green paper on the urban environment* (EC).

EC. (1997) *Towards an urban agenda in the European Union* (EC).

Ehlers, E. (2001) "City models in theory and practice: a cross-cultural perspective". *Urban morphology* 15, 97-119.

Cars, G. & Engström, C.-J. (ed.) (2008) *Stadsregioners utvecklingskraft: trender och nya perspektiv* (Kungliga tekniska högskolan, Stockholm).

Choay, F. (1969) *The modern city: planning in the 19th century* (George Braziller, New York).

Conzen, M. R. G., & Conzen, M. P. (2004) *Thinking about urban form: papers on urban morphology, 1932-1998* (Peter Lang Pub Incorporated).

Habermas, J. (1989) *The structural transformation of the public sphere: an inquiry into a category of bourgeois society* (Polity Press, Cambridge).

Harris C.D. & Ullman E.L. (1945) "The Nature of Cities", in *Annals of the American Academy of Political and Social Science* 242, 7-17.

Hillier, B., Hanson, J., & Peponis, J. (1984) "What do we mean by building function?"

Krier, L. (1984) *Leon Krier: houses, palaces, cities* (Architectural Design, London).

Krier, R. (1979) *Urban space* (Academy Editions, London).

Latour, B. (2005) *Reassembling the social: an introduction to actor-network-theory* (Oxford University Press, Oxford).

Le Corbusier. (1929/1987) *The city of to-morrow and its planning (*Dover publications, New York)

Luke, T.W. (1990) *Social theory and modernity: critique, dissent, and revolution* (Sage Publications, Newbury Park, California).

Lynch, K., & Rodwin, L. (1958) "A theory of urban form", *Journal of the American institute of planners* 24.

Lynch, K. (1960) *The image of the city* (M.I.T. Press. Cambridge, Massachusetts).

Marshall, S. (2005a) *Streets & patterns* (Spon, Cambridge, Massachusetts).

Marshall, S. (2005b) *Urban Pattern Specification* (Institute of Community Studies, London).

Marshall S. & Gong Y. (2009) *SOLUTIONS WP4 Deliverable Report: Urban Pattern Specification* (University College London, London).

Marchetti, C. (1994) "Anthropological invariants in travel behavior", *Technological forecasting and social change* 47, 75-88.

McLoughlin, J.B. (1969) *Urban and regional planning: a systems approach* (Faber and Faber, London).

Mitchell, R. B., & Rapkin, C. (1954) *Urban Traffic – A Function of Land Use* (Columbia University Press, New York).

Rådberg, J. (1988) *Doktrin och täthet i svenskt stadsbyggande 1875-1975* (Statens råd för byggnadsforskning, Stockholm).

Rådberg, J. (1997) *Stadstyper i Västerås: bebyggelseanalys med hjälp av geografiskt informationssystem*. (Kungliga Tekniska högskolan, Stockholm).

Rådberg, J. & Friberg, A. (1996) *Svenska stadstyper: historik, exempel, klassificering* (Kungliga Tekniska högskolan, Stockholm).

SCB. (1969) *Historisk statistik för Sverige Del 1. Befolkning Andra upplagan* (KL Beckmans Tryckerier AB, Stockholm).

Sivak M. & Schoettle B. (2011) *Recent changes in the age composition of drivers in 15 countries.* Report UMTRI-2011-43. Ann Arbor (Transportation Research Institute at University of Michigan, Michigan).

SLL (2010) "*Guide to the Regional development plan for the Stockholm region – RUFS 2010: how we will become Europe's most attractive metropolitan region*" (http://www.tmr.sll.se/Global/Dokument/publ/2010/RUFS_2010_short_version.pdf) Accessed on 26 June 2013.

Urry, J. (2004) The 'system' of automobility, *Theory, Culture & Society* 21, 25-39.

Urry, J. (2007) *Mobilities* (Polity, Cambridge).

Von Thünen, J. H. (1966) *Isolated state*. P. Hall (ed.) (Pergamon Press, Oxford).

Webber, M.M. (1964) "The urban place and the nonplace urban realm", in *Explorations into Urban Structure* (University of Pennsylvania Press, Philadelphia).

Whitehand, J. W. (1967) "Fringe belts: a neglected aspect of urban geography", *Transactions of the Institute of British Geographers*, 223-233.

Whitehand, J.W.R. (2001) "British urban morphology: the Conzenian tradition", *Urban morphology* 5, 103-9.

Whitehand, J. W. R., & Morton, N. J. (2003) "Fringe belts and the recycling of urban land: an academic concept and planning practice", *Environment and Planning B* 30, 819-840.

Zahavi, Y. (1974) *Travel time budgets and mobility in urban areas* (US Department of Transportation, Washington D.C.).

Using the 'Subtracto-Silhouette' parametric view-shed method in structure planning and architectural design

Marcus White

Faculty of Architecture, Building and Planning, University of Melbourne, Melbourne, Australia
Email: mrwhite@unimelb.edu.au

Abstract. *Significant building silhouettes and city skylines are an important part of urban composition and contribute to a city's identity. Pressure to accommodate higher population densities in the form of tower developments can threaten these silhouettes. This paper discusses a parametric view-shed design method for setting height restrictions or maximum building envelopes that maintain culturally significant silhouettes whilst allowing high density urban development. I describe the process of using digital special effects found in animation software reconfigured to create three-dimensional maximum planning envelopes. The technique called 'Subtracto-Silhouette' uses animated particle systems (normally used to simulate explosions), 'shot' from a specific viewing position, traced through vertices of a key building's geometry, intersected with an extruded site boundary to create an envelope. Inside this envelope, a developer can build anything without affecting the silhouette of the building in question from the key viewing position. I demonstrate the 'Subtracto-Silhouette' technique by describing two case studies. Firstly I discuss input into a planning amendment for the City of Stonnington Forrest Hill Precinct in South Yarra in Victoria, where a three-dimensional planning envelope was generated to protect an historic silhouette of the adjacent Melbourne High School. The second study is an architectural proposal for the Flinders Street Station design completion where I show the technique used in both a preservation as well as generative manner. I discuss the results of the technique applied on both case studies, demonstrating its effectiveness in policy development with the resulting Amendment C58 for Forrest Hill and show how it can be used as an integrated part of schematic design process in the Flinders Street Station proposal.*

Keywords: preservation, visual integrity, urban modelling, silhouette, skyline, view-shed.

Introduction

Cities can be understood as part of a visual culture through their skyline and formal composition (Lynch, 1960). Significant building silhouettes and city skylines are an important part of urban composition and contribute to a city's identity (Oktay, 2002; Ford, 1998). Until the 20th century, key civic building silhouettes announced themselves on the skyline (Bluestone, 1988) be it library dome, gothic church spire or minaret, contributing to a visual representation of the accumulation of historic, social, cultural and economic structures of a city over time (Guney et al., 2012b).

The importance of size, shape and placement of these key civic buildings was amplified during the Renaissance when the relationship between graphic representation and composition intensified. Renaissance designers' new understanding of the perspective drawing technique (Alberti et al., 1804) led to the city being represented with more accuracy as a whole, which influenced public understanding of the city skyline and urban composition (Cuthbert, 2003). In the second half of the 16th century, the general circulation of perspective representations of cities led to the urban realm becoming a collective concern within European cities – "perspective, the tool used to create these images was subsequently and

continuously employed for the rectification of urban settings" (Benevolo, 1995). Consideration was given to urban composition in terms of skylines and street networks that emphasised vanishing points (Bacon, 1967). Both the axial boulevards of the Beaux-Arts movements and the compositional landscape of the picturesque movement of the 1700s were influenced greatly by perspectival composition techniques (Field et al., 2013).

In cities today, the urban skyline is still an important part of legibility and composition and is also an extremely important component of tourism – the 'image of a city' impacts on its potential as a tourist destination (Lim and Heath, 1994). Many cities throughout the world are currently experiencing the challenge of maintaining an historic 'image' skyline or silhouette, facing difficulties reconciling conservation and development (UNESCO, 2013). With rapidly increasing urbanisation (Major Cities Unit, 2012) and a greater understanding of the relationship between transport, density and sustainability (Newman and Kenworthy, 1999; Newman et al., 2009), there is great pressure for cities to grow vertically. Cities need to accommodate higher population densities in established, well serviced, inner urban areas often in the form of low rise or high rise tower developments. These forms of development may be considered more sustainable environmentally (Newman, 2006) and financially (O'Hara, 1997) but can threaten city skylines or historic building silhouettes which may be considered an important part of social or cultural sustainability. Therefore, there is a growing need to protect the views to and from many cultural heritage properties (UNESCO, 2013) in numerous cities throughout the world.

