The Footprint of Tight: Hinterlands, Landscape and Dense Cities

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The Supertight refers to the small, intense, robust and hyper-condensed spaces that emerge as a by-product of extreme levels of urban density.

These ideas were explored through a site specific architectural installation and curated exhibition that was held in Melbourne in 2019 and drew on contributions from practitioners throughout Asia to explore the role of design in negotiating and expressing density in urban environments. The project explored the term 'Tight' as a positive and more nuanced approached to thinking about urban density.

If the Supertight is focused on cities, its consequence is equally on the landscapes that support cities. While we as architects focus on the object of density, the centre of cities – their organisation, occupation and formal characteristics, we often overlook the vast hinterland that supports dense urban cores. Cities such as Singapore and Hong Kong, which were explored heavily through the exhibition and are in many ways models of the physical and social management of extreme density, are equally exemplars of cities that rely heavily on supply chains that stretch well beyond their borders.

This paper will build upon discussions emerging from the Supertight exhibition and will critically reflect upon and document the relationship between dense urban cores and the broader networks that support their existence. While urban density and compact cities are generally understood to be more sustainable than sprawl, to what extent does the close settlement of cities result in an expansion of terrain and resources to support them? Do dense cities require more to enable their existence, and how does behaviour and patterns of consumption impact that potential for density to be sustainable?

The paper will explore how productive landscapes that support dense cities be absorbed within dense urban cores, and what would need to shift to enable this.

This paper will explore the concept of the 'tight' city as a by-product of urban density. It will examine the relationship of urban density to the broader collection of landscapes that support the planet's cities and begin to posit possibilities for the folding of the hinterlands outside density into the core of cities.

We live in a period of unprecedented urbanisation. For the first time, more than half the world live in cities. The fastest growing urban type is the mega city, defined as a city of greater than ten million. By 2050 the earth is projected to have more than 50 mega cities, the majority of which will be in Asia. The world's densest cities, almost all of which are Asian have been consolidated through the absorption of massive population growth over the last fifty years. As this trend accelerates, the design of dense environments, and understanding its consequences will become increasingly important for architecture and creative practices.

The term 'Super Tight' refers to small, intense, robust and hyper-condensed spaces that emerge from extreme levels of urban density. Tightness is a consequence of density but it is more than density. Tightness captures social, economic and cultural practices that have developed in cities as a response to their rapid growth and consolidation. To be tight is to be small and perhaps constrained, but also to be open to the economies and social intimacies of being close.

These ideas were explored through an exhibition that was held in Melbourne in 2019 and which drew on contributions from design practitioners throughout Asia. These works explored the role of design in negotiating and expressing density in urban environments. The project explored the term 'Tight' as a positive and more nuanced approach to thinking about urban density. Tightness is the reconciliation with and adaptation to social behaviours for hyper dense environments. It is best exemplified in fast changing Asian cities, the by-product of unprecedented metropolitan convergence which demonstrate new urbanisms, new architectures, and new models for living and making culture.

That exhibition included a series of video and still image projections contributed by architects, designers and artists working in cities throughout Asia. These projections accompanied large scale drawings set in Tokyo by Taishin Shiozaki

Figure 1. Supertight Exhibition RMIT Design Hub 2019. Tobias Titz

Laboratory (Tokyo Tech), and a site specific installation that explored particular fragments of cities at full scale. These installations, a fragment of the iconic hẻm laneways of Ho Chi Minh City, as well as a transposition of one of Tokyo's ubiquitous tiny yokocho bars, were recast as live gallery event spaces in which presentations, workshops, discussion and debate took place and were recorded as a form of design research.

While the exhibition was primarily focused on the tight city object and its occupation, a key discussion that took place during the exhibition forums, centred around a video contributed to the exhibition by Dr Alban Mannisi, Associate Professor Charles Anderson and Dr Yazid Ninsalam from RMIT University's Landscape Architecture programs. The film entitled Hokkien Mee Diplomacy (2019) documented the relationship between the dense urban environments of Singapore, and the market gardens of Johor, located across the Johor Strait in Malaysia. This work and its accompanying research offered a useful counterpoint to the exhibition through its insight into a vast peri-urban hinterland that exists on the Malaysian peninsula and which supports the extreme population density of Singapore, and its residents affluent lifestyle. This work and its discussions confronted the knowledge that considerations of urban density cannot be separated from considerations of the landscapes that support it and which are largely hidden from those cities.

