Back to Future. Morpho-typological approach and environmental performance of urban fabrics

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Abstract. Human settlements grew up over time due to the action of many generations, taking shape according to the local geo-climatic characteristics and resources. This article discusses the co-evolutionary, largely unintentional and complex quality of the built environment, envisaged by studies on its morphogenesis since the mid-20th Century, in its relationship to the studies on the energetic performance of building fabrics, based on an urban morphological approach. The research-and-action proposal for the adaptive reuse of a historic residential neighbourhood in China, described here, endeavours to provide fine-tuned and 'tailor-made' improvements, making the most of the existing quality of the built environment while meeting present-day needs and expectations of the inhabitants.

Keywords: Adaptive Reuse; Morpho-typology; Historical urban fabric; Environmental performance.

Introduction

Human settlements grew up in layers over time, due to the action of many generations, taking shape according to the geo-climatic peculiarities of places and to local resources. This co-evolutionary nature of the built environment, noticed a long time ago by scholars, such as Geddes and Mumford, pairs with the notion that the built environment itself is mostly made up by ordinary buildings. One cannot understand the structure of cities without exploring the urban common fabric, the back streets, their pattern and the way they change in time (Habraken, 1998). Evolutionary overtones – often recur in the works of Saverio Muratori in Italy and M. R. G. Conzen in the UK (Muratori, 1959; Maretto, 1960; Muratori et Al., 1963; Conzen, 2004), who recognised the role of time in shaping the built environment, and identified the permanent morphological elements as long-lasting traces of complex cultural systems. Urban morphology represents the physical grounding of populations, as the process of urban growth reveals a civilization's progress. Local cultures operate over time, shaping the environment by uses, dimensions, materials and forms, which endure or change – that is: evolve – according to their capability to meet the challenges posed by the succession of historical events. Thus, permanence represents an evolutionary condition of fitness, and morphological endurance represents diachronic fitness of urban fabrics.

The morpho-typological aspects of traditional architecture as a response to environmental forces represented the core of Victor Olgyay's seminal bio-climatic studies (Olgyay, 1963). Giving full account of the huge variety of buildings in different regional traditions, Olgyay demonstrated how all main typological variations find a reason in the environmental site-specific situation, and can be seen as «building expressions of true regional character», harmonising their place and shape to the constraints posed by local climate and topography.

Further development of this line of research, which takes into account the whole urban morphology rather than single buildings (Martin and Steadman, 1971; Martin and March, 1972; Bottero *et al.*, 1984; Alvarez *et al.*, 1991; Weber and Yannas, 2014; Franco, 2015; Morganti, 2018; Scudo, 2018) brought about a deeper knowledge of the relationship between energy and the built environment. Both the solar radiation that buildings receive and their energy needs depend upon the set of geometric and dimensional characteristics of the local urban form: the road network and orientation, the plots, the blocks and the intermixed open spaces all combine to determine the energetic behaviour of buildings. Such behaviour should be analysed within the system of urban morphology to be fully understood (Morganti, 2018). Accordingly, persistent urban settlements layered over time within the mould of local geo-climatic characters provide significant clues about their 'environmental fitness' and promote meaningful strategies for adaptation and sustainable reuse. This consideration gives a further, fresh perspective to morphological studies, which have recently been proposed as a planning framework to promote guidelines and to support self-maintenance by inhabitants, towards sustainable reuse and urban regeneration of historical neighbourhoods in South-East China (Xie, 2018, 2019).

Time, the great Master Builder

The idea of the built environment as a «palimpsest, an accumulated, if partly erased and rewritten, record of human history in a place» (Conzen, 2004), implies that the reality of the urban structure grows during time, through a succession of reactions and processes that develop from previous stages. Muratori's *operante storia urbana* revealed the logic of morphogenesis as a result of culture layering material form over time, within the mould of the local physical environment. In his own words, urban morphology expresses a continuity of development, and a vital and unifying exchange with the environment.