This study aims to produce and test a new parametric view-shed design method for setting height restrictions or maximum volumetric building envelopes that maintain culturally significant silhouettes while allowing high density urban development. The study provides a brief background to the silhouette preservation issue discussing international and local examples. It outlines a description of the development of the new silhouette envelope generation technique and how it differs from other current practice methods. It presents two case studies, the first exploring the application of the technique in a planning legislation context, and the second describing the application to an architectural building design proposal. Finally, the paper assesses the effectiveness of the technique, limitations and its potential for further development.

Protecting 'visual integrity' of world heritage skylines and silhouettes

The background paper prepared by the World Heritage Centre with inputs from ICOMOS, ICCROM and IUCN for the *WHC International World Heritage Expert Meeting on Visual Integrity* held in March 2013 in Agra, India, introduced the term 'visual integrity' stating that it "may pertain specifically to vistas, panoramas, viewpoints, and silhouettes". The paper notes that visual integrity is "frequently considered a crucial element related to the preservation of cultural and natural World Heritage sites" (UNESCO, 2013). The paper cites the *Operational guidelines for the implementation of the world heritage convention*, describing the use of planning 'buffer zones' to protect 'visual integrity' or 'important views':

> For the purposes of effective protection of the nominated property, a buffer zone is an area surrounding the nominated property which has complementary legal and/or customary restrictions placed on its use and development to give an added layer of protection to the property. This should include the immediate setting of the nominated property, important views and other areas or attributes that are functionally important as a support to the property and its protection. The area constituting the buffer zone should be determined in each case through appropriate mechanisms. Details on the size, characteristics and authorized uses of a buffer zone, as well as a map indicating the precise boundaries of the property and its buffer zone should be provided in the nomination. (Cultural and Heritage, 1995)

The paper further describes specific examples where heritage views or silhouettes are threatened and their recommendations for preservation methods. Among the 13 examples discussed, the historic centre of Vienna (Austria) is described as being threatened by a development known as the Wien-Mitte Urban

Development Project. The World Heritage Committee threatened to remove Vienna from the World Heritage List unless a "comprehensive visual impact assessment" report was produced to provide evidence that views "of and from the area were not impacted" (Decision 26 COM 21B.35).

Another example, the Guia Lighthouse in Macau, China, has similarly been threatened by high-rise development with towers obscuring the view of the lighthouse from the sea "undermining the very function and character as a landmark of the city" and from the Monte Fortress to the West. To combat the potential impact of this development, the Macao SAR Government setup height restricted 'buffer-zones' surrounding the building. Though this action is praised, there is some doubt about the effectiveness of height restriction buffer zones due to the complex topography of the site concluding a "reactive monitoring mission to the property is necessary to determine the appropriateness of these new regulations with respect to future possible development proposals" (UNESCO, 2013).

A performance based method of control is described in the example of the Cologne Cathedral (Germany) where a visual impact study carried out by the University of Aachen identified the 'classic' view of the cathedral which was relatively intact and should be protected but also identified various 'everyday citizen' viewpoints which should also be protected through limiting development. A method for testing the performances (visual impact) of potential developments was developed by the Institute of Urban Design and Regional Planning at the University of Aachen. This involved:

> overlaying of [photographic] data with a digital computer model, which was generated with laser scan recordings, so-called scatter-plot, planned constructions can be visualized realistically and with millimeter precision. Through referencing these visualizations to earlier examination steps, it is possible to substantiate precisely, to what extent urban and landscape scenery is altered by the planned building activity (Kloos, 2012).

Melbourne examples

The issue of historic silhouette preservation is not limited to 'ancient' cities; Melbourne, Australia shares this concern. In the 19th century, Melbourne's skyline was dominated by civic buildings, but like most cites, through the second half of the 20th century, the dominance of civic buildings was overtaken by increased prominence of commerce and the development of office towers (Dovey, 1992). Though height limits were proposed in Melbourne at various stages of the 20th century, for example to restrict building heights within the CBD to 40 m (El-Ghul and Ghanimeh, 2010), these restrictions have been relatively unsuccessful.
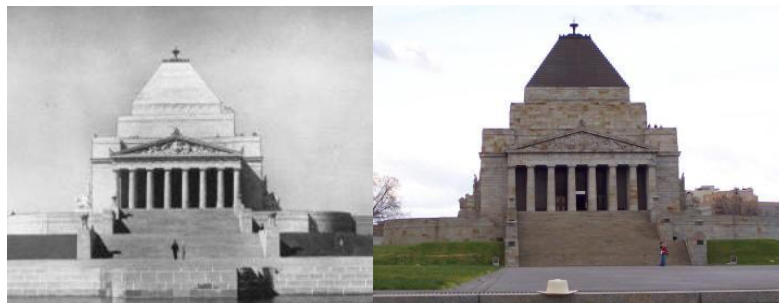

Figure 1. *Photo of the Shrine in the 1930s (LHS), and photo taken in 2006 (RHS). Note the absence of buildings in the background due to the preserved silhouette.*

There are, however, two key legislative regulations that have made an impact on the Melbourne skyline with respect to historic vistas/silhouettes: The Shrine of Remembrance (war memorial) (Burry, 2010) and St Paul's Cathedral. The Shrine of Remembrance was built between July 1928 and November 1934 in memory of the men and women of Victoria who served and died in the Great War of 1914-18. The Shrine has been protected since the passing of the *Shrine of Remembrance Act* in 1978, with various master plans for the area over the years, all protecting the historic silhouette that can be seen when looking down St Kilda road to the South (Fig. 1).

Figure 2. *Plan from the St Kilda Road Master Plan document describing the City of Melbourne (DDO17) & Port Phillip (DDO13) 'Shrine Vista' design development overlays (Portphillip, 2012).*

The other important protection of historic vistas in Melbourne has been characterised by the highly publicised St Paul's Cathedral/Federation Square 'Shard' controversy (Mitsogianni, 2000, MacMahon, 2001, Dovey, 2005). In 2000, the Victorian State Government commissioned a report on the effects of the proposed Federation Square development. The report concluded with a recommendation that "the heritage vista of St Paul's Cathedral southern façade and complete silhouette should be preserved and protected in perpetuity" (Treasurer, 2000). This led to a redesign of the 'Shard' building so it did not interrupt the view or the silhouette of the Church (Fig. 3).
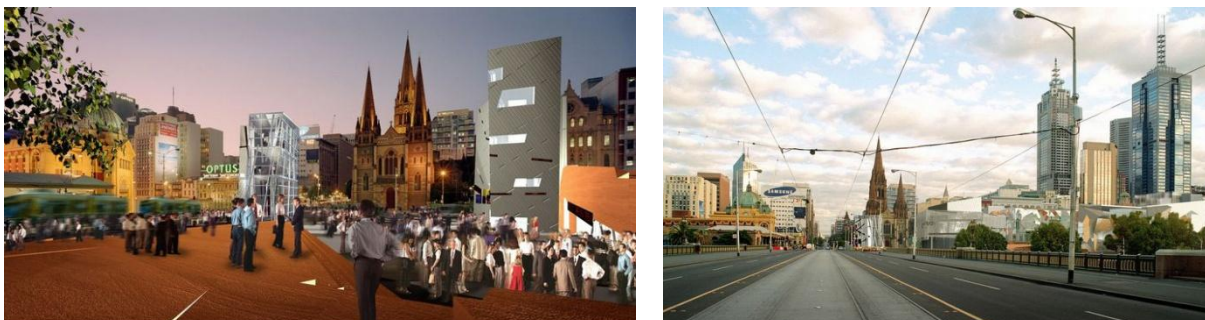
Figure 3. *LHS: Federation Square original scheme with full sized 'shard'. RHS: view from the 'Walker position' showing shard reduction for view.*
Source: Design by LAB Architecture. Image Courtesy of John Gollings and Flood Slicer.

These two Melbourne examples of regulations to restrict development to protect heritage silhouettes or vistas are based on performative restrictions. The performative restrictions state that a particular viewing position is privileged and that new development cannot detract from the heritage value of this particular view. Both of the examples discussed above have been difficult to communicate and enforce and consequently have been surrounded in controversy, particularly the example of Federation Square (Brown-May et al., 2005).