This paper is couched as a response to and expansion of this hinterland proposition, exploring the broader regional and planetary impact of urban density. If the Supertight is focused on the space inside cities, its consequence is equally on the landscapes outside cities that support them. While we as architects focus on the dense centre of cities, and their organisation, occupation or formal characteristics, we often overlook the vast peripheral hinterland that supports dense urban cores. Cities such as Singapore and Hong Kong, which are a focus of the Supertight exhibition are in many ways models of the physical and social management of extreme density. They are equally exemplars of cities that rely heavily on supply chains that stretch well beyond their borders.

Dense and compact cities are generally agreed to be more environmentally sustainable than sprawled settlements. There is a correlation between increased levels of urban density, close proximity of employment and urban amenities, and a reduction in the overall carbon footprint of city. This logic is simple as smaller, and more consolidated building footprints suggest fewer resources are required to build and service a

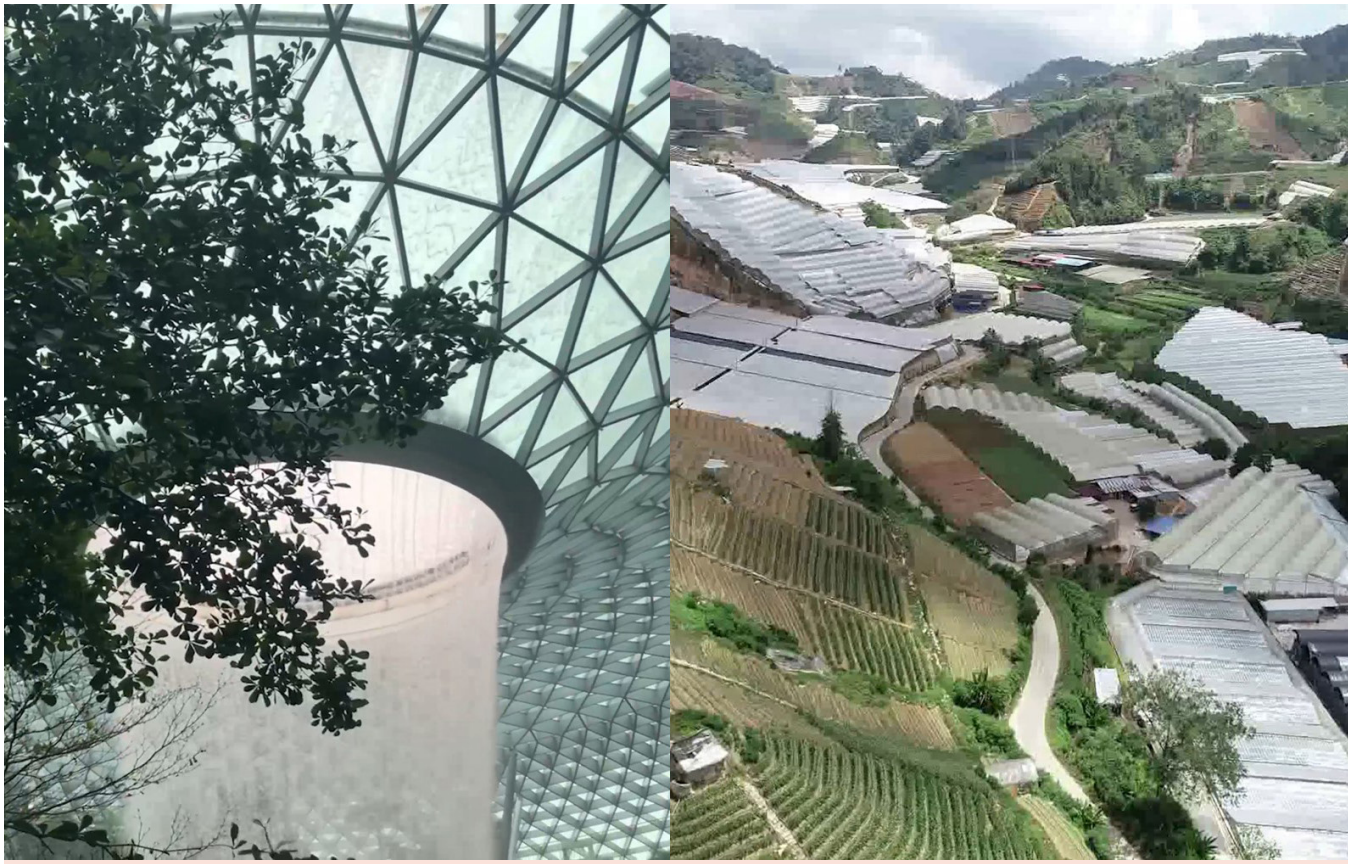


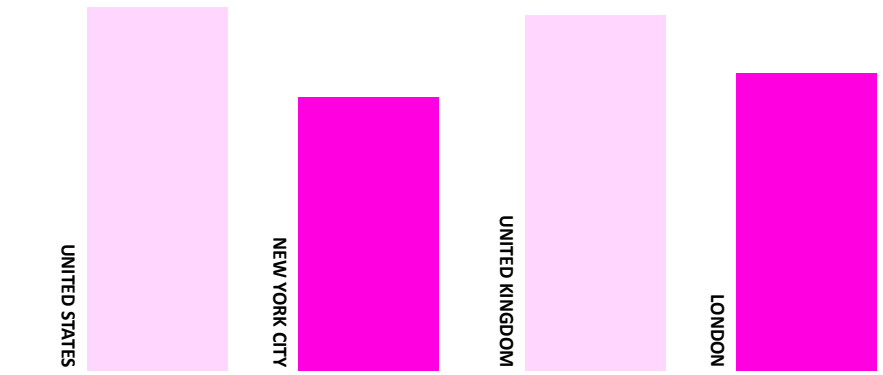
Figure 2. Still frame from Hokkien Mee Diplomacy. Alban Mannisi, Charles Anderson & Yazid Ninsalam.

city on a per capita basis. Likewise a smaller urban footprint increases the efficiency and viability of both mass rapid transport systems and urban walkability.[1]

A similar outcome is observed when one reviews the overall ecological footprint of dense cities. Ecological footprint, measured as 'global hectares'; land area required to support total urban consumption,[2] provides comparisons. Per capita, dense cities perform better than the overall countries that support them. For example, New York City has an annual consumption of 6.1 global hectares (gha) per person,[3] the national average for the United States being 8.1 gha.[4] This is not universal but common, particularly in developed countries. Tightened cities have a measurable benefit to the environmental costs of human settlement.

These measures are on a per capita basis. As cities increase in population and scale, so does the ecological footprint, or land area required to support their consumption. Scale and population density leads to efficiencies relative to that population, however in very large cities the vast hinterland and supply chain that supports them is exaggerated. This is particularly relevant in the discussion of the super dense or tight city. Measuring gross areas, dense cities tend to have a disproportionately large ecological footprint relative to the actual physical footprint of the urban core that generates it. For example, Melbourne is the densest city in Australia, but sparse by global standards (508.175/km2) [5]. With an ecological footprint of 6.8 gha the land that is required to support it is approximately 344,196 km2.[6] New York City has a comparable footprint per capita, but with a larger population requires a larger area to support it of approximately 510,222 km2. This is self-evident, however the consolidated population affects the proportion of hinterland area to the city limits. Melbourne requires approximately 38 times its urban footprint to support itself. New York by contrast, consumes 1441 times its own footprint.

