行政院國家科學委員會專題研究計畫 期末報告

都市規劃與設計工具於生態都市之住商混合使用與商業區規劃的功能

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中 華 民 國 102 年 10 月 30 日

中文摘要：於新都市主義與追求永續發展的趨勢中，傳統的土地混合使用於北美分離式土地使用、與原有具有混合土地使用特色的國家與都市中，重新受到重視、檢討、或甚至推行。住商混合使用，具有對住戶的高度商業可及性、對商業的高客戶可及性的優勢，因此形成永續的交通環境。然而，住商混合於有限空間存在的造成居住品質的衝擊，同時住商空間於建築物設計可能的需求不同，也可能造成對零售商業的負面影響。針對住商相容性問題，過去研究多針對商業種類、強度進行研究；然而，理論與實務界面，鮮少有由都市設計與規劃提供開發商或建築師建築與規劃之參考依據。因此，本研究的主要目的有三，一、彙整可能影響土地混合使用的都市計畫與設計之工具；二、土地混合使用住宅居住品質與零售商業經營的面向與指標分析；三、分析都市計畫與設計工具對住商混合之住宅品質與商業經營指標之影響。本研究以住商混合衝擊最大的垂直式混合使用為研究主體，以台北市捷運車站之住三實例進行情境建立與模擬。研究成果發現，低樓層（商業使用）較大的建蔽率、高樓層（住宅）較小建蔽率（或底面積）所形成垂直式退縮建築為較佳的建物型態，其提供地面層連續的、最大面積的友善商業空間；又於高層的住宅使用，其與鄰棟間的大距離可保有較高的隱私性；同時其可綠化空間、通風、採光、及地面與天空綜合視野皆較佳；除此，適當的建蔽率亦可提供綠化的人行步道。

中文關鍵詞：永續、混合使用、都市計畫、都市設計

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residences and commercials from the perspective of types and quantity of commercials. However, little literature, nevertheless, has been conducted on evaluating the impacts of various urban planning or design tools in improving the space-related physical environment for both residents and retail businesses. In order to fill in the research gaps above, the objectives of the paper are three fold: (1) to develop an inventory of the urban planning and design tools that could be applied by planners to impact on the physical environment of mixed-use communities; (2) to compile a list of indexes corresponding to the quality of space-related physical environment for both residents and retail businesses; and (3) to examine the impacts of these tools on the physical environment indexes, respectively and jointly. The research found the stair-shaped buildings surpassed others in many regards, such as more natural environment, more privacy for residents, more space for retail stores on the ground, and greenery for pedestrians.

英文關鍵詞： Sustainability, Mixed Use, Urban Planning, Urban Design

行政院國家科學委員會補助專題研究計畫 □期中進度報告 ■期末報告

都市規劃與設計工具於生態都市之住商混合使用與商業區規劃的功能

計畫類別：■個別型計畫　□整合型計畫
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計畫主持人：蔡育新
共同主持人：無
計畫參與人員：白可欣、張懿萱

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中　華　民　國 102 年 10 月 30 日

Abstract

In the wake of new urbanism, regressing to traditional mixed land use communities has been widely promoted since it has the potential benefit in achieving environmentally sustainable development. Mixed use may increase the residents' usage of transit, walking and biking due to residents' accessibility to a variety of stores on the one hand, and may be also retail-business friendly due to higher accessibility to potential customers. On the contrary, commercial and residences mixed-use may lower residents' livability resulting in residents' residential preference to live in mixed-use area. From the business perspective, the coexistence of both residents and consumers, there could also be upsides, such as closer to consumers and downsides, such as different space requirement. Plenty research has put efforts in resolving conflicts between residences and commercials from the perspective of types and quantity of commercials. However, little literature, nevertheless, has been conducted on evaluating the impacts of various urban planning or design tools in improving the space-related physical environment for both residents and retail businesses. In order to fill in the research gaps above, the objectives of the paper are three fold: (1) to develop an inventory of the urban planning and design tools that could be applied by planners to impact on the physical environment of mixed-use communities; (2) to compile a list of indexes corresponding to the quality of space-related physical environment for both residents and retail businesses; and (3) to examine the impacts of these tools on the physical environment indexes, respectively and jointly. The research found the stair-shaped buildings surpassed others in many regards, such as more natural environment, more privacy for residents, more space for retail stores on the ground, and greenery for pedestrians.