The onus is placed on the architect and developer to design potential buildings on impeded sites, test the design's impact on the silhouette using physical modelling or 3D digital models, then alter their design in a 'trial and error' manner. This trial and error process is made more difficult as no publicly available digital city model is available that has the kind of millimetre accuracy described in the Cologne example discussed earlier or that described in the *Vilnius – Lithuania Management of Visual Integrity of the Historic City Centre* paper (UNESCO, 2012).

Method: the 'Subtracto Silhouette' technique

This section of the paper explores an alternate method for analysing and generating volumetric permissible envelopes using a parametric 'view-shed' design method. The technique is demonstrated by discussing two case studies. The first case study describes the application of the technique to inform planning envelopes for an inner urban Melbourne council. The second case study describes the technique applied as part of an architectural proposition for a prominent inner Melbourne site.

In order to provide unambiguous volumetric restrictions based on a silhouette for either a city skyline or historic building as an alternative to performance base criteria, a method was needed for modelling the urban scenario. This included setting up perspective view positions and being able to extract silhouette lines that could be used to generate a height restriction envelope.

Skyline extraction and analysis has not usually been available in current GIS functionality (Guney et al., 2012a) and, where it has been used, it has been a raster based (digital elevation model) analysis lacking the required architectural level of detail for this particular form of analysis. Relatively recent developments in GIS programs have expanded this functionality to be able to assess mesh geometry such as the 'Skyline tool' within the 3D Analyst™ add-on extension to the latest version of ESRI's ARC GIS 10™ (Biology, 2012). This add-on allows for the assessment of 'view-sheds' within the GIS model with a potentially wide range of applications such as military airspace modelling (Shephard, 2010), visualising terrorist sniper hazards (VanHorn and Mosurinjohn, 2010), and environmental sensitivity visual analysis modelling (Shephard, 2010; Kim et al., 2004).

This research was conducted within architectural practice without access to ARC GIS with additional 3D analyst software and was preformed prior to the release of ESRI's 'Skyline tool'. For this reason, a technique a call 'Subtracto-Silhouette' was developed. This works within Autodesk's 3dsMax™ animation software, which is common within architectural practice for modelling and rendering. The technique involves five steps to create a maximum envelope for a particular site so as not to impact upon a historic silhouette.

The first step involves creating an accurate digital model of the historic building with particular care taken in the modelling of the upper elements of the building such as ridge and parapet heights. Survey data or 3D scanned point cloud data can be used in this step but must be converted to simplified polygon meshes for best results (Fig. 4 L).

The second step is to extrude the perimeter boundary of the site in question to a nominal height to create a site's potential maximum envelope prior to silhouette consideration. This creates a solid mass higher than the expected maximum height for the site, from which the silhouette is then subtracted (Fig. 4 R).
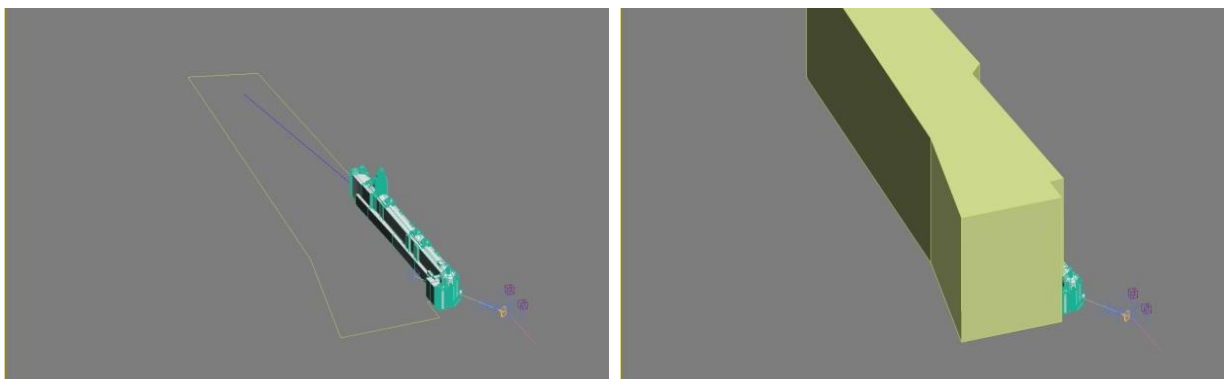
Figure 412. *Digital model of existing historic building (LHS). Development site boundary extruded to create a site envelope (RHS).*

The third step is to set up a camera within the digital model in the exact position designated to be the point at which the silhouette should be preserved. The decision for choosing a particular viewing point may be straight forward and based on a particular historic photograph or may be the result of community consultation or a heritage report (Stonnington, 2005). Depending on how this point is chosen, a camera is created in the scene and moved to position (XY) as well as height (Z) to match a specific geo-referenced coordinate. If a silhouette from an historic photograph is to be preserved, the 'camera-match' utility can be used to accurately match a digital camera position to a physically taken photograph.
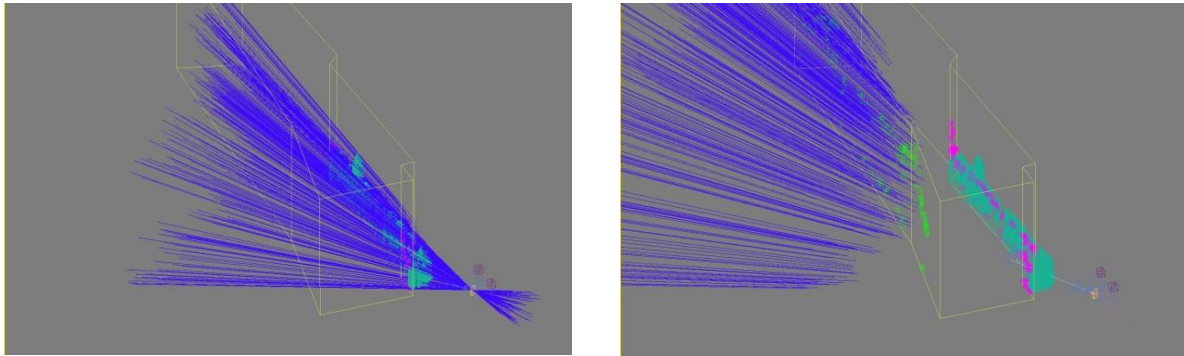
Figure 5. *Particle rays projected from camera intersecting with site boundary planes, leaving intersection marks.*

The fourth step involves an animated particle system (normally used to simulate explosions), which is parametrically linked to the specific viewing position, used to generate particle rays that move from the eye (camera) position through each of the corners (vertices) of the historic building then an marker point (X,Y,Z) is left where the particles intersect with the site in question's extruded volume (Fig. 5R).

The fifth and final step involves these points being used to generate a surface which, in turn, is used to subtract the geometry above the silhouette line (Fig. 6). This process creates an envelope, inside which a developer can build anything without affecting the silhouette of the building in question from the key viewing position.
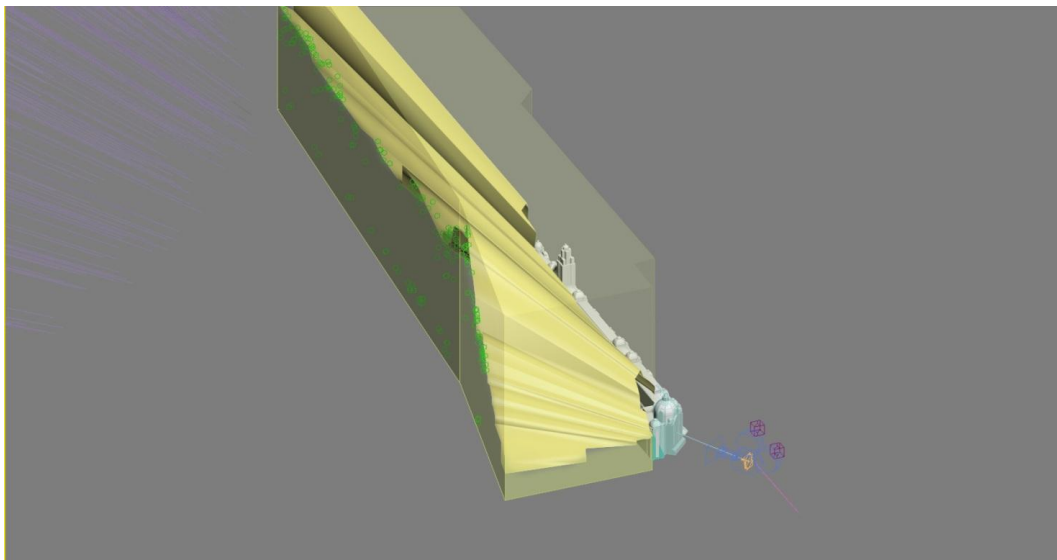
Figure 6. *Resulting maximum envelope, within which any building could be constructed and it would not impact on existing historic building silhouette.*