This is again, a self evident effect of population density for a given consumption level, but it does re-focus the discussion. Urban density is mostly maintained by displacing production, particularly food production, elsewhere. The increase in population density is not matched proportionally by an efficiency of hinterland footprint, and perhaps exaggerates the effect of an invisible footprint to a dense city. It also poses the question, for a less dense metropolis like Melbourne, whether that productive hinterland can absorbed within its physical boundary.



National vs City Ecological Footprint

Geographical Footprint vs Ecological Footprint

Figure 3. Ecological and geographic footprint comparisons. Data sourced from Global Footprint Network.

The phenomenon of a footprint shadow is particularly exaggerated in city states that do not have the productive capacity to support themselves. In an era of global trade it is accepted that a large percentage of the materials and energy that support cities will be sourced abroad, however in the case of Hong Kong and Singapore as examples, virtually the entire productive landscape that supports them has been displaced to other places around the world.

The ecological footprint of Singapore is 5.9 gha per capita, however it has a biocapacity of approximately 0.04 gha per person.[7] Virtually all the energy and resources consumed in the city is imported. A parasitic relationship is particularly evident across the border where much of the state of Johor and the south eastern Malaysian peninsula has been been relied upon by Singapore to provide resources for its growth. This has changed in recent years with a decline in agricultural productivity and with inflationary pressures in Malaysia, particularly fresh food and perishable goods; yet it remains critical:

> 'As late as 2013, observers were still considering Singapore a "captive market" for Malaysian chicken eggs, with over 94 per cent of fresh eggs found in Singapore's wet markets, supermarkets and restaurants coming mostly from Johor (the proportion has since come down, mostly due to a resurgence of local production in Singapore, but still remained above 75 per cent in 2016).' [8]

The production-consumption compact between Singapore and offshore neighbours is in some ways an accident of history and politics - an international border separates a dense urban core from the adjacent landscape hinterland that supports it, however the need to import becomes far more problematic when basic resources are imported from long distances.