Key words: Sustainability, Mixed Use, Urban Planning, Urban Design

摘要

於新都市主義與追求永續發展的趨勢中，傳統的土地混合使用於北美分離式土地使用、與原有具有混合土地使用特色的國家與都市中，重新受到重視、檢討、或甚至推行。住商混合使用，具有對住戶的高度商業可及性、對商業的高客戶可及性的優勢，因此形成永續的交通環境。然而，住商混合於有限空間存在的造成居住品質的衝擊，同時住商空間於建築物設計可能的需求不同，也可能造成對零售商業的負面影響。針對住商相容性問題，過去研究多針對商業種類、強度進行研究；然而，理論與實務界面，鮮少有由都市設計與規劃提供開發商或建築師建築與規劃之參考依據。因此，本研究的主要目的有三，一、彙整可能影響土地混合使用的都市計畫與設計之工具；二、土地混合使用住宅居住品質與零售商業經營的面向與指標分析；三、分析都市計畫與設計工具對住商混合之住宅品質與商業經營指標之影響。本研究以住商混合衝擊最大的垂直式混合使用為研究主體，以台北市捷運車站之住三實例進行情境建立與模擬。研究成果發現，低樓層（商業使用）較大的建蔽率、高樓層（住宅）較小建蔽率（或底面積）所形成垂直式退縮建築為較佳的建物型態，其提供地面層連續的、最大面積的友善商業空間；又於高層的住宅使用，其與鄰棟間的大距離可保有較高的隱私性；同時其可綠化空間、通風、採光、及地面與天空綜合視野皆較佳；除此，適當的建蔽率亦可提供綠化的人行步道。

關鍵字：永續、混合使用、都市計畫、都市設計

In the wake of new urbanism, regressing to traditional mixed land use communities has been widely promoted since it is potential benefit in achieving environmentally sustainable development. In the cities pursuing sustainable development, i.e., sustainable city or eco-city, mixed use policy, along with density, may increase the residents' possibility in encouraging usage of transit, walking and biking due to residents' accessibility to a variety of stores, particularly retail-business. Mixed use may be also retail-business friendly due to higher accessibility to potential customers. In sum, mixed use may mutually benefit retails' and residents' accessibility to customers and daily commercial needs.

However, mixed-use may also lower the livability in such as physical aspect as crowd and traffic, amenities, light, noise, and downgraded residents privacy, so as to possibly decrease the residents' preference to live in mixed-use area. The more commonly applied tools in urban planning to resolve some but possibly not all of the above livability quality includes restricting types of commercials, quality of commercials, and possibly some designs from architecture perspective, for example, the separation of entrances to lower floor stores and higher-levels residents. Nonetheless, lack of theoretical understanding spatial tools that cant affect livability in mixed-use, and the guidelines for urban planners, designers, and architects in planning or designing mixed use communities put the promotion of mixed use on the and stake and possibly causing long term unsolved problems due to the endurably characteristic of modern, tall buildings.

From the business perspective, the coexistence of both residents and consumers, there could also be upsides and downsides. For example, the spatial design in order to incubate stores could be different from residences. For example, the former could be seeking for large coverage on the ground level to provide continuous and efficient shopping settings for economic sustainable settings, while the later may seek for lower coverage rate to provide more privacy between neighboring residents.

Little literature, nevertheless, has been conducted on evaluating the impacts of various urban planning or design tools in improving the space-related physical environment for both residents and retail businesses. The space-related physical environment is intended to address the issues caused by the relative spatial relationship between downstairs business and upstairs residents. Other space-centered are not the focus of this paper, such as the types of commercials permitted.