Case study 1: Melbourne High School

As part of the Chapel Vision Structure Plan for the Melbourne suburbs of South Yarra and Prahran, an analysis of potential future development adjacent the historic school was undertaken. The heritage report

produced by Bryce Raworth Pty Ltd Conservation recommended that the view of the school from the corner of Yarra Street and Alexander Avenue should be retained unimpeded by development – 'the castle hill view' (Fig. 7). Due to its form and castled parapet, it was considered that the 'visual perception of the ridgeline against the sky is indeed a defining feature in an appreciation of the siting and prominence of the 1920s building' (Keaney, 2008) and the building's silhouette should be preserved. Any development to the east of the school must therefore be restricted in height (MGS, 2007).
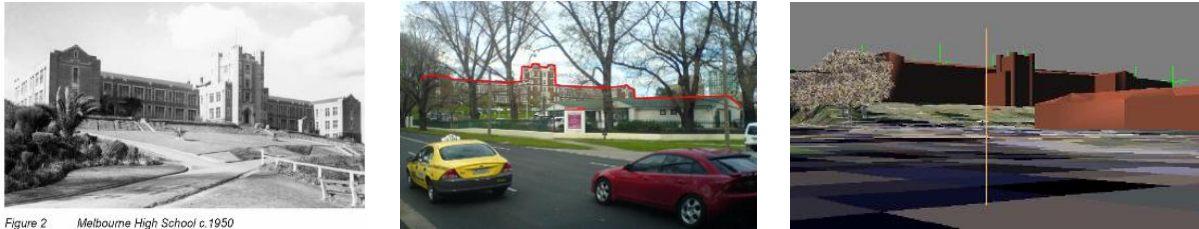

Figure 7. *LHS: Image of historic of Melbourne High School ca 1900-1949 (image courtesy of State Library of Victoria Archives) Middle: Photo from designated historic view point (photo MW 2006), RHS: Digital model perspective matched to photo.*

To work out the permissible heights, the *Subtracto-Silhouette* technique was employed (Fig. 8 and Fig. 9). The resulting envelope maximised the potential yield of adjacent sites while ensuring the heritage silhouette is protected.
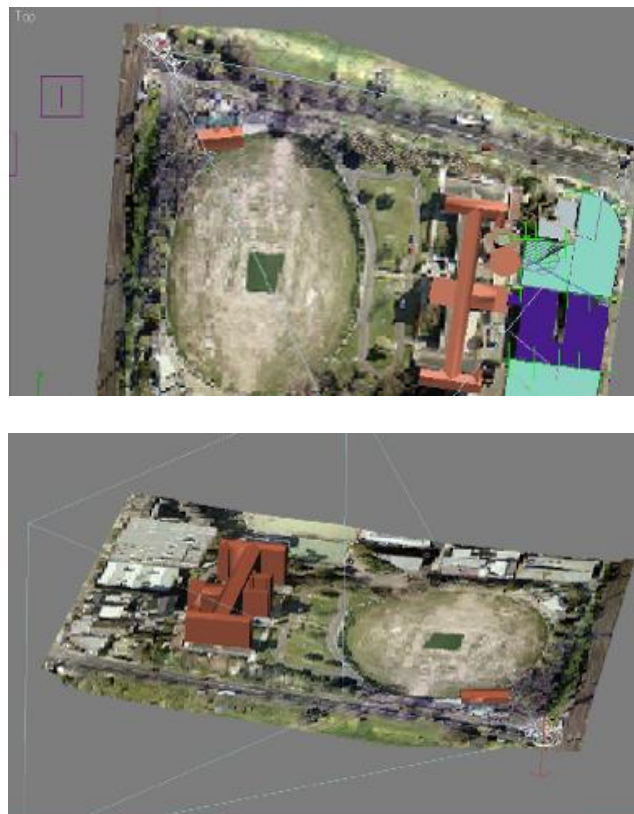
Figure 8. *Images showing positioning of camera to match historic photograph.*
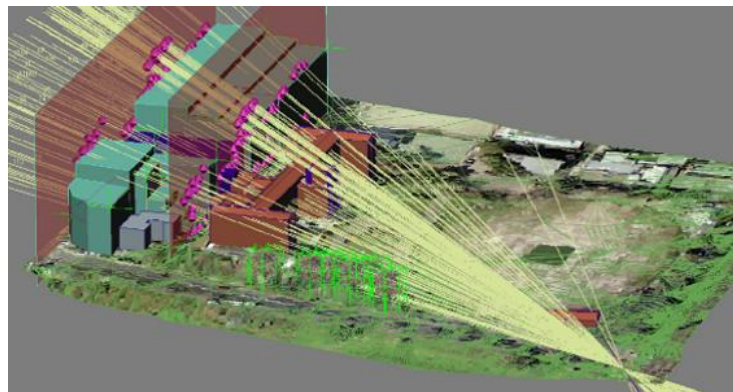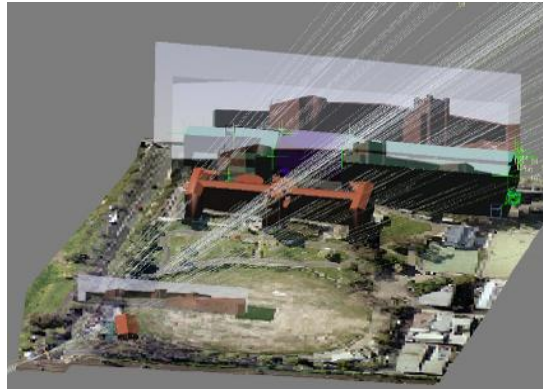
Figure 9. *Particle rays projected from camera intersecting with site boundary planes, leaving intersection marks used to generate 'maximum permissible envelope'.*

The proposed envelope was incorporated into the planning report (MGS, 2007) and has been presented and approved by the Stonnington City Council having also successfully undergone a public consultation process. The building envelope described using this technique became part of the structure plan for the City of Stonnington resulting in changes to the planning scheme with Amendment C58 (DPCD, 2009) and *Schedule 8 To The Design And Development Overlay DDO8 Forrest Hill Precinct* (Stonnington, 2009). The technique has proven to be as accurate as the surveyed digital model and can be tested by checking with independent 3D cameras.

Thus far the technique has withstood the scrutiny of a Civil Court challenge by developers but remains a contentious issue (Keaney, 2008). The preservation silhouette form remains as a restricting condition on development sites adjacent the Melbourne High School, though there is scope in the regulations for this silhouette to be interrupted if an "architectural solution can be demonstrated as to be suitable high quality and have minimal visual impact upon the view" (Keaney, 2008).

## Case study 2: Flinders Street Station competition entry

The second study is an architectural proposal for the Flinders Street Station design competition where the technique was used in both a preservation as well as part of the form finding design process. In March 2012, Victoria's then Minister for Major Projects, Denis Napthine, announced the State Government's intention to hold a design competition for the renewal of the Flinders Street Railway Station in Melbourne, Victoria. The competition's briefing documents outlined challenges for the site such as the expected doubling of transport patronage in the next decade; the need to improve integration with surrounding precincts such as Federation Square and the Yarra River; and restore areas of the heritage-listed existing building (Victoria, 2012c). One of the competition's critical objectives listed in the *Statement of Key Objectives* briefing document stated that the "new building forms must maintain important view lines of significant landmarks on the station land such as the main dome" (Victoria, 2012b).

This sentiment was reinforced in the competition submission requirements which explicitly stated the importance of the historic 'post card' views of the railway station:

> The dome, Elizabeth Street clock-tower and frontage to Flinders Street form the 'iconic' view of the station. New development must not be sited within close view of, and must minimise impact on, views of these elements and open sky behind (Victoria, 2012a).

Another requirement was that each competition entrant must produce a rendered perspective view from eight chosen view points, one of which was the 'postcard' view of the main dome (Victoria, 2012a).