Hong Kong has a similar productive capacity deficit to Singapore, with even less productive land (0.03 gha).[9] Hong Kong can rely on mainland China for many of its resources, particularly power and water. Yet, despite increasing integration between the two systems there is persistent issue of food security in the city. Hong Kong imports more than 90% of the food that is consumed in that city.[10] About a third of this comes relatively locally from mainland China, however the remainder comes from overseas and further away. The USA and European Union account for another third, with food travelling more than 11,000km and 8,000 km. There is a substantial environmental cost associated with the sourcing of food and resources from the other side of the world, global shipping being one of the major transport sector contributors to greenhouse gases. It is arguable that the dislocation of a city from its productive hinterland cultivates an 'out of sight out of mind' mentality to patterns of consumption in which once pushed outside of jurisdictional control and immediate social experience it becomes just as reasonable to source beans from Brazil as from an immediate neighbour.

The social behaviours and expectations of individuals in their consumption plays a major role in the environment footprint of cities, and the degree to which high urban density could be effective in mitigating climate change. There is a clear correlation between affluent developed nations and larger ecological footprints, regardless of density. For example, New York and Ho Chi Minh city are both the largest cities of their respective countries and major commercial centres. New York (10,716.36/km2)[11] is approximately twice as dense as Ho Chi Minh City (4,400/km2).[12] Despite this the ecological footprint of New York is more than 3.5 times that of Ho Chi Minh City.[13] The gains afforded by tighter urban environments in the form of smaller buildings, public transport etc are offset by what Michele Gelfand has described as 'loose' cultural frameworks [14] and associated patterns of consumption. That is, the individual freedoms prioritised in a `loose' culture may mitigate against the dense built fabric of an affluent city. Tightness as we described in the Supertight exhibition seeks to link the built environments and the behavioural patterns of urban life.

Tightness is a cultural and social practice where the answer to a question of urban footprint must always less rather than more. This logic cannot however mean less urban footprint physically; it must extend to the cultivation of a culture tight consumption in which dense settlement is coupled with contiguous production frameworks and a tightening of the resources required to sustain then. To cultivate a culture of tight consumption a city must be closely coupled to its productive hinterland. Further to this, a tight city might be one in which the productive hinterland that supports it is folded into the same space as the city itself.

The technical limitations to these questions are closely bound to the history of modernity. During the 19th and 20th centuries cities invested vast resources and efforts in infrastructural projects which moved the productive networks of cities beyond their boundaries. Water supply, waste removal and power generation were distributed from hinterlands to the centre of cities. This process as a marker of urban development remains incomplete for a substantial percentage of the world's urban population without running water, sewage or power . There are however trends towards the devolution of infrastructure to decentralised models where power and water are captured locally. In Australia, for example, more than 21% of homes (2.46 million) have a rooftop solar array, producing around 5.2% (or 11.7 TWh) of Australia's total energy production.[15] Similar distributed solutions have been implemented for storm water harvesting and waste management. As these measures unfold and accelerate they will impact the relationship of cities to their hinterland. These are largely technical solutions which may however reframe the understanding of a city and its footprint.

Figure 4. Making Vietnam Wall Court infill manufacturing. Graham Crist, Gretchen Wilkins & Ton Vu.

In order to fold cities and their productive landscapes into one another, it is necessary to radically reconsider the planning regimes that underpin them. In particular, it is necessary to reconsider the concept of single use or Euclidean planning approaches which strongly separate productive land from the intensity of consumption. Historically the separation of urban functions, in particular populations from manufacturing, have been underpinned by the logic of public health. The logic of the healthy garden city providing clean air and water, had parallel motivations for segregating urban functions; the reconsideration of this logic and the transformation of technologies and standards for manufacturing that allow for the cleaner production of goods, materials and food (industry 4.0) has allowed for a reconsideration of this separation.

Globally there are trends toward the reintegration of manufacturing as a component of high density urban cores. The Vertical Urban Factory project led by Nina Rappaport has documented examples of high-density urban manufacturing facilities and precincts, and argued for the vitality and importance of urban manufacturing as both a driver of environmental and social sustainability. In Vienna, a project operating from TU Wien has developed a series of prototypical models for urban manufacturing that serve as a catalyst for the creation of integrated work-live and mixed use neighbourhoods. 'Mixing residential and working areas contributes significantly to energy-efficient urban development and the achievement of ambitious smart city goals and a lively urban fabric. Paradoxically, the necessity for integrated production-consumption cities has been heighted by the ongoing COVID-19 pandemic. The privileges for those who can work locally and source their goods locally over those reliant on commutes and long supply chains has amplified inequalities, at times tragically.In the following section we will unpack in detail two projects that explore how the return of making and production to already dense urban centres, could contribute to the tightening of those cities in an integrated sense.

