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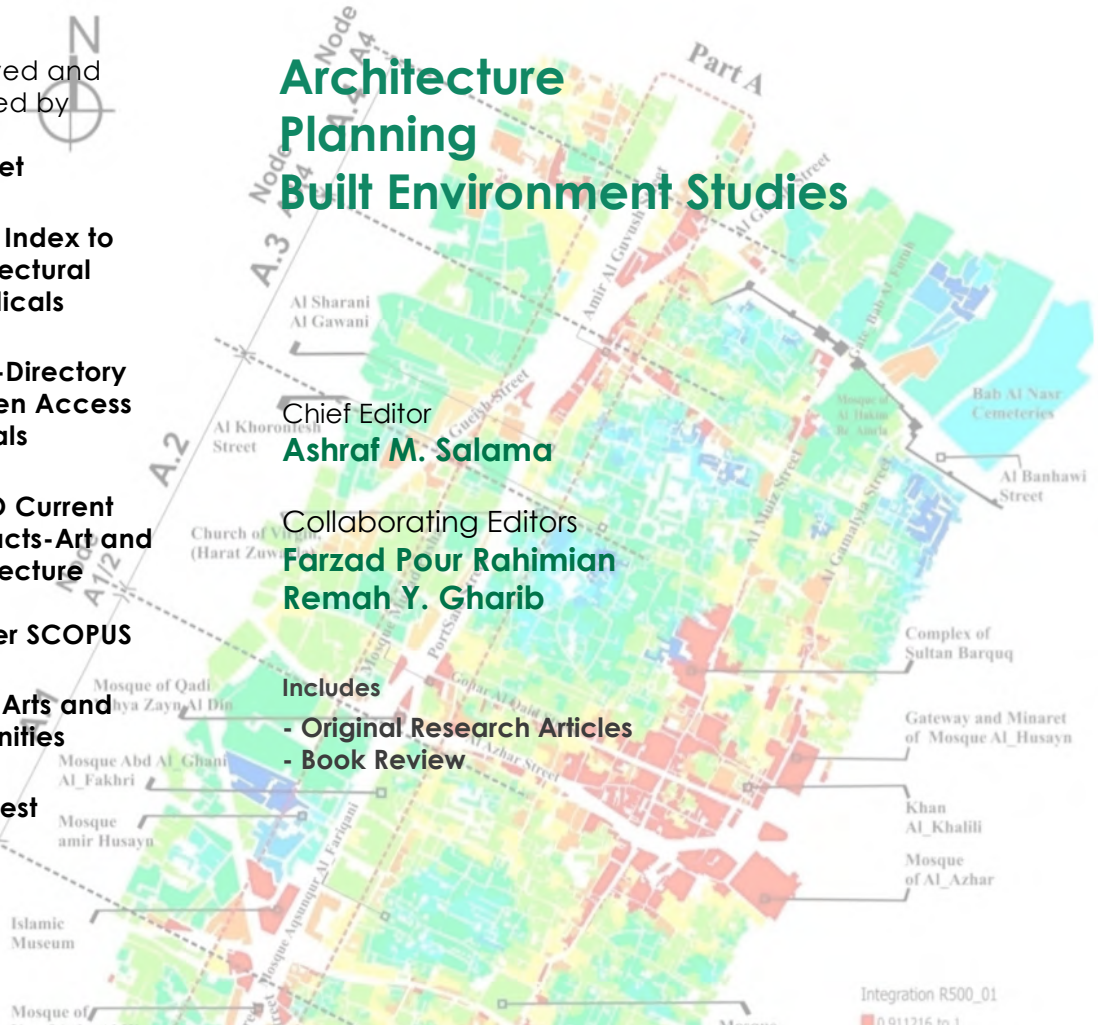

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URBAN DISPLACEMENT AND LOW-INCOME COMMUNITIES: THE CASE OF THE AMERICAN CITY FROM THE LATE TWENTIETH CENTURY

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Abstract
How can urban redevelopment benefit existing low-income communities? The history of urban redevelopment is one of disruption of poor communities. Renewal historically offered benefits to the place while pushing out the people. In some cases, displacement is intentional, while in others, it is unintentional. Often, it is the byproduct of the quest for profits. Regardless of motives, traditional communities, defined by cultural connections, are often disrupted. Disadvantaged neighborhoods include vacant units, which diminish the community and hold back investment. In the postwar period, American cities entered a program of urban renewal. While this program cleared blight, it also drove displacement among the cities' poorest and was particularly hard on minority populations clustered in downtown slums. The consequences of these decisions continue to play out today. Concentration of poverty is increasing and American cities are becoming more segregated. As neighborhoods improve, poorer residents are uprooted and forced into even more distressed conditions elsewhere. This paper examines the history of events impacting urban communities. It further reviews the successes and failures of efforts to benefit low-income communities.

Keywords: *Urban renewal; urban redevelopment; Baltimore; displacement; community; housing; poverty; gentrification*

INTRODUCTION
The history of urban redevelopment, in Baltimore and cities around the world, is one of displacement for the poor and disruption of low-income communities. Rather than benefiting residents who already occupy urban space, renewal historically offered benefits to the place while pushing out the people with rising expenses, especially rents. In some cases, displacement is intentional, or even the point, as seen in Haussmann's 19th century redevelopment of Paris. In others, it is unintentional, as in more recent efforts to revitalize cities that consistently trigger rising rents and gentrification. Often, it is the cynical byproduct of the quest for private profits. Regardless of motives, traditional communities, sometimes defined by ethnic, racial, or other cultural connections, are often disrupted. Disadvantaged low-income neighborhoods include high numbers of renters as well as elderly residents on limited fixed incomes. They also feature many vacant units, which promote crime, diminish the sense of community, and hold back investment. Baltimore, like many cities, has a long history of efforts to renew its urban core. In the postwar period, American cities entered a program of urban renewal to overcome decay in prominent areas. While this program cleared blight, it also drove displacement among the cities' poorest populations and was particularly hard on minority populations that had clustered in downtown slums. There was little effort to provide improvements for communities in place.

The consequences of these decisions continue to play out today. Even when physical housing conditions were drastically improved, loss of community was the top reason cited for housing dissatisfaction among displaced residents. The concentration of poverty is increasing

and our cities are becoming more segregated. All too often, as neighborhoods improve, poorer residents are uprooted and forced into even more distressed conditions elsewhere. Through studies of urban displacement, redevelopment, and gentrification, along with research into the sociology of community, this paper identifies the ways that urban renewal has exacerbated problems in low-income communities and examines ideas of how Baltimore's community renewal can avoid these pitfalls.

THE FRAMEWORK, FUNCTION, AND VALUE OF COMMUNITY

There is much to consider if one is to understand the dynamic qualities of urban life, of community, or of slums. What these concepts have in common urbanism, community, and slums – is the quality of sharing an environment with others. In each, it is the experience of interactions and the contexts in which such interactions take place that contributes a great deal to our personal social identities and shapes our understanding of one another. There are unseen forces that motivate group and individual actions, with consequences that extend beyond the immediately observable. There are historical factors, social factors, economic factors, and psychological factors that can be hard to grasp. One cannot simply directly observe a community and understand all that is acting to define that community.

These concepts can be understood scientifically and they can be understood philosophically. In the 1940s, the American sociologist Amos Hawley pioneered the understanding of Human Ecology. Hawley linked the interactions of individuals with others and with their surroundings to the field of Ecology, which is the study of relationships between entity and environment, in general and Biological Ecology in particular: "Human ecology, then, may be defined more fully as the study of the development and the form of communal structure as it occurs in varying environmental contexts". Thus equipped, later researchers, in sociology and related fields, gained the opportunity to predict outcomes based on observations and then apply those predictions elsewhere. Rather than dealing with individuals one by one, the researcher can look at groups as a sort of super-organism with its own set of conditional behaviors. If human ecology is a scientific framework for understanding urbanism, community, and slums, it then meshes nicely with the philosophical understanding of the same. As such, we can start to understand the concept of "I" as a byproduct of the interactive "We." That is to say that within these contexts, individual identity is at least partly derived from one's interactions with others and with the environment. However, according to the Czech philosopher Vilem Flusser, "the new image of humanity as a knotting together of relationships doesn't go down easily, and neither does the image of the city that rests upon this anthropology (Flusser, 2005)". The persistent image of the individualist is in conflict with the socially derived nature of humanity. Flusser seems to argue that the social nature of the city is a point of existential tension in the psyche of the individual.

THE IMPACT OF DENSITY ON COMMUNITY FUNCTIONS

It is a testimony to the disastrous history of high-density low-income housing in American cities that many still instinctively think of it in terms of "slums". More disturbing yet is that when we think of these slums, rarely does the word "community" come to mind. So much of low-income urban housing centers on density. How close together can we really live and get along and make progress? While there is no magic number beyond which life is too dense, there has been significant effort to develop framework understandings of density and community success (Ramsden, 2011). Thanks to the work of behavioral researcher John Calhoun, using lab rats and simulations of cities and dating back to the 60s, there is a framework of basic observations about dense living conditions. In spite of the controversial nature of Calhoun's work, subsequent findings have largely supported his arguments about density. For example, the higher the density, the higher the frequencies of violence and other social challenges (Ramsden, 2011). Of course there are other factors besides density that contribute to community success and failure. Armed

with a sensitivity to Calhoun's studies, more recent research has shown that difficulties related to density can be mitigated through strategies of engagement (Forsyth, Nicholls, and Ray, 2010).

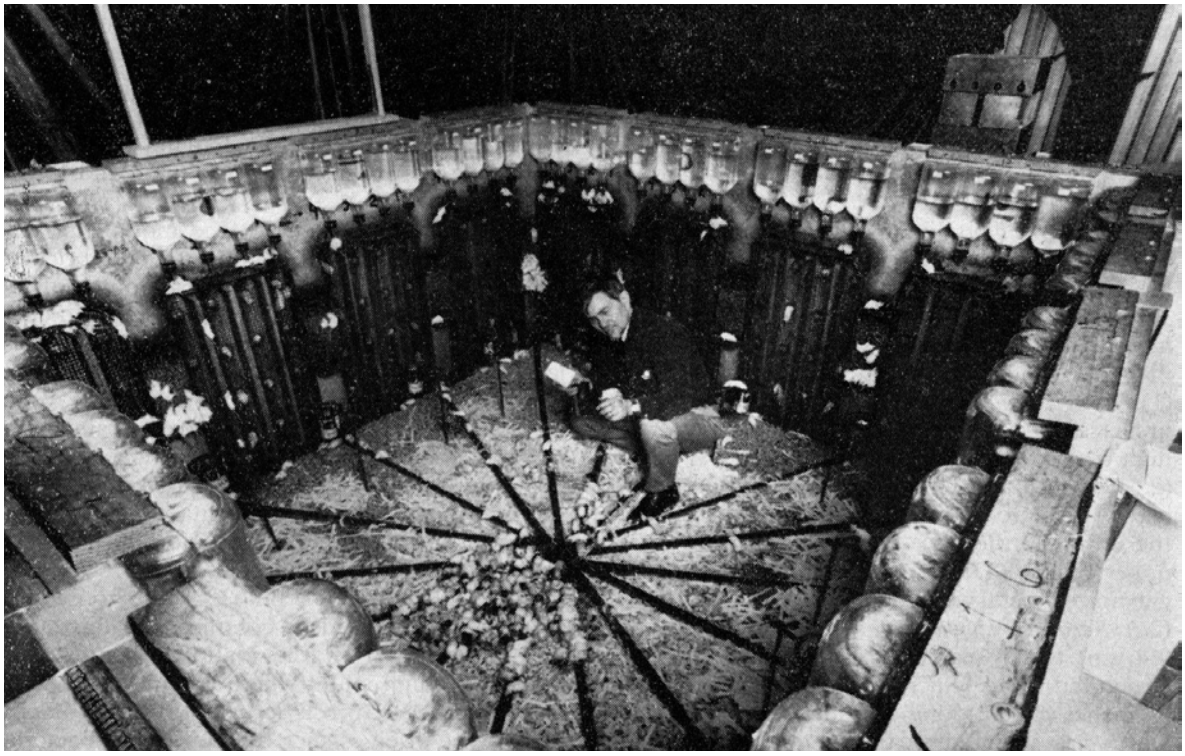

Figure 1. John Calhoun and his mice experiment (Source: Yoichi R Okamoto, 1970) [National Institutes of Health]

In one case, a team of academics and city planners, working in Minneapolis-St. Paul in 2010, sought to improve resident acceptance of higher density in a low-income community. Their stated goal was to increase "community capacity" for a more active role of residents in the decisions that most impact their experience of the community. City planners were attempting to increase density in places like transit corridors to reduce dependency on cars and increase access to services generally. The research team stepped in and executed a series of community exercises designed to promote inclusive processes and tailored for after-action study and propagation to similar projects. Among these activities were "participatory design" sessions, where residents used wooden blocks and maps to assemble and present their values and goals for housing. Additionally, the team conducted numerous group discussion sessions, while taking care to shuffle up the mix of contributors to include experienced facilitators and a cross section of residents, rather than just the most motivated. The team was successful in meeting their goals of neighborhoods being held intact, a reduced dependency on cars, and more affordability, demonstrated by higher rates of resident satisfaction with the final housing product than seen in similar scenarios (Forsyth et al, 2010). The Minneapolis-St. Paul exercise, while it is only one example, demonstrates that ongoing engagement with residents in decision making, in contrast to top-down planning, may increase satisfaction and overall planning success.

THE EXPERIENCE OF LOW INCOME COMMUNITIES IN THE UNITED STATES

The success of the effort to increase "community capacity" in Minneapolis-St. Paul is a refreshing event in an otherwise dismal history of housing for the poor. All too often, the experience has been one of repeated and frequently unjustifiable displacement. If communities thrive on the

strength of their residents, then a constant turnover of residents can be seen as a serious challenge to the resiliency of the community and a harm to those that are displaced and also those that are caught in such unstable communities. In the modern era, discussions center on three primary drivers of displacement among the urban poor: housing situation, gentrification, and slum clearance. However, there is in fact a fourth driver that far outstrips these three: *eviction*. In one 2012 study, conducted in Milwaukee, Wisconsin, researchers found that 1 in 14 renter-occupied households was evicted annually (Desmond, 2012). While Detroit has the highest eviction rate in the U.S., Baltimore fares little better as "every year… more than 6,000 renters and their families are evicted from their homes" (Broadwater, 2015). Evictions are the area of interest for sociologist Matthew Desmond. He has improved our understanding of the underlying factors that contribute to the high rates of eviction and finds these factors to be numerous. One such factor was an unusually high rate of women evictions in Milwaukee's black and Hispanic neighborhoods, driven at least in part by high rates of males with criminal records (thus precluding them from acquiring a lease) and high rates of single motherhood in these communities. Rates in white neighborhoods were about equal for men and women. This concentration of evictions in black neighborhoods can be further linked to the high rates of African-American urban poor and their concentration in high-poverty, segregated neighborhoods (Desmond, 2012).

Figure 2. Robert Moses is closely associated with urban renewal in the United States, during the mid-20th century (Source: C.M. Stieglitz, 1939) [Library of Congress]

Beyond the persistent forces that drive displacement, like eviction, there have been a number of punctuated moments of extraordinary displacement. In modern times, outside of war or famine, nothing compares to the disruptive impacts of urban renewal. With the support of the Housing Acts of 1937, 1949, and 1954, which dedicated significant money to “cleaning up” American cities, figures like Robert Moses, the powerful leader of New York’s urban renewal efforts, championed massive initiatives that destroyed entire communities, which many called slums, and replaced them with top-down solutions, including highways, which helped create suburban culture and the housing projects that swept up those left behind (Walker, 2012). Meanwhile, equally visionary figures like urban theorists and activists Jane Jacobs and Charles Abrams saw the tragic impacts on community long before they played out and worked tirelessly and often in vain to alter the march of urban history. Abrams for one “took no delight in the kind of ‘order’ that Moses’ vision of urban renewal created: displacement of the poor, rampant discrimination against minorities, and homogeneity of neighborhoods” (Walker, 2012). Abrams and Jacobs saw that urban renewal was failing to meet the needs of those most in need of its intended improvements.

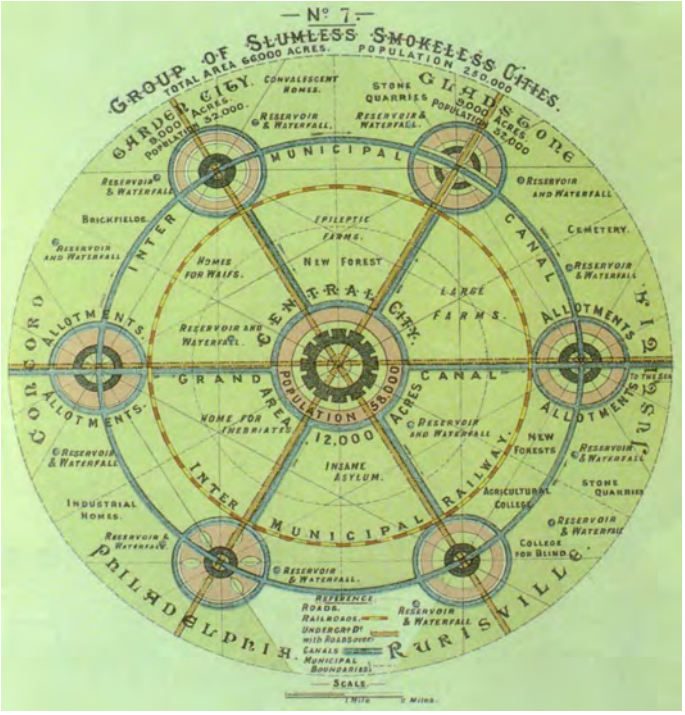

Figure 3. Urban Renewal had its roots in utopian thinking, including the Garden City Concept (Source: Ebenezer Howard, 1902) [Wikimedia]

Although the historic record of urban renewal in America’s beleaguered cities is one of failure to provide satisfactory solutions for the most vulnerable, it was not simply that urban renewal was intent on destroying lives. Rather, it was supposed to bring market forces, with government sponsorship, to bear on urban America’s most entrenched problems. For example, “the slum-clearance, or urban renewal, projects that Robert Moses initiated in New York City, began with the idea that people are the products of their environments” (Walker, 2012). It was not until it was too late that we began to understand the consequences of uprooting communities, even if they existed in dire conditions. The roots of urban renewal of the postwar period were based, in large part, on modernist ideals and utopian thinking. Ideas like Garden Cities and important modernist

voices like Le Corbusier and Walter Gropius all pointed to a vibrant future, brought about by visionary rethinking of cities (Zipp, 2012). While utopian ideals of vast public spaces and structured living conditions were the seeds of urban renewal, capitalist priorities conflicted with the more altruistic components of such ideals. Efforts like the 1966 Model Cities Program, a federal act that funded smaller scale experiments in various housing programs from President Lyndon Johnson's Great Society initiatives, started out as empowerment programs that brought disenfranchised voices into the process of addressing their own needs. But, in the subsequent Nixon years, Model Cities became another works project about building things instead of solving issues (Weber and Wallace, 2012). With such a shift, what started out with much promise and early, albeit uneven, successes came to an end in 1974 and became part of the long history of failed investment in market-driven solutions for low-income problems.

After World War II, as urban renewal was taking hold in America, many of the nation's intellectuals took up the issue and offered their thoughts and observations. Pioneering social worker and civil rights activist Frankie Adams, writing in 1958, astutely identified many of the consequences of urban renewal projects across America. She also promoted the fairness of the programs in the effort to create positive outcomes for the displaced, including addressing the psychological needs of those who find themselves in new communities – often against their wishes. She rightly suggested that there are three options in the matter of urban slums: urban renewal, clearance, or conservation (Adams, 1958). So-called slums can be replaced with newly planned solutions, they can be swept away and residents left to find new solutions, or they can be left in place. Adams also identifies the value of diversity – economic, educational, and aspirational – for the health of a community (Adams, 1958). Meanwhile, the disruptive impacts of urban renewal rippled outward from the invested areas, as the disrupted arrived in other communities and in turn triggered additional disruption there, such as suburban flight. Building on the work of Adams, researchers in Lubbock, Texas working in 1968, postulated correctly that those displaced from intact communities in slum conditions to new housing that lacked such community would be less satisfied with their new conditions. It did not matter that the physical conditions were improved. Rather, residents most often cited loss of community as the primary reason for their dissatisfaction (Edgley, Steglich, and Cartwright, 1968). An additional component of this phenomenon is that, according to sociologist Charles Edgley, "some families affected by urban renewal were forced to become welfare clients, even though they had been self-sustaining tenants in pre-urban-renewal slum housing" (Edgley et al, 1968).

The 1980s is closely associated with the rise of conservatism to the forefront of American political, social, and economic discourse. Still, it is important to keep in mind how close on the heels of the major urban renewal projects in America this era follows. With many projects still playing out and many more showing catastrophic outcomes, conservative ideology turned to trickle-down economics for new ideas (Smith, 1982). Noted urban planner and Yale professor Alex Garvin seems to have been one important thinker to consider such notions. While many were scratching their heads over the failure of much of urban renewal's lofty goals, Garvin and others were promoting the idea that investing in middle-income development would trigger benefits for low-income populations as the middle-income groups would "hand-down" their perfectly acceptable old housing in exchange for better opportunities (Garvin, 1980). However, his example, Corlears Hook, along the East River, was a story of displaced *white* residents and glosses over the uneven impacts on minorities that were commonplace in the often segregated solutions of urban renewal.

In a search for new approaches, one might consider what the New Urbanists can contribute to old urbanist problems. New Urbanism, first articulated in 1993, "is a movement united around the belief that our physical environment has a direct impact on our chances for happy, prosperous lives" (CNU: The Movement, 2015). It is largely structured around the ideals of community, but as Paul Walker Clarke, a professor of architecture, argues in "The Ideal of

Community and Its Counterfeit Construction," the New Urbanist idea of community is one of pre-planned, highly structured, and physically-based solutions. Their efforts rework much of the arguments of Jacobs and Abrams and their compatriots that say community is spontaneously composed by invisible forces and chance encounters. According to Clarke, "community is an arena of participation that evolves through discourse, a constituent missing within the philosophy and constructed developments of New Urbanism" (Clarke, 2005). Addressing the pressure placed on threatened, or indeed dispersed, communities calls for more than the "design" of the trappings of community, without access for those most in need of its benefits. Rather, pressured urban communities need renewed engagement with the larger social fabric of their environment. Linkages to diversity seem very much to be the opposite of the work, if not the stated intentions, of new urbanists.

In 2005, researchers in urban housing, based in Montreal and looking for more fairness-driven distribution of affordable housing, took efforts in that city as their focus. There, housing is required by law to be distributed equally in every district of the city in an effort to avoid ever-increasing concentration of poverty. The researchers identified three criteria for successful public housing: "the social environment, the physical environment, and the accessibility of services and facilities" (Apparicio, Séguin, and Naud, 2008). While efforts to distribute housing evenly throughout the city were somewhat successful and produced a variety of positive outcomes, there was still latent discrimination in the policy as the affordable housing was consistently located in each district's least desirable areas, near railways, highways, and assortments of existing blight, as well as distant from city services. Even in cases where public housing was located in what the researchers term "less socially deprived" areas in the periphery of the city, rewarding residents with high qualities of social and physical environment, they were often disconnected from services and facilities that may be considered critical for those living on limited income (Apparicio et al, 2008). In this way, residents in affordable housing still often found themselves in unfortunate conditions, even though some important benefits were realized.

If past efforts at renewal have been often underpinned with utopian or even altruistic motives, there have also been many who engaged in the process for the age-old motivations of personal gain. In 2001, sociologist Kevin Fox Gotham examined renewal programs in Kansas City, Missouri and found that, at some point in the evolution of urban renewal, there was a shift to the priorities of private interests (Gotham, 2001). This shift had profound consequences for the black urban poor, who found themselves in more segregated conditions than ever as they were shepherded into profit-minded housing solutions. In a privatized model, public interests, such as housing for the poor, or countering the forces of segregation, are turned over to private for-profit contractors, ostensibly to promote improved efficiencies and therefore expanded services for the same costs. Whereas privatism was often promoted as the most efficient way of delivering public services, the reality is that "privatism is the underlying commitment by government to helping the private sector grow and prosper" (Gotham, 2001). Public benefit is *not* the central function of privatism. So, it follows that the transfer of responsibility for public benefits to private interests served first to benefit such interests and only coincidentally served the needs of those for which benefit was actually sought.

Movements in urbanism have not fared much better in Modern America. With the onset of the administration of Mayor Rudy Giuliani in 1994, New York entered into a period of revanchism, wherein those that believe the city has been "taken away" from them, seek to reclaim what they believe is their right to possess (Smith, 1999). In every sense, this turn pitted the middle and upper classes against the lower classes, who were held responsible for all the declines experienced in New York and other large cities, including Baltimore, which implemented its own zero-tolerance policies, with New York police veterans at the forefront (Smith, 1999). It disregarded any role political leaders and profit-minded developers might have had in driving the poor into ever more crowded and difficult situations, with ever fewer resources committed to

community welfare (Smith, 1999). In large part, this is the condition we continue to find today. This is the policy of "broken windows" and can be traced forward all the way to the protests that swept American cities in 2014 and 2015. Such shifts were not exclusive to American cities, nor were they entirely delineated by race. The case of Berlin after the fall of the Wall presents an interesting perspective. Here, the shift from socialistic housing solutions to capitalistic was profound, as half the city found itself suddenly transformed. The sum of urban sociologist Andrej Holm's research and analysis in Berlin demonstrates that the rise of privatization and decline of government investment is the root cause of extensive displacement of long-standing, sometimes low-income communities, in favor of wealthier gentrifying groups (Holm, 2006).