Such an evolutionary idea of the built environment resounds in the work of Gianfranco Caniggia (Caniggia and Maffei, 1979; Caniggia, 1981). Typological analysis discloses «formation and transformation processes of anthropic structures», revealing how the built environment is spontaneously structured, slowly becoming «unitary, homogeneous and organic» due to the «self-correction mechanisms that derive from being produced by a community operating in time and space». This process produces a «spontaneous planning» and guarantees the best performance of the individual contributions, thus «structuring the environment»[1].

It has been noted (Samuels, 2005) that since the 1970s, when morphological studies all over Europe introduced the physical aspects of urban fabrics into the realm of planning and later in urban design, the main focus has not been «concern with the aesthetics of buildings», but rather with «the deeper and more enduring elements of the townscape»[2].

In the early 1960s, Christopher Alexander (Alexander, 1964; Alexander, 1966) argued that *form* represents the solution of a complex problem posed by a context, as «an irregular world tries to

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DOI: 10.13128/techne-10683

compensate for its own irregularities by fitting itself to them»[3]. Following D'Arcy Thompson, who defined form as the diagram of forces for the irregularities of the world, arguing that Nature provides its phenomena «with the just right form» (D'Arcy Thompson, 1917), Alexander claimed that enduring urban morphologies represent the "good fit" for the ensemble consisting of a given human settlement plus its physical and social context over a long time.
Thus, Time appears as the great Master builder (Fontana, 2019) to which human settlements owe their most durable, fittest configuration within a given environment.

Regionalism and global thinking: morpho-typological approach and energetic performance of the built environment

In the middle of the debate on Post-modern architecture, Kenneth Frampton wrote a celebrated essay (Frampton, 1983) advocating "critical regionalism" and claiming that architecture should focus more on the local elements that shape the built environment, such as topography, climate, light, and on the qualities appealing to senses other than sight, which determine delight and comfort. It is worth noticing that this essay, groundbreaking as it was labelled, was published twenty years after Victor Olgyay's seminal book *Design with Climate - Bioclimatic approach to architectural regionalism* (Olgyay, 1963), that focused on the assumption that the «ancients recognized that regional adaptation was an essential principle of architecture». In Olgyay's work, the term "region" relates to the solar altitude angle, and the regional characters of buildings are defined in terms of heat conservation, thermal demand, orientation, natural lighting and ventilation[4]. Olgyay famously explained how basic building forms, in traditional architecture, answer to the needs of comfort and protection against the local environmental difficulties; yet there is no prosaic determinism in this approach. His research took into account cultural and symbolic factors, and his idea of regionalism in architecture encompasses enduring knowledge and wisdom, quite far away from shallow questions of style, vernacular compliance or commonplace functionalism. However, in those days, his ideas did not make their way to the forefront of the architectural mainstream cultural debate, as was the case with the Cambridge group (Martin and Steadman, 1971; Martin and March, 1972), which investigated the flows of energy and matter according to urban morphology. The research focus here was on the interaction between clustered buildings and their neighbouring open spaces, as well as the thermal performance of the built environment as a whole. This approach provided inspiration to studies about energy and the built heritage for many years to come (Franco, 2015)[5] but, once again, the theme remained in the outskirts of the architectural debate, apparently restricted to the realm of "technical issues".
Built surfaces represent both morpho-typological features and the main interface for radiation exchanges. Building characteristics and elements, such as size, shape, geometry, material, colour, windows, balconies and roofing, define the architectural character as much as the environmental behaviour of the urban fabric. They determine heat transmission, shading, and the flow of wind and rain, making each building interact with those nearby[6].
There should be no doubt that the ability to shape the built environment in order to achieve thermostable conditions, that – in Olgyay's words - has been the main goal of generations of anonymous builders for centuries, rightfully belongs to the architectural culture[7].