'Making Vietnam' was an urban research and speculative design project carried out through RMIT University School of Architecture and Urban Design in 2015. The project involved an examination of Vietnamese cities, in particular Ho Chi Minh City, with a focus on historical and contemporary manufacturing cultures. Over the past thirty years there has been a dramatic change in the form of Vietnamese urban manufacturing, which has coincided with the arrival of international capital and the development of global manufacturing centres in designated economic zones. Since 1990 the density of Ho Chi Minh city has halved as it follows western development patterns. The project set out to consider how the return of manufacturing to

the centre of Vietnamese cities with an accompanying re-tightening of its urban fabric. Towards this end the project sought to integrate factory manufacturing with dense urban fabric, both in use patterns and urban form. It examines for example, techniques for integrating big box urban objects with the fine grain lived fabric of Vietnamese cities.

These cities have a strong culture of intricate density, and also of small scale workshop manufacturing. Vietnam's economic growth has seen huge scale factories built for export industries, divorced from the urban fabric, and separated even from the domestic economy. This has had implications for both the city and its peripheral hinterland. Straightforward models were tested which hybridise these two situations; the informal or semi-rural buildings which skirt a factory shed; or the urban market where a labyrinth is contained under a big roof. These are examples that can be catalogued as urban models toward tightening the periphery and hinterland.

Making Vietnam identified three urban types which commonly exist; the residential apartment tube; the industrial shed and the informal shack. These were designed into three urban models. One: the Wall Court (Tube housing being a device to shield private space from adjacent industry) Two: The Big Roof (The open shed accommodating and unifying diverse functions and inserted into dense fabric) Three: Street Teeth (Small scale buildings buffering industry from the street and stitching streets to the factory). These models were applied and tested in the Ho Chi Minh sites of District 5 and Binh Dang District as prototypes for tightening the industry/ city relationship and the metropolis/hinterland connection.

A project concurrent with Making Vietnam, FarmHD was carried out through the RMIT University School of Architecture and Urban Design. The project ran from 2016-2018, and explored the relationship between dense cities, the food supply chains that support them, and design led strategies for the reintegration of food production in the world's densest urban environments.

The project focused on Hong Kong as an urban case study of extreme density and significant food security challenges. The project developed a series of speculative design proposals that sought to capitalise on latent opportunities within the city's urban fabric to enable future high density urban farming economies.

One of the proposals explored the potential for repurposing multilevel carparking structures within the city. Despite extremely efficient and heavily used mass transport systems and a largely walkable footprint, metropolitan Hong Kong has over 700,000 car spaces.[16] As autonomous vehicles become a reality, it is very likely that car parking as we know it today will become redundant. Most car parking structures are not designed for human occupation, and few are easily adaptable for habitable program such as apartments or office space. At the same time, demolishing and rebuilding these buildings would require a colossal waste of carbon, both in existing and future embodied energy costs. High intensity factory food growing under lights uses less water, no pesticides and is up to 20 times more efficient than conventional agriculture. Because the system requires no daylight it is perfect to take advantage of the deep plan of unused carparks. Through the Farm HD project a model of adaptive reuse was developed that took advantage of existing concrete structures, repurposed to pack together a hyper dense structure of growing bed modules.

Testing this model on a carpark in Kowloon, we found that eight storeys of car parking on site could accommodate 16,775 Growing Modules producing 11,850 kg of leafy greens per day, which is the daily vegetable intake of around 38,000 people. This is the equivalent to around 695,000sqm of land using conventional farming techniques. If we extrapolated this to every car space in Hong Kong it would be possible to produce more than 10,000 tonnes of vegetables a day, enough to feed up to 35 million people. This would have the effect of reversing Hong Kong's bio-capacity deficit. More importantly it would place the means for controlling the food production for the city, and the ecological cost of its density within the jurisdiction of the city itself.

Cities and their infrastructures are responsible for more than two thirds of global carbon emissions. While many of mechanisms to mitigate climate change are beyond the domain of architecture and urban design, the tightening of our cities is one of the greatest contribution we can make. It is not enough to simply build dense urban cores as places to live and work. We must look to a future in which cities integrate all the elements of their production-consumption cycle within a tight urban culture.

Figure 5. FarmHD: Franklin Street Farming Tower. John Doyle & Laura Martires.

ENDNOTES

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