In America, it is rare to find naked ambition when observing efforts to impact social policy. To expose the underlying motivations, it becomes important to understand how language shapes and is shaped by the agenda of those that are seeking to compel the moment. Regarding social housing policy, professor of social policy and human services, Michael Darcy offers an overview of such evolution and outright manipulation of the language. In particular, he argues that the shift from "public" housing to "community" housing is one from centralized planning to decentralized models, including privatization, which he sees as insidious in the social housing arena. "Community" here does not indicate self-management, but rather a local non-government organization, which may have little actual connection to the community for which it is responsible (Darcy, 1999). Perhaps the most notorious example of language being used to manipulate public opinion in America is Welfare-to-Work, the controversial overhaul of the American welfare system, enacted in 1996 (Bowie, 2004). While the concept of getting away from welfare and finding a decent job is appealing, it is easy to overlook the troubling findings of research in this area, including extensive evidence that jobs found are sort-lived and that "welfare leavers" frequently fail to maintain an independent status. Instead of moving from welfare to work, participants often find themselves simply in possession of neither support nor independence (Smith, 1999).

Figure 4. Prenzlauer Berg experienced gentrification pressure after decades of being confined behind the Berlin Wall (Source: Henri Cartier-Bresson, 1962)

THE HISTORIC IMPACTS OF RENEWAL

In 1978, research backed by the Department of Housing and Urban Development in the US found that black mayors tended to focus more on housing than other mayors. It was supposed that this might be because black mayors were largely operating in older cities with poorer populations and therefore housing is more of an issue. A number of strategies being employed by these mayors

have proven resilient, as they continue to be used today, including cities taking derelict properties and offering either below-market resale, or reducing excess housing inventory through demolition (Bryce, Cousar, and McCoy, 1978). Previous research, as outlined in this paper so far, has demonstrated the disparate impacts of renewal. But, more recent studies have shown that we are still facing the same challenge. Even now, the higher the concentration of black or Hispanic residents, the less benefits a community will receive from private reinvestment. Ultimately, modern laissez faire policies that depend on private investment may in fact deepen racial divides, by providing benefits to white communities and furthering segregation trends (Hwang and Sampson, 2014). What may be more startling is that so few whites lived in high concentrations of poverty and so few blacks in low concentrations, that making statistical observations that seek to isolate race as a factor in mobility proved elusive (Sharkey, 2009).

Expanding on this point, British geographers presented work on suburbanization and how this trend, which continues even now, disrupts the value of constant intermingling on the streets that promotes a higher order of community. In this sense, the failure to realize utopian visions of urbanization, such as Howard's Garden Cities and Corbusier's Radiant City, is exacerbated by flight to the suburbs by a crucial group of that intermingling (McLeod and Ward, 2002). It does not take much to recognize that minorities face disproportionate impacts in housing policy, but it remains important to constantly develop new tools for understanding this fact and observing its patterns and trajectories.

As has been demonstrated repeatedly, community engagement unlocks potential for greater success (Rosen and Sullivan, 2012). On this topic, public housing experts Marcia Rosen and Wendy Sullivan state: "Once notorious for urban renewal that… displaced residents, San Francisco is now renowned for its best practices in housing and community development" (Rosen and Sullivan, 2012). With this unexpected opening declaration, the authors of a brief paper begin an outline of the keys to San Francisco's newfound success in providing affordable housing, in the nation's tightest real estate market. Among the keys to San Francisco's success, such as it is (San Francisco in fact has a somewhat notorious housing market, known mostly for its inability/refusal to build sufficient housing at all economic levels.), a concerted effort to gather and understand the needs of local residents stands out. In spite of efforts like those in San Francisco, poverty is becoming more concentrated and this started before the Great Recession, and for blacks this growth has been fastest in mid-sized cities, such as Syracuse, Dayton, and Baltimore (Jargowsky, 2015). New housing initiatives have some benefits for low-income residents, but they are largely failing to accomplish the important goal of social integration. There are a variety of factors, including discriminatory site selection and insufficient funding, but chief among these are class-related distinctions within the mixed-income communities. According to Robert J. Chaskin, a professor of urban policy and social services, "the interplay among institutional mechanisms, organizational actions, and individual responses within the contexts foster community dynamics that place poor people in circumstances of different kinds of disadvantage and generate new forms of exclusion" (Chaskin, 2013).

GENTRIFICATION

There is a strong connection between location and a sense of one's cultural identity. This anchored identity is easily threatened by the displacing pressures of gentrification. Gentrification has been described as "the process by which central urban neighborhoods that have undergone disinvestments and economic decline experience a reversal, reinvestment, and the in-migration of a relatively well-off middle- and upper middle-class population" (Hwang and Sampson, 2014). Gentrification is a dirty word in most conversations, but it is not as simple as that. Cash-strapped cities yearn for incoming residents with more wealth, to prop up the tax base and increase their ability to deliver services, from road maintenance to housing for the city's poorest residents. Looking back to the urban renewal of the 1940s, -50s, and -60s, it is worth remembering that

those programs were intended not only for low-income minorities, but for middle-income residents and whites as well (Walker, 2012). But, whites balked at the new housing dynamic, even with segregated communities. They fled for the suburbs, leaving poor minorities just as isolated as ever (Clarke, 2005). Writing in 1958, during its peak, civil rights attorney George Nesbitt saw urban renewal itself as a vital step in the recovery of American cities, writing:

> *The promise of urban renewal is beginning to materialize in many communities. More and more land is being readied for housing, schools, and parks, highways and public buildings, parking space and industrial and commercial expansion to make our cities for all of us – cleaner, more attractive, and more efficient communities in which to live (Nesbitt, 1958).*

Even as Nesbitt was singing its virtues, he acknowledged the serious consequences urban renewal might have for the displaced residents in communities targeted for redevelopment under urban renewal. Chief among his concerns was that there would be insufficient resources dedicated to the needs of the dispossessed, with African Americans being identified as particularly vulnerable. It is clear that this increased vulnerability had its roots in the very active segregation of the urban population into white and "non-white" (Nesbitt, 1958).

If there is a case to be made in favor of gentrification, there is most certainly a case against it, or at least its uncontrolled effects – displacement in particular. While gentrification can help a struggling city like Baltimore with an increased tax base, its extended benefits impact cities in a decidedly uneven way. The realities of gentrification are that incoming residents make preferential choices that lead to parts of a city "winning" and receiving the increased direct investment of new residents and the attendant new businesses and services. Meanwhile other parts of the city are left out of these investments and can even end up worse off, as they absorb those low-income residents displaced by rising costs in the improving areas. The mechanics of such uneven development are complex and often invisible. According to the theory of Ground Rent economics, as proposed by Neil Smith in 1982, it is not simply a function of social preference, but also the nature of economics itself that investments move cyclically, with capital seeking places (and actual land) to grow and avoiding places where it might become trapped (Smith, 1982). Where the current and future values of land are seen as differing, capital will flow. If the future is not promising, capital will flee. Thus conditions for gentrification are variably impactful depending on where one looks in a given environment.

Cultural identity and sense of place is of course not the sole providence of America and gentrification pressures are not simply the story of race stratification, as researchers in Edirne, Turkey showed in 2007. The residential environment – the community – is central to "individual quality of life" (Erdogan, Akyol, Ataman, and Dokmeci, 2007). In Edirne, they found that housing satisfaction was constructed on the basis of five dimensions: "overall housing satisfaction, perceived living conditions, physical surroundings, social relations, and local authorities" (Erdogan et al, 2007). Residents here were displaced from older, badly deteriorated communities into more modern locations. Interestingly, while they found that the modern neighborhood enjoyed higher scores in almost all dimensions, the residents of the traditional neighborhoods reported higher overall housing satisfaction (Erdogan et al, 2007).

In Istanbul, professor of architecture Elmira Gur found gentrification is paired with rapid overall growth of the city, fuelled by in-migration from rural areas and immigration. This has had two significant impacts on the city. First, long neglected neighborhoods, like the Fener-Balat districts along the waterfront have seen significant displacement and loss of authenticity, as the area underwent regeneration (Gur, 2015). Relatedly, the city has seen a rapid urbanization of its periphery, as displaced low-income residents have struggled to make space for themselves, often crowding more people into smaller spaces. In many rapidly expanding Gulf State cities, like Jeddah in Saudi Arabia, the development of affordable housing verges on crisis as the growth

from an influx of rural and desert populations has greatly out-paced the creation of housing. Accompanying the crisis of quantity is a debate about the qualities of a suitable home (Salama, 2007). This pattern of overloaded urban centers is less common in rust belt American cities, where high rates of vacancy make densification – sought after, or otherwise – a rare phenomenon. High-demand cities such as San Francisco and New York City are the exceptions.

In some instances, communities organize to resist gentrification, as is the case in Humboldt Park in Chicago where the Puerto Rican Cultural Center, established in the late seventies, acts as the front line for the preservation of its community and the place it calls home. By combining individual power through the cultural center, residents have been able to persevere despite pressure from neighboring gentrified communities and thus, existing residents have retained their community while also gaining benefit from the influx of capital to their area of the city, though pressure from rising rents can be seen and some physical "drift" of community borders has happened (Rinaldo, 2002). In some cases, cultural identity can be rediscovered, as in the case of the Weeksville Heritage Center in Crown Heights, Brooklyn, established in 1971. A historic site dating to 1838 that was tied to the story of emancipated blacks living in New York in the mid-nineteenth century was developed into a focal point for the surrounding community and subsequently became the story of the rediscovery itself of this important piece of black history. Today, the site serves as a community centerpiece and embodies four core values that it claims are central to the health of a community: sanctuary, abundance, normalcy, and celebration (Scott, 2015). For residents, the Weeksville Heritage Center is a tangible statement of belonging.

RENEWING THE ENDANGERED COMMUNITY

Community, as a defining quality for a group of people, is not a permanent construct. Rather, it must be constantly renewed and defended. Few will step forward to defend a community from the outside. To those outsiders, a neighborhood is often an abstraction and more a collection of built things than a fabric of interactions. Jane Jacobs played an outsized role in changing our understanding of urban community and it was her role in the Committee to Save West Village (CSWV) along with her advocacy at the *Architectural Forum* that shined a brilliant spotlight on the consequences of urban renewal. Among the many successful qualities of the CSWV was the ability to draw media attention, including support from the *Saturday Morning Post*, which publicly condemned New York City for its "suicidal passion to destroy [its] most distinctive neighborhoods" (Hock, 2007). Moreover, the CSWV replaced older models of individuals advocating for the protection of their own homes, to a collective argument about the potential for the community as a whole (Hock, 2007). This critical moment of direct advocacy – with residents articulating their own vision – continues to inform similar efforts at community self-determination.

New Orleans presents an interesting opportunity to understand the dynamics of community, as populations have been displaced *suddenly* rather than through a drawn out process. One such story of sudden displacement actually involves a community that has been displaced *twice*, once from its century old rural roots and again from its adopted location in the middle of New Orleans. The residents of Fazendeville, Louisiana had the original misfortune of living on the grounds of the Battle of New Orleans, from the Battle of New Orleans, and in the 1960s, they were displaced by the restorative fervor of federal parks officials. It did not matter that their own history on the site spanned 100 years; that history was discarded and the residents reformed their community in New Orleans' Lower Ninth Ward, which led to their second displacement, August 29, 2005 as Hurricane Katrina swept away whole neighborhoods (Jackson, 2006). Today, the Fazendeville community remains dispersed, but its residents cling to their shared identity, suggesting the potency of a strong community identity.

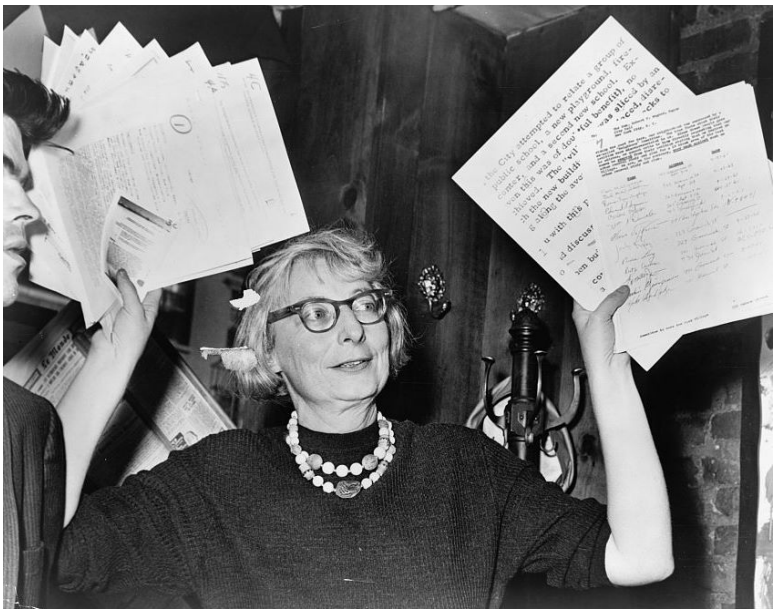

Figure 5. Jane Jacobs was a leader of the opposition to Robert Moses in New York. (Source: Phil Stanziola, 1961) [Library of Congress]

With special focus on and inspiration from post-Hurricane Katrina New Orleans, architects, since 2005, have joined the conversation, with planners, sociologists, city officials, and others, making calls for a fresh approach. Dr. Mark Clayton, an architect and engineer, calls for an urgent re-examination of architectural priorities focused on "evidence-based practice," wherein he calls for a five-fold principle of what he dubs "renewal architecture": scientific, sustainable, comprehensive, holistic, and innovative. He decries the mistake of the "false freedom of the highways" (Clayton, 2006) and seeks to frame renewal architecture as a complement to New Urbanism, which he describes as nostalgic and set in historic precedents. Renewal architecture, on the other hand, is "based on a firm commitment to innovation, technology, and change" (Clayton, 2006). Clayton says New Orleans, and the city as a general concept, needs architecture that combines "principles of design, urban planning, construction, sociology, psychology, law, [and] political science" (Clayton, 2006). In this way, cities might rediscover their value in a post-suburbanization context.

Building on the logic of community engagement, researchers in the 60s and 70s examined the nature of community *power* in achieving effective change for residents. Sociologist Amos Hawley argued in 1963 that by concentrating power, by unifying voices as a singular force, communities could affect change at the highest possible efficacy. In response to Hawley, sociologist Richard Smith wrote in 1976 that context mattered and that in many cases a community could achieve better results through dispersed power – the activation of many forms of power across a spectrum of issues. Smith Writes:

> *Cities with more diffuse power structures are more likely to achieve success in mobilizing resources for innovating new programs because, where many centers of power exist, there is a stronger possibility that the needs for various types of programs will be identified and that interested partisans will initiate actions for instituting these diverse programs (Smith, 1976).*

Throughout the history of urban renewal, there has always been a quest for those actions that catalyze improvement (Walker, 2012). If the history of urban renewal really is one in which the

poorest residents have been consistently disrupted and displaced to make way for profit-minded improvements that benefit the wealthiest, then what can be done to break this pattern? In fact, there are many cases in which researchers, planners, social workers, residents, and others have found catalysts for change that positively impact low-income residents. One such example comes from researchers in Kansas City, writing in 2008. They hypothesized that "strategic planning will lead to increased rates of community change" (Watson-Thompson, Fawcett, and Shultz, 2008). Their strategic intervention in two communities did indeed produce increased rates of change, driven by priorities set by residents themselves, including beautification, crime and safety, and youth development objectives. What they found was that engaging residents in planning for their own community greatly improved outcomes (Watson-Thompson et al, 2008).

In another example, whereas prior research in urban redevelopment took as a starting point the perception that low-income communities generated negative social systems, a team of psychologists and public health experts in 2009 in New York City took the novel approach of examining the conditions within low-income communities that generate altruistic action (Mattis et al, 2009). Using qualitative interview-based research, they found a variety of motives for altruism, which they categorized as needs-based, norm-based, abstract moral principles, and socio-political. For example, a respondent's needs-based motives might stem from an "awareness of the emotional, material, financial, physical or other needs of individuals – 'she didn't have anyone to turn to'" (Mattis et al, 2009). These motivated acts of altruism existed in abundance in low-income urban communities and ultimately undermine the argument that middle-class flight from cities "erodes social capital," and that middle-class equals pro-sociality and lower-class represents anti-sociality (Mattis et al, 2009).

Another potential catalyst for change is the rethinking of the typological qualities of older urban communities. In one example of engaging the built environment to promote renewed community vigor and dynamism, Baltimore-based Trace Architects has begun, this year, the development of a new use for Baltimore's many vacant blocks of rowhouses. With 48,600 vacant houses in Baltimore, this effort is showing one way that existing housing stock can be combined and reorganized to better suit the needs of modern residents. Moreover, the efforts of these architects is focused on allowing older residents to age in place and therefore is directly related to concerns about improvements and displacement. In short, Trace Architects is proposing the combination of four units of existing rowhouses into three new units: one accessible unit on the ground floor for aging residents and two multi-story units that wrap around it. The architects at Trace have assessed the factors that contribute to redevelopment and the displacing pressures faced by existing residents, especially the elderly (Cooke, 2015). By offering a strategy for renewing the existing housing stock in Baltimore, they hope to contribute to improved community continuity.

CONCLUSION

Communities consist of individuals with unique qualities, motives, and interests. But, they are also an entity unto themselves. Communities have their own layers of needs, power, support, and values. Among many pressures in the urban context is density, which is associated with elevated levels of violence, crime, and dysfunction. But, density and its attendant ills can be mitigated through direct engagement at the community level. Historic efforts at improvement of low-income communities have often failed at engaging members of the community. Whether well-intentioned or motivated by personal gains, powerful agents have consistently employed top-down solutions to what they identified as blight and slums. Slowly now, those interested in advancing the quality-of-life for residents, rather than for *places*, are recognizing the value of the contributions that can be made by the residents themselves. Indeed, if most historic failures at renewal have been characterized by top-down approaches, the most fruitful have been those following a bottom-up, community-led process. Empowering residents strengthens communities, promotes stability,

builds identity, and facilitates growth, to the benefit of existing residents (the hardest part of urban renewal.) "In whatever place he has lived for any length of time he develops a sense of belonging. Therefore, he has security in himself, and a desire to protect what he considers his. (Frankie Adams, 1958)."

As this study indicates, American cities like Baltimore have an urgent need to grow and attract new middle- and upper-income residents. But, they also have a responsibility to their lower-income residents and a significant mission to improve quality-of-life for all. Promoting a culture of community is one piece of the complex puzzle of urban life. Providing residents with a rallying point – a place to help in focusing one's sense of identity – may promote an enhanced sense of place and in so doing, further enhance the individual's sense of belonging. By advocating for residents under the structure of community, displacement, and loss of a sense of place and belonging may be diminished and stability may be achieved. This quality alone is among the most critical contexts in facilitating an improved experience in the urban setting.

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LEARNING FROM COMMERCIAL VERNACULAR BUILDING TYPES: A NORTH AMERICAN CASE STUDY

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Abstract
A substantial literature exists on commercial vernacular architecture in North America. This literature has examined everyday places and iconic building types including suburbia, roadside motels, vintage diners, fast food franchises, residential trailer parks, signage, unique commercial establishments, and shopping malls. These places and buildings are generally classified as expressions of folk vernacular culture. In response, Attention Restoration Theory, an environmental cognition perspective based in human information processing research, provided the foundation for an investigation of the food truck/ trailer and its immediate installation context within a North American case study context. Visual documentation, interviews, and archival fieldwork provided the basis for the articulation of a typology. These structures were found to express automaticity, as satisfying the timeless human preference for association with nature, a sense of psychological respite, and as a physical setting visually distinct from its larger urban environment context. Directions for future research on this topic are outlined together with insights for application by architects and urban planners.

Keywords: *Commercial vernacular typology; environmental psychology; preference theory; urban design*

INTRODUCTION

A substantial literature exists on the architecture of the North American roadside landscape. This literature documents and examines a broad range of building types constructed along two-lane highways and in older urban cores in the decades prior to the 1960s, prior to the construction of massive highway networks that would in time crisscross the North American continent. A significant proportion of the visual essays and field research on this subject have romanticized the road and the experience of automobile travel (Liebs, 1985). This literature examines and celebrates iconic roadside motels, movie palaces built during the classic age of the cinema, gas stations, neon signage, billboards, diners, rail and bus stations, shopping malls, and fast food franchises. In-depth treatments of specific building types include examinations of roadside diners (Gutman, 2000), travel lodges and resorts (Baeder, 1982), roadside motels (Jakle, Sculle and Rogers, 1996), and venerable fast food chains (Hirshhorn and Izenour, 2007). Other investigations have focused on particular cities, such as Los Angeles in the early 20th century (Heinman, 2001; Peterson, 2004), and that city's 1950s and 60s *Googie* architecture, designed by architects to reflect the by-then seminal role of the automobile in everyday suburban life (Hess, 2004). The commercial vernacular architecture of New Orleans has also been comprehensively examined in a similar manner (Verderber, 2009; Christensen, 2011).

One such commercial vernacular building type, the motorized food truck, and its non-motorized counterpart, the food trailer, have been integral to the North American roadside landscape since the advent of the internal combustion engine. These portable food vending

vehicles are, ironically, both old and new-again, in our present era when three hundred hours of YouTube content is uploaded every minute and humanity 'tweets' over five hundred million times each and every day (Grossman, 2015). Transportable commercial vernacular food establishments, unfortunately, have been overlooked as architecture or as works of art that possess intrinsic aesthetic merit. This has resulted in an absence of attention devoted to food trailers/ trucks, a condition in some measure attributable to their spatial impermanence, temporality, or insubstantial structural attributes. However, sociologists and cultural anthropologists have studied these relocatable structures in association with marginalized, nomadic subcultures, i.e. gypsies, traveling circuses, vagabonds, and other 'outcast' constituencies. The most aesthetically inventive of portable buildings are worthy of designation as high-order folk architecture, with the best examples representative of an architecture of temporality, and beyond, expressive of broader population mobility and migration patterns across time and geographic space (Kronenburg, 2013). These ramifications are evidenced in portable food trucks and trailers at instant pop-up event cities such as the Burning Man festival that takes place each year in the southwestern desert United States, and as integral adjuncts to the annual Haj Pilgrimage in Mecca, Saudi Arabia (Erickson, 2013).

Portable commercial vernacular structures built for the food industry have for generations also functioned as entertainment attractions in their own right, such as the iconic Oscar Meyer Wienermobile and the ubiquitous Good Humor Truck in the U.S. (Henderson and Landau, 1982). Even in times of disaster, food trucks have served to provide invaluable assistance and this is attributable to their rapid deployability to disaster strike zones, often on only a few hours' notice. As for service in times of war, during WWII, the American Red Cross commissioned dozens of mobile coffee and donut vendor trucks for deployment on military bases throughout the United Kingdom (Verderber, 2015). Since the early 1950s, prefabricated food canteen trucks have been fixtures on U.S. Army bases worldwide (Jones, 1928; Sharpe, 1996; Butler, 2014). The Salvation Army and the U.S. Federal Emergency Management Agency (FEMA) now routinely deploy first response food trucks to post-disaster strike zones to dispense pre-prepared meals to disaster victims and emergency relief aid workers (Verderber, 2008; Webster, 2011).

The earliest Industrial Age precursor to the contemporary food truck/ trailer was the horse drawn wagon in the experimental circus and gypsy encampments in 19th century Eastern Europe. There, confections and simple dishes were served to the working classes and to itinerant vagrants. By the late 1850s, traveling rail line diner cars became an important fixture of passenger trains, in response to expanding settlement patterns across the North American continent. In the American Southwest, in 1866, Charles Goodnight, a West Texas cattle rancher, outfitted his old surplus U.S. Army wagon with interior shelving and drawers and stocked it with kitchenware, food, and essential first aid supplies. This became known as the *Chuck Wagon*. Later, in the Northeastern region of the U.S., other 19th century precursors included Walter Scott's covered food wagon (1872) featuring small round windows cut into a canvas-sheathed covered wagon, parked daily in front of the town's local newspaper office in Providence, Rhode Island (Butler, 2014).

Outside North America, the American Doughnuts food truck has been a stationary fixture in Melbourne, Australia's Queen Victoria market since the mid-1950s, spawning myriad imitators in subsequent decades (Puvanenthiran, 2013). In Texas, the Tex-Mex push cart and food stand movement dates from the barrios of old San Antonio and the numerous Rio Grande border towns, in the 1920s and 30s, gradually spreading to towns throughout the Mexican border region (Arellano, 2013; Engber, 2014). The vendors who operated these businesses in the post-WWI decades would themselves often become beloved fixtures in the local community (Bryant, 2009). During this period most mobile food vending trucks and kiosks were modest, nondescript, and unselfconsciously designed and constructed, serving mostly construction site and factory workers (Belluz, 2010). The current food truck craze in the United States dates from 1974 when Raul

Martinez converted his decrepit ice cream truck into the first taco truck in the U.S. and then parked it outside his East Los Angeles barroom cantina. By 2015, the mobile food truck and trailer had become important fixtures at large rock music festivals, food festivals, in downtown business districts, at major sporting events, art festivals, and on college campuses across North America (Jones, 2015).