As in the previous case study, the Subtracto-Silhouette technique was applied to generate a maximum envelope to directly respond to the preservation of the iconic silhouettes of the existing heritage railway building. This application differs from the previous project in that the technique was used multiple times simultaneously for different important silhouettes (including the dome 'postcard' view and the historic Sandringham rail link view) (Fig. 10). The technique was also undertaken concurrently with a series of other subtractive processes which directly informed an architectural form generation. Other subtractive processes included: the solar access preservation technique discussed elsewhere (White, 2012); structural optimisation in response to railway infrastructure location and potential structural placement, internal planning/internal light optimisation; and the introduction of a light rail connection on a secondary eastern concourse utilising a re-activation of the Sandringham Bridge to service the Fisherman's Bend development. These subtractive design aspects along with the many other design considerations will not be discussed in detail in this paper. However, it is worth noting that the Subtracto-Silhouette process was highly integrated into a design process which involved a great number of other design considerations.
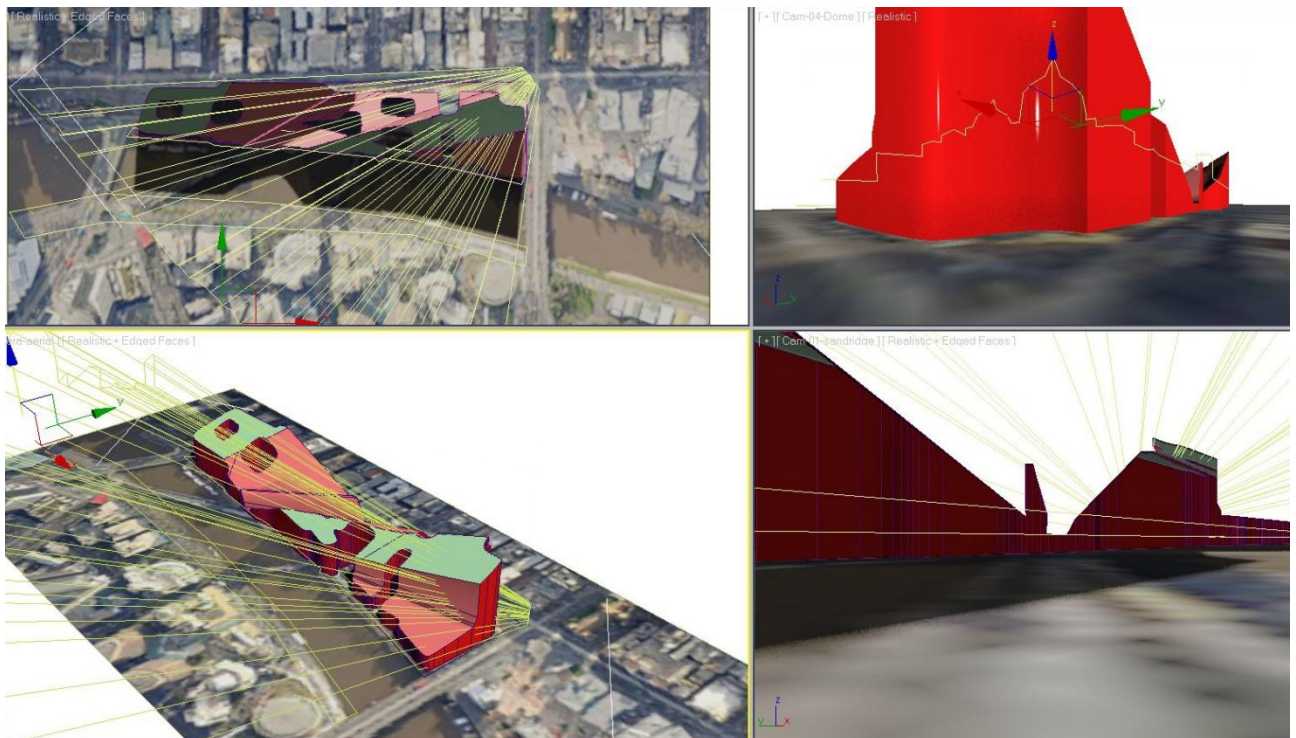

Figure 10. *Camera position matched to 'post card' view of Flinders Street Station entry and dome. Subtracto-Silhouette process applied.*
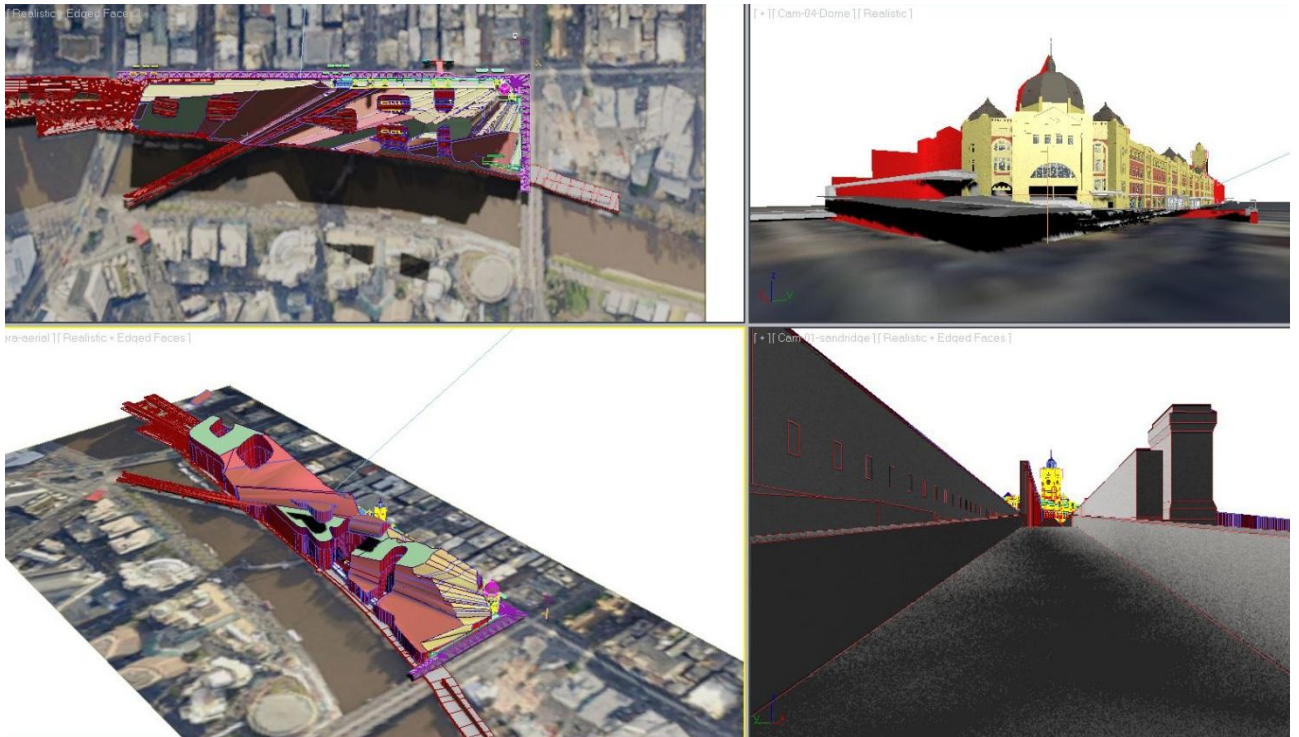
Figure 11. *The resulting geometry of the process creates an architectural form that does not impact the historic view.*

The resulting architectural envelope (Fig. 11 and Fig. 12) is formally expressive with the design process clearly legible from views other than those designated as heritage views. As one moves away from the designated preserved views, the new architecture is revealed, with a dynamic relationship between the old and the new.
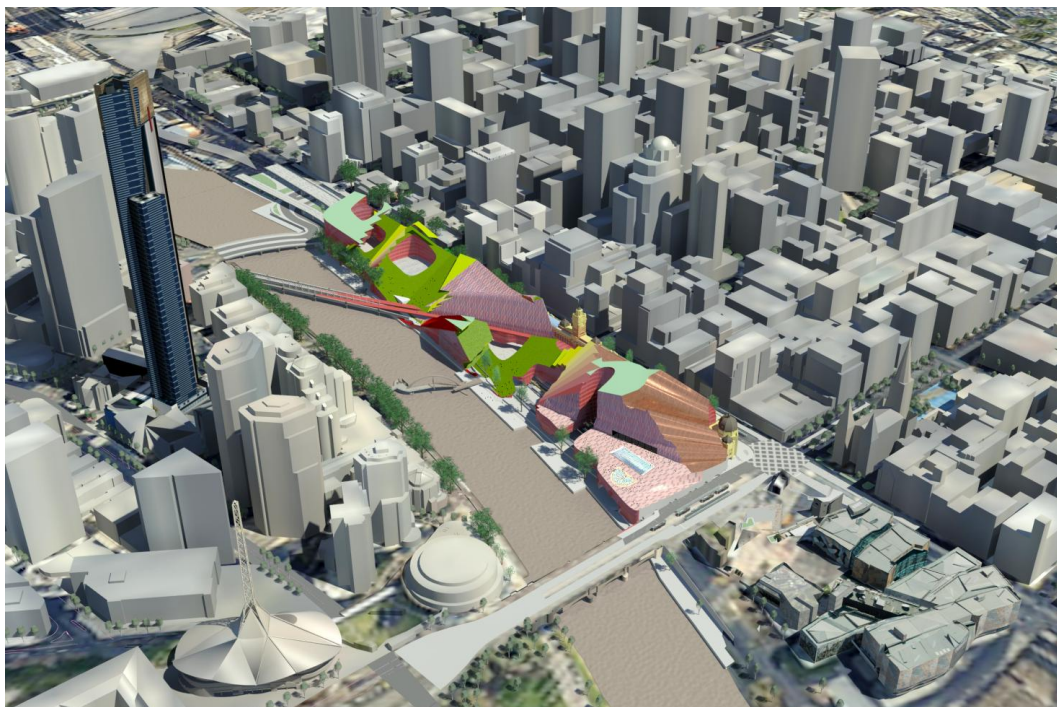
Figure 12. *Aerial view showing resulting architectural form in the urban context of Melbourne.*