A transcultural proposal for chinese endangered historical neighbourhoods

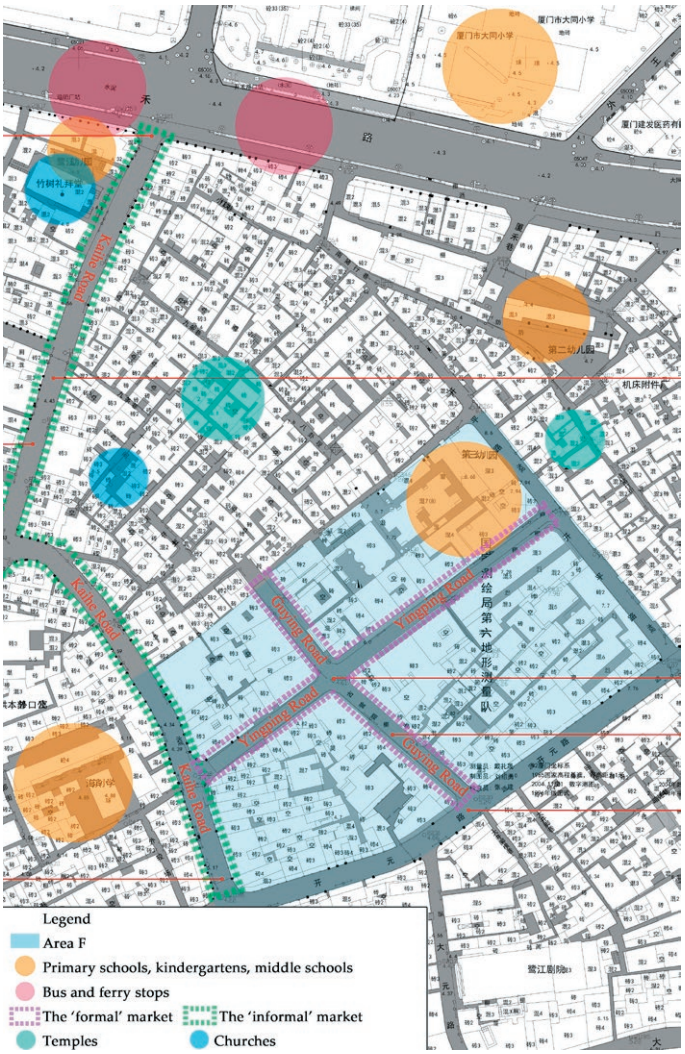
Chinese philosophical and religious traditions do not provide strong support to the physical conservation of the built heritage[8], focusing more on immaterial elements, such as the spiritual and symbolic meaning of particular buildings and places, rather than on preserving physical objects (Xie *et al.*, 2020).
This approach has greatly changed in recent times (Xie, 2018; Xie *et al.*, 2020). Intellectual and government awareness about conservation gradually developed during the 20th century. After the foundation of People's Republic of China in 1949, the legislation for the protection of monumental buildings was reinforced, and the conservation system gradually extended from antiques and single monuments to historical built complexes and sites. Urban policies, on the other hand, generally promoted renovation of the old cities, with the main goal of meeting new needs and of providing a brand new, socialist image of cities, in opposition to the old feudal one.
After the economic reforms of 1978, communication between China and the Western world increased, and the domestic tension between development and conservation intensified, causing significant contradictions in the approach to urban heritage. On the one hand, the attention to historical heritage preservation grew, and legislation and policies striving for the international principles of physical protection of the built heritage were gradually introduced[9], making urban conservation more practicable[10]. On the other hand, a thriving real estate market developed, as well as a growing flow of foreign tourism. Urban development projects were driven by the socialist market-oriented economy, while the old urban fabrics were often altered by new inhabitants[11], leading to heritage loss (Buiard and Xi, 2007) and widespread gentrification (Abramson, 2001). Ironically enough, destruction and gentrification were often induced by "conservation projects", which substituted the original urban fabrics with new, pseudo-historical buildings, thus turning large parts of old cities into 'theme parks' for tourists.
In the case of Yingping, the research question is how to preserve the historical fabric and heritage value, while improving living