Three types of portable food preparation/ dispensary units are most prevalent at this time: (1) Self-powered autonomous vehicles free to roam the landscape; (2) Non-motorized trailer units that must be pulled by a motorized vehicle such as a pickup truck, or freestanding units transported atop another vehicle such as a flatbed trailer; and (3) Ubiquitous street vendor pushcarts (not included in this investigation). The contemporary food truck/ trailer is an artifact of enduring fascination and, in many contexts, is associated with a distinct subculture. With this said, the objectives of this investigation were threefold: first, to articulate a typology of food trucks/ trailers operating in a place well known for these food establishments. Second, to examine the physical attributes of various installation contexts within an urban environment, and third, to examine the role of environmental cognition as a theoretical and operative tool to learn why these structures and their immediate installation/site environs are of enduring interest and fascination (DeCassia, Ryzia, and Marras, 2014).

ATTENTION RESTORATION THEORY

The field of environmental psychology, and more specifically, theory and research in the subarea of environmental cognition, can provide helpful insight in terms of examining this enduring person-environment fascination with commercial vernacular building types such as food trucks/ trailers and their placemaking qualities, qualities which enable these structures and their place contexts to function as genuine attractions as much as *attractors*. Environmental cognition research emerged in the late 1960s in the work of geographers and psychologists largely by means of a technique known as cognitive mapping, whereby individuals and groups were requested to draw out on paper their internalized cognitive representations of a specific built environment, route, or geographic terrain known to them (Golledge, 1998). The manifold of topical foci within environmental cognition research has increased much since to now include salient explorations into the relationship of the role of neuroscience in how an individual experiences the everyday built environment (Robinson and Pallasmaa, 2015).

A particularly influential research stream within environmental psychology has been centered on the functionalist-evolutionary theory of human functioning in the physical environment, as developed by Stephen and Rachael Kaplan (Kaplan and Kaplan, 1982). The Kaplans' theory postulates that humans are biologically predisposed through our evolutionary past in a highly uncertain environment to crave visual information about our environmental surroundings, and this predilection compels people to endeavor to adroitly comprehend - to make sense of - incoming information (stimuli) of a type and quality as necessary to maintain a satisfactory degree of functional coping capability. Secondly, this information is essential to ensure our successful functioning, i.e. survival, in light of the rampant uncertainty that surrounds us in our daily existence. As a species, humans continuously crave and strive to process useful environmental information with the cognitive patterning of this information allowing one to discern foreground from background, color palettes, charging animals, and such, as we actively seek out any such relevant information to aid in our coping mechanisms in order to reduce our level of cognitive uncertainty. This requires a sufficient level of incoming visual information and stimulation, together with the promise of information of legible quality, which facilitates informational coherence. This thereby allows one to be further drawn into a specific scene or place with the promise of additional positive informational affordances obtainable as one further engages with a given object, setting, or building, perhaps repeatedly.

The bedrock of functionalist evolutionary theory is research premised on directed attention fatigue, a neurological phenomenon resulting from the overtaxing of the brain's inhibitory attention mechanisms which accommodate incoming distractions while allowing one to maintain one's focus on a specific task, place, or object. Directed attention fatigue assumes it is natural for one to alternate between periods of attention to a task, place, or object to periods of distraction from such stimuli. This latter condition is due to the need to cope with (suppress) excessive incoming external stimuli that may be otherwise difficult or impossible to make sense of. This inability to psychologically cope with the incoming flow and rate of external stimuli can result in environmental stress due to mental fatigue. A prime characteristic of mental fatigue is *inattention*. The two types of attention involved in this process are *involuntary* attention, which refers to attention that requires no effort at all (as when something intrinsically fascinating or exciting occurs) and *voluntary* attention, or directed attention (referring to attention that requires a great deal of effort) as when something is perceived as monotonous, undifferentiated, tedious, or simply boring (Kaplan and Kaplan, 1989). This theory has been researched in both laboratory and in field settings on topics ranging from Attention Deficit Hyperactivity Disorder (ADHD) to post-cancer treatment therapeutic regimens (Kuo and Taylor, 2001).

An aesthetically satisfying, inherently compelling task, place, or object, one that draws an individual to it for the promise of a positive experience, has been shown to aid in fostering recovery from attentional (mental) fatigue due to antecedent associated environmental stressors (Kaplan, 2001). Natural environments, such as forests, mountain landscapes and beaches have been found to be particularly effective in attention restoration in this regard and this occurs because these places and objects provide compelling stimuli. If it follows that fatigue and stress can be alleviated through exposure to nature, i.e. nature immersion, and exposure to compelling, interesting settings in some way connected with nature and landscape, these places will likely be perceived as especially preferred from an information processing perspective (Kaplan, 1995). Further, these places and landscapes will tend to attract individuals who seek them out, repeatedly. By extension, it stands to reason that individuals will involuntarily seek out a food truck or food trailer set in a context identifiably set apart from its surroundings. Such installations may be viewed as "islands" or oases once removed in some way, or set apart - refuges - providing a needed break from one's routine in a setting that simultaneously facilitates direct immersion with nature and/ or landscape.

This psychological phenomenon is referred to as Attention Restoration Theory (ART). It is based on an extrapolation of psychologist William James's 1892 definition of involuntary attention, which James described as having a directly fascinating, interesting quality, including "strange things, moving things, bright things, pretty things, metallic things," even including in his taxonomy of involuntarily interesting phenomena blood and wild animals (James, 1892). This theory posits that the term *automaticity* distinguishes between involuntary and directed attention and that, once again by extension, involuntary attention is activated when one is being automatically drawn towards a unique or compelling task, place, or object, such as a food truck/ trailer situated in nature and/ or landscape and at least somewhat autonomous from its everyday urban context, especially when sited 'off the beaten path' insofar as simultaneously fostering exposure to nature, i.e. trees, shade, grass, and/or picnic tables set amid a park-like ambiance, and thereby expressing a condition of relative cognitive automaticity.

A NORTH AMERICAN CASE STUDY

The contemporary food truck/ trailer movement in North America is in many respects epitomized in Austin, Texas, the state capital of Texas and the home of the University of Texas at Austin. This city has grown exponentially in recent decades. In 2000, Red Wassenich, a local civic booster who believed Austin's pre-boom, laid-back atmosphere was being threatened with extinction, first coined the phrase "Keep Austin Weird" (Hylton, 2013). He did this to counter his

fear that Austin was becoming merely another anonymous, faceless, *Anywhere USA* city. The Austin metro area is expected to expand to 5.3 million persons by 2050 (Hutheesing, 2013). Meanwhile, public transit alternatives such as a light rail system remain politically elusive and suburban sprawl is ongoing and rampant (Holtz, 1997; Yglesias, 2013). The two types of mobile food vending units predominant in Austin at this time are the self-powered truck and the non-self powered trailer variously pulled by a motorized vehicle from site to site. The food trailer is the most prevalent type, with approximately fifty units operating in Austin at this writing. Most mobile self-powered units roam about the urban landscape on a scheduled basis while others are stationary, remaining at a single site for months or even years at a time.

The field investigation consisted of firsthand and archival research conducted in 2014 and 2015. A qualitative methodological approach was adopted, with fieldwork consisting of two-hour site visits and photographic documentation of twenty-eight autonomous installation sites in Austin and its suburban environs, plus documentation of multi-unit installation sites each occupied by 6-10 units. Site visits to autonomous installation sites consisted of individual interviews with staff personnel and their clientele. For collective installations, where numerous units shared a single site, sit-down focus groups, each forty-five minutes to one hour in length, took place. These occurred with staff persons who sometimes worked in one or more units at a shared installation site. Focus group sessions were also held with unit owners. Small groups of clientele were also interviewed at these various shared installation sites. Five to six persons participated in each focus group (directed by this author) with all sessions and the one-on-one interviews recorded for purposes of content analysis. This data collection method illuminated many insights into the local food services industry relative to the role and perception of these portable food establishments. This information was augmented with archival research on the history and evolution of the food truck/trailer phenomenon in Austin and elsewhere in North America.

Based on the fieldwork, consisting of installation documentation, four types of food truck-trailer installations became discernable within three primary site locational variants: the downtown core, adjacent inner urban perimeter neighborhoods, and suburban/ edge city site contexts. Urban core sites were installations situated along main arteries leading to and from the Central Business District (CBD), where strings of *One-off and Arterial Necklace* installations operate (Type 1). *Type 1* installations consist of units installed on autonomous sites such as in parking lots, gas stations, or places shared with another commercial establishment such as a 7-Eleven convenience store. Multiple installations situated along a single artery collectively function as *necklaces* comprised of perhaps eight to twelve individual units sited intermittently along the same four to six block stretch of roadway on one or both sides of the street. More specifically, three primary Austin north-south commercial strips (South Lamar, South Congress, and South 1st Street) contain the majority of such installations, with the majority of these unattached trailer units, including (pictured) the *Best Wurst* and the *Regal Ravoli* (both custom built), *Crepes*, and *Chicken* (both adapted Airstream motor home travel trailers), *Torchy's Tacos* (an adapted carnival food trailer), and the *Purple Tounge* (an adapted private residential camper unit). These units typically feature a small adjacent outdoor seating area consisting of a shaded area with picnic tables, a bike rack, and an unpaved parking area in close proximity to the sidewalk or street. This is the predominant unit type in Austin: one–off independently owned and operated establishments either custom-designed for their current function or repurposed from a different, prior, non-food dispensary function (Figure 1a-1f).

A second installation type, *Type 2*, consists of units configured non-linearly on a single parcel of land expressly dedicated for the purpose of aggregating mobile units on a single site. These *Freestyle Food Court Encampment* installations operate in neighborhoods surrounding the CBD, in East Austin, and in the University area, including one noteworthy enclave in the Guadalupe Street neighborhood to the immediate north of the University of Texas at Austin campus; this neighborhood is the home of "The Slider House", a semi-sequestered outdoor food

court/ quasi-compound that houses eight units surrounding a former private residence repurposed as a bar and restaurant. Two of the eight units installed here, behind a tall wood fence, include *Love Balls* (an adapted yellow school bus) and *The Vegan Yacht* (an adapted Airstream travel trailer). In these examples of Type 1 and 2 installations, each unit is artfully and inventively painted in bright colors, with many featuring bold graphics, small festive lights strung above, and bright, offbeat neon signs (Figure 1g and 1h).

A third unit installation type, *Formal Food Court Encampments*, consists of quasi-informal groupings configured in a strength-in-numbers organizational pattern. These *Type 3* installations are more elaborate and aggregated, in plan. The most prominent, centrally located shared site in close geographic proximity to the Central Business District is the *Barton Springs Picnic* (2014), designed by the architectural firm Studio 8. This open-air food court was constructed on the site of a former 1950s trailer park. The 1.2-acre site was to be turned over for construction of a row of generic national fast food franchise outlets, but a sympathetic local developer intervened at the last minute when learning a number of the units were about to be displaced from an arterial necklace site to make room for construction of a generic national chain hotel. In response, permanent infrastructural support was provided on this new, shared site. Because many of these units were previously well-known 'refugees' being displaced from an ad hoc Type 1 *One-off and Arterial Necklace*_context, at *Barton Springs Picnic*, these dislocated trucks were clustered together in a semi-radial configuration. This tourist-centric place currently houses *Hey Cupcake!, Tapas Bravas*, *Turf n' Surf*, *The Seedling Truck, Mr. P's Electric Cock Fried Chicken*, and the *Gourmet Sandwich*_plus a few lesser-known units. Permanent restrooms are provided as is all utility infrastructural support (Figures 2a-2b). This 'wagon circle' surrounds an open-air central court with picnic tables placed beneath a pair of permanent canopies, together symbolizing a rapidly evolving, darker side of the equation, locally, as if now these units have to be installed safely together, not unlike a threatened animal species displayed to the public in a zoological park in order to ensure their continued survival (Figure 3).

Type 4 units, *Informal Suburban Encampments,* are located in suburban contexts. One notable example, the *Midway Food Park* (2014)*,* is situated in an urban fringe context on the Capital of Texas Highway 360 near the beginning of the Texas Hill Country. This master planned enclave consists of a parking lot with a fenced-in site, a playground, permanent restrooms, tree-shaded picnic tables at the center, and an outdoor stage for weekend musical performances (Figure 4). These amenities are surrounded by ten food trucks/ trailers configured in a semi-circle including the Dock & Roll Diner, an adapted fireworks truck (Figure 5) and The Celia Jacobs Cheesecake Experience, an adapted Airstream trailer (Figure 6). Other units installed in this open-air food park include the King & Country (trailer) and One Taco: An Urban Eatery (truck). Most of these units, as in the case at Barton Springs Picnic, were exiled from former installations in Type 1 arterial necklace sites in the urban core and later displaced to the urban fringe due to skyrocketing land values in the center of Austin. Its circle-the-wagons configuration is not dissimilar from Barton Springs Picnic only here the arrangement is somewhat looser and less spatially constricted. It is noteworthy that many food trucks and trailers in Austin, such as The Celia Jacobs Cheesecake Experience and The Love Bug, overtly draw aesthetic inspiration from a persistent romanticization of the 1960s "hippie" psychedelic counterculture movement in Austin.

Figure 1a-1h. Type 1 Installations: One-off and Arterial Necklaces (upper six images), and Type 2 Installations: Freestyle Food Court Encampment, The Slider House, Austin (bottom two images) (Source: Author).

Figure 2a-2b. Type 3 Installations: Formal Food Court Encampment, Barton Springs Picnic, Austin (Source: Author).

In documenting installations throughout Austin, it soon became apparent that nature and siting have a prominent role. Many installations afford protected refuge, a sense of escapism, even retreat, and as such, their operators seek to position the unit in close proximity to trees, lawns, and shrubs, and even water elements such as a small fountain. Connectivity with nature was in evidence, often, with the most financially successful and aesthetically offbeat, iconic, units almost always framed by a backdrop of nature. Such objects or structures set in natural environments or in urban oases such as is the case here, in point of fact, consistently fostered positive involuntary attentional behaviors as exhibited on the part of their clientele. This is most likely because these places are perceived as providing some measure of restorative amenity. By contrast, from an information processing perspective, food establishments, whether mobile or otherwise, lacking in iconic aesthetic imagery and nature amenity of this type may generally be perceived as significantly less compelling (Kaplan and Berman, 2010).

Figure 3. Type 3 Installations: Barton Springs Picnic, Austin, Axonometric View (Source: Author).

Automaticity

Automaticity, from an environmental cognition perspective, and with regards to the most highly preferred installations described above, is likely attributable to their being preferred over what is around them. The One-off *Arterial Necklace* installations depicted here are somewhat sequestered micro-settings onto themselves, possessing a separateness and autonomous identity as if throwbacks to an era when Austin was much smaller (and far more small-town in its ambiance). These installations are nested, as such, within their sites, making maximum use of any available landscape elements as if to draw one in effortlessly into an immersive world if even for a short period of time while eating an ice cream cone or sandwich. The *Freestyle Food Court Encampment* type is the result of many trucks/ trailers bundled on one site amid large shade trees surrounding a main house not unlike chicks snuggled around the mother hen. Its six-foot high wood fence, surrounding a nearly full square block refuge in the center of the city, reinforces an atmosphere of autonomous refuge. Operating hours are clearly defined and a large outdoor wood deck at the center of this compound further draws people together, inward, as if gathered within an outdoor room around an open-air fireplace, where one can see and be seen. It is a world onto itself, with landscaping elements seamlessly interwoven, all adding up to a sequestered ambiance and it being a place that fosters cognitive restoration, a sense of respite.

The *Formal Food Court Encampment*, personified by *Barton Springs Picnic*, is less informal and less random in its spatiality. It, too, possesses a degree of automaticity as it seeks to create a memorable experience with nature integrated yet somewhat less so compared to the more sequestered experience provided at *The Slider House*. At *Barton Springs Picnic*, the physical setting is overtly commercial and designed to be readily seen by the general public. Success is predicated upon its rapid identification from the road with the goal of drawing tourists in as well as locals. A row of mature trees frames two edges of this site as a sort of *nature wall*, providing a backdrop and yet integral to the overall aesthetic experience. On site, the individual experiences a strong sense of place. As for *Informal Suburban Encampments*, as personified by *Midway Food Park*, its automaticity lies in a restorative park-like setting protected by, in the case at Midway, a low fence that allows children to engage with the play spaces created for them and as a means to

Figure 4. Type 4 Installations: Informal Suburban Encampment, Midway Food Park, Austin (Source: Author).

Figure 5. Dock & Roll Diner, Midway Food Park, Austin (Source: Author).

draw families into this 'food park.' Its automaticity is derived from its geographic autonomy from the urban core, where the vast majority of food truck and trailer installations operate. Midway is designed to attract a clientele who might otherwise opt to drive further out from the city such as to a state park, for an afternoon

picnic. Its ART 'quotient' stems, most likely, from a perception of it being involuntarily fascinating while simultaneously affording the condition of cognitive respite, not unlike the experience of being on a camping trip.

The collective automaticity of the examples discussed above is premised on individuals' deep-rooted human information processing needs, and these needs likely explain why these places are so preferred, as well as because they are seen as novelties. Individuals are repeatedly drawn to them because they stand apart from their otherwise generic, even bland, i.e. non-restorative, everyday urban surroundings. They stand apart in a positive way. They each provide the opportunity for some degree of immersion in nature. As noted earlier, involuntary attention is defined as incoming stimuli about the physical environment that is perceived as relatively effortless. Voluntary attention, on the other hand, typically requires a significant degree of directed, i.e. fatigue inducing, attention in order for an individual to be able to maintain sufficient focus on the task, place, or object at hand. The latter condition is, as mentioned, far less preferred compared to the former.

Figure 6. The Celia Jacobs Cheesecake Experience, Midway Food Park, Austin (Source: Author).

Moreover, excessive periods of directed attention can result in deleterious behavioral and health outcomes beyond fatigue alone. One's workplace may be seen as stressful, although going out to a food truck for lunch and sitting at a picnic table amid shade trees can constitute an antithetical experience. From an environmental cognition perspective, for these reasons, these places stand apart as different, as magnetic. In this regard, the most compelling food truck/ trailer installation sites described above provide a sense of being nestled amid a backdrop of nature/ landscape. It is an atmosphere in some ways tantamount to an individual occupying a natural 'outdoor room' amid a dense urban environment. As such, these places and structures possess the timeless capacity to satisfy deep-rooted human functionalist-evolutionary predilections. As a species, humans are attracted to informationally interesting objects set in natural environments, novel and

unique physical forms and attributes, all of which is in direct support of what William James first hypothesized in 1882.

Learning from Roadside Commercial Vernacular

The role and function of commercial vernacular architecture in the everyday milieu is no less important now than when Robert Venturi and Denise Scott Brown traveled to Las Vegas with their Yale University architectural design studio in 1970 (Venturi and Scott Brown, 1972). This seminal work remains highly instructive insofar as it illustrates how intrinsic meaning often lies hidden amid the ordinary everyday vernacular built landscape (Esperdy, 2012). Architects and urban designers can draw numerous positive lessons from the food truck and trailer movement in North America at this time, including, specifically, the following:

A Canvas for Design Experimentation: The portability and scale of a mobile food establishment and its installation context allows for aesthetic experimentation in tone, timbre, and visual appearance, with messages ranging from the risqué to the political to the whimsical, sometimes all at once, and in a mutually reinforcing manner. Here, the whole can yield something entirely greater than the sum of any of its individual component parts, all in an effort to fuse pragmatic functionally with an inventive symbolism (Rice, 2013).

Health Promotion Amenity: A food truck/ trailer can contribute to a neighborhood's vitality, ambience, and walkability. One or more units on a shared site can function as a destination point in support of a community's physical wellness and behavioral health needs, and hence, in the promotion of healthier urban lifestyles in a community (Verderber, 2012; DeCassia, Ryzia, and Marras, 2014). One such example is the South Congress (SOCON) neighborhood in Austin, where locals and tourists congregate to patronize food truck and trailers sited in a *necklace* installation pattern along a three-block long stretch of this street.

The Virtues of Mobility: An autonomous food truck/ trailer is able to roam with freedom in a manner not otherwise possible with any conventional permanent-site building. This freedom to roam untethered can take on extreme expressions, an ability to operate for one day or even for one hour at a site and then the next hour at a different site, perhaps miles away, without being hampered by the logistics associated with tedious building codes and site preparation work, all costly, tedious, painstaking processes even in the best of times with respect to the successful operation of a permanent-site food establishment.

A Minimal Carbon Footprint: A food truck/ trailer unit is a prefabricated, often modular, 'offsite-built' structure. Its manufacturing process consumes far less non-renewable resources and space compared to a conventional building because excess construction materials and unused resources can be minimized in type and volume. Prefab buildings designed in this manner are lightweight and transportable, not unlike a yellow school bus or mobile Airstream trailer repurposed for use as a food truck/ trailer versus the comparatively costly up-front expenditures necessitated with the design and construction of a conventional, permanent-site building.

Urban Catalysts: A run-down aggregation of vacant lots on Harrison Avenue in the South End of Boston provided an ideal stage for the emergence of the now-popular *SoWa Market*. There, the establishment of artists' studios, an open air farmers market, and a food truck enclave has injected new life into a once-forlorn urban zone near Boston's CBD, which had suffered from decades of benign neglect and disinvestment (De Costa Klipa, 2015). This off-the-beaten-path yet now 'hip' enclave demonstrates how, when effectively sited, one or more food trucks or

trailers can foster urbanity by drawing people to a place previously considered off the "hipness" cultural grid (Van Wettering, 2014).

SUMMARY AND FUTURE DIRECTIONS

This has been the first attempt to apply an environmental cognition theoretical perspective to the study of commercial vernacular architecture in North America. More specifically, it is the first time Attention Restoration Theory (ART) and the concept of automaticity, as embedded within environmental cognition theory and research, has been applied to further understand the enduring and repetitive-exposure psychological importance of these structures and their immediate installation contexts. The perspective afforded by ART and the role of automaticity helps in explaining why the best of these places and structures are compelling, even fascinating. It is a perspective premised on humans' deep-rooted psychological preference for places and buildings in some way rooted in our biological evolutionary past. At present, this relationship between environmental stress, fatigue-reduction, and the aesthetic preference for commercial vernacular places and buildings remains only minimally understood. Regardless, it is a subject that warrants further qualitative as well as quantitative research. It is hoped that future research will address what has been a limitation of the work reported above: the dilemma of objectification. In other words, what is of most importance to an individual? Is it the imagery and physical attributes of its immediate natural environs, the imagery and physical attributes of the installation itself, or some combination of both?

The 19th century food wagon was a strictly utilitarian device, serving the day-to-day survival needs of its customers. The journey could be quite inhospitable and the food wagon would typically be stationed in a clearing that provided shade and respite for the weary journeyman worker or traveler, and these amenities undoubtedly contributed to its early, and continued, financial longevity. It is not unreasonable to draw parallels between its automaticity and the current practice of locating a food truck/ trailer in a semi-sequestered location next to yet apart from a road or worksite, yet not disconnected from nature/ landscape. This provides an equivalent experience, namely, a psycho-socially preferred alternative to the repetitiveness encountered in the everyday generic urban environment.

As for the future of the food trailer/ truck in North America, unit operators are often seen as threats to nearby permanent-site restaurants and at times have been subjected to NIMBYism (Settembre, 2014). In some cities, discriminatory actions continue to occur with some regularity against unit operators (Millar, 2008; Kendzior, 2014). In Chicago, a prosecutorial ordinance was adopted in 2014 that requires food trucks and trailers to remain at least 300 feet from any existing 'permanent' food establishment (Stroka-Rickert, 2014). Because of this, a historical perspective is in order; J.B. Jackson, in his 1984 essay "The Moveable Dwelling and How it Came to America," elaborated upon the merits of Charles Goodnight's 1866 innovation, extolling the merits of the portable building as an important cultural artifact, commercial or otherwise (Jackson, 1984). Jackson viewed transportable buildings as expressing a libertarian ideal, symbols of an unbounded freedom on the periphery of the open North American frontier. To him, they deserved to be independent (free) of any conventional land ownership laws, free to stand as vibrant, prefabricated, low-cost, environmentally sustainable alternatives to conventional (permanent) buildings.

As mentioned at the outset, some misperceptions still persist within the Academy regarding the merits of North American commercial vernacular architecture, the automaticity of food trucks and food trailers notwithstanding. Within postmodern urban discourse, however, Michael de Certeau has drawn the distinction between the preordained (sanctioned) and the tactical (unsanctioned). He views them as opposing interventional strategies in the design of cities, and yet as entirely compatible strategies in urban resuscitation efforts, with the ability to function within a loose *both/ and* somewhat randomized pattern as opposed to a rigidly didactic

either/ or polarity (deCerteau, 1988). Denise Scott Brown and other leading urban designers have similarly advocated for the virtues of *both/ and* spontaneous spatial interventions in the everyday urban milieu (Scott-Brown, 1990; Crawford, 2008). Portable architecture personifies what can be achieved if thoughtfully, imaginatively, and effectively implemented. An inventively designed and sited food truck or trailer can help to energize an otherwise forlorn, decaying urban space, neighborhood, or district, and for this reason alone they are worthy of further investigative architectural and urban research attention.