Figure 13. *Perspective rendering of architectural form illustrating the preservation of the historic view, while allowing for a dramatic increase in usable floor area.*

The proposal directly responded to key aspects of the brief, creating a variety of spaces to suit a diverse set of programmed uses. The form allows for a large area of new development with over 40,000m² of new floor space within an important central location in Melbourne without detracting from the historic architectural qualities of the existing 19th central buildings and urban morphology as demonstrated in the rendered perspective view of the dome (Fig. 13).

Discussion

The technique and case studies

The Subtracto-Silhouette technique has been demonstrated to be a flexible method for generating envelopes to protect historic silhouettes. The technique is rapid to apply, particularly when compared to performance based methods of trial and error modelling and allows designers and policy makers to test potential implications of volumetric heritage overlay strategies in both a large scale on numerous sites at a structure planning level and at a micro scale of individual buildings.

The technique can be used as part of policy development as illustrated with the City of Stonnington's Amendment C58 for Forrest Hill case study but also how it can be used as an integrated form-finding component of the design process in the Flinders Street Station proposal.

The case studies illustrate the important relationship between buildings and the broader urban context, where buildings on a single site can dramatically influence the reading of a city and policy and design decisions can either enhance or detract from a heritage reading.

Urban densification maximisation and links with picturesque

The technique described shows how it is now possible to balance one particular visual aspect of heritage (the silhouette) with densification in urban settings. In both case studies, sites were maximised in terms of potential yield while not losing the heritage qualities of urban space or detracting from civic formal gestures of important heritage buildings and skylines. The technique also allows the co-existence of old and new urban fabric, setting up a non-static hierarchy where the relationship between the old and new changes dynamically as a person moves through the city. At some vantage points, only the old is visible, in some points only the new is visible, and at some points juxtaposition of old and new occurs.

This relationship between the viewing location or 'vantage point' and the heritage view has striking similarities with the picturesque movement of 1700s which was mentioned earlier. Picturesque landscape designers such as Capability Brown and Uvedale Price used the projected perspective views as a compositional tool informing their landscape plans (Broglio, 2008). Key moments along a path were chosen as viewing points where one would dismount from their horse and view the intended perspective composition of the estate. In the contemporary projects described in this paper, instead of the spectator being the English 'leisured class' showing off their designed estates to colleagues during horseback 'pleasure rides' (Clark, 2004), the spectator is the general public. Instead of the composed view being an artificial composed rural landscape, the view is the protected heritage building and skyline within a dense gridded cityscape.

Other aspects of urban morphology

It should be noted that although the technique was useful in the demonstrative case studies, the envelope generation technique is limited in relation to considering other morphological aspects when designing buildings or urban design guidelines near heritage or significant buildings. In addition to important views and silhouettes, there can be many other aspects which can include visual and non-visual aspects (UNESCO, 2013). Function, materiality, formal articulation, colour and detailing might be considered important when assessing visual impact, particularly in cases where scope in the regulations allow for silhouette to be interrupted if a suitable 'architectural solution' can be demonstrated such as in the first case study (Keaney, 2008). However, a key advantage of the technique is the fact that the modelling all takes place within a 3D visualisation program which is capable of testing many other assessment criteria such as material or colour contrast, formal articulation and shadows at different times of day.

Further development

The technique and the case studies outlined in this paper suggest the potential usefulness of the method within the architecture and urban design disciplines. The effectiveness of the technique warrants further development to take it from a 'step by step' process requiring a highly skilled CAD operator, to a user-friendly design tool with a simple graphic user interface. The tool could potentially be developed as a software 'plug-in' for a variety of CAD programs such as Autodesk's 3dsMax™, Maya™, AutoCAD™ and Trimble's Sketchup™.

This research suggests the potential application of the technique on other sites within Melbourne and other cities internationally. As noted earlier, many cities throughout the world grapple with increasing urbanisation and urban densification, while seeking to protect existing heritage buildings and skylines. The technique may also be useful in the design of new cities which may have natural topographical heritage features that may need to be protected both environmentally and visually. New cites might also incorporate new civic urban gestures which can relate to placemaking strategies or ideas of social, environmental and cultural sustainability.

Acknowledgements

References

Alberti, L.B., Bartoli, C. & Tiraboschi, G. (1804) *Della pittura e della statua di Leonbatista Alberti* (Società tip. de'Classici italiani, Milano).
Bacon, E. N. (1967) *Design of cities* (Thames & Hudson, London).
Benevolo, L. (1995) *The European City* (Blackwell, Oxford UK & Cambridge USA).
Biology, I.O.E.A.E. (2012) *What's new in ArcGIS 3D Analyst 10*. Taiwan.

(http://ecology.lifescience.ntu.edu.tw/gis2012/20121108/ArcGIS10/What's%20new%20in%20ArcGIS%203D%20Analyst%2010.pdf) accessed 17 April 2013.

Bluestone, D. M. (1988) 'Detroit's City Beautiful and the Problem of Commerce', *The Journal of the Society of Architectural Historians*, 245-262.

Broglio, R. (2008) *Technologies of the Picturesque: British Art, Poetry, and Instruments, 1750-1830* (Associated University Presse, New Jersy, US).

Brown-May, A., Day, N. & Coney, C. (2005) *Federation Square* (Hardie Grant Books, Melbourne).

Burry, M. (2010) 'Models, Prototypes and Archetypes', in *Homo Faber: Modelling, Identity and the Post Digital* (Archadia Press, Sydney) 111-124.

Clark, G. (2004) *Rhetorical landscapes in America: Variations on a theme from Kenneth Burke* (University of South Carolina Press, USA).

Cultural, U.I.C.F.T.P. O.T.W. & Heritage, N. (1995) *Operational guidelines for the implementation of the world heritage convention* (UNESCO – Intergovernmental Committee for the Protection of the World Cultural and Natural Heritage).

Cuthbert, A. (2003) *Designing cities: critical readings in urban design* (Blackwell Publishers, Melbourne)

Dovey, K. (1992) 'Corporate towers and symbolic capital', *Environment and Planning B: Planning and Design* 19, 173-88.

Dovey, K. (2005) *Fluid city : transforming Melbourne's urban waterfront* (Routledge/ University of New South Wales Press, New York/Sydney, NSW).

DPCD (2009) Stonnington Planning Scheme – List of Amendments.

El-Ghul, A. F. & Ghanimeh, A. A. (2010) 'Humanization of Tall Buildings: Case Study of the City Centre of Melbourne in Australia', *Journal of Human Ecology* 30, 165-169.

Field, C. R., Gournay, I. & Somma, T. P. (2013) *Paris on the Potomac: the French influence on the architecture and art of Washington* (Ohio University Press, USA).

Ford, L. R. (1998) Midtowns, megastructures, and world cities, *Geographical Review* 88, 528-547.

Guney, C., Akdag Girginkaya, S., Cagdas, G. & Yavuz, S. (2012a) 'Caner Guney, Suzan Akdag Girginkaya, Gulen Cagdas, Sinem Yavuz'. *Landscape and Urban Planning* 105, 160-173.

Guney, C., Akdag Girginkaya, S., Cagdas, G. & Yavuz, S. (2012b)'. 'Tailoring a geomodel for analyzing an urban skyline', *Landscape and Urban Planning* 105, 160-173.

Keaney, J. A. K., A (2008) Stonnington Planning Scheme Amendment C58 – Forrest Hill Structure Plan – Panel Report.