01 | In Area A (North), older buildings and poorer inhabitants and activities are concentrated in a dense and intricate urban pattern. Area F (South) has a more regular pattern, dating back to the 19th century; it hosts two very popular seafood markets: the "formal" covered market, and the "informal" one, where the local shopkeepers occupy the street with makeshift extensions to display their goods, by S. Xie

02 | The "formal market", by S. Xie

03 | The "informal market", by S. Xie

01 |



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conditions and, at the same time, resisting gentrification. Many aspects of this question entail, first of all, economic and social issues, which need a specific political stance and consistent policies. On the other hand, planning and urban design aspects were addressed with an approach derived from the Italian morpho-typological studies and experience (Xie, 2018 and 2019), supporting both the local planning action and the self-maintenance capability of inhabitants towards sustainable regeneration.

The historic neighbourhood of Yingping dates back to the Ming Dynasty (1368-1644). It is located in the city centre of Xiamen Island, Fujian Province in southeast China, beside the Taiwan Strait. At 24° 28' N, it has a subtropical climate, with hot and humid summers and short, dry winters, with a mean minimum temperature of 12°C and typhoons in late Summer and early Autumn. Yinping covers about 25.42 ha, and had 22,027 inhabitants at the 2010 census, with a density of 866 persons/ha, mainly living in poor, low rise dwellings. Its main function is residential, with lively commercial activities distributed along a few main streets. Between the main streets lies a network of narrow and winding streets and alleys, and the urban fabric is dense and stratified, due to the complex topography, traditional customs, and long-term spatial practices (Xie, 2019). There is still a strong sense of community among the population, and outdoor spaces maintain their traditional significance for social life (Figs. 2-3).

In 2006, a municipal regeneration plan, aiming to replace most of the ancient fabric with a mixed commercial, financial, and tourist district, was suspended due to widespread criticism. In 2013, a group from the School of Architecture of Huaqiao University in Xiamen was invited by the local administration to complete a physical survey of the whole neighbourhood, and to provide a new proposal

04 | Arcade buildings (Qilou), with shops at ground level, dwellings at the upper floors, and layered additions for ancillary space, by S. Xie

05 | A typical courtyard house (Dacuo), by S. Xie

06 | The Old Theatre Cultural Park after renovation, by S. Xie

for regeneration (School of Architecture of Huaqiao University, 2013). Intensive survey activity and field work with the inhabitants provided deeper knowledge of the densely stratified urban fabric, and of the complex and intertwined layers of activities that give it life. Six typical areas were identified, according to geographical, physical and sociological characteristics (Fig. 1). In 2015, a pilot project provided the restoration of the Lujiang Theatre and the creation of a new high quality public space: the Old Theatre Cultural Park (Fig. 6). In the same year, general guidelines for controlling and managing private additions and renovations were proposed. As a result, the government of the Siming District provided financial contributions to local property owners for self-maintenance and self-renovation actions, such as the reconstruction of façades and interiors. Most of the interventions (involving 51 owners until March 2016) included commercial functions, such as coffee bars, galleries and small restaurants (Fig. 4). This improved the local economy of the neighbourhood, as well as its touristic appeal, since the renovation also involved its six listed monumental buildings. Nevertheless, the housing situation remained largely critical. Yingping is popular and vibrant not only because of its heritage, its busy commercial

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centre and shops, but also because of its good accessibility and low rent housing stock, which attracts low income tenants. These inhabitants make an essential contribution to the colourful street life, which is so appealing to visitors; at the same time, they cannot afford to take care of the existing buildings, which are mostly in poor conditions. This means that they rather sub-divide spaces and add service units, makeshift storages and awnings in inner courtyards and even in public open areas (Fig. 5). Therefore, their participation in any regeneration project is paramount, and the proposal entails the development of suitable criteria and guidelines to support self-maintenance interventions by local inhabitants.