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ACCESSIBLE HOUSING AND HEALTH-RELATED QUALITY OF LIFE: MEASUREMENTS OF WELLBEING OUTCOMES FOLLOWING HOME MODIFICATIONS

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Abstract
The multi-dimensional relationship between housing and population health is now well recognised internationally, across both developing and developed nations. This paper examines a dimension within the housing and health relationship – accessibility – that to date has been considered difficult to measure. This paper reports on the mixed method results of larger mixed-method, exploratory study designed to measure the impact of home modifications on Health-Related Quality of Life, supported by qualitative data of recipients' experiences of home modifications. Data was gathered from 157 Australian HACC clients, who had received home modifications. Measurements were taken for both before and after home modifications and reveal that home modifications were associated with an average 40% increase in Health-Related Quality of Life levels. The qualitative results revealed that participants positively associated home modifications across six effect themes: increased safety and confidence, improved mobility at home, increased independence, supported care-giving role, increased social participation, and ability to return home from hospital. This exploratory research gives an insight into the potential for accessible architecture to impact improvements in community health and wellbeing.

Keywords: *Home modification; housing; accessibility; disability; aging population*

INTRODUCTION
At the core of this research is the fact that housing is more than bricks and mortar; it provides not only shelter, but also influences a range of social and health outcomes (Thomson et al, 2009). This study offers an understanding of how investing in housing design through a program of home modifications directly influences measurable health outcomes in the form of Health Related Quality of Life. (HRQoL) in the houses of older people and those living with a disability. This examination of home modifications and HRQoL enables a broader understanding of the links between accessible housing, aging, and disability and ultimately contributes to a picture of the dynamic relationship between the built environment and community health and wellbeing in the context of the changing health of populations due to ageing and disability.

Also critical to this research is the fact that most existing Australian housing was designed with an 'average user' (a healthy, young, adult male) in mind (Burns, 2004; Heylighen, 2008; Imrie, 2003). In the case of Australia, this has resulted in an older housing stock of predominantly inaccessible housing (Carnemolla and Bridge, 2012). This pattern of ageing populations, increased levels of disability, and older housing stock is a situation that is replicated across both developed and developing nations (Brodsky, 2003; Liebig, 2000).

Motivations for this research

The housing and health relationship has received increasing interest in recent years with a number of systematic reviews (Gibson et al, 2011; Thomson, Petticrew, and Morrison, 2001; Thomson et al, 2009) and is now considered one of the major environmental, as well as social, determinants of population health (Marmot et al, 2008). Globally, many studies have investigated the health of populations and their housing conditions, with a body of evidence that strongly associates between poor health and poor housing (Bonnefoy, 2007; Bridge et al, 2003a; Thomson et al, 2013). The findings in this study respond directly to calls for intervention studies aimed at assessing the health effects of building modifications (Braubach, 2011) and elaborating on the pathways between housing and health (Gibson et al, 2011).

In housing and health reports, housing interventions vary broadly from focusing on living conditions, such as thermal or air quality, to housing poverty, to levels of accessibility within the home. There has been little research measuring and comparing levels of access in housing by comparing the physical built environment. Indeed the social impact of inaccessible housing is difficult to measure because the association between housing and health is complex and causal relationships can be hidden or influenced by multiple factors (Jacobs et al, 2010). This, in part, explains the lack of data or research studies exploring the relationship between access and community health and wellbeing. Despite there being an extensive international body of evidence identifying non-shelter outcomes of housing and the subsequent impacts on vulnerable populations (such as older people and those living with a disability), there is less research exploring how the architectural attributes themselves can play a role in impacting non-shelter outcomes for people.

This paper draws on the quantitative results of a larger mixed methods research study, whereby the home modification experiences of 157 participants are examined, sourced from a group of Australian Home and Community Care (HACC) clients. HRQoL data for both before and after home modifications was collected in a survey and was measured using the Assessment of Quality of Life (AQoL). This was converted to pre- and post-utility and dimension scores enabling comparison.

This exploratory research project was designed to measure how incremental improvements to the accessibility of housing has a direct impact on health and wellbeing outcomes. The study design is single arm and captures the ‘before’ and ‘after’ data in a single survey. The quantitative results suggest the existence of a positive relationship between home modifications and HRQoL.

What is a home modification?

Throughout this paper, the term ‘home modification’ is used to describe the structural changes made to the home environment to help people to be more independent and safe in their own home and reduce any risk of injury to their carers and care workers (Adams et al, 2014). These modifications are often prescribed by an occupational therapist and relate specifically to a person’s health, comfort, and ability to live independently at home. Research into home modifications has steadily increased since 1990 (Carnemolla and Bridge, 2015) and is interdisciplinary, spanning the fields of housing and health.

Accessibility as it relates to home modifications

This paper is concerned with accessibility as it relates to architecture and the built environment. Accessibility in this context can be understood to be an approach to the design, construction, and improvements of the built environment that consider how people, regardless of their age or ability, experience the design in terms of mobility, usability, independence, and equity. The term accessibility is often used to describe the built environment alongside nuanced terms such as

inclusive, *barrier-free, visitable*, and *universal design*. Home modifications, as measured in this study, are an architectural intervention designed to improve the accessibility of people's houses.

Measuring wellbeing in the context of how we experience the built environment

In a recent systematic review on home modification evidence (Author citation, 2015), all the included studies that actively reported on links between home modifications and wellbeing had positive findings (Ahmad, Shakil-ur-Rehman, and Sibtain, 2013; Lin et al, 2007; Allen, 2005); however, they all measured home modifications as part of a multi-factorial intervention. Overall, there has been relatively little direct investigation into how home modifications influence Health-Related Quality of Life and wellbeing of recipients This study responds to the need for research to be conducted on home modifications as a single intervention, rather than as a component of a multi-factorial intervention. This enables a unique understanding of the impact of the built environment independent of other interventions.

Wellbeing is a broad concept that integrates physical, mental, and social domains. Global indexes that attempt to measure the overall wellbeing of populations tend to have numerous categories of wellbeing, illustrating how it is impacted by many life domains, e.g. the Organisation for Economic Co-operation and Development (OECD) has developed a Better Life Index with 11 categories of wellbeing, housing being one, while the Canadian Index of Wellbeing has eight. Housing encompasses a range of characteristics that are integral to wellbeing (Bratt, 2002). Wellbeing has strong associations with the meaning of home and research suggests that, along with other non-economic factors (such as health deterioration, family composition changes, and local amenities), it is an important determinant in the housing choices of ageing populations (Sabia, 2008).

This paper is specifically concerned with wellbeing as it relates to people's experience of changes made to the physical, built form of their housing following home modifications. This study is designed to isolate and measure the influence of built form on the wellbeing of older people and people living with disabilities and it uses an established measurement in the form of Health-Related Quality of Life (HRQoL)

Measuring wellbeing as HRQoL

Health-Related Quality of Life (HRQoL) can be understood to be quality of life measurement in a health care context. It is a multi-dimensional indicator that, like quality of life, incorporates domains related to physical, mental, emotional and social functioning. These are also health-related to the extent that they are influenced by disease, injury, treatment, or policy (Patrick and Erickson, 1993). Measurements of HRQoL are converted to utility scores, a cardinal number, and are often incorporated as a component in health economics (Sullivan, 2003). The measurement of HRQoL changes associated with home modifications is an important indicator of the success of such home modifications as a community health intervention, for a number of reasons.

- It is linked to self-care models of health care (Aalto, Uutela, and Aro, 1997; Buck et al, 2012) and autonomy (Vernooij-Dassen et al, 2005);
- It acknowledges person-centered (patient-centered in the case of health care provision) models of health and care that are focussed not only on need but individual choice and preference (Reeve et al, 2013); and
- It considers health in broader context than simply the body (e.g. wellbeing, social, and environmental)

METHODS

The study is a single arm analysis of data on HRQoL gathered for both before and after home modifications. Eligibility for the study was based on participants being community dwelling recipients of Australian government supported care services (Home and Community Care

clients). This meant that all participants would be either frail older people or people living with a disability. All of the Home and Community Care (HACC) clients included in the study had received home modifications prescribed by an occupational therapist. Participants were included in the study where their home modifications had been completed within a six-month period prior to the survey being distributed.

Data

Primary data was collected in a survey distributed to recent recipients of HACC-supported home modifications via the two home modification service providers in New South Wales, Australia. The survey was designed as a cross-sectional capture of longitudinal data (before and after), meaning that self-reported data on care, HRQoL and related comments about experiences of home modification were captured in a single survey at a single point in time, between one to six months after home modifications were completed.

In addition to the survey data, data was available in the form of detailed health information and home modification information. This was derived by matching the survey responses with the relevant client files (which were de-identified on site) containing both medical diagnoses and home modification information.

Measuring HRQoL in a survey

When measuring wellbeing or quality of life in relation to a particular intervention (such as home modification), there are various kinds of surveys that can be used. The constitution of the World Health Organization (WHO) defines health as “a state of complete physical, mental, and social wellbeing not merely the absence of disease…” (WHOQOL Group, 1993). The more specific concept of Health-Related Quality of Life (HRQoL) has evolved in recent decades to encompass those aspects of overall quality of life that can be clearly shown to affect health, either physical or mental. HRQoL instruments, also known as multi-attribute utility (MAU) instruments, measure the utility of health states that is suitable for an economic evaluation such as a cost utility analysis. Selection of the most appropriate instrument requires an understanding of a particular instrument’s validity and reliability for the sample population being studied (Guyatt, Feeny, and Patrick, 1993). The Assessment of Quality of Life was chosen for this research study because it was based on Australian populations and in particular had been validated for older, community-dwelling Australians.

The Assessment of Quality of life (AQoL)

The Assessment of Quality of Life (AQoL) instrument was developed by the Centre for Health Economics, Monash University, Victoria, Australia. There are four versions of the AQoL, based on length of instrument. AQoL-4D is the shortest, with 12 questions in a 1-2-minute completion time. The AQoL-4D instrument was specially formatted to capture pre- and post- HRQoL data in the single survey. Throughout the survey design process, the developers of AQoL-4D, Centre for Health Economics, Monash University, were consulted about the modifications and the final survey design was approved by representatives of the Centre for Health Economics. AQoL-4d was the instrument chosen for this research.

The Assessment of Quality of Life (AQoL-4D) was integrated into the survey design to determine Health-Related Quality of Life. AQoL-4D was administered in the form of 12 questions to gather utility data regarding recipients’ experiences before and after home modifications. The response was then converted to a utility score using SPSS statistic software. Australian population norms are available for the AQoL (Hawthorne, Korn, and Richardson, 2013), which has been validated for use in Australian health studies. The AQoL is also considered valid for testing older, community-dwelling populations (Osborne et al, 2003). The resultant utility scores are a measure of Health-Related Quality of Life.

The aims of the survey were to collect a range of primary data unavailable in secondary data sources including:
Demographic details about respondents, including age, income status, tenure, living status, and health.

- AQoL-4D responses for before and after home modifications. This enables any difference in utility scores (calculated from the AQoL-4D instrument) between before and after home modification to be measured.

The survey design had to gather longitudinal data of HRQoL in a single capture. The successful completion of the survey required a level of cognitive understanding that could differentiate between before and after the home modifications. The single capture methodology is vulnerable to recall bias on the part of respondents as they are being asked to provide data on two different time points in the one survey. The survey was designed and laid out using Adobe Illustrator software. The final format was a four-page, double-sided A4 document that was colour printed for distribution. A total of 650 surveys were distributed with 157 valid responses received.

Table 1. Matrix documenting the quantitative variables analysed in the study.

Variable	*Description*	*Unit*	*Measured*	*Source*
AQoL Utility Scores	AQoL utility	Utility (0-1)	Before and after home modifications	Self-reported in survey and converted using SPSS
AQoL Dimensional Scores	Independent Living Dimension	Cardinal score (0-1)	Before and after home modifications	Self-reported in survey and converted using SPSS
	Relationships Dimension	Cardinal score (0-1)	Before and after home modifications	Self-reported in survey and converted using SPSS
	Mental health Dimension	Cardinal score (0-1)	Before and after home modifications	Self-reported in survey and converted using SPSS
	Senses Dimension	Cardinal score (0-1)	Before and after home modifications	Self-reported in survey and converted using SPSS

The AQoL-4D instrument estimates utility using a three-stage procedure. Items are (i) weighted and combined using a multiplicative model to obtain dimension scores; (ii) these are weighted and combined to obtain an initial AQoL score; (iii) this is then transformed econometrically to produce the final estimate of a health state utility (Richardson, Peacock, Iezzi, Day and Hawthorne, 2007). AQoL-4D utility algorithms for the conversion were downloaded from the AQoL website.

Five variables were calculated in the data collection: an overall utility score and 4 dimension scores (uD) that related to the four sections within the AQoL-4D 12 questions. These

five variables were collected in a pre- and post- format, for comparison between before and after home modifications. The utility dimension (Ud) scores are not comparable with the total utility score, but before and after Ud scores are comparable within each dimension. Dimensions included independent living, relationships, mental health, and senses.

Inferential statistics

Statistical analysis was undertaken using the Statistical Package for Social Sciences (SPSS) version 21. Descriptive statistical analysis was completed on the demographic information, AQoL scores, and informal and formal care hour data. Primary collected data was confirmed as having normal distribution and ANOVA testing was performed. The statistical procedures used in this research included summary statistics, standard ρ analysis. ANOVA testing is one-sided and considered to be significant where ρ value was < 0.05.

RESULTS

Sample Demographics

A total of 157 respondents were included in the analysis. This yielded a survey response rate of 24.1% (157 participants out of a sample of 650 eligible participants). A summary of the sample characteristics follows:

- The average age of respondents in the sample was 72 years, with an age distribution in line with HACC population data sets for NSW.
- In terms of being categorized as older people, or younger people living with a disability, 13% (20) were younger than 55 years old and living with a disability and 87% (137) were frail or unwell older people.
- The gender balance approximated the NSW HACC population, with just over half (54%) being women.
- Within the sample, 1.3% identified as Indigenous.
- The sample overall predominantly lived with a partner or spouse, followed by people living alone. Those who lived alone were predominantly women while the men in the sample tended to be living with a spouse or partner.
- The sample population tended to be financially supported by the aged pension.
- The sample featured overwhelmingly owner/ occupiers of their home.

Table 2. Demographic statistics of sample.

	Count	Percentage of total sample
GENDER	157	
Female	85	54.1%
Male	72	45.9%
MEAN AGE (years)	71.86	
HOUSING TENURE		
Being purchased	2	1.27%
Fully owned	149	94.90%
Live with family members	2	1.27%
Own caravan and annex and rent site	1	0.64%
Private rental	2	1.27%
Retirement village	1	0.64%

	Count	Percentage of total sample
LIVING ARRANGEMENTS		
Live alone	42	26.75%
Live with a spouse or partner	84	53.50%
Live with family or friends	30	19.11%
SOURCE OF INCOME		
Carers allowance	2	1.27%
Disability support pension	28	17.83%
Full aged pension	102	64.97%
Part aged pension	16	10.19%
Self-funded retiree	8	5.10%
Wage or salary full time	1	0.64%
INDIGENOUS STATUS		
Indigenous	2	1.27%
Non-indigenous	155	98.73%

Health of the sample

Detailed health information was derived by matching the survey responses with the relevant client files (which were de-identified on site), containing both medical diagnoses and home modification information. This enabled a snapshot of the overall health diagnoses of the sample, indicating the prevalence of co-morbidities. Co-morbidities (also referred to as multi-morbidities) are defined as the 'simultaneous occurrence of two or more chronic conditions' (Taylor et al, 2010, 1).

More than half (53%) of the participants were diagnosed in their medical reports as frail aged. Although on average, participants were diagnosed with two morbidities, a number of them had up to five (5) chronic or life-threatening health conditions (Figure 9).

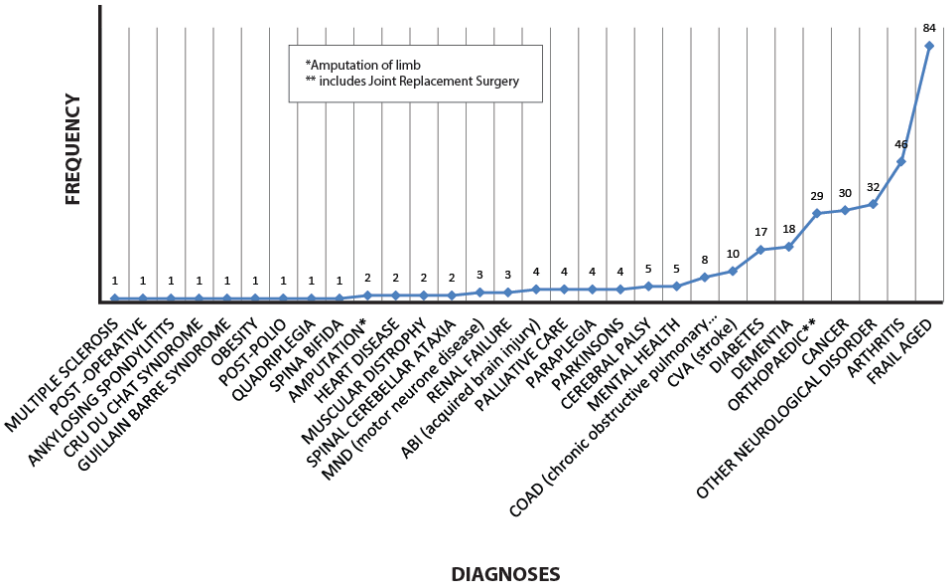

Figure 1. Analyses of diagnoses in the sample - average 2 diagnoses per participant.

Figure 1 shows the frequency of all diagnoses reported in the data. A total of 323 morbidity diagnoses were recorded for the 157 participants, with 'frail aged' being the most prevalent diagnosis in the sample (54%), followed by arthritis (29%), neurological disorders (20%), and cancer (19%).

Living situation and source of income

Twenty seven percent (27%) of the sample in this study reported living alone. The survey asked respondents to nominate their main source of income. Analysis of the responses showed that, overall, the full age pension was the predominant source of income (64%).

Housing tenure

Information on housing tenure was sought in the survey and revealed that the sample reported overwhelmingly (95%) to be owner/ occupiers of their own homes.

AQOL data results

The AQoL data results (in the form of utility scores) reveal whether a home modification changes the Health-Related Quality of Life of the recipient of a home modification. Analysis of the utility scores and utility dimensions (independent living, relationships, senses, and mental health) communicate the potential for home modification to impact autonomy and overall wellness/ wellbeing.

Inferential Statistics

Paired sample t-testing was conducted for all pre-post variables. All pairs were calculated to have statistically significant results, except for the utility dimension of senses (uD3SEN), which revealed a p score of 0.06. This result is unsurprising, given the two questions in the AQoL-4D that relate to uD3SEN ask about vision and hearing changes, health aspects that in the dataset were not targeted by home modifications specifically.

AQoL utility scores are reported in Figure 2 and display averages for:

- Average AQoL utility scores for the data set before and after home modifications
- AQoL utility scores for the Australian population of equivalent average age (70-79) as reported by Hawthorne et al (2013)
- Australian population norm (includes all ages) as reported by Hawthorne et al (2013)

The graphing of before and after average utility scores for the data set indicates that home modifications resulted in an average increase of 0.12 utility points, increasing from 0.3 to 0.42 for the study participants. However, the data set still has a lower average utility score than the general Australian population (0.81) and the Australian population aged between 70-79 years (0.76).

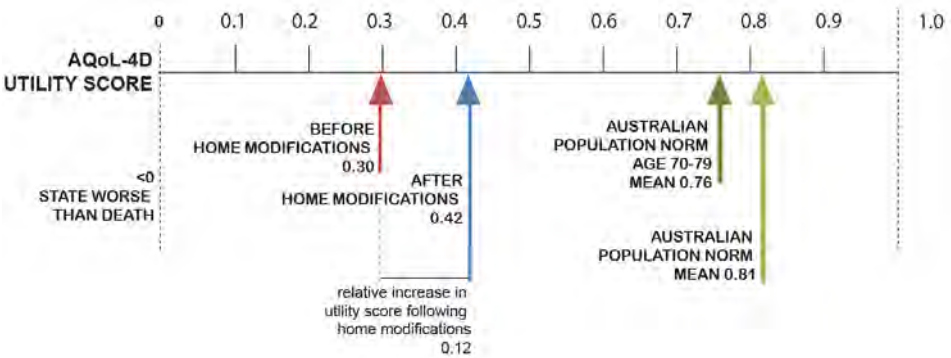

Figure 2. Analysis of the utility dimensions (uD).

The AQoL-4D instrument used for this research included 12 questions about the following four quality-of-life dimensions: Independent Living, Mental Health, Relationships, and the Senses. Data from the survey was collated and analysed using AQoL algorithms in SPSS software. Mean utility could also be analyzed according to the individual utility dimensions of AQoL-4D. Table 18 indicates how utility was distributed for each of the dimensions.

Table 3. AQoL Utility Dimension (uD) data.

AQoL Dimension	Mean Dimension Score Before Home Modifications	Mean Dimension Score After Home Modifications	Change in Dimension Score	% Change from Original Score
uD Independent Living	0.62	0.72	+0.10	+ 16%
uD Relationships	0.75	0.81	+0.06	+ 8%
uD Mental Health	0.82	0.87	+0.05	+ 6%
uD Senses	0.84	0.87	+0.03	+ 3.5%

Of note, and as anticipated, the biggest change in mean utility was in the Independent Living dimension (+0.10). Levels of self-reported independent living, mental health, relationships, and senses are all important influencers of utility scores in this context. As shown in Table 17, the Senses dimension was the least significant of dimension variables and the difference in before and after results is the smallest of all the dimensions. This was in line with expectation, due to the Senses questions being about changes to hearing and vision, not attributes targeted by home modifications.

What modifications were made

In order to understand what home modifications were made in the sample, home modification data was analyzed in terms of where the modifications took place in the home, specifically the bathroom, the kitchen or laundry, or as an access modification to help move in/ out/ through the house. Given their broad variability (from a bath hand rail to an electric lift), they were considered too variable to be typified according to type. Figure 23 compares the home modifications in each location. Bathroom modifications were the most common in the sample (78.3%) followed by modifications to help in moving through the home (61.8%) and, well behind in third place, kitchen or laundry modification (4.4%).

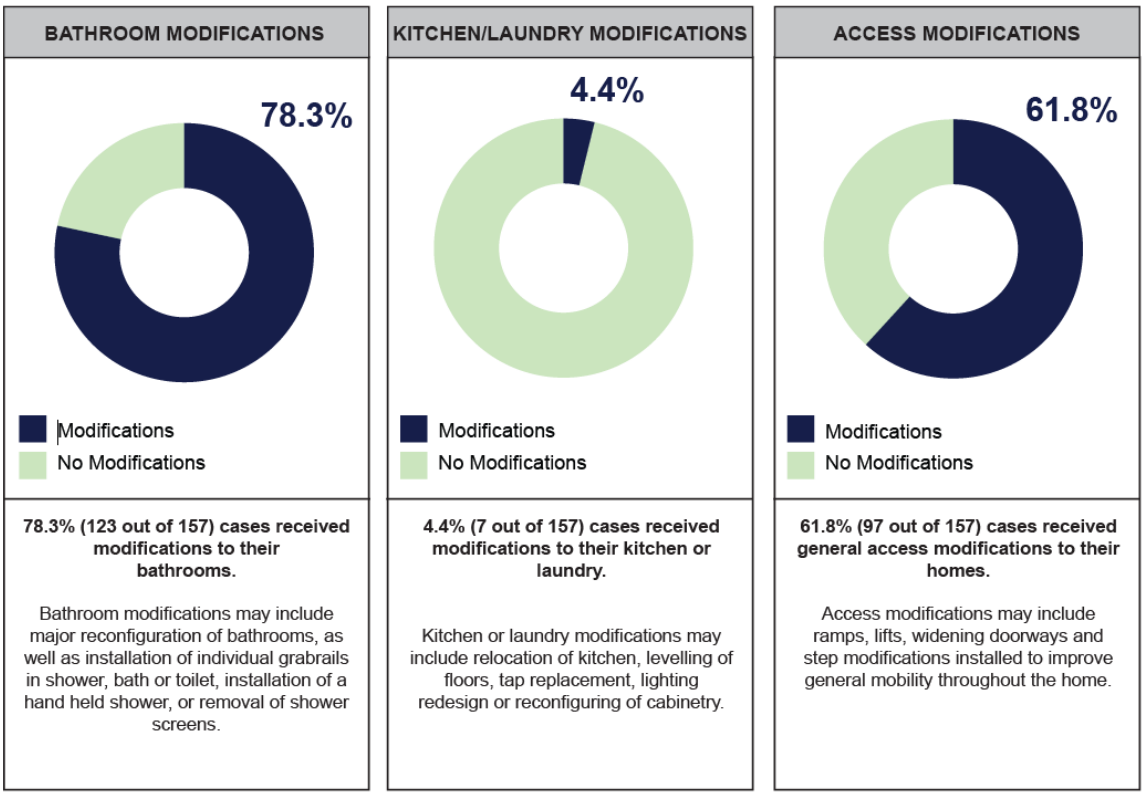

Figure 3. Where home modifications were made in the home.