In order to fill in the research gaps above, the objectives of the paper are three fold: (1) to develop an inventory of the urban planning and design tools that could be applied by planners to impact on the physical environment of mixed-use communities; (2) to compile a list of indexes corresponding to the quality of space-related physical environment for both residents and retail businesses; and (3) to examine the impacts of these tools on the physical environment indexes, respectively and jointly.

1. Literature Review

This section demonstrates current knowledge on the definition, indexes of urban planning tools, physical livability in dense built environment, and their relationship, as well as mixed land use.

1.1 Density, Urban Planning/Design Tools, and Physical Livability

Increased residential density brings more building mass into a neighborhood, which is likely to influence livability and may hinder residents' willingness to live in such urban settings. In a wide sense, livability refers to the quality of the

residential environment with regard to meeting residents' daily needs (Leby & Hashim, 2010). The aspects employed include physical aspects (e.g., openness or perceived density, lighting, and noisiness), social aspects (e.g., social contact, community life, and sense of place), functional aspects (e.g., infrastructure and transportation), safety aspects, and economic vitality aspects (Balsas, 2004; Leby & Hashim, 2010). The high density policy is likely to depreciate physical livability in terms of lighting (Martin & March, 1973; Weiss, 1992; Putra & Yang, 2005; Yang et al., 2007a, 2007b), wind environment, urban heat island effect, and amenities such as higher perceived density, visibility (Putra & Yang, 2005; Yang et al., 2007a, 2007b), and privacy. Some of these physical livability aspects are related to biological conditions and environmental sustainability; others concern unattractiveness due to a reduction in amenities. Hence, physical livability is of fundamental concern in promoting higher-density policy.

The impact of high density on the physical livability may depend on the spatial arrangement of building mass; in other words, the impact may vary for different alternatives controlled by urban planning/design. In principal, the large-scale spatial arrangement of building mass can be directed by urban planning/design, such as location and height of buildings; on the contrary the detailed parts of buildings are generally designed by architects. Conceptually, the arrangement of buildings or space in a neighborhood resembles internal design in terms of the location, height, or shape of furniture. In general, given the same overall volume of furniture, different shapes and spatial arrangements of furniture affect the lighting, perceived openness and density, and so on differently.

1.2 Use of Urban Planning/Design Tools for Improving Physical Livability

Past research and planning/design guidelines or ordinances and practical cases in Taiwan, New York City, and Vancouver from Google Maps provide a range of tools that can arrange building mass or outdoor spaces at the neighborhood level. At the city level, the density distribution plan and open space plan, such as parks, principally determines the large-scale space or building mass arrangement. At the intermediate level, the tools encompass block size, shape, and orientation as well as street width and network layout. At the block level, the spatial arrangement of building mass is generally controlled by a series of planning/design tools, including building shape, floor–area ratio (FAR), BCR, height–distance ratio (HDR), side yard width, back yard width, and SB (Taipei City Government, 2011a; Brook McIlroy Planning + Urban Design, 2006).

The corresponding functions of the block-level tools vary in arranging outdoor space or building mass. FAR determines how much mass or outdoor space is available within a three-dimensional spatial unit, which essentially regulates building or population density. Given the same FAR, BCR foundationally decides the extent to which open space is reserved on the ground level for such purposes as spatial openness, planting, and drainage. HDR is originally applied to insure daylight exposure at the ground level. The stair-shaped SB (SSB) can work as HDR does, but can also provide more space between buildings along the street (Table 1). Moving-back SB generally functions to leave space along the street as sidewalk or open space, but may suffer from less space at the back (Table 1). Side yard width (SW) and back yard depth (BD) can insure a minimum distance between adjoining buildings at the side and back, respectively, for the purpose of lighting or prevention of fire. Building shapes such as tower, slab, enclosed courtyard, and cross work to leave outdoor space in the specific location.

1.3 Aspects and Indexes of Physical Livability

This section reviews the aspects of physical livability and their corresponding indexes concerning fundamental biological conditions and amenities of high-density residential areas. Five major aspects are elaborated when residents walk in the neighborhood or stay in the residence: pedestrian-friendly environment, spatial openness, daylight exposure, wind environment, and residential privacy. These aspects can be affected by the outdoor space arrangement and then perceived by residents, and therefore they affect the residents' choice of location. However, the physical environment is generally very likely to be perceived subjectively by residents. For example, some may prefer enclosed environments, but others prefer openness.