The comprehensive, morpho-typological approach proposed aims to evaluate the actual environmental quality of the existing fabric and its "aptitude" to meet the present-day expectations of the inhabitants, and to provide fine-tuned and "tailor-made" improvements, promoting adaptive reuse and conservation rather than radical

modification or reconstruction. Morphology-led planning practices[12] identify, within the urban fabric, the recognisable parts that have survived countless events to the point of representing a significant urban landscape. At the same time, they investigate the daily spatial practices of dwellers and different city users, revealing the multi-layered nature of urban structures, their specific dynamics and their mutual interaction. Regarding the methods of intervention, a morpho-typological approach[13] reveals the material and technological consistence of buildings, their strong and weak points, together with their aggregation rules, thus clarifying their actual capability to afford new uses and to satisfy new needs.

Conclusions

Under the effect of the changing needs of their inhabitants, built environments adapt, expressing at the same time both change and persistence. Paying closer attention to the interplay between the built environment and the daily spatial practices of human communities that change it while allowing permanence, recalls the idea of "affordance-based transformation"[14]. This idea takes into account both the users' present and perspective needs and desires and the opportunities offered by the built environment in its evolutionary condition. This approach could also help clarify the meaning of "adaptive reuse". Furthermore, the morpho-typological analysis of urban fabrics that developed long before technical heating and cooling systems became of common use, provides valuable knowledge of the environmental wisdom and the skilful strategies perfected by generations of builders in order to achieve the best site-specific "well-tempered environment".

These assumptions can be traced to the maintenance-oriented planning framework proposed for the regeneration of Yingping. Its morpho-typological approach provides strong foundations to incremental, fine-tuned and 'tailor-made' improvements, while enhancing the qualities that urban fabrics have acquired over time.

NOTES

[1] G. Caniggia, G.L. Maffei (1979), p. 30.

[2] I. Samuels (2005), p. 138.

[3] C. Alexander (1964).

[4] The notion of Critical Regionalism had been introduced a few years earlier into the realm of proper architectural critique by Alexander Tzonis and Liane Lefaivre, in "The Grid and the Pathway", 1981. The Authors promoted a vision of architecture focused on regional topography, climate, and culture.

[5] An excellent overview, together with important advancements, is provided by G. Franco, 2015. Liguria seems to be a hotbed for this kind of studies. An early example is in B. Merello, L. Zuaro, 1982, where the analysis of the energy system in the built environment entailed the correlations between local urban morphology of a small hamlet in the hinterland of Genoa.

[6] See M. Morganti, 2018. The Author further investigates the property of density in urban fabrics, which allows "to measure and express in quantitative, objective factors both the morphological and the typological-constructive components, so that they can be related to energy behaviour".

[7] Kenneth Frampton himself, from a strictly critical point of view, noted that the environmental issue should be seen as a cultural, rather than technical issue, and complained that architectural culture did not seem prepared to fully embrace it as such. See: Cairns, 2012.

[8] A comprehensive overview of the Chinese heritage and urban conservation culture and policy is in: Xie, 2018, and Xie *et al.*, 2020.

[9] In 1982 the Cultural Relics Preservation Act was published. In 1985, China joined the UNESCO's Convention Concerning the Protection of the World Cultural and Natural Heritage and became a member of ICOMOS.

[10] The Historical and Cultural Conservation Areas was published in 1986, addressing both historic buildings and cities. This principle was incorporated into China's urban conservation system in 1996, and in 2008 the concept of Historic and Cultural Quarters was proposed. The Principles for the Conservation of Heritage Sites in China, issued in 2002 and revised in 2015, adopted contemporary Western conservation ideas - in particular, the concept of authenticity.

[11] In 1965, private urban real estate property was nationalised, and large houses and establishments were rented out by the local municipalities to low income tenants. The new inhabitants often fragmented the original, large spaces, adapting them to their own needs.

[12] Main references were the plans of Urbino (De Carlo, 1966) and Caltagirone (Leone *et al.*, 1988), and the structural plan of Antwerp (Viganò and Secchi, 2009).

[13] The main reference for this aspect was the Plan of Schio (Mancuso, 1990).

[14] The reference is to Gibson, 1979, and Maier *et al.*, 2009.

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