DISCUSSION

The research findings suggest the existence of a relationship between home modifications and HRQoL, more specifically, they suggest that home modifications lead to an overall increase in participants' utility scores. Overall, with an average increase in utility score of 40 % after home modifications were installed, this relationship is significant. This positive result in self-reported wellbeing measures following home modification is reflected in two previous qualitative studies, Andrich et al (1998) and Pettersson et al (2012).

Overall, there has been relatively little direct investigation into how home modifications independently influence wellbeing measures such as HRQoL. Therefore, a major contribution of this present research is the study of a single-factor home modification intervention with directly-compared 'before' and 'after' HRQoL values.

When reviewing the sample demographics it becomes clear that people receiving home modifications through government funded services are overwhelmingly owners of their own home while receiving a government pension. The significance of a predominance of home owners is that it signals an exclusion of private renters, possibly due to difficulties in authorizing home modifications through landlords. This brings to light the need for research in this area in the context of building and construction policy: how home modifications might be able to be better provided to older people in a way that does not exclude private renters who are older or living with a disability.

The utility dimensions

This is the first study to apply the Australian-developed and validated Assessment of Quality of Life directly to changes in utility following home modifications, and therefore, the first time that the utility dimensions have been explored from the perspective of home modifications.

The findings relating to the utility dimensions as part of the overall utility score support the idea of an overlapping suite of effects working in combination, all as a result of home modifications. Increases were found to be statistically significant in three of the four utility dimensions: Independent Living, Mental Health, and Relationships. The fact that the fourth utility dimension, Senses, is least influenced by home modifications is unsurprising, given that, although home modifications can improve the environment for hearing or vision, by improving light levels for example, they cannot directly improve a person's vision or hearing levels.

An implication of these findings in utility dimensions is that it reinforces the multi-layered influence a home modification can exert in a hierarchy: firstly, providing independence, secondly, impacting mental health, and thirdly, impacting relationships in the home.

Relating the study to Australian population norms of HRQoL and health of the sample

This study found that average self-reported measurements of HRQoL (measured as a utility score) increased by 40%, from 0.3 before home modifications to 0.42 after home modifications. This means that the sample population (whose average age was 72 years) sits well below the Australian population norm of 0.76 for the compatible average age bracket (70-79) (Hawthorne et al, 2013). The study sample is even further below the overall Australian population norm for all age groups, which is 0.81. The lower average utility scores in this study can be explained, at least in part, by the complex and serious health problems consistently found throughout the sample.

Being a sample drawn from the HACC-eligible population would suggest that the participants were more likely to be frailer and have more co-morbidities than the equivalent-aged non-HACC eligible population. It would be fair to consider that the sample represents a snapshot within the Australian population who are likely to rely considerably on public health budgets and community health services. The significant positive influence of home modifications on overall HRQoL as well as the dimensional increases in Independent living, mental health, and relationship is an important signaller for the value of our home environments to contribute to public health and community services costs, such as caregiving for more vulnerable populations. Indeed, further research within this wider study explores the influence of home modifications on caregiving directly and is pending publication.

HRQoL and home modification location

The mapping of where home modifications were carried out in the home indicates that the bathroom was the most common location at 78.3%, followed by general access modifications. This tells us that the design of bathrooms has a significant role to play in maintaining levels of independence and wellbeing in the houses of older people and those living with a disability. This is unsurprising on two levels; first the nature of personal self-care tasks such as toileting and washing are undertaken in the bathroom. Requiring care with these tasks can significantly impact the nature of relationships in the home. Therefore, maintaining or restoring independence in the bathroom not only restores the autonomy and ability of the person, but the care relationships in the home. This is reflected in the increase in utility dimensions of Independent Living and Relationships.

CONCLUSION

Implications of the research

Evidence from this research shows that home modifications have the potential to improve HRQoL scores by 40%. Taking into consideration the exploratory nature of the research and the possibility of recall bias in the self-reported results, the resulting data was found to be statistically significant and the results remain compelling.

The results for the utility dimension data highlight the role home modifications can play in influencing a number of different, yet overlapping wellbeing factors (independent living, mental

health, and relationships) that, when combined, result in significant improvements in Health-Related Quality of Life. There is supporting evidence for each of the overlapping factors, including independence (Gignac, Cott, and Badley, 2000; Pettersson et al, 2012).

The contribution that the results of this study make to an understanding of housing and health pathways are fourfold:

- It gathers primary housing and health data directly and concurrently, where previous evidence has tended to be populated by less direct housing and health associations, due to multi-factorial research, indirect health data, or estimated care data.
- It measures health from the perspective of the built housing domain, which is important for future cross-disciplinary policy making.
- Given the lifespan of buildings, it focuses on rehabilitation or improving buildings to bring about health improvements, as evidenced by the increase in HRQoL results following home modification.
- It provides a basis from which to understand the broader health consequences of regulatory and performance-based building codes relating to accessibility.

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SUSTAINABLE TALL BUILDINGS: CASES FROM THE GLOBAL SOUTH

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Abstract
This paper examines recent sustainable tall buildings in the Global South, mainly in the Middle East and China. These buildings are redefining how architects, engineers, and planners view skyscrapers, creating a new building typology in regards to function, ecology, technology, and user comfort, in the process. These "futuristic" buildings are setting new social, spatial, and environmental standards, setting a milestone in ecologically friendly architecture. Most of the reviewed projects in this paper have achieved national and international recognition from architectural and planning organizations. They represent the most recent work in the field and have exerted a profound impact on the architectural profession. This paper also summarizes the key lessons that sustainable tall buildings have brought to the field, highlighting the role of breakthrough technologies in enhancing the efficient performance and sustainability of future tall buildings.

Keywords: *Sustainable design; new technologies; creative forms; innovative approaches; green aesthetics*

INTRODUCTION

Sustainable tall buildings will become extraordinarily important in the 21st century, as many cities around the world embrace vertical density to house their growing urban populations. Twenty years ago, the world's urbanized population was only about 33%; today, more than half of the world's population lives in urban settings. By 2030, it is expected that about 60% of the world's population will reside in urban environments. Researchers project that in 2050, over 80% of the world population will live in urban areas, with the world's population reaching approximately 9 billion people, and most of this growth occurring in the Global South (Al-Kodmany, 2015).

Given the large-scale problems of conventional skyscrapers, the benefit of sustainable towers is that any improvement in their design and construction will be significant. Tall buildings serve many people and exert powerful demands on the environment and existing transportation, sewage, and electrical infrastructure. Thus, green design may better serve the tenants of these skyscrapers, while also mitigating their environmental impact and enhancing their integration with city infrastructure. Given a skyscraper's large size, there is plenty of justification to employ green features in the construction of new skyscrapers and to retrofit existing ones. These accumulated factors have engendered a substantial interest and demand in the research, design, and development of eco-towers. Historically, building competitions have centered on designing the largest and most iconic towers. Today, however, competitions are shifting toward building greener skyscrapers (Goncalves, 2012).

This paper examines the recent "green" solutions that have been integrated to make skyscrapers more sustainable. It strives to find ways to make future skyscrapers more sustainable at the architectural scale. Building on a growing body of work, in practice and from architectural literature, this research reviews key skyscrapers that have been labeled as "green," "eco-friendly", or "sustainable", specifically in two regions: the Middle East and China (Hsu, et al, 2009; Martona, 2006). The towers examined by this research represent a new generation of tall buildings, offering high-performance systems, high-quality materials, and healthful interiors for both workers and residents.

These new designs are reshaping the future of tall buildings and employing green technologies at a prolific scale. For this reason, architects are designing cutting-edge energy systems, including helical wind turbine technology, water-saving technologies, solar panels, sunlight-sensing LED lights, rainwater catchment systems, graywater and blackwater recycling systems, and seawater-powered air conditioning to further reduce the environmental impact of these monumental structures (Kong, 2007).

THE MIDDLE EAST

In the Middle East, many cities are investing in skyscrapers. Example of these include Dubai and Abu Dhabi in the U.A.E., Doha in Qatar, Kuwait City in Kuwait, Manama in Bahrain, and Mecca, Jeddah, and Riyadh in Saudi Arabia. The height of these skyscrapers, along with the intensity with which they are being built, is rapidly changing the face of many of these cities (Al-Kodmany and Ali, 2013). In Mecca, Saudi Arabia, the 601 m (1,972 ft) megatall (exceeding 600m tall) Abraj Al-Bait Towers Complex, which overlooks the site of Islam's holiest shrine, the Kaaba, has recently been completed. It has a large elevated clock, a seven-star hotel, an enormous prayer area, and a shopping mall. It is the tallest building in Saudi Arabia and it has the largest floor area of any building in the world, at about 1.5 million square meters (16 million square feet) (Dupre, 2013). As of this writing, the construction of Jeddah's 1,000 m (3,281 ft) high Kingdom Tower is underway. When built, it will be the tallest building in the world surpassing the height of the Burj Khalifa in Dubai. Similarly, Qatar has also seen unprecedented growth in tall buildings, including the Burj Qatar, rising 231 m (760 ft), and the 300 m (984 ft) Aspire Tower, the tallest building in Doha at present (Al-Kodmany and Ali, 2013; Pacione, 2005). However, this new trend constitutes an architectural paradigm shift that focuses on sustainable design, exemplified in the following case studies.

O-14 Building, Dubai, U.A.E.

O-14 is located along the extension of Dubai Creek in the Business Bay area of Dubai, occupying a prominent location on the waterfront esplanade. Dubai is located in the United Arab Emirates (U.A.E.), a country situated on the southeast coast of the Persian Gulf. With over two million inhabitants, Dubai is the second most populous city in the U.A.E. and possesses the greatest land area in the country. In a matter of two decades (1990-2010), Dubai has emerged as a global city that functions as a hub for business, commerce, culture, and transportation.

O-14 is a 22-story commercial tower that rises from a two-story podium. The building contains 27,871 m^2 (300,000 ft^2) of office space and offers ground level retail spaces that link the tower with the Business Bay's waterfront esplanade. Four levels of below grade parking provide capacity for over 400 cars. Reiser + Umemoto, RUR Architecture P.C., and the structural engineer, Ysrael A. Seinuk, (YAS) P.C. collaborated on this project, titling it "O-14" given the site's numbering system of the Business Bay district. The construction of the 37,036 m^2 (398,655 ft^2) tower on a 3,159 m^2 (34,000 ft^2) site was completed in 2010 (Al-Kodmany, 2015; Parker and Wood, 2013).

The dominant feature of the iconic O-14 tower is its curvaceous, white exoskeleton that stands 1 m (3 ft) away from the inner glass-walled enclosure, evoking a monumental and monolithic exterior. With swerving contours, the concrete shell is perforated by 1,326 openings of varying sizes that were positioned through a complex and "random" pattern, creating a lace-like effect on the building's façade. Architecturally, the varying openings seek to attenuate the monotony of the external façade. They also provide an ever changing sense of interior space through a fascinating interplay of natural light and shade. Furthermore, the random pattern provides flexibility in the possible re-arrangement of the floor plates in the event of potential structural change. Overall, the exoskeleton possesses a unique sculptural quality that expresses sublimity and monumentality (Al-Kodmany, 2012a and 2012b).

In addition to providing architectural and aesthetic quality, the tower's shell serves as the prime structural component. It provides an efficient exoskeleton that frees the core from the burden of lateral forces and creates a column-free, spacious interior of about 557 m^2 (6,000 ft^2). The shell is organized in an efficient diagrid pattern that maintains a minimum structural member by adding material where necessary and taking away where possible.

The required structural effectiveness of the shell was achieved by balancing material strength and aperture size. That is, larger openings received greater support through changes in concrete mixture. The total height of the exterior shell is 106 m (347 ft) with a thickness of 60 cm (2 ft) at the ground level through the 3rd level, and 40 cm (1.25 ft) from the 3rd floor to the rooftop. The openings were classified into five different types based on their sizes with the smallest diameter spanning a distance of 1.4 m (4.5 ft) and the largest spanning a distance of 8.3 m (27 ft) or a full two stories. Altogether, the openings take up about 45% of the façade (Al-Kodmany, 2015).

Environmentally, the concrete shell responds well to harsh desert conditions more effectively than the typical glass-clad box. The shell functions as a sunscreen that is open to light, air, and views. In addition to structural requirements, the openings are modulated according to view, sun exposure, and luminosity. The one-meter gap between the main enclosure and the exterior shell creates a “chimney effect”, whereby hot air rises to cool the surface of the glass windows behind the perforated shell. This passive solar technique is a natural component of O-14’s cooling system, which has resulted in over 30% decreases in energy consumption and costs.

In order to create the perforated exoskeleton, O-14 used a slip-form construction technique that utilizes Computer Numerically Cut (CNC) polystyrene void forms. Super-liquid concrete was cast around these void forms, and once the concrete had cured, the forms were loosened and moved up the tower to resume construction on the subsequent level. This process reduced the costs typically incurred by a more geometrically complex structure.

Jesse Reiser and Nanako Umemoto have become best known for devising creative architectural solutions, bringing innovative designs and a distinct look to make the tower stand out from the generic office towers of the region. O-14 could function as a new and influential “desert prototype” that protects occupants from the high heat and the dust storms of the Middle East, while still providing attractive views. The building has garnered international interest and has been featured in major architectural magazines. It was also a finalist in the CTBUH’s 2010 Best Tall Buildings in the Middle East and Africa award. The jury’s statement emphasized the innovative and multi-functional façade, noting the building’s structural efficiency, natural ventilation, solar shading, and brilliant aesthetics. Specifically, they commended the spectacular light-and-shadow created by the perforated shell to evincing a unique internal mosaic. The building design offers a striking and successful departure from the modernist’s glass box, providing a skyscraper prototype that should be mimicked in desert climates (Figure 1).

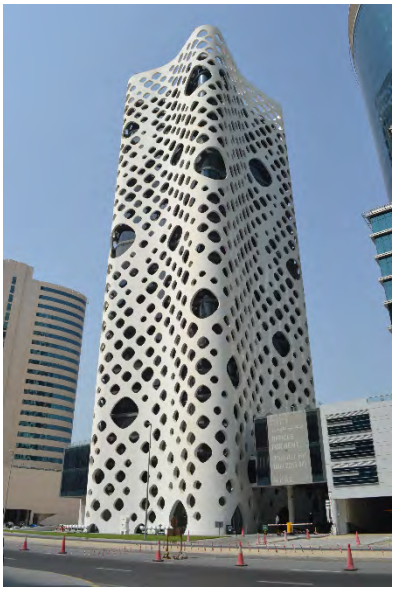

Figure 1. O-14 Building in Dubai, UAE. (Source: Author)

Al Bahar Towers, Abu Dhabi, U.A.E.

Al Bahar Towers, the new headquarters for the Abu Dhabi Investment Council, occupy a prominent site on the North Shore of Abu Dhabi Island, in the United Arab Emirates (U.A.E.). They overlook Eastern Mangroves, Sadiyaat Island and the Arabian Gulf. Abu Dhabi is the capital and the second largest city in the U.A.E., with about one million inhabitants. Completed in 2012, the project comprises two 25-story, 150 m (490 ft) tall towers totaling 70,000 m^2 (753,000 ft^2) of office space. They can accommodate about 1000 employees and share a common podium and a two-level basement. The towers possess a distinct elliptical form, a slight bulging of the middle reminiscent of London's Swiss Re Building. However, the most striking feature of the Al Bahar is the modernized mashrabiya system it uses to protect itself from the harsh desert sun. In addition to the visual interest it evokes, the Al Bahar is a far-reaching feat of sustainable engineering. The towers are among the first buildings in the Gulf to receive the U.S. Green Building Council LEED Silver rating (Al-Kodmany, 2015; Wood, 2012).

In the last decades, Abu Dhabi has witnessed significant high-rise development that embraces Western models of all-glass curtain walls, ignoring local climatic conditions. Cooling all-glass buildings is costly, both financially and environmentally, particularly in hot climates like that of Abu Dhabi where intense sunlight causes temperatures to frequently rise above 38ºC (100ºF). Despite this fact, glass towers prevail in the Middle East. Genuine concerns have been raised against unsustainable practices resulting in the publication of the Abu Dhabi 2030 Plan, which consists of a comprehensive development framework based on the principles of cultural and environmental responsibility. This framework plan has been further refined by the Estidama environmental management standard and the Masdar initiative on renewable energy. Because of the Abu Dhabi 2030 plan, tall buildings have started to witness a design shift from "imported" to "custom-built", addressing environmental issues while simultaneously developing a unique desert aesthetic (Cilento, 2012; Parker and Wood, 2013).

The architectural design of Al Bahar Towers relies on local climate and culture, perhaps the most intuitive and longstanding sources of inspiration for any design. The towers have modernized the traditional mashrabiya, a shading device formed by perforated wooden-lattice screens in geometric patterns that is commonly found in vernacular Islamic architecture. The mashrabiya fulfills multiple functions by providing privacy, reducing solar gain and protecting inhabitants from glare. Furthermore, it adds visual complexity and interest to the building's exterior. Unlike the static and two-dimensional traditional mashrabiya, Al-Bahar's mashrbiya is dynamic and three-dimensional, consisting of a series of transparent umbrella-like units (made of PTFE-polytetrafluoroethylene) that open and close in response to external solar conditions. Sensors on the façades communicate solar conditions to the building's management system (BMS), which controls the opening and closing of the units, creating an intelligent façade.

The outer skin is set two meters from the inner skin which is comprised of a glass curtain wall. The mashrabiya system, forming the outer skin, features 2000 transparent umbrella-like units (1000 on each tower) which have been strategically placed along the exterior to block the direct light of the sun. In response to direct sunlight, the mashrabiya can unfold to cover the façade, and when the sun is obscured, they can close to allow for light penetration. Parametric and algorithmic modeling have been used to optimize the mashrabiyas' location on the façade, precluding the use of dark tinted glass, which would permanently restrict incoming light. The system provides a 50% reduction in solar gain, resulting in decreased energy consumption and CO_2 emissions. Geometrically, the mashrabiya system follows a hexagonal pattern that simulates traditional Arabic-Islamic design. As a mashrabiya system opens and closes, the towers always change their appearance stimulating intriguing aesthetics. The south-facing roof of each tower incorporates photovoltaic cells to generate enough power to adequately operate the mashrabiya system. The system was designed by Aedas from London Studio in collaboration with the engineering firm Arup.

Al Bahar Towers have been well-recognized, earning the CTBUH Innovation Award and the Best Tall Building in the Middle East and Africa Finalist Award in the 2012 CTBUH Awards Program. The Awards Chair Richard Cook of Cook+Fox Architects has commented that "the façade has an interactive relationship to the environment which is reminiscent of the opening of a morning glory flower to the sun …The winners display remarkable creativity, as well as a respect for the environment, connection with place, and the urban surroundings" (Al-Kodmany, 2015, 212).

Antony Wood, the council's executive director, has added that "the dynamic façade on Al Bahar, computer-controlled to respond to optimal solar and light conditions, has never been achieved on this scale before." The twin towers came second in the Emporis (a German-based skyscraper data company) skyscraper awards for projects completed in 2012. The Emporis praised the Aedis-designed office towers for providing "a dynamic, translucent façade that runs off power generated by photovoltaic panels and which reacts to sunlight" (Al-Kodmany, 2015, 212) (Figure 2).

Figure 2. Al Bahar Towers in Abu Dhabi, UAE. (Sketch by author)

Doha Tower, Doha, Qatar

Doha Tower (2012) is a 46-story, 231 m (758 ft) tall high-rise located in the West Bay of Doha, Qatar. Situated on the east coast of the Persian Gulf, Doha, the country's capital, is home to approximately one million people, making it Qatar's largest city and the economic and political center of the country. Both day and night, Doha Tower is a remarkable building in the city's iconic skyline due to its innovative façade and integrated lighting system. Doha Tower (also known as Burj Doha and Burj Qatar) serves as a beacon and symbol of Arab-Islam's cultural melding with technology and modern architecture reviving local meaning in the face of rapid globalization.

Overlooking the Gulf, the 45 m (147 ft) diameter building contains 41 floors of offices, a restaurant with panoramic views located on the 42nd floor, and a private penthouse. The tower is topped by a full-span dome and spire, and clad in an intricately patterned stainless steel screen with Arabic-Islamic geometrical patterns. The light and shadow interplay facilitated by the intricate geometric patterns has created one of the most remarkable penthouse spaces in the history of tall buildings. Constructed without the central support column common to most skyscrapers, the tower is instead formed from a circumference wall of reinforced concrete diagrid columns. Giant X-shaped pieces are linked to create the building's tubular skeleton from which its floors are supported. This system creates a unique effect in the office spaces in conjunction with the façade screen. The cylindrical form of the tower possesses an aerodynamic profile that provides structural efficiencies. The circular floor plan maximizes the perimeter of the building with relatively short distances to the core, which house the elevators and services. The core of the building is shifted off-center to allow for more flexible configurations in the office spaces, with the subtly changing form of the building giving each floor a different capacity to meet various programmatic functions.

Designed by Jean Nouvel, the tower innovatively hints at a postmodern design through references to local culture and vernacular architecture. The outer skin of the tower draws on the "mashrabiya," a prevailing form of wooden lattice screen that integrates Arabic-Islamic geometrical patterns. Mashrabiya is often incorporated in the façades of vernacular Islamic architecture for multiple purposes includeing

privacy, reductions in solar gain, and protection from glare. In Doha Tower, Nouvel modernized the mashrabiya and applied it at a grand scale at various density patterns with multiple layers responding to solar orientations and weather conditions. In areas exposed to direct sun, extra, denser layers were used to cope with summer temperatures that often rise above 50ºC (122ºF). Approximately 25% opacity has been achieved on the north façade, 40% on the south, and 60% on the east and west (Parker and Wood, 2013).

The resulting visual impact is provocative. While the geometric patterns appear uniform from afar, the variation becomes clear up close, lending the building to multiple textural experiences. The inner skin of the building is a typical all-glass curtain wall that facilitates abundant natural light, with the mashrabiya and diagrid systems enhancing the spatial quality of the interior giving it ever-changing pattern of light and texture. The cavity between the tower's skins is spacious enough to prevent overheating from occurring while allowing for maintenance crews to walk in between. User-operable solar shades are also available behind the glazed curtain wall. The overall façade system is estimated to reduce cooling loads by 20%.

While the intricate façade gives the tower a graceful dignity during the daytime, Nouvel collaborated with lighting expert Yann Kersalé (designer of the Post Office Tower's lighting system, the second case study in this paper) to develop an appropriate lighting scheme that enhances the appearance of the tower at night. Kersalé employed a clever lighting scheme that accentuates the mashrabiya design with programmable capabilities that transition between 'gold' and 'silver', giving the tower a jewel-like quality and making it highly identifiable in the city's crowded skyline. Luminaires were placed in the cavity between the cladding system and the curtain wall, each lighting an area approximately 2 m (6 ft) wide by 3 m (9 ft) high. On average, 82 luminaires were placed in each of the 44 floors, while other luminaires were placed atop the tower to illuminate the long spire. Lighting units were carefully located so as not to clash with the window cleaning cradle that runs along a rail that circles each floor of the building. UNIVERS, an IP addressable control system, was used to operate the entire lighting scheme. It was also used to check the temperature of every luminaire on the project and to remotely update the programming.

The base of the tower is wrapped in a 25-meter-wide pergola that provides a shaded entry. A gentle grade slopes down to the lobby entrance, providing a smooth transition from the well-landscaped outdoor space to the interior of the building. A large interior atrium reaching a height of 112 m (400 ft) houses eight glass elevators which offer breathtaking views of the surrounding city. Three levels of parking that accommodate a total of 870 cars were built below grade. Located within the dome, the office tower houses a luxury residence that enjoys private access and elevator service. This penthouse offers an awe-inspiring 360 degree view of the city and a splendid interior aesthetic, the culmination of the mashrabiya cladding system.

Doha Tower reflects Jean Nouvel's deep interest in façade detailing and reveals his outstanding commitment to culturally-sensitive design, drawing on traditional practices combined with modern technology. In the eighties, Nouvel modernized the traditional mashrabiya concept by designing the southern façade of the Institut du Monde Arabe (IMA) [Arab World Institute] in Paris, France. He created a technology-based mashrabiya that incorporated several hundred light sensitive diaphragms which regulate the amount of light which may pass into the interior. The design simulates the opening and closing of camera lenses in response to various lighting conditions. Guided by the light sensors and based on the exterior solar conditions, the mashrabiya opens and closes to create changing geometrical patterns of squares, circles and octagonal shapes – a dynamic interplay of light and space. As in the case of Doha Tower, the IMA's mashrabiya system not only evokes an intriguing aesthetic, but also controls solar gain and glare. Whereas the IMA's mashrabiya is dynamic, the Doha Tower's mashrabiya is static. However, it is layered to respond to various solar conditions, creating similar visual textures and complexity. IMA won the Aga Khan Award for Architecture in 1989 and the Equirre d'Argent for French architecture in 1987.

The technological elements, holistic design, energy efficient strategies, and green features of this tower are commendable. However, it is the tower's cultural and geographic context that makes it a truly unique work of architecture as well as a national icon. Consequently, Doha Tower has received the 2012 CTBUH Skyscraper Award for the Best Tall Building Worldwide. Richard Cook of Cook+Fox Architects,

the Awards Chair, commented that the towers' skin is the most innovative feature of the building. By modernizing the mashrabiya, the building evokes a new aesthetic rooted in the Arabic-Islamic culture. The tower's design is particularly remarkable given that architects in today's globalized world typically give little consideration to local climate and culture (Figure 3).