1.3.1 Pedestrian-Friendly Environment

The pedestrian-friendly environment or walkability has gained increasing significance in promoting environmental sustainability, social equality and interaction, economic vitality, health, and so on (Lo, 2009). The aspects of walkability can be classified into the quantity and quality of the pedestrian's rights of way; the latter involve accessibility, safety, security, amenities, and diversity of pedestrians and activities, among others. These aspects can be affected by the availability of sidewalks, design of the sidewalk network, characteristics of sidewalk segments (e.g., width, planter strips, shades, and street furniture), number of intersections with roads, land use along the sidewalk (density and diversity), design of buildings along the sidewalk (e.g., front yard design), and a buffer on the sidewalk or streets to remove traffic (Ramirez, et al., 2006). For this research, which is focused on the impacts of space-based planning/design tools on pedestrian-friendly environment, the primary associated aspects may involve availability of sidewalk and green sidewalk, depending on the width of the sidewalk.

1.3.2 Daylight Exposure

Sunlight can be impeded by building mass in two ways: building height (Martin & March, 1973) and lack of permeability between buildings (Fisher-Gewirtzman et al., 2005), which limits the sky view. Conventionally, HDR, representing the angle of obstruction of sunshine, is adopted as an indicator to quantify daylight exposure and also as a planning tool to retain a minimum level of sunlight. A drawback of HDR as a daylight exposure indicator is that it only measures daylight exposure that is affected by buildings across the street. The sky view factor (SVF), defined as the ratio of sky observed to total sky hemisphere from a vantage point, takes into account the blocking of sunlight from all directions (Ratti & Richens, 1999). A more delicate indicator is the gauging of solar radiation (insolation) with the assistance of an ArcGIS extension, which calculates direct and diffuse radiation from the winter solstice to the summer solstice for a point location or whole area (ESRI, 2007).

1.3.3 Spatial Openness

Spatial openness differs from actual building density (e.g., gross plot ratio/GPR); it characterizes the space bounded by buildings in urban settings that is potentially correlated with perceived density, visibility, amenities, fresh air, and daylight exposure (Yang et al., 2007a, 2007b). To be more specific, it can be defined as visual openness from a vantage

point in terms of visual width, distance (one-dimensional perspective), viewshed and sky view (two-dimensional perspective), or visual volume (three-dimensional perspective), which is regarded as the best index since it quantifies the entire space bounded by buildings (Fisher-Gewirtzman & Wagner, 2003; Yang et al., 2007a). The two-dimensional indexes encompass viewshed and isovists (Benedikt, 1979), measuring spatial openness on the ground, as well as SVF (Ratti & Richens, 1999) and Sky Opening (Teller, 2003), measuring spatial openness in the sky. The three-dimensional indexes measure visual volume, including the Volume of Sight Index (VoS) (Yang et al. 2007a), which can be standardized by dividing it by the hypothetical volume of a hemisphere and then results in Spatial Openness Index (SOI) (Fisher-Gewirtzman, &Wagner, 2003; Fisher-Gewirtzman et al, 2005), and Viewsphere Index (VSI) (Yang et al. 2007a). With spatial openness as an input to eyesight, directional visibility analysis taking into account eyesight capacity can be conducted to determine the perceived density (Yang et al., 2007a).

1.3.4 Residential Privacy

Residential privacy is essential in high-density built environments, and concerns how private life is protected from being viewed, observed, or heard by neighbors. However, little research has shed light in this regard. In general, the closer the neighbors and the greater their number, the lower the privacy. Hence it can be measured by such variables as distance to the buildings in front (Conway & Adams, 1977; Yuen et al., 2006), at the back, or at the sides, and number of residences or neighbors, primarily those on the same floor or height.