Kim, Y.-H., Rana, S. & Wise, S. (2004) 'Exploring multiple viewshed analysis using terrain features and optimisation techniques', *Computers & Geosciences* 30, 1019-1032.

Kloos, M. A. W., K (2012) *Evaluation, nomination and management of UNESCO-World Heritage Sites* Department and Institute of Urban Design and Regional Planning (http://arch.rwth-aachen.de/cms/Architektur/Forschung/Forschungsprojekte/Cultural_Heritage/~sha/UNESCO_Welterbestaetten/lidx/1/) accessed 20 August 2013.

Lim, B. & Heath, T. (1994) 'What is a skyline: A quantitative approach', *Architectural Science Review* 37, 163-170.

Lunch, K. (1960) *The image of the city* (MIT Press, Massachussets).

MacMahon, B. (2001) *The architecture of East Australia : an architectural history in 432 individual presentations* (Edition A. Menges, Stuttgart).

MGS (2007) City of Stonnington – Chapel Street North Guidelines for Forrest Hill (DPCD, Melbourne, Australia).

Mitsogianni, V. (2000) Survey Response in How can we understand the decision to remove the Shard at Federation Square, *Architect Victoria*.

Newman, P. (2006) 'The environmental impact of cities', *Environment and Urbanization* 18, 275-295

Newman, P., Beatley, T. & Boyer, H. (2009) *Resilient cities: responding to peak oil and climate change*, (Island Press, Washingtong).

Newman, P. & Kenworthy, J. (1999) *Sustainability and cities: overcoming automobile dependence* (Island Press, Washington).

O'Hara, F. (1997) The cost of sprawl, (State of Maine, Executive Department, State Planning Office, USA).

Oktay, D. (2002) The quest for urban identity in the changing context of the city: Northern Cyprus. *Cities* 19, 261-271.

City of Port Phillip (2012). Review of DD03 and 4 Draft Report September 2012 (City of Port Phillip, Australia).

Shepard. (2010) Answering Real-World Questions, Using 3D volumetric analysis techniques in ArcGIS 10. *ArcUser* (http://www.esri.com/news/arcuser/1010/3danalysis.html) accessed 5 April 2013.

Council of Stonnington (2005) Forrest Hill Structure Plan.

Council of Stonnington (2009) Schedule 8 To The Design And Development Overlay DDO8 Forrest Hill Precinct.

Office of the Premier and Treasurer (2000) Government accepts recommendation to save St Paul's vista [press release].

UNESCO (2012) Vilnius – Lithuania Management of Visual Integrity of the Historic City Centre. *Historic Cities in Development: Keys for Understanding and Acting,* 39.

UNESCO (2013) International World Heritage Expert Meeting on Visual Integrity. Agra, India: World Heritage Expert

Meeting.

Major Cities Unit (2012) State of Australian Cities (Commonwealth of Australia, Canberra)

Vanhorn, J. E. & Mosurinjohn, N. A. (2010) Urban 3D GIS modeling of terrorism sniper hazards, *Social Science Computer Review* 28**,** 482-496.

Victoria, M. P. (2012a) Flinders Street Station Design Competition – Design Brief (Victorian State Government, Melbourne).

Victoria, M. P. (2012b) Flinders Street Station Design Competition – Statement of Key Objectives (Victorian State Government, Melbourne).

Victoria, M. P. (2012c) *Flinders Street Station Design Competition > News* (http://www.majorprojects.vic.gov.au/flinders-street-station-design-competition/news#news-417113) accessed 5 April 2013.

White, M. (2012) The "Subtracto-Sun" – Using 4D solar planning envelopes to maintain solar amenity whilst increasing population density, *City2020+ conference – Demographic and Climate Challenges in the City* (RWTH Aachen, Aachen, Germany).

Biographies

Laura Machado de Mello Bueno
Pontifícia Universidade Católica de Campinas, Brazil
Dr Laura Machado de Mello Bueno is an architect, planner and PhD at University of São Paulo, Professor in the Faculty of Architecture and Planning and at the Graduate Program in Urban Planning from PUC Campinas. She is leader of the Research Group Water in urban environment, and currently coordinates a collaborative research Climate Change and Urban Form in the metropolitan regions of Rio de Janeiro and Campinas.

Glenda Caldwell
Queensland University of Technology, Australia
Glenda Caldwell is a Lecturer in Architecture at the Queensland University of Technology. Her research interests focus on digital fabrication, architectural pedagogy, alternative research methods, and the creation of hybrid place. Her current PhD is titled *Fabricating Hybrid Place*. She has a Bachelor of Science (Architecture) from the University of Michigan, Ann Arbor, USA. Having commenced a Masters in Architecture at SCI-Arc in Los Angeles and completing the degree in Miami at the Florida International University. Glenda participated in the dLAB course at the Architecture Association, London in 2009 focusing on digital fabrication. Glenda teaches 4th year Architectural Design and Introduction to Visualisation II at QUT.

Glauco Cocozza
Federal University of Uberlândia, Brazil
Dr Glauco Cocozza is Adjunct Professor in Faculty of Architecture and Urbanism and Design, at the Federal University of Uberlândia, Minas Gerais, Brazil, with emphasis on urban design, landscape architecture, open spaces system and urban morphology. He holds a PhD. in Architecture and Urbanism from the University of São Paulo (2007), and Master in Urban Engineering from the Federal University of São Carlos (2002). He is currently developing two research projects which address historic squares in the constitution of the urban form of cities in Triangulo Mineiro and Alto Paranaiba region in Minas Gerais, Brazil, and the configuration of urban open spaces in the urban form of medium sized cities at the same region.

Stael de Alvarenga Pereira Costa
Federal University of Minas Gerais, Brazil
Dr Staël de Alvarenga Pereira Costa is an architect and urban planner. She graduated from the School of Architecture at UFMG in 1974, the completed by urban planning studies at UFMG in 1978. She holds a Master of Arts in Urban Design from the Oxford Brookes University (1980) and PhD in Urban Environmental Structures from the Faculty of Architecture and Urban Planning at the University of São Paulo (2004). She is an Associate Teacher at the Federal University of Minas Gerais, in the School of Architecture and in the Department of Urbanism. She is the current coordinator of the Landscape Laboratory of the Department of Urbanism, EAUFMG. She involved in the development of five research projects sponsored by national and a state funding's boards. Her research interests include Urban Design, Urban Morphology, Environment, Urban Landscape, Mining Towns, Revitalization, Heritage, Architecture and Urbanism and Landscape Interpretation.

Sumita Ghosh
University of Technology, Sydney, Australia
Dr Sumita Ghosh is an architect and urban planner with teaching, research and professional experience in Australia, New Zealand and India. Her research interests focus on sustainable settlement planning, urban morphologies and performance assessment. Her research interests also focus on understanding green infrastructure potential such as carbon benefits of trees and food efficient built environment design and planning in creating healthy communities in cities. She is the Course Director for Master of Planning course in the School of Built Environment at the University of Technology Sydney in Australia.

Kai Gu
University of Auckland, New Zealand
Dr Kai Gu is a Senior Lecturer from the School of Architecture and Planning at the University of Auckland.

Mirko Guaralda
Queensland University of Technology, Australia
Dr Mirko Guaralda is currently Lecturer in Architecture in the Creative Industries Faculty of QUT. Previously, he has worked at the Politecnico di Milano where he was involved in research in the areas of urban morphology, open space design and mobility facilities. He has varied experience, which includes private practice and public administration environments, both in Italy and Australia. He has been involved in a wide range of projects at different scales, from small dwellings and gardens, to new estate and urban strategic planning. Mirko's area of expertise includes Urban studies, History of architecture, Architectural design, Landscape architecture and Urban design.

Pedro Guedes
University of Queensland, Australia
Dr Pedro Guedes read Architecture and Fine Art at the University of Cambridge. In 1976 he co-founded Berman & Guedes Architects in London, working on private and public housing, industrial and commercial buildings. He moved to Pentagram Design in 1986, where he became Associate Partner in this multi-disciplinary international design firm. His recent design practice has focused on curating and designing exhibitions with an interest reaching wider audiences. Pedro was Unit Master at the Architectural Association and Course Leader in Architecture at the Royal College of Art. He emigrated to Australia in 1995 and is currently a Senior Lecturer in architecture at the University of Queensland, where he completed his doctorate focusing on the entry of iron into the building industry. His current research addresses Colonial Architecture before the Twentieth Century, where a wide range of approaches were developed in the formation of settlements, public space, monumental and domestic buildings.