Figure 3. Doha Tower in Doha, Qatar. (Photograph by W. Maibusch)

CHINA

China is the world's leader in skyscraper construction. In the world's entire history of construction, China's recent construction boom is unprecedented (Wood, 2011). With only 10 skyscrapers from 1929 until 1945, China was a non-factor in skyscraper discourse. Today, however, China has exceeded the United States in the number of skyscrapers within its boundaries. The country now accounts for 53% of the world's skyscrapers that are under construction. There are currently 259 skyscrapers (buildings over 150 m/492 ft) under construction in China, more than any other single country. Nine of the world's tallest 20 buildings under construction are located in China, three times more than any other country. China now plans to build the tallest skyscraper, Sky City, in Changsha that will be a 220-story structure standing at 2,749 ft (838 m). It will house 17,400 people and also boast hotels, hospitals, schools, office space, and 104 high-speed lifts (Wu and Mab, 2006; Zhang, 2007). Interestingly, similar to the case of the Middle East, the new trend constitutes an architectural paradigm shift that focuses on sustainable design, exemplified in the following case studies.

Pearl River Tower, Guangzhou, China

The 71-story, 309 m (1,016 ft) tall Pearl River Tower is home to the CNTC Guangdong Tobacco Corporation located in the Tianhe District of Guangzhou, China. Guangzhou, known in English as Canton, is a large port city and the capital of China's Guangdong province. It is located on the Pearl River about 120 km (75 mi) north-northwest of Hong Kong and north-northeast of Macau. Guangzhou contains a population of over 12 million people, making it China's third most populous city. The spacious Pearl River Tower brings an instant iconic identity to the city. Designed by Smith and Gill during their tenure at the Chicago-based SOM, the tower was topped out in 2010 and officially opened in 2013.

The Pearl River Tower serves as a pioneer in collaborative design. The form of the skyscraper not only minimizes wind pressure, reducing the need for structural steel and concrete and the carbon emissions embodied therein, but also utilizes wind power. Featuring a sculpted body that relieves wind pressure on its windward side, Pearl River Tower contains 4 large wind turbines (6 m by 6.8 m or 20 ft by 22 ft) which capture wind funneled by the building's unique form. The funneled wind (up to 1.5 to 2.5 times ambient wind speed) pushes the turbines to generate energy up to 15 times more powerful than freestanding turbines. In addition to powering the building, this wind is rerouted throughout the tower's

ventilation system, filtering the air through the building's floor and ceiling spaces. In order to maximize the wind effect, the tower has been positioned so that its broadest side faces the prevailing wind (Fairley, 2014).

The 212,165 m^2 (2,281,949 ft^2) building is also fitted with advanced double-glazed façades that provide abundant natural light. The outer skin features a high permeability for solar heat while the inner skin prevents solar gain. The trapped heat rises up creating natural ventilation along the building's façade. Toward the top, exchangers absorb, reuse and store this rising heat. The inner skins on the eastern and western sides have been made of a triple glazed glass that helps insulate the building's interior. Given the tower's shallow floor plate, natural light is able to permeate most of the interior spaces. On the south façade, large-scale solar panels have been installed on the roof and on lower areas where wind openings are used to generate electricity. The skyscraper's metal window blinds automatically track the sun, opening and closing to regulate solar heat gain. These window blinds are also equipped with photovoltaic cells which capture the s sun's energy when they are pulled shut. Because the building is located in a sub-tropical region (characterized by high heat and humidity), it faces challenges of cooling. In this regard, SOM utilized a passive dehumidification system that removes moisture, heat sinks, radiant slabs, and underfloor displacement ventilation to efficiently cool the building. Other sustainable features include the cooling beam structure and the graywater collection system. The design team's original goal was to construct a positive-energy building that would sell its excess power to the local electrical grid. However, due to local regulations and fire codes, the original design was compromised, and consequently, the completed building consumes about 40% of the energy a similarly sized traditional building might use (Figure 4).

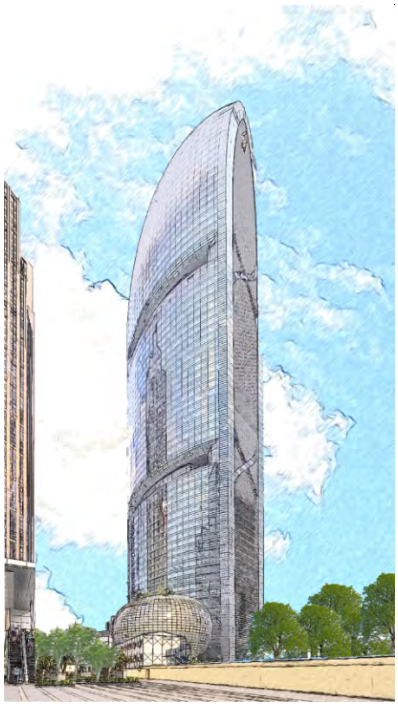

Figure 4. The Pearl River Tower by SOM in Guangzhou, China.
(Sketch by author)

Shanghai Tower, Shanghai, China

The Shanghai Tower is the third tower in the trio of supertall buildings including Jin Mao tower and the Shanghai World Financial Center located in the heart of Shanghai's new Lujiazui Finance and Trade Zone adjacent to the Huangpu River. Spurred by the Chinese economic reforms of the 1980s, the Lujiazui district in Shanghai has been transformed from farmland to a skyscraper city (nicknamed Manhattan of the East) in just two decades. As is the case in many Chinese cities, rapid urbanization has engendered vertical density. With 23 million inhabitants, an increase of almost 50% in the past decade,

and 9 million migrant workers, the City of Shanghai has had no choice but to build upward. According to the city's officials, it is more efficient to build a giant skyscraper near mass-transit stations, referring to Shanghai Tower, than to build smaller skyscrapers in the suburbs.

The Shanghai Tower rises to a height of 632 m (2,073 ft) dwarfing its neighboring skyscrapers, the Jin Mao Tower 421 m (1,380 ft), and the Shanghai World Financial Center 492 m (1,614 ft) as well as every other skyscraper in the Lujiazui area. It is the tallest building in China and the second tallest building in the world, after Dubai's Burj Khalifa at 828 m (2,717 ft) tall. The twisted Shanghai Tower also surpasses the world's tallest twisting tower, the Cayan Tower, located in Dubai. That building was inaugurated in 2013 and stands at 307 m (1,010 ft) tall. This new iconic landmark in the ever evolving Shanghai's skyline enjoys an evocative curved façade that symbolizes the dynamic emergence of modern China. The 121-story tower anchors Lujiazui and offers a mix of functions including offices, hotels, shops, restaurants, as well as the world's highest open-air observation deck at 562 m (1,844 ft). Overall, Shanghai Tower's sustainable strategies will reduce the building's carbon footprint by 34,000 metric tons per year and the tower is targeting LEED Gold certification from the U.S. Green Building Council and a three-star rating from the China Green Building Council. The tower broke ground in 2008, and was topped out in 2013. It is anticipated to open to the public in 2015. The cost is estimated at $2.5 billion (Xia, et al, 2012).

The Shanghai Tower represents a new paradigm of rethinking the sustainable vertical city. It is a city within a city, a collection of multiple neighborhoods. The 623 m (2,043 ft) tower is divided into nine neighborhoods, stacked vertically, making it a self-contained city. What also makes this arrangement unique is that one third of the tower is assigned as a "true" public space where all visitors are welcomed. This urban concept builds on practices of the Chinese culture and tradition, but represented vertically. Each neighborhood in the tower contains a sky garden intended to evoke the landscaped courtyards of Shanghai's historic homes. In traditional lane houses found in Beijing's hutongs and Shanghai's shikumen, families live in close-knit dwellings organized around a communal open space. In the case of Shanghai Tower, the neighborhoods are vertical, each comprising 12 to 15 floors and featuring a 24-hour accessible sky garden to foster social interaction and a sense of community. Each vertical neighborhood rises from the sky garden to create a sense of unity and community, as well as to support daily life with a mixed-use program that caters to both tenants and visitors. Furthermore, the sky gardens help to ease traffic jams near elevators and provide spectacular views of the city.

The sky gardens also provide energy savings and ventilation advantages. They act as buffer zones between the inside and the outside by warming up cool winter air and dissipating accumulated summer heat from the building's interior. Stale indoor air is blown across each garden before being exhausted from the building. Since only the lowest ranges of the 12-to-15-story-tall sky garden are occupied, these spaces will require minimal conditioning. Spatially, the sky gardens are formed by the interplay of the tower's two glass skins: the inner skin being circular, while the exterior skin takes on the shape of a triangle with rounded corners. The outer skin rotates around the inner skin almost one degree per floor, resulting in an impressive twisting form. The double-skin-façade (DSF), advanced lighting controls, and an efficient central plant, among other features, are expected to help the Shanghai Tower use 21% less energy than if it were compliant to 2004 ASHRAE 90.1 standards (Xia et al, 2012; Gensler, 2014).

In addition to being iconic, the tower's form is meant to resist the typhoon-level winds common to Shanghai. To that end, the form embraces multiple strategies including asymmetry, tapering, rounded corners, and a reduced floor plate as the tower rises. Testing scenarios and simulation were carried out to simulate typhoon-like conditions, suggesting a 120-degree twist as the optimal rotation for minimizing wind loads. The resulting form reduced the lateral loads of the tower by 24 percent, saving $58 million in building materials (Gensler, 2014).

The structural system comprises a concrete core and several composite super-columns, which rest on a 20-foot-thick concrete mat of 1,079 bored piles. The building enjoys a strong 30 meters squared core that is designed to resist the threat of a windy climate, active earthquake zone, and clay-based soils typical of a river delta. The core acts in concert with an outrigger and super-column system. There are four paired super-columns, two at each end of each orthonormal axis. In addition, "four diagonal super-columns along each 45-degree axis are required… at the base between the main orthonormal super-columns" (Al-Kodmany, 2015, 260). The tower's inner skin is attached to circular floor slabs and the protruding outer skin is suspended from the building's mechanical floors, which are supported by a series of radial bars and encircling girts.

The tower's site incorporates a garden inspired by traditional Chinese landscaping, which satisfies the Shanghai government's requirement that 33% of the site is reserved as an open space. The garden engages people with nature, enhances the human scale, and provides a space for social interaction and relaxation.

Renewable energy technologies have been employed to provide on-site energy. Wind turbines, located directly beneath the parapet, generate power for the upper floors, while a 2,130 kW natural gas-fired cogeneration system provides electricity and heat energy to the lower floors. Rainwater is collected via the building's spiraling parapet and has been used for the tower's heating and air conditioning systems. Water treatment plants have been incorporated into the tower's shaft, podium, and basement to reduce the energy required for pumps. The building also recycles gray water and storm water for irrigation and toilet flushing. These strategies will result in a 38% overall reduction in water consumption.

The HVAC system, strategically placed in the mechanical floors, provides heating, ventilation, and cooling to the building's various vertical zones. It also preconditions, filters, and measures air quality before entering the building. Mechanical floors also house electrical transformers, water systems, and other equipment. Locally sourced materials with a high-recycled content have been used throughout. The sustainable measures employed by Shanghai Tower are expected to reduce the building's carbon footprint by 34,000 metric tons per year compared to a typical structure of the same size. The tower has a five-story, 37 m (121 ft) podium totaling 46,000 m^2 (495,000 ft^2) that contains retail, banking, restaurants, conference meeting, and banquet facilities.

The level below-grade floors features retail, 1,800 parking spaces, services, and MEP (mechanical, electrical, and plumbing) functions. Designed by Mitsubishi, Shanghai Tower will have the world's fastest elevators, transporting visitors at speeds of up to 18m/s or 40 mph. It should be noted that Gensler Architecture, in collaboration with the Architectural Design and Research Institute of Tongji University, provided the sophisticated design work done on this building. The Shanghai Tower Construction & Development Co., Ltd served as the project's developer, while Thornton Tomasetti provided structural design inputs along with Cosentini Associates, which specialized in the building's mechanical and electrical design.

Parkview Green FangCaoDi, Beijing, China

Parkview Green FangCaoDi complex (literally in Chinese, "green, grassy area") is located in the heart of Beijing's Central Business District (CBD). It is an iconic landmark and a potent symbol of creative design thinking that promotes attractive forms, efficient utilities, functionality, and enjoyable experiences. The project was designed by Integrated Design Projects, engineered by ARUP, developed by Hong Kong Parkview Group, and is owned by Beijing Chyau Fwu Properties Ltd. Parkview Green FangCaoDi has earned multiple prestigious "green" awards, setting impressive sustainability standards in Beijing and in China at large. It has achieved LEED Platinum Certification. It was also named the "Best Green Building" in Asia by MIPIM Asia Award in 2010, the first mainland Chinese project to win the award. MIPIM Asia is an Asia-Pacific property market exhibition, first introduced to Hong Kong in 2006. In 2011, the project was presented with the International Green Award Copper Award for Best Green Intelligence Architecture, and in 2012, it was presented with the Green Building Award Asia Pacific Grand Award.

The project was first conceptualized in 2001, completed in 2010, and opened to the public in late 2012. The public opening was delayed due to fire code complications. The complex constituted a brand new type of indoor-outdoor hybrid for which fire authorities had to conduct special studies to ensure its safety. One of the benefits of receiving the LEED certification was that it helped the owner to secure commercial tenants with a global CSR (corporate social responsibility) policy that requires them to rent in LEED certified buildings.

The complex (dubbed the urban pyramid) simulates a city-within-a-city or a "vertical neighborhood". It occupies two city blocks covering an area of 200 m by 200 m (656 ft by 656 ft) and is sheltered by a mega pyramidal envelope. A spinal bridge connects the two opposite ends of the blocks diagonally allowing outside pedestrians to make a walkable short-cut through the complex. Parkview Green complex comprises four towers (two 9-story and two 18-story towers) that include 50,000 m^2 (538,195 ft^2) of luxury retail spaces, 82,000 m^2 (882,640 ft^2) of Grade-A commercial office space, a luxury boutique hotel, as well as restaurants, a state-of-the art cinema, and a 60,000 m^2 (645,834 ft^2) underground parking garage. The complex's components include towers, atria, sky-gardens, terraces,

and bridges, which cluster around a central interior space (courtyard or public plaza) and are sheltered by way of a microclimatic envelope. Offices have a maximum depth of 15 m (49 ft) from façade to core and a floor-to-ceiling, glass curtain wall of 2.9 m (9.5 ft), which provide optimal daylight and reduce the energy required for artificial lighting.

The hotel, with 120 luxury rooms, including a 500m² (5,381 ft^2) presidential suite, is located at the highest floors of the complex and is accessible exclusively via a private entrance and through glass elevators. The hotel rooms enjoy expansive outdoor terraces and private swimming pools. Among the hotel's most salient amenities is a suspended sky lounge located near the tip of the pyramidal envelope so as to provide spectacular views of the entire interior space of the development as well as awe-inspiring views of downtown Beijing. Also, most of the office spaces, hotel rooms and residential apartments enjoy direct views to the central courtyard.

The four-level retail mall surrounds the courtyard, which acts as the center stage for events form the heart of the complex. In the same way that streets facilitate access to a central city square, the courtyard has been designed as a "true" public place where everyone may gather. Retail spaces have been given flamboyant lighting systems, adding another layer of visual drama to the building's interior. The 236 m (774 ft) pedestrian bridge that diagonally cuts through the complex offers a bird's-eye view of shops and the public plaza.

Also, a series of glass encased lifts and 18 six-meter-long (20 ft) escalators dramatize the interior spaces. Mimicking the ceaseless activity of the city, the complex is open 24/7, and with easy access to various modes of transportation (metro, taxi and bus), the Parkview Green FangCaoDi has direct connections to other districts and facilities in Beijing, making the urban pyramid integral to the life of the city both spatially and temporally. In addition to providing functional services, the complex attracts people from all over the world, given that its accessible interior public space shelters visitors from Beijing's sweltering summers, freezing winters, and year round air pollution.

Technologically, the mega pyramid's microclimatic envelope comprises a Texlon ETFE membrane system of glass and structural steel façades. The envelope protects tenants and visitors from adverse weather conditions, while providing an outdoor environment with abundant natural light and thermal comfort. "Texlon consists of pneumatic cushions restrained in aluminum extrusions and supported by a lightweight structure. The cushions are inflated with low pressure air to provide insulation and resist wind loads," and they are composed of multiple layers of a modified copolymer known as Ethylene Tetra Fluoro Ethylene (ETFE).

ETFE provides numerous advantages. It does not degrade under ultra-violet light or atmospheric pollution. It also facilitates the transmission of light and is very low weight compared to that of glass (about 1%), creating light and elegant structures. The smooth and non-stick outer surface of Texlon ETFE is self-cleaned externally by rain, while the inner surface of cushions may be cleaned with water every few years. Texlon ETFE is 100% recyclable. This type of roof structure has also been used in the Olympic National Aquatics Center of Beijing, also known as the Beijing Olympic Water Cube.

The urban pyramid evokes a structural expressionism by jutting out of the diagonal structural steel frames from the building's exterior, leaving a space in between. The envelope's corners have been given vertical cuts to denote entrances, producing an effect of grandeur. While the pedestrian bridge, painted a bright red, protrudes from the connecting sidewalks to further accentuate the entrances. Finally, it should be noted that the tip of the pyramid reaches a height of 87 m (285 ft) (Al-Kodmany, 2015).

The microclimatic envelope creates a thermal buffer that enhances thermal conditions. In the summer, it reduces the need for air conditioning, and in the winter, it reduces heat loss. This is perfectly suited to Beijing's vacillating seasonal climate. Parkview Green FangCaoDi's microclimate is supplemented in the summer through the use of operable ventilation louvers installed at the top of the building's envelope. These louvers are strategically placed and computer-controlled so as to respond effectively to varying environmental conditions.

The pyramidal form stimulates the natural stack effect or "natural chimney" effect that allows hot air to rise up and exit through the roof. As the air escapes, cooler and fresher air is drawn up from the bottom of the building, creating air movement and natural ventilation. The ETFE roof is set at a constant 3 m (10 ft) distance away from the inner buildings so as to maintain air movement. Furthermore, the complex as a whole is "sunken" down 10 m (30 ft) below street level and recessed about 15 m (50 ft) to provide another buffer space that contains a sunken garden decorated with sculptures. In the summer,

this garden is the coolest space in the building and supplies the complex with intake air through operable openings in the envelope. Interestingly, a large water fall with fountains is located in the garden, which helps to cool air in the summer while simultaneously increasing oxygen levels. Consequently, the microclimatic envelope keeps the atrium warmer in the winter and cooler in the summer. Although air conditioning is still required, loading is reduced and, for much of the year, natural ventilation maintains comfortable conditions within all areas. At these times, supplementary heating and cooling is supplied via a radiant ceiling, enabled by a geothermal source that uses a 'closed circuit' water system.

Just as the geothermal system relies on the buffer of the earth to keep temperatures below ground around 13ºC (55ºF), the Parkview building relies on a buffer of external glass to keep temperatures within the building from rising too high or dipping too low. It is estimated that the hybrid passive and active mechanical systems will save 60% on cooling costs and 80% on heating costs (Al-Kodmany, 2015).

The complex also incorporates water-conservation systems, including "electronic taps, water-saving sanitary ware and low-flow shower facilities". Waste water from sinks, showers, and washing faucets is also treated for flushing and for irrigating the native, drought-resistant plants present in the surrounding landscape. The complex also gathers rainwater from the roof and paved areas, which is then filtered and recycled to irrigate the landscaped areas. Native plants and trees were chosen for their low water intake and low maintenance.

Collectively, the sustainable strategies employed at the Parkview Green FangCaoDi add up to a savings of 48% in water use. Its materials were selected based on their sustainability. The structure includes recycled content from building demolitions and 25% of the total building materials were made from recycled goods. Quickly growing softwoods were used instead of hardwoods. The design of the interior spaces embraces an adaptive reuse scheme to accommodate future changes and rising needs, enabling tenants to save 10-15% on renovation costs. The project also pursued a "green" construction standard where 81% of its own construction waste was recycled, minimizing the complex's carbon footprint.

In addition to emphasizing sustainable design, the complex takes a deep interest in art work by offering the largest private collection of artwork in China. The art focus reflects the interest of Leo Hwang's uncle (Leo is a third-generation successor in the Chyau Fwu Group and the Executive Director of the Parkview Green Project). The uncle's philosophy stresses that a building is not alive until it is landscaped and filled with art and people. Much of the older art pieces in the complex were donated by Leo's uncle. The complex's art pieces represent both the Western and contemporary Chinese arts. Within the collection are over a hundred original pieces by Salvador Dali, the largest collection of his sculptural work outside of Spain. The complex also exhibits the art work of contemporary Chinese artists such as Luyan Wang, Wenling Chen, Guangyi Wang, and Xiaowu Gao.

The lobby also contains an original Andy Warhol panda print. Parkview Green FangCaoDi hosts a space on its second floor for art galleries and institutions that hold commercial shows. Art exhibits form the core of the educational program for the complex, turning art appreciation into an informal and fun activity. Some of the art pieces are permanent while others are temporary, allowing new pieces to be introduced over time. Collectively, the project provides a unique opportunity to discover the work of some of the world's most famous artists in an intriguing setting.

The high quality and creative work of the complex is also attributed to Leo's father and grandfather. "From the very beginning, my grandfather has said that we need to place great care into everything we build. He has always looked at building as a privilege and a responsibility, and he believes that we are lucky to be in this position. My grandfather started from nothing, and he realizes that when you're building, you're creating places that will last way past your lifetime." (Figure 5)

Figure 5. Parkview Green FangCaoDi in Beijing, China.
(Source: Author)

CONCLUSIONS

The significance of embracing green or sustainable design principles for skyscrapers cannot be understated. A new generation of "green" towers aims to improve energy performance and enhance environmental quality. Shanghai Tower's green design process, through its use of sustainable technologies, may provide a good model. The tower's swiveling asymmetrical glass façade reduces wind loads on the building. The building's spiraling parapet collects rainwater to be used for the tower's heating and air conditioning systems, and wind turbines situated below the parapet generate on-site power. Furthermore, the gardens nestled within the building's façade create a thermal buffer zone that improves indoor air quality. Power for the building will also be partially generated by wind turbines (Xia et al, 2012).

Skyscrapers are often cited as among the largest energy consumers in a city, but the new generation of skyscrapers is addressing these issues in innovative ways. Skyscrapers in Dubai could consider integrating photovoltaic technology to harness solar energy. Skyscrapers in Shanghai could collect rainwater to reduce flooding events. The treatment of waste has become a serious environmental issue in Dubai and green skyscrapers may provide self-treatment systems to address this issue. These tall buildings can also employ air filters to improve air quality, as can be observed in New York City's Bank of America Tower (Al-Kodmany, 2012b; Aboulnaga, 2006).

Sustainable skyscraper development should take into consideration impact on city life, environment, transportation, public communal spaces and pedestrian life, sidewalks, and safety. In constructing futuristic skyscrapers and intensifying land use, public spaces have become fewer and smaller. Concern about the quality of public spaces is becoming increasingly important since new skyscrapers are often owned by private developers. Most importantly, cities need to reexamine the need for skyscrapers, since some have been constructing skyscrapers without sufficient underlying demand (Aucto, 2010).

Sustainable skyscrapers should be developed by multi-disciplinary teams that possess diverse qualifications and combine skills from several professions, encompassing both the modern technologies of the age and the richness of local heritage. In order to achieve a degree of consensus among existing residents, buildings can be constructed that respect the dominant styles of the locality. When considering globalization, architects and planners should perceive the opportunities that globalization provides in regards to place-identity considerations. In order to link global technologies (including green technology and modernization) with local values and cultures, these professionals must anticipate the threats that affect local heritage. This will require great sensitivity and substantial talent to successfully weave together appropriately chosen traditional characteristics with technologically modern elements. It will also demand a regionally derived form-making language with its own compositional grammar and vocabulary for materials and details that makes a skyscraper in the Middle East different from one in China. Essentially, a sustainable design should proceed "glocally", a composite term that refers to an inclusive design approach that combines considerations of local needs and global forces. A sustainable design

should find a balance between these two factors, reinforcing a distinct urban identity while at the same time remaining open to positive foreign influences (Al-Kodmany et. Al, 2013; Bagaeen, 2007).

Design simplicity, elegance, and logic, coupled with exploration and experimentation of new forms, likely will form the basis of the next generation of sustainable tall buildings. Future designers will face several challenges when designing tall buildings. Some of these will include the debate of whether or not to build tall. The increasing demand for buildings to be energy efficient and sustainable will shape the future of skyscraper construction. In the endeavor to build tall buildings sustainably, new questions regarding environmental effects, property and space ownership, regulations, and real estate marketability, will arise. Insofar as it responds to emerging needs for energy efficiency and increased population pressures, the sustainable tower is likely to prevail as an architectural typology. Ultimately, as they embrace local culture, context, environment, and the technology of the era, these skyscrapers will set the path for future sustainable cities.