1.3.5 Wind Environment

In urban areas, wind speed and direction can be affected by building mass, layout, height, and alignment. Most of the past research has addressed discomfort issues caused by gusts and strong winds (ASCE, 1999; Ng, 2009). Recently, in contrast, much research has addressed weak winds in densely populated cities, considering public health issues such as airborne contagious diseases and the urban heat island (UHI) effect (Oke, 1982; Wong et al., 2010).

Four principal measures have been applied to gauge wind speed in urban settings: field surveys, wind tunnel modeling (Mfula, 2005), numerical models including computational fluid dynamics (CFD) modeling (Blocken, 2007), and morphometric method or urban-form-based indexes. For the former three methods, the wind velocity ratio, defined as the ratio of wind velocity at a certain height above the roof tops to that on the ground level, is applied (Ng, 2009). These three methods, however, have not been adopted by planners for reasons such as the need for instruments, lack of a controlled environment, and the fact that the technology is demanding and costly (Wong et al., 2010).

The morphometric method is more likely to be applied by planners due to its relative ease of use and data availability, including indexes measuring the degree of surface roughness in urban settings (Lettau, 1969; Grimmond & Oke, 1999), which affects ground wind velocity. The frontal area index, defined as the ratio of building facets facing the particular wind direction to the plane area, is mostly used to gauge the district-based area average (Grimmond and Oke, 1999; Wong et al., 2010; Chao et al., 2010). The ground coverage ratio (GCR), which is defined as the ratio of total built area to total area and is highly positively correlated with the frontal area ratio, is proposed as a proxy to measure the pedestrian-level wind environment due to its simplicity (Ng et al., 2011). However, GCR is not able to measure wind permeability at micro-level (Ng et al., 2011), such as building level. Theoretically, viewshed could be used as a proxy

since it can quantify the degree to which built environment is close to a plane without buildings to allow wind to travel along to the test point.

1.4 Review of Impacts of Urban Planning/Design Tools on Physical Livability

The re-arrangement or relocation of building mass as a result of variation of planning tools can affect the physical environment differently: on the one hand, the "efficiency" of each of the planning tools varies. For example, in a high-density neighborhood where spatial openness is of concern, which planning tool can most efficiently improve it seems unclear. On the other hand, different planning tools are likely to affect various aspects of the physical environment differently. What complicates the overall impact of all aspects is the potential trade-offs among aspects. For instance, with the same FAR, a lower BCR can increase the distance between buildings and hence result in more privacy; on the contrary, building height that increases as a result of a lower BCR may reduce sky view and daylight exposure. One piece of the limited research shows that an enclosed-courtyard building shape (i.e., higher BCR and lower height) conveys less spatial openness than a pavilion building shape (i.e., lower BCR and higher height) (Yang et al., 2005).

1.5 Mixed Land use

Mixture of land use in a metropolitan area is a nature, and accessibility level is contributed by density and mixed use policies. In a metropolitan area, self-sustaining to a large degree, diverse land uses coexist within the boundary; within a metropolitan area, each and every type of land use provides acceptable accessibility to users in terms of travel time or distance, and quantities. In other words, for being self-sustained purposes, certain types and enough quantity of land uses are required, and the spatial arrangement of diverse land uses by such policy as overall spatial allocation of land uses, mixed use and density provide certain levels of accessibility.

Narrowing down to the accessibility of residential areas (households or resident to other uses, it can further be broken down by type of other uses or activities, the degree of compatible/incompatible, good or harm they cause, mostly a blend of both, and the degree of direct needs, and frequency at which households need to physically go to the land use sites to conduct activities. From perspective of type of other uses or activities, accessibility ranges from one single land use (e.g., park accessibility, and rapid transit accessibility), to multiple land uses (e.g., work accessibility, which occurs in diverse land uses). It can also be classified by degree of compatibility/incompatibility, which can be defined by the degree of negative impact that they cause to residential areas. Furthermore, It can as well be classified by the degree of good and harm as a whole that a land use bring to the house, e.g., Not-In-My-Backyard (NIMBY), and Yes-In-My-Backyard (YIMBY). In addition, some land uses are of direct need for residents (such as commercial areas

for shopping), but some are of indirect needs (such as garbage dumping site). Some are of frequent needs (such as shopping), but some are of less frequent needs (such as city hall). Accessibility may not a neutral term; it may mostly implies to some land use in need.