Tony Hall
Griffith University, Queensland
Tony Hall is Adjunct Professor with the Urban Research Program at Griffith University.

Jiawen Han
University of New South Wales, Australia
Jiawen Han is a PhD candidate in the Faculty of Built Environment, University of New South Wales, Sydney. Her research addresses the possible ideological tensions in the formation of contemporary architecture and urban morphology. She studied architecture in China, Japan and Australia. Her research interests include modern architecture and urban issues in China and Japan, and women in architecture. She writes independently on urban culture and modern architecture for several magazines.

Solmaz Hosseinioon
University of Melbourne, Australia
Solmaz Hosseinioon is an urban designer and researcher, currently a PhD candidate in the University of Melbourne. She has two masters – in urban design and architecture – from Shahid Beheshti University, Iran. She has worked in private and public offices and organisations in the fields of architecture, urban design and disaster mitigation, specifically earthquake risk reduction via urban design. Presently, she is working on the effects of formalisation of informal settlements in Tehran, Iran as an urban design study for her PhD research. She has published in research and professional journals as well as conferences, and has translated books to Persian. She has taught in Azad University in Tehran and is now involved with the University of Melbourne. She is interested in urban design and multidisciplinary approaches for delivering quality of built environment, sustainable design and resilience.

Po Ju Huang
National Taipei University, Taiwan
Poju Huang is PhD Student at the Graduate Institute of Urban Planning in National Taipei University. Huang graduated from Department of Architecture in Feng Chia University, Taiwan. He has participated in several international activities and conference including IXth International Landscape Urbanism workshop, OSA – Research Group of Urbanity and Architecture, Katholieke Universiteit Leuven, 2012 ISUF Conference, and the EAAC 2012 International Conference on East Asian Architectural Culture.

Shu-Li Huang
National Taipei University, Taiwan
Shu-Li Huang is a PhD candidate at National Taipei University in Taiwan. She completed double Master degrees of Architecture and Interior Design at the College of Design, Chung Yuan Christian University. In 2011, she participated in the European Module in Spatial Development Planning program at the Katholieke Universiteit Leuven, Belgium. Her research interests include history, theory and urban design, with special interest in the preservation of urban settlments from the postcolonial perspective.

Toshiyuki Kaneda
Nagoya Institute of Technology, Japan

Hisako Koura
Osaka University, Japan
Hisako Koura is Associate Professor at Osaka University.

Aleksandra Krstikj
Osaka University, Japan
Aleksandra Krstikj graduated from the University Ss. Cyril & Methodius in the Republic of Macedonia, with a major in Architecture. She obtained a Master of Engineering in March 2011 from Kyoto Institute of Technology, Department of Architecture. From April 2011, she was enrolled in the PhD course at the Graduate School of Engineering in Osaka University. Her field of study is urban design.

Chaolee Kuo
National Taipei University, Taiwan
Chaolee Kuo is Associate Professor at the National Taipei University, Taiwan and president of the Taiwan Institute of Architectural Modernity. Kuo graduated from Yale University, USA and continued his PhD studies at Katholieke Universiteit Te Leuven in Belgium. He was the Chairman of the Department of Architecture at Chung Yuan University from 1994-97, head of Graduate Institute of Urban Planning at National Taipei University from 2008-11. He was also curator of Taiwan Pavilion for the 11th International Architecture Exhibition – La Biennale di Venezia in 2008.

Harry Margalit
University of New South Wales, Australia

Maria Manoela Gimmler Netto
Federal University of Minas Gerais, Brazil
Maria Manoela Gimmler Netto is a Master of Science candidate in the Built Environment and Sustainable Heritage course at the Federal University of Minas Gerais, School of Architecture. Currently she is a researcher member of the Landscape Laboratory at the School of Architecture, UFMG. Between 2008 and 2009, she worked as an architect with Vale in Rio de Janeiro. She graduated from Architecture and Urbanism studies at the School of Architecture, UFMG in 2006.

Rim Meziani
Abu Dhabi University, Abu Dhabi, UAE

Kouhei Okamoto
Nagoya University, Japan

Gabrielle Astier de Villatte Wheatley Okretic
Pontifícia Universidade Católica de Campinas, São Paulo, Brazil
Gabrielle Astier de Villatte Wheatley Okretic is an architect and urban planner from the Catholic University of Campinas. She is currently working in the masters program in Urban Planning at the Catholic University of Campinas, researching housing in risk areas. She has been with the Outreach Program of the State University of Campinas, working with ecological construction in rural settlements.

Akira Ota
Tokyu Land Corporation Ltd, Nagoya, Japan

Paul Sanders
Queensland University of Technology, Brisbane
Professor Paul Sanders is the Head of the School of Design at QUT. He has been an academic for 12 years and practicing architect for 20 years. He has been published in international journals in the fields of architecture and urban design, and completed a Master of Architecture by research in 2003. Paul's current research is in the field of urban morphology. He has extensive design experience through built work, as well as international design competitions. His areas of expertise include Architectural design, Architectural technology, Urban morphology and Regional modernism.

Jaqueline Duarte Santos
Federal University of Minas Gerais, Brazil
Jaqueline Duarte Santos MSc. gained her Master of Science through the Constructed Environment and Sustainable Heritage Mastership in the beginning of 2013, at the Federal University of Minas Gerais, School of Architecture. During the mastership, she worked at the Landscape Laboratory at the UFMG School of Architecture. Between 2008 and 2009, she was collaborating architect at A&M, an architecture office in Belo Horizonte In the same year, she achieved the title of Specialist in the course of Architectonic and Urban Revitalization of the Federal University of Minas Gerais, School of Architecture. She graduated in architecture and urbanism from the University of Brasília, Brazil, in 2007.

Leigh Shutter
Griffith University, Australia
Associate Professor Leigh Shutter's architectural and academic work has focused on integrated scholarship: an ongoing and active participation in both innovative research oriented practice and teaching. He graduated from the University of Adelaide in 1981 and is a registered architect. He has worked in and directed architectural consultancies in Australia and internationally for over 25 years. He is the founding principal of the Brisbane based architectural practice Planet Design Collaborative and Director of Griffith SEED lab. He has a Master of Science (Architecture) degree from Columbia University and has held academic positions in Australia and overseas. Prior to joining Griffith, Leigh was a Senior Lecturer in the School of Design at Queensland University of Technology. He plays an active role in the Australian Institute of Architects and in national education affairs. He is currently Chair of the ANZ APAP (Australia and New Zealand Architecture Program Accreditation Procedure) Steering Committee.

Todor Stojanovski
KTH, Royal Institute of Technology, Sweden
Todor Stojanovski graduated in architecture in Macedonia and holds a Master of Science in built environment from KTH, Royal Institute of Technology, Stockholm, Sweden. He is currently a PhD candidate at Transport Science at KTH, Royal Institute of Technology where he researches BRT (bus rapid transit), TOD (transit-oriented development) and linkages between cities and mobility, urban form and public transport. His professional interests include cities, public transports and transport planning, architecture, urban design and planning, urban morphology, environment, sustainability and futures.

Sílvia Tavares
Lincoln University, New Zealand
Sílvia Tavares is a doctoral student in Landscape Architecture at Lincoln University in Christchurch, New Zealand, and tutor (PhD Teacher Fellow) at the same institution. She holds a master's degree of Building Habitability from the Urban Research Program from Federal University of Rio Grande do Sul (2007), and graduate degree in Architecture and Urbanism at the Federal University of Pelotas (2003).

Enqi Wang
Southeast University, China
Enqi Wang is studying at the College of Architecture in Southeast University, China as a PhD Candidate. His research focuses on the formal interpretation of contemporary cities and related design strategies. Also, as an urban designer, he has practiced urban design and architectural design for six years in the Urban Architecture Lab, an open professional design studio. His major works include projects such as Urban Design for Puko New Urban District of Nanjing in 2010, Urban Design for the Northern New Urban District of Nanchong in 2011, Urban Design for Wanling Lake Area of Xuancheng in 2012.

Xin Wang
Southeast University, China

Marcus White
University of Melbourne, Australia
Dr Marcus White is an award winning architect and urban designer, co-director of Harrison and White Pty Ltd and Lecturer at the University of Melbourne. He has been awarded the RAIA Haddon Travelling Scholarship, the Victorian and National AIA Emerging Architect Award for his contribution to practice, teaching and research, an AIA residential architecture award and was recently awarded the Graham Treloar Fellowship. His design research has been widely published and exhibited throughout Australia, North America, Asia and Europe.