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SEARCHING FOR URBAN PATTERNS
AN ASSESSMENT OF HISTORIC EDGES AND ITS SURROUNDING CONTEXT: HISTORIC CAIRO AS A CASE STUDY

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Abstract
This paper analyzes the urban edges of historic cities. Managing these edges would enhance the success of any intervention projects inside the historic fabric. The paper develops and tests a method of analytical assessment framework that is applicable for quantitative analysis within an urban edge. It is capable of measuring micro and macro levels of analysis of historic urban edges with reference to their spatial configuration. In addition, the paper searches for repetitive spatial configuration patterns. The main case study is Historic Cairo. The paper reveals that there are apparent patterns of cause and effect of both spatial configurations and related activities along the urban edges, forming different type of barriers. The paper discovers the repetitive spatial, architectural, and land-use patterns that exist on various edges. These patterns enable the possibility of learning and acquiring from other successful interventions that have been applied to similar patterns, without being limited to cultural or contextual differences.

Keywords: *Urban edges; urban patterns; spatial configuration analysis; historic Cairo*

INTRODUCTION

Most research, in general, focuses on the urban form inside historic cities; however, the urban edge of historic fabrics is commonly ignored in the literature (Conzen et al, 2012, Kai and Gu, 2010; Unlu, 2013) and most regeneration interventions. Although the urban edges represent the transitional interrelation between the historic core and the extending modern urban growth, as well as possessing characteristics of both historic and modern features, they are mostly classified as non-historical fabric or as less important than the historic core. Hence, their development is ignored by both sides, the historic and the modern.

The paper aims to develop a method of quantitative analytical assessment framework that is capable of examining the urban edges of historic cities with reference to their spatial configuration, in this paper Historic Cairo's urban edges. Consequently, this assessment will help in developing appropriate regeneration plans for the site. Second, it enhances the process of comparison with other cases, in order to inherit those successful interventions that might fit according to base similarities, such as the urban form, architectural characteristics, spatial configuration, or other features. When analyzing urban edges, the paper introduces two hypothesis questions as follows:

1. Does the urban edge of the historic city form a 'barrier' between the historic core and the adjacent fabric?
2. Are there apparent patterns of cause and effect of both spatial configurations and the related activities along the historic fabric's path forming that barrier?

SCOPE

The spatial features of urban edges have a direct cause and effect on the economic conditions of the historic fabric, as more accessibility on the levels of both pedestrian and vehicle movements in non-residential areas would enhance the economic level of the place, whether through current traditional crafts or other commercial activities (Hillier et al, 2007). This paper focuses on the spatial configuration of the edge of the historic city in the foreground and considers its consequences on economic, cultural, and social aspects as its background interest.

Historic Cairo has been selected as a case study because of three main issues. First, it has evolved along different historical eras and consists of accumulated layers of development. Second, its defined boundaries make it effortless to analyze the cause and effect of spatial and social relationship inside the case study (micro-level) and test their connections with the macro-level (on the edge and outside the case study). Finally, the urban edges of Historic Cairo are in varying conditions. The northern wall fully exists, while the western part is semi-demolished and the western side is completely demolished. Moreover, the spatial configuration pattern inside the urban edges does not encourage heavy vehicle movement; it tends to depend on pedestrian movements (as an inner movement) rather than vehicles. Consequently, this suits the paper's aim of understanding the spatial and social relationships in a pedestrianized environment, with a mixture of stakeholders dealing daily with Historic Cairo. There are a variety of cross-sectional routes, in addition to the existence of varied architectural styles and historical buildings. This variation reflects on the range of socio-cultural activities within the same routes, providing a rich visual experience throughout the historic site.

LITERATURE REVIEW

Throughout history, boundaries have evolved and transformed, creating forms of distinction. Emphasizing those boundaries affects the social relationships that take a spatial form and over time will cause a changing social phenomenon (Madanipour, 2003). The urban peripheries of a historic city have become different from their original formatting as, today, they appear to be more complex and situated between historic centers and their adjacent urban growth. Francesca Governa et al (2004) view the periphery from two main perspectives: spatial characteristics and the socioeconomic point of view.

There are other terms describing the boundary of historic cities. Gallent differentiates between the terms 'edge' and 'fringe', suggesting that they describe two consecutive issues: the last zone considered to be more typically urban (or urban historic fabric) is described as an edge, while the landscape (or context) outside the built-up (historic) area represents a fringe, with various characteristics depending on its distance from the urban edge (Gallent et al, 2006).

The 'urban edge' represents a boundary between two kinds of areas (Lynch, 1960). It comprises buffer zones as an effective conservation policy for maintaining the interrelationship between the walled city and its settings, in addition to managing the development scale on both sides (Creighton, 2007a; ICCROM, 2008), where its size varies from one historic site to another. An urban edge is not a defined line based on walls, fences, and gates; it is more where the edge of a city becomes a zone that comprises gates, areas of social and commercial activity, and architectural character, rather than a rigid line (Bosselmann, 2008; Creighton, 2007a). At the periphery of a historic city, there is the 'urban fringe-belt'. This belt evolves developing an urban fabric over time with mixed land uses. It is less dense and differs from the main architectural character found in the historic core (Conzen, 2009). The urban edge has distinct patterns of spatial configuration, distribution of activities, and architectural features (Kostof, 2010), in which defensive walls cannot be analyzed separately from their surrounding urban patterns.

The paper reviews methods and theories for the analysis of urban edges. The urban fringe is one of the theories introduced to understand the growth belts (edges) around cities (Whitehand, 2007; Conzen, 2009; Gallent et al, 2004). In addition, realizing the context as one entity is

common in the literature in terms of using selective points or indicators for analysis (Bruce and Creighton, 2006; Abada, 1999); others use SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis with different indicators (Doratli et al, 2007). Reviewing the morphological analysis is crucial for fulfilling the research scope that highlights the urban structure, patterns, and form issues (Larice and Macdonald, 2012; Obrasli, 2000; Madanipour, 2003). The spatial configuration has many methods; space syntax is one of its quantitative methods, which emphasizes the relationship between social and spatial two-way interactions (Dalton and Holscher, 2006; Hillier and Hanson, 1984; Hillier et al, 2007). Mental and visual theories are introduced to highlight how people navigate, experience, and grasp spaces (Carmona and Wunderlich, 2012; Carmona and Tiesdall, 2007; Cullen, 1995; Lynch, 1981). Finally, physical environment theories are discussed to understand the way in which people shape their built environment through an incremental growth of parts that over time enriches the shape of the whole (Alexander et al, 1987; Trancik, 1986; Carmona et al, 2007).

Addressing the urban edges and city growth through visual descriptions rather than structural analysis has been argued to be a limited view of the morphological description and conceptualization of contemporary urban growth outside a city's borders (Serra and Pinho, 2012). From the previous theories and methods, the research extracts a number of indicators and establishes the selected type of analysis needed in the assessment framework of analysis.

HISTORICAL BACKGROUND OF HISTORIC CAIRO

Cairo consists of more than one thousand years of extended layers of history (Abu-Lughod, 1971). The problem with using terms and adjectives such as 'old', 'historic', 'Islamic', 'Fatimid', or 'Coptic' Cairo is not in their meanings specifically defining their edges; the problem is defining which layer(s) or edge(s) of history need to be included in any study (Daher, 2008). This paper uses Historic Cairo as a term, considering the World Heritage Committee WHC's suggestions (WHC, 2006), and the defined parts within the Fatimid and Ayyubid walls of Historic Cairo's boundaries are selected from Al Gamalia Qism and part of Darb Al Ahmar Qism, which is defined by Mohamed Ali Street (see Figure 1).

The walls of Historic Cairo were the main defined periphery at the early stage of Cairo's history. They were constructed in three main phases between the tenth and the twelfth centuries. The first and the second phases were in the Fatimid era; they started at the foundation of Cairo (AD 969) and continued until the end of the eleventh century during the period of civil unrest. The third phase was consolidating the existing Fatimid wall and constructing new parts, carried out Salah Al-Din during the Ayyubid era in the twelfth century (1170–1238 AD), in addition to the construction of the Citadel, which had a political as well as military stronghold (Siravo and Matero, 2004). The northern wall was extended westwards to the port of Al Maqs at the river Nile (currently, it is Ramsis square), and the eastern wall southwards to the Citadel. After two centuries since its construction, the area on the east wall was slowly declining and becoming increasingly marginal. The area outside the wall to the east was used as a dumping ground for the city's rubbish, which prevented the city's growth on the eastward side. The Al Hakim Mosque represents the physical edge of the northern extent of the city, although it was originally located outside the city's wall before the eleventh century refortification construction. The western city boundary wall has all but disappeared and the urban boundary was mainly a canal called Khalij Al Masri, which was filled in during the nineteenth century and converted to a route named Port Said Street; see Figure 2 for the spatial transformation of historic edge of Cairo.

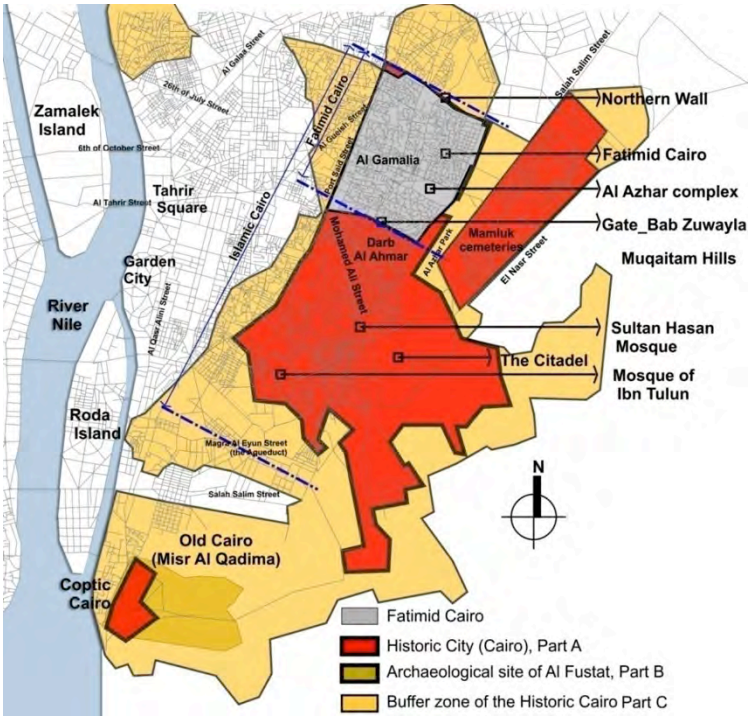

Figure 1. Boundaries for various terms defining 'Historic Cairo'; the highlighted areas are the delimited Law of 2008, which has delimitated the Historic Cairo boundaries (Source: Boundaries' information is from (URHC, 2012); base map and other graphics are by the author).

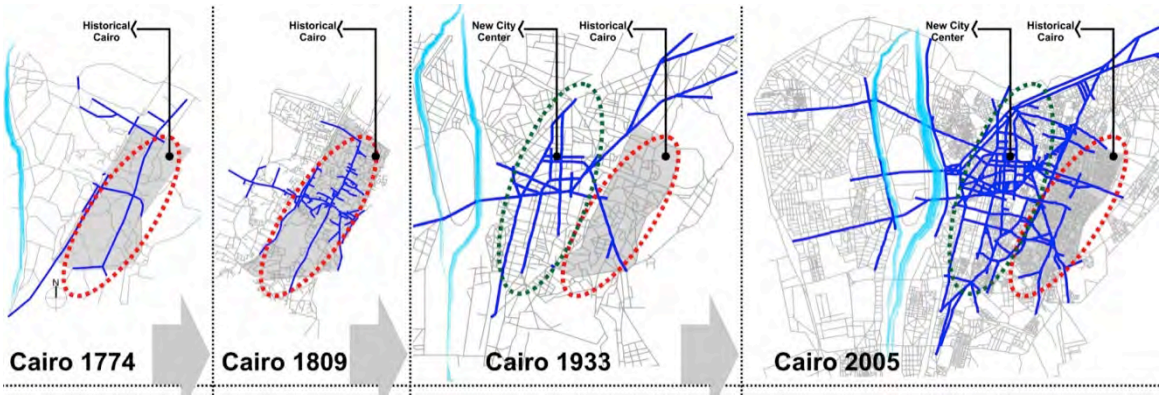

Figure 2. Highlighting the comparative analyses for Cairo in 1774, 1809, 1933 and 2005 showing the shift in important daily routes through different historic areas of Cairo. The lines shown represent the highest 10% potential selected daily routes for movement (Source: Mohareb, 2010).

METHODS OF ANALYSIS

The analysis depends on three main methods: spatial configuration, socioeconomic activities that are directly related to the land use typology and distribution, and the architectural features along the urban edges (Madanipour, 2003; Governa and Saccomani, 2004; Kostof, 2010). In this section, the paper expands in detail the theories and tools that are used in each method, highlighting the level of intervention in the case study stages.

The spatial configuration analysis adopts Hillier's theory of space syntax (Hillier, 1999; Hillier, 2005), in conjunction with Martin's examination of the block size and its effect on both the space and its inhabitants (Carmona et al, 2007; Carmona et al, 2010), and Bosselmann's temporal factors of movement experience (Bosselmann, 1998). The research will use each theory in combination to form the spatial configuration part of the framework.

The architectural features are categorized into their main usages: residential buildings; monumental buildings, whether they are religious or administrative buildings, or objects such as the defensive wall itself, if it exists; warehouses; and commercial buildings. Due to their location on the urban historic edge, the research expects to find different variations compared to the buildings located far from the edge on both sides of the wall. Therefore, the following main variables are considered for the analysis of these variations: the ground floor facade and whether it is an active or passive facade; the various architectural styles and their locations; the buildings' morphology; and, finally, the buildings' physical and structural conditions.

Land-use variables are interlinked with transportation, spatial configuration, and people's preferable movements, as source, destination and densities. These variables are mainly investigated through field surveys and observation, in addition to the GIS maps available for such data. The land-use analysis will also be linked to the previous investigating issues of spatial configuration and architectural features.

The main purpose of the framework is to be able to examine urban edges based on their spatial configuration, land-use, and architectural features. Moreover, it is meant to be used as a comparative analytical tool that can work across cultures, scale, and different spatial conditions.

It is clear that the framework depends more on the tangible and quantitative variables as the foreground of the analysis (see Table 1), while the other issues, such as cultural and economic factors, are only represented as a by-product of the spatial, architectural, and land-use analyses. This point of view might be considered as a limitation of the analytic framework; however, the research considers it as an advantage. The framework is a multi-layer of analysis; its base is designed as a quantitative investigation, in order to be used either as a single analysis of an urban edge or for comparing different cases in order to understand them. In both situations, the variations that might occur, even in different parts of the same case, do not limit the analysis as non-quantifying variables. Nevertheless, other layers could be added to the framework, according to the needs of the research. Therefore, the framework is flexible, as more layers of analysis could be added according to the case study situation, without the need to alter the entire framework, see Table 1.

Table 1. The analytical research framework (Source: Author)

Location	Urban form indicators	Variables	Measuring methods and tools
Historic Cairo in three different locations: **Section I** **Section II** **Section III** Each section is divided into number of subsections And each subsection is examined in	**1. Spatial features** - Measuring the degree of accessibility (visual and permeable) and locating integrated and segregated sectors	- Identify the urban edge	Using point-depth analysis FS, DR
		- Urban growth destination/ type	SSx, GIS
		- Type of spatial configuration - Inside the historic walled city; - On the edge; - Outside the walled city	SSx, GIS
		- Degree of accessibility - Visual accessibility - Permeability	SSx, GIS
		- Key accessible points/ locations	SSx, FS
		- Continuity of spatial fabric types	FS, GIS
		- Related facilities - Parking - Type of transportation	SSx, GIS

three different positions related to the urban edge itself.	**2. Architectural features** - Is there a style barrier? How, and to what extend?	- Architectural character/ style - Historic - Contemporary - Eclectic	FS, Sd, GIS
		- Level of architectural style continuity	FS, Sd, GIS
		- Architectural condition - Physical condition - Structural condition - The wall's condition - The surrounding buildings	FS, GIS
		- Degree of interaction to the surrounding context	- Ground floor frontages (passive/active) FS, GIS
	3. Land uses analysis - Is there an activity barrier? - What is the role of peripheral activities?	- Land use distribution (location, continuity)	FS, GIS, SSx
		- Land use categorization/ type - Concentration - Ground floor - Type	FS, GIS
		- Landmarks' location - Related to movements - Related to the edge	FS, GIS
FS, field survey; Sd, secondary data; SSx, space syntax; GIS, geographic information system; DR, data records			

ASSESSMENT PREPARATION

The assessed variables consist of three main parts: preliminary data; syntactical analysis on both scales, micro- and macro-scales; and an urban form analysis of the historic edges. The preliminary data investigates the edges' existing conditions and reviews the historic evolution to understand their current existing conditions. The location section identifies the security jurisdiction (*qism*) and the subdivision (*shiakha*) that the walls are located in. Finally, population distribution per *shiakha* is considered as a weighting factor in the analysis due to the various sizes of the *shiakhas*, as some have huge sizes that cover spaces beyond the studied urban edges, while others are just cemeteries, as in the northern cemetery of Bab Al Nasr.

The syntactical data highlights the macro-spatial analysis of Historic Cairo in general, including the surrounding context and the inner fabric, showing the different mean values of accessibility as a reference guide. On the micro-scale, each accessibility value, local integration R 500m, global integration Rn, local choice R 500m, and global choice Rn, is examined across three locations: both outside and inside the historic urban edge, with a buffer zone of 500m, in addition to the physical edge itself, with a buffer zone on both sides. This reminds that lower radius 500m is a pedestrian indicator, while a higher radius Rn represents longer trips using a vehicle.

The urban form data on the three sections of the urban edges relies mainly on the field observation as a first-resource data and other available resources as secondary data. The urban form data includes spatial features, architectural features, and land-use analysis. The spatial features deal with the usage of space from the point of view of pedestrian movements. This highlights the degree of visual accessibility of the urban edge and its real condition of permeability to approaching various locations, in addition to monitoring the spatial fabric continuity across the urban edges and, finally, highlighting the daily facilities needed in terms of parking lots, appropriate spaces for walking, street furniture, and other relevant issues.

The architectural features' study considers whether there is an authentic architectural style or character along the studied sections, highlighting the continuing status of that style along that edge. Finally, the degree of interactivity of the ground floor with different users is emphasised –

passive means a solid or closed facade, while active means the existence of voids or land uses that interact with pedestrians.

Land-use analysis shows the overall type of usage: residence, commercial, or mixed usage. It also shows whether there is a concentration of usages, their continuity, and their location on main access routes. Finally, the analysis considers the existence of landmarks and their location on the edge.

The three sections, A, B, and C, are divided into subsections (see Figures 3, 4, and 5) in order to facilitate the analytical study and to thoroughly monitor the various conditions and variables along the urban edges. This would highlight any tangible or intangible barriers along the edges. In addition, these subdivisions would ensure that the study and its results do not focus on the main routes as the only potential tangible edges between different urban fabrics. The subsections have been selected according to the sudden changes in urban morphology along the edges. These concern the architectural character, specific land use, the cross-section of the route, or the existence of tangible barriers such as the walls, which exist partially in the cases of sections B and C.

Finally, the sums of the previous values are aggregated in each subsection, according to three main positions along the studied edge. First, there is an analysis of outside the historic fabric which, in some subsections, such as C(1), is also extended traditional fabric. Second, there is a consideration of the inner fabric inside Historic Cairo in terms of whether it is traditional or modern, such as partially in C(3). Third, the analysis investigates the edge itself, in terms of whether it is the wall or any physical edge, and it highlights the interrelationship between the edge and both its sides. Finally, the averages of the data from the previous three positions are aggregated to give a total overview average of the subsection edge.

OVERVIEW OF URBAN EDGES (SECTIONS A, B, AND C)

Reviewing the four subsections of section A (see Figure 3), the maximum accessible part is outside the historic fabric, particularly in subsection A(2), in addition to being the highest value in the urban form features, while the minimum part is on the edge of the subsection A(4). Inside the historic fabric, subsection A(1) represents the highest accessible part among the other inner fabrics. Subsection A(1) has the highest average of the urban form features (2.23), while A(4) has the lowest average (1.15); see Table 2. Subsections A(2) and A(3) have the highest interrelations between the inner historic fabric and the outer urban edges, nodes A(1/2) and A(3/4) in particular. Their main inner spine (Al Muiz Street) is connected to the outer context with a series of commercial activities along Amir Al Guyush Street and Gohar Al Qaid Street. Their inner fabric is segregated due to their residential nature.

Part B is located at the northern urban edge of Historic Cairo; see Figure 4. Subsection B(1) is partially walled, and B(2) is completely concealed behind the defensive historic wall, while B (3)'s edge is an archaeological site of the wall traces, with a width of 60m, juxtaposed to a modern gridiron fabric with no walls. Reviewing the three subsections of section B, the maximum average values and outside fabric accessibility, including the urban form values, are in B(1). It is a partially walled fabric, but connected directly to two main routes: Port Said Street and Al Banhawi Street. However, the inner fabric of subsection B(2) has the highest values among the others in terms of either inner or outer fabrics. The reason for this is not its connection by the two gates to the outside fabric, but its connectivity with the two main perpendicular spines to the north wall – Al Muiz Street and Al Gamalyia Street. Both streets possess commercial and daily life activities, while the fabric adjacent to the wall is less accessible, especially the section towards the east side, due to its introvert residential nature; see Figure 4. The walled subsections B(2) and B(3) have lower values in terms of both outer and on-the-edge accessibility, including urban form features; see Table 2.

Each subsection of section C has a unique character from the others. C(3) has a modern fabric with the minimum intervention of the archaeological site of the wall. In contrast, C(2) is the most isolated inner walled historic fabric compared to all other subsections, and on its other side is the Azhar Park, which is located on a higher topography. Finally, C(1) has no wall, but it is composed of different types of fabrics and land usages; see Figure 4. Reviewing the three subsections of section C, on the average scale, it is obvious that the non-walled subsections C(1) and C(3) have almost the highest aggregated values of accessibility and urban form features compared to the walled subsection C(2); see Table 2. However, on the individual subsection scale, C(3) has the lowest values in the inner fabric and the highest on the edge value. The walled part C(2) has the lowest outside value due to the existence of Al Azhar Park, which does not have any active connections with the inner fabric, while the inside historic fabric has moderate connections with the main inner routes; see Figure 5, Figure 6, and Table 2.

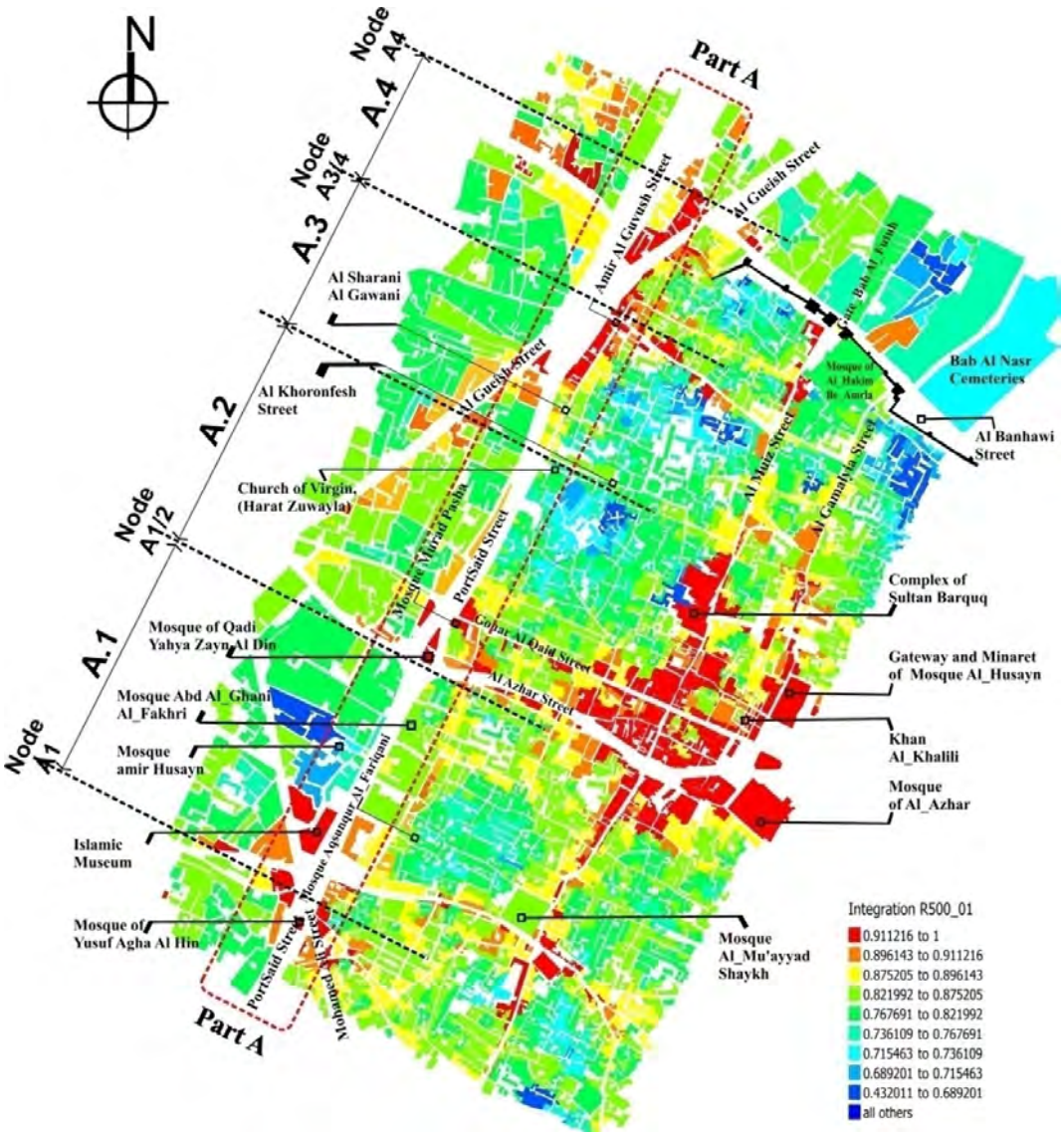

Figure 3 shows the integration R 500m analysis (potential pedestrian movements; shorter trips). Red colors indicate more accessibility compared to the blue colours, which indicate segregated parts (Source: Author).