2. Research Methods

This research first conducts an in-depth literature review on the urban planning/design tools that may be adopted by planners, as opposed to by designers; to be more specific, this paper will focus on the tools that the general planners can apply since these tools work in a more "engineering" mechanism rather than the "free-hand design/planning" mechanism that is the expertise of designers or architects. In this sense, these tools can be applied more universally by planners.

Secondly, the physical aspects of built environment quality affected that various stakeholders of the mixed-use, retails stores, or offices areas will be analyzed through literature review. For examples, the stakeholders of mixed-use communities are composed of residents, pedestrians, including consumers, businessmen, plants, and possibly animals. The stakeholders may share some common physical aspects of significance, such as day light exposure, wind environment. On the contrary, each of the stakeholders may require unique physical aspect of environment quality, which might even conflict against one another, such as. Additionally, the coexistence of residential and commercials in one building has incompatibility issue per se. Some of the physical aspects of the stakeholders are compiled and described above in the literature review.

Finally, to assess the efficiency of planning/design tools for achieving ecological mixed-use, retail stores, and offices areas, simulation analyses will conducted in the hypothetical high-density urban settings. The simulation analyses are adopted rather than empirical study for two reasons: in practical cases, planning/design tools affecting the built environment are intermingled, and hence hard to identify and measure, and all possible required variations of various planning/design tools can be systematically specified in the hypothetical neighborhood. The hypothetical neighborhood hence provides a test bed with a controlled built environment, which allows variations in one single tool for most cases so that scenarios can be developed. All the scenarios are developed with the same density—for instance, the highest residential FAR of 300% (i.e., residential type IV in Taipei city, allowing high degree of mixed use; Taipei City Government, 2011a) and uniform building shapes and road systems, among others. The software packages applied are Google SketchUp, AutoCAD, ArcGIS, and Excel. The details of the simulation analysis are elaborated below to demonstrate how the simulation analyses will be conducted.

2.1 Mixed-Use Residential Community

A high-density vertical-mixed-use residential community is developed based on two primary guidelines: On the one hand, it is the most common mixed-use community in Taipei, Taiwan. Second, it is located within four hundred meters from a rapid rail transit station since it is where transit oriented development (TOD) community are designated, if it happens. A community is selected in Taipei city on the north-west corner from Shong-Jiang station.

3. Impacts of Urban Planning/Design Tools on Space-related Mixed Use Communities

3.1 Pedestrian-Friendly Environment

Among the series of archetypal building shapes, the tower shape provides the most accessible pedestrian environment through providing sidewalk surrounding the buildings where sidewalk it generally not available. If slab building shape chosen, the building coverage shape has better to stay lower than 60% to provide good accessibility. Additionally, the stair-shape building does not affect accessibility.

If the quality of pedestrian is raised from availability of sidewalk to green sidewalk, the width of sidewalk needs to be widened to increase. For this purpose, building coverage is suggested to be no larger than 55%, while if the building shape is slab, then BCR can be increased to 60%-65% due to the shape of the block shape for the demonstrate case. The finding in this regard also applies to the traffic buffer environment.

The third aspect of pedestrian-friendly environment-visibility both horizontally and vertically- goes along the low BCR. This aspect seems to have been overlooked or misunderstood, reflected in the high building coverage rate. The reason for being overlook might because traditionally, the density was relatively low in the past that visibility is not so important an issue. In addition, since the buildings are relatively short that vertical visibility is not as significant either. For the buildings with the same footprint, the stair shape generally has better vertical visibility into the sky.

Store accessibility to pedestrians with shopping trip purpose is positively associated with building coverage rate; the higher the BCR, the more available retail store space for shopping. The building coverage rate on the ground level hence plays a crucial role in providing commercial environment for the shoppers. To go further into the continuity of commercial space, on the one hand, the larger the BCR, the more continuing the stores since the space between buildings are smaller. On the other hand, slab building provides long cascade for stores to have more continuous shopping environment along the road or shopping routes.

3.2 livability for Residents

Greened built environment has become a central factor in today's sustainable, livable communities, which however has not equally weighted in many old communities decorated by stones, bricks, or concrete. For example, sidewalk in many cities, particularly in central cities, are simply space provided for walking purpose with no vegetation, demonstrated in pale, cold atmosphere. In mixed-use communities, greenery is also highly weighted in this study. The general, reasonable finding is that the lower the building coverage rate, the higher the rate of space for planting. Furthermore, if the techniques for planting on the roof to preventing water leakage issues are expected to gain progress in the near future, the stair-shape buildings is more green environment friendly since more green environment is nurtured at the roofs of lower part of buildings, which can benefit more pedestrians since they can be seen and can purify the air pollution from ground traffic and for residents living in the floor above by providing air-garden other than

the ground garden, which not only improve their off-window view down the ground but also possible green garden in mixed used environment with commercial environment.

The lower the BCR, the more the open space on the ground for growing plants; and once the green space reach the certain, normally the minimal size of a community park for the city, the accessibility to park is increased from the perspective of calculation. In this regard, tower shape performs best, followed by slab in providing equivalent of (small-sized) community park.

The quality of visibility from residence, composed of mid-building view from both front and back windows/balcony, is the best for slab since it provide more space between buildings in the front and at the back, where the windows and balconies normally designed to locate. This attribute also affects level of privacy from neighboring buildings. However, the BCR does not play a significant role since building with lower BCR block more skyview than buildings with higher BCR

3.3 Commerce friendly environment for retail stores

The first index considered as a commerce friendly environment for retail stores in the city is the space available for setting outdoor table for consumers to sit and drink or eat. The minimum of four meters is required to accommodate coffee or dinner tables, which is, predictably, higher associated with building coverage and building shapes. When the BCR of tower-shape buildings is lower than 50%, most of the sidewalk can be wider than the four-meter threshold, which is a higher, i.e., 55%, for the slab.

The continuity of shopping environment is attractive to consumers and hence import for stores as a whole. Slab is the best shape among all building types given others equal such as building coverage rate.

Building coverage rate on the ground level fundamentally affect the space to accommodate sale needs. Seemly the higher the BCR is, the more available the commercial space.

3.4 Natural Environment

In pursuing environmentally sustainable mixed use communities, setting the nature, ecology-oriented built environment outlines the foundational base stone. While providing the amenity shelter from overheated sunshine in such tropical, or subtropical cities, such as those in Taipei, providing as much sunshine for plants are important. On the contrary, providing penetration between buildings to prevent barriers of natural flow of air is significant to maintain a natural environment in the cities in general, but also blow out potential heat-island phenomenon. For vitalization purposes, building coverage is encouraged to keep as small as reasonably small. For the same shape of building, stair-shape on the vertical dimension provides even better ventilation since penetration between buildings increased for higher floors, which also increases daylight exposure.

4. Conclusions of Policy Implications

To fill the gap of systematic knowledge for urban planners, designers and architects in designing vertical mixed used communities, with retail stores on the lower levels and residential on the upper levels, this research sheds some lights into the space-related attributes that three primary stakeholders/users, i.e., residents, store owners, and pedestrians including shoppers from the community and other places, are likely to weigh. This the findings of research has the potential of equip planners and designers with limited knowledge on this regard. The indexes chosen from these three stakeholders are weighted based outcome they have a hand in, rather than based on their input, and output, i.e., types of buildings. For example, BCR, as an input index, does not weigh only one since it affect more than one aspect of outcome. Also, viewshed, as a output indicator, is weighted twice as much as since it causes impact on both viewshed and perceived sunshine.

In the vertical mixed-use buildings, the combination of low building coverage rate ideal for residences and mid-to-high building coverage rate leads to the conclusion that stair-shaped buildings play in important roles in this regards. Stair-shape enhances more shopping environment by providing more commercial space on the ground levels and raising shopping space continuity. However, the building coverage rate at the ground level should not be too high to prevent the existence of greenery in the garden the sidewalk, or even sidewalk outdoor dinning space. Stair-shape can also allow greenery on the elevated garden or open space on the roof of shopping space, playing as the mid-air garden for the residents living in the upper floors of the building. Lower floor coverage rate for the upper floor residences allow more penetration between buildings, increasing privacy in dense built environment, more breezeway, daylight channels for the grounds, and more privacy for residents with less level of being exposed to neighbors.

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國科會補助計畫衍生研發成果推廣資料表

日期:2013/10/30

國科會補助計畫	計畫名稱: 都市規劃與設計工具於生態都市之住商混合使用與商業區規劃的功能
	計畫主持人: 蔡育新
	計畫編號: 101-2410-H-004-207- 學門領域: 都市及區域

無研發成果推廣資料

101 年度專題研究計畫研究成果彙整表

計畫主持人：蔡育新	計畫編號：101-2410-H-004-207-
計畫名稱：都市規劃與設計工具於生態都市之住商混合使用與商業區規劃的功能	

成果項目			量化			單位	備註（質化說明：如數個計畫共同成果、成果列為該期刊之封面故事...等）
			實際已達成數（被接受或已發表）	預期總達成數(含實際已達成數)	本計畫實際貢獻百分比		
國內	論文著作	期刊論文	0	0	100%	篇	
		研究報告/技術報告	1	1	100%		
		研討會論文	0	0	100%		
		專書	0	0	100%		
	專利	申請中件數	0	0	100%	件	
		已獲得件數	0	0	100%		
	技術移轉	件數	0	0	100%	件	
		權利金	0	0	100%	千元	
	參與計畫人力（本國籍）	碩士生	2	2	100%	人次	
		博士生	0	0	100%		
		博士後研究員	0	0	100%		
		專任助理	0	0	100%		
國外	論文著作	期刊論文	0	1	100%	篇	最後成果尚於進行中，因次尚未發表。
		研究報告/技術報告	0	0	100%		
		研討會論文	0	0	100%		
		專書	0	0	100%	章/本	
	專利	申請中件數	0	0	100%	件	
		已獲得件數	0	0	100%		
	技術移轉	件數	0	0	100%	件	
		權利金	0	0	100%	千元	
	參與計畫人力（外國籍）	碩士生	0	0	100%	人次	
		博士生	0	0	100%		
		博士後研究員	0	0	100%		
		專任助理	0	0	100%		

其他成果 (無法以量化表達之成果如辦理學術活動、獲得獎項、重要國際合作、研究成果國際影響力及其他協助產業技術發展之具體效益事項等，請以文字敘述填列。)	無

	成果項目	量化	名稱或內容性質簡述
科教處計畫加填項目	測驗工具(含質性與量性)	0	
	課程/模組	0	
	電腦及網路系統或工具	0	
	教材	0	
	舉辦之活動/競賽	0	
	研討會/工作坊	0	
	電子報、網站	0	
	計畫成果推廣之參與（閱聽）人數	0	

國科會補助專題研究計畫成果報告自評表

請就研究內容與原計畫相符程度、達成預期目標情況、研究成果之學術或應用價值（簡要敘述成果所代表之意義、價值、影響或進一步發展之可能性）、是否適合在學術期刊發表或申請專利、主要發現或其他有關價值等，作一綜合評估。

1. 請就研究內容與原計畫相符程度、達成預期目標情況作一綜合評估

■達成目標

□未達成目標（請說明，以 100 字為限）

□實驗失敗

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□其他原因

說明：

2. 研究成果在學術期刊發表或申請專利等情形：

論文：□已發表 □未發表之文稿 ■撰寫中 □無

專利：□已獲得 □申請中 ■無

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本研究成果具理論上混合使用之規劃工具的評估，與後續對於混合使用規劃與設計準則研擬的參考作用。其於世界對於混合使用規劃與設計正進行重新省視的國家、都市具有一定的參考作用，尤其當都市規劃師對於設計並不全然清楚、建築師對於混合使用設計的都市計畫議題亦不全然清楚的情況下，此研究成果可提供基礎的資訊。酸然研究是老議題，但對都市計畫從業者而言，此問題的答案一直不清楚。