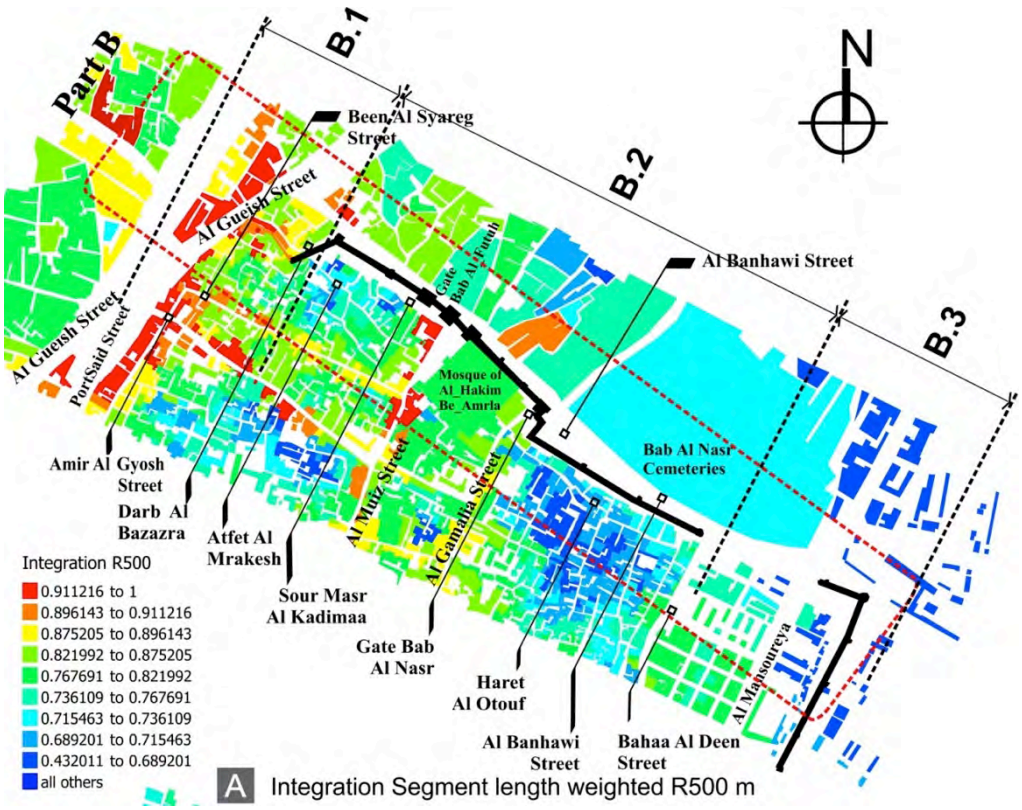

Figure 4 highlights the accessibility in the B subsections: B(1), B(2) and B(3). (A) shows the Integration R 500m analysis, while (B) illustrates Integration Rn. Red colours indicate more accessibility compared to the blue colours, which mean segregated plots (Source: Author).

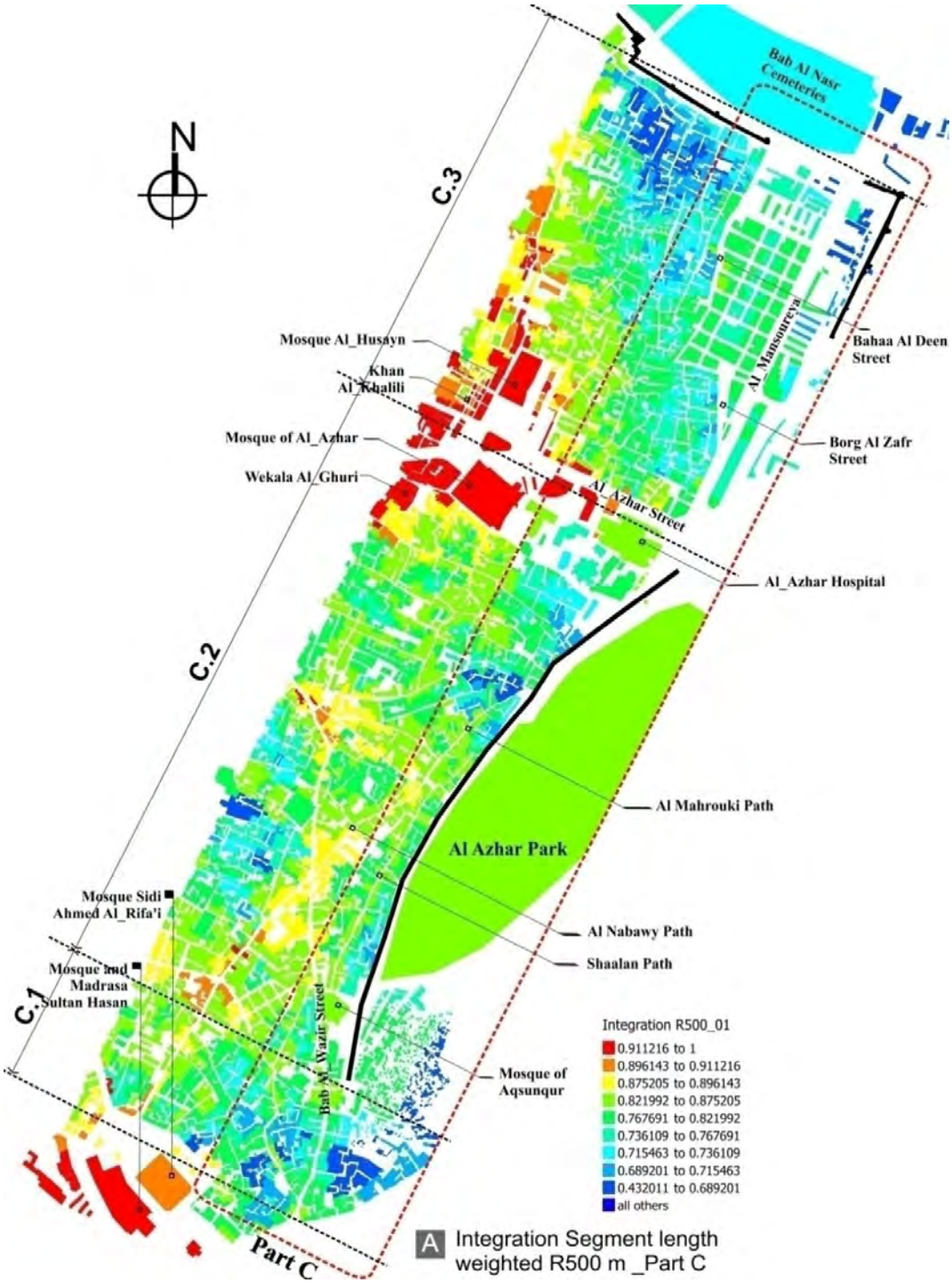

Figure 5 illustrates the accessibility in the C subsections: C(1), C(2) and C(3). It shows the Integration R 500m analysis, while (B) illustrates Integration Rn. Red colours indicate more accessibility compared to the blue colours, which mean segregated plots (Source: Author).

Table 2 highlights all the subsections' syntactical data (normalized average values for each measurement), in addition to the urban form features, architectural features, and land-use analysis of sections A, B, and C (the values used are 0, 0.5 and 1 to describe each point). The abbreviations used in the table are as follows: OTS for outside the urban edge; INSD for inside the urban edge; OEG for on the urban edge; and, AVRG for average values (*Source: Author).*

Part _A, B and C

Syntactical data (Normalised average values)	Section A.1				Section A.2				Section A.3				Section A.4				Section B.1				Section B.2				Section B.3				Section C.1				Section C.2				Section C.3			
	OTS	INSD	OEG	AVRG	OTS	INSD	OEG	AVRG	OTS	INSD	OEG	AVRG	OTS	INSD	OEG	AVRG	OTS	INSD	OEG	AVRG	OTS	INSD	OEG	AVRG	OTS	INSD	OEG	AVRG	OTS	INSD	OEG	AVRG	OTS	INSD	OEG	AVRG	OTS	INSD	OEG	AVRG
Local integration R 500m	0.76	0.83	0.84	0.81	0.83	0.81	0.84	0.82	0.83	0.81	0.83	0.82	0.87	0.87	0.83	0.86	0.85	0.9	0.87	0.87	0.78	0.77	0.78	0.77	0.65	0.77	0.73	0.71	0.63	0.82	0.81	0.75	0	0.82	0.82	0.82	0.67	0.78	0.77	0.74
Global integration Rn	0.62	0.58	0.65	0.61	0.71	0.54	0.66	0.63	0.62	0.59	0.62	0.61	0.65	0.72	0.68	0.68	0.53	0.5	0.52	0.52	0.51	0.64	0.59	0.61	0.64	0.59	0.61	0.61	0.57	0.6	0.5	0.59	0	0.52	0.52	0.52	0.68	0.51	0.54	0.57
Local Choice R 500m	0.84	0.85	0.86	0.85	0.85	0.84	0.86	0.85	0.85	0.84	0.85	0.84	0.85	0.81	0.84	0.83	0.81	0.82	0.82	0.81	0.82	0.85	0.85	0.84	0.76	0.83	0.82	0.8	0	0.83	0.83	0.83	0.84	0.83	0.84	0.83	0.83	0.84	0.84	0.83
Global Choice Rn	0.75	0.72	0.76	0.74	0.74	0.72	0.75	0.73	0.72	0.73	0.73	0.72	0.72	0.71	0.74	0.72	0.74	0.77	0.74	0.75	0.71	0.72	0.72	0.71	0.79	0.76	0.77	0.77	0.74	0.74	0.75	0.74	0	0.71	0.71	0.71	0.81	0.72	0.74	0.75
Population total	15375 (residents)				8045 (residents)				9255 (residents)				14379 (residents)				20939 (residents)				5382 (residents)				8957 (residents)				8997				11958				10549			
Population normalized (between 0-1)	0.13	0.13	0.13	0.13	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.12	0.12	0.12	0.12	0.18	0.18	0.18	0.18	0.081	0.081	0.081	0.081	0.078	0.078	0.078	0.078	0.08	0.08	0.08	0.08	0.1	0.1	0.1	0.1	0.091	0.091	0.091	0.091
A. Urban form (values 0, 0.5 or 1)	Section A.1			AVRG	Section A.2			AVRG	Section A.3			AVRG	Section A.4			AVRG				AVRG				AVRG				AVRG				AVRG				AVRG				AVRG
A.1 Degree of visual accessibility	1	0	0.5	0.50	1	0.5	0	0.50	0.5	0.5	0	0.33	0.5	0	0	0.17	0	0	0.5	0.17	0	0	0	0.00	0	1	0	0.33	0	0	0.5	0.17	0	0.5	0	0.17	0.5	0.5	0.5	0.50
A.2 Degree of permeability	1	0.5	1	0.83	1	0	0	0.33	0.5	0.5	0.5	0.50	1	0.5	0.5	0.67	0.5	0	0.5	0.33	0.5	0.5	0	0.33	0.5	1	0	0.33	0.5	1	0.5	0.67	0	1	0	0.33	0	1	0.5	0.50
A.3 Key accessible points/locations	1	0.5	0.5	0.67	0.5	0.5	0.5	0.50	0.5	0.5	0.5	0.50	1	0	0	0.33	0.5	0.5	0.5	0.50	0.5	1	0	0.50	0	0.5	0.5	0.33	0	1	0.5	0.50	0	0.5	0	0.17	0.5	0.5	0.5	0.50
A.4 Continuity of spatial fabric type	1	1	0	0.67	0.5	1	0	0.50	1	1	0	0.67	0	1	0	0.33	0.5	1	0	0.50	0	1	0	0.33	0	0.5	0	0.17	1	1	0	0.67	0	1	0	0.33	0	0.5	0.5	0.33
A.5 Daily facilities	1	0.5	1	0.83	1	0	0.5	0.50	1	0.5	1	0.83	0.5	0	0.5	0.33	0.5	0	0.5	0.33	0	1	0	0.17	0	1	0	0.33	0	0	0	0.00	0	0	0	0.00	1	0.5	0.5	0.67
Average	1.00	0.50	0.60	0.70	0.80	0.40	0.20	0.47	0.70	0.60	0.40	0.57	0.6	0.3	0.2	0.37	0.40	0.30	0.40	0.37	0.30	0.50	0.00	0.27	0.00	0.80	0.10	0.30	0.30	0.60	0.30	0.40	0.00	0.60	0.00	0.20	0.40	0.60	0.50	0.50
B. Architectural Features (values 0, 0.5 or 1)				AVRG				AVRG				AVRG				AVRG				AVRG				AVRG				AVRG				AVRG				AVRG				AVRG
B.1 Architectural Character/Style	0.5	1	0	0.50	1	1	0	0.67	0.5	1	0	0.50	0	0.5	0.5	0.33	0.5	1	0.5	0.67	0	1	0	0.33	0.5	0	0	0.17	0	1	1	0.67	0	1	0.5	0.50	0	0.5	0	0.17
B.2 Architectural continuity	0.5	1	0.5	0.67	1	1	0	0.67	1	0	0	0.50	0	1	0.5	0.50	0	1	0.5	0.50	0	1	0	0.33	0	0.5	0	0.17	1	1	0.5	0.83	0	1	0	0.33	0.5	0.5	0.5	0.50
B.3 Architectural Condition	1	0.5	1	0.83	1	0	0.5	0.50	1	0.5	0.5	0.67	1	0	0.5	0.50	0.5	0.5	0.5	0.50	0.5	0.5	0.5	0.50	0	1	0	0.33	0	0.5	0.5	0.33	1	0.5	0.5	0.67	1	0.5	1	0.83
B.4 Architectural form	0.5	1	0	0.50	0.5	0.5	0.5	0.50	0.5	1	0	0.50	0.5	0.5	0	0.33	0.5	1	0.5	0.67	0	1	0	0.33	0	0.5	0	0.17	0	1	0.5	0.50	0	1	0	0.33	0.5	0.5	1	0.67
B.5 Interactive ground floor facade	0.5	1	0.5	0.67	1	0	0.5	0.50	0	1	0.5	0.50	0	0	0	0.00	0.5	0	0	0.17	0	0.5	0	0.17	0	0.5	0	0.17	0	0	0	0.00	0.5	0	0	0.00	0.5	0	1	0.50
Average	0.60	0.90	0.40	0.63	0.90	0.50	0.30	0.57	0.50	0.90	0.20	0.53	0.30	0.40	0.30	0.33	0.40	0.70	0.40	0.50	0.10	0.80	0.10	0.33	0.10	0.50	0.00	0.20	0.20	0.70	0.20	0.37	0.50	0.40	0.70	0.53	0.50	0.50	0.50	0.53
C. Land use analysis (values 0, 0.5 or 1)				AVRG				AVRG				AVRG				AVRG				AVRG				AVRG				AVRG				AVRG				AVRG				AVRG
C.1 Land use type	0.5	1	0.5	0.67	1	1	0	0.67	0.5	1	0	0.50	0	0	0.5	0.17	0.5	0.5	0.5	0.50	0	0	0	0.00	0	0	0	0.00	0	0.5	0.5	0.33	0	0	0	0.00	0.5	0.5	0.5	0.50
C.2 Land use distribution	1	1	0.5	0.83	1	1	0.5	0.83	0.5	0.5	0.5	0.50	0.5	0.5	0.5	0.50	1	1	0.5	0.83	0	1	0	0.33	1	1	0	0.67	1	1	0	0.67	0	1	1	0.67	0	0.5	0.5	0.33
C.3 Land use location	1	1	0.5	0.83	1	1	0.5	0.83	0.5	0.5	0.5	0.50	0.5	0.5	0.5	0.50	0.5	0.5	1	0.67	0	1	0	0.33	0	0.5	0.5	0.33	0.5	1	0.5	0.67	0	0.5	0	0.17	0	0.5	0.5	0.33
C.4 Landmarks' location	1	0.5	1	0.83	0.5	0.5	0.5	0.50	1	1	1	1.00	0	0.5	0	0.17	0	0	0	0.00	0	1	1	0.67	0	0	0	0.00	0.5	1	0.5	0.67	0	1	0	0.33	0	0.5	0	0.17
C.5 Land use continuity	0.5	1	0.5	0.67	0.5	0.5	0.5	0.50	0	1	0	0.33	0.5	1	0.5	0.67	0	1	0	0.33	0.5	1	0.5	0.67	0	0.5	0	0.17	0	1	1	0.67	0	1	1	0.67	0	0.5	0.5	0.33
Average	0.80	0.90	0.60	0.77	0.80	0.80	0.40	0.67	0.50	0.80	0.40	0.57	0.20	0.50	0.30	0.33	0.50	0.60	0.50	0.53	0.00	0.80	0.20	0.33	0.30	0.50	0.20	0.33	0.40	0.80	0.30	0.50	0.00	0.70	0.40	0.37	0.13	0.50	0.50	0.33
Sum of averages (A+B+C)+ Population	2.53	2.43	1.73	2.23	2.57	1.77	0.97	1.77	1.78	2.38	1.08	1.75	1.22	1.32	0.92	1.15	1.48	1.78	1.48	1.58	0.48	2.18	0.38	1.01	0.48	1.88	0.38	0.91	0.98	2.18	1.28	1.48	0.30	2.10	0.70	1.03	1.12	1.59	1.79	1.46
Sum of averages (A+B+C)+ population + syntactical data				AVRG				AVRG				AVRG				AVRG				AVRG				AVRG				AVRG				AVRG				AVRG				AVRG
Local integration R 500m	3.29	3.26	2.57	3.04	3.40	2.58	1.81	2.59	2.61	3.19	1.91	2.57	2.09	2.15	1.78	2.00	2.33	2.68	2.35	2.45	1.26	2.95	1.16	1.78	1.13	2.65	1.11	1.62	1.61	3.00	2.09	2.23	0.30	2.92	1.52	1.85	1.79	2.37	2.56	2.20
Global integration Rn	3.15	3.01	2.38	2.84	3.28	2.31	1.63	2.40	2.40	2.97	1.70	2.36	1.88	1.92	1.57	1.78	2.13	2.50	2.16	2.26	1.01	2.68	0.90	1.52	1.12	2.47	0.99	1.52	1.55	2.78	1.88	2.07	0.30	2.62	1.22	1.55	1.80	2.10	2.33	2.03
Local Choice R 500m	3.37	3.28	2.59	3.08	3.42	2.61	1.83	2.62	2.63	3.22	1.93	2.59	2.07	2.13	1.76	1.98	2.34	2.65	2.34	2.44	1.29	3.00	1.20	1.82	1.30	2.73	1.23	1.75	1.74	3.01	2.10	2.28	0.30	2.93	1.53	1.86	1.96	2.42	2.63	2.29
Global Choice Rn	3.28	3.15	2.36	2.97	3.31	2.49	1.72	2.50	2.50	3.11	1.81	2.47	1.94	2.03	1.66	1.87	2.22	2.55	2.04	2.33	1.19	2.90	1.10	1.72	1.27	2.64	1.15	1.68	1.72	2.92	1.95	2.22	0.30	2.81	1.41	1.74	1.93	2.31	2.53	2.21

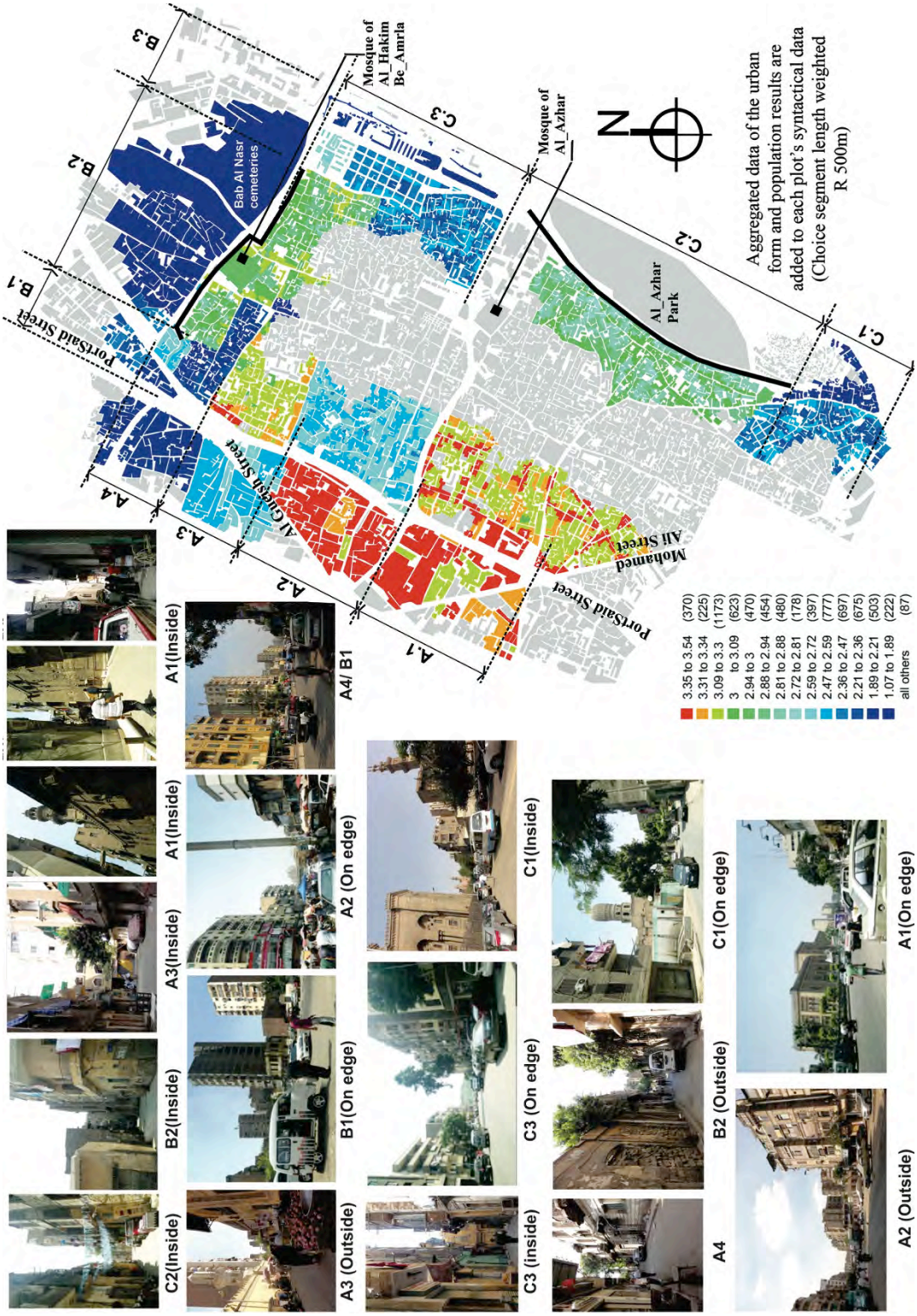

Figure 6 shows the aggregated data (highlights the main (macro) patterns) in the different sections A, B and C, while the base map is choice segment length weighted of R 500m (mainly for pedestrian accessibility). Similar colours means similarity in the urban form character, based on the results of Table 2. (Source: Author).

ASSESSMENT OVERVIEW

This section examines the relationship between the subsections and their degree of correlation, considering various values of urban form features, syntactic data, and population ratios. The result of the correlation discloses the similarities in the configuration of the case-study subsections. Correlating with more than one subsection would reveal, if they exist, repetitive spatial foreground patterns, accompanied by their urban form features as their background pattern. This assumption does not promote the exact existence of identical spatial or urban form patterns; however, it highlights the existence of similarities in conditions. These similarities would help urban regeneration developers to adopt best practices from other similar projects, while, at the same time, forecasting the success and the failure of their selection. They would also help researchers compare and choose similar projects and evaluate their intervention results, knowing that the selected projects have similar genotypes and phenotypes for analysis.

This research reviews the results of the previous individual assessments of each subsection and compares these results in three different ways. First, the urban form and population results are added to each plot's syntactical data in the GIS map; see Figure 6. The aggregated results would highlight the accessibility patterns in a GIS holistic map of Historic Cairo. The second method is a comparative assessment according to the edge position (as a value) – whether inside, outside or on the edge – and the total average; see Figure 7. This analysis reveals the similar values between subsections based on the same position condition. Finally, the assessment highlights the possible correlation between subsections, also according to their positions; see Figures 7 and 8.

COMPARATIVE RESULTS

The comparative GIS assessment, Figure 6, shows that some subsections apparently have similarities on the plot level. This is obvious in inner fabric subsections behind walls, such as C(2) and B(2), and, partially A(3), although it is not a walled fabric. In addition, subsections C(1), C(3), and B(1) have similarities and they are all adjacent to a walled fabric.

Generally speaking, within each subsection, there is apparent correlational consistency between the five points of analysis in the charts of Figure 7: the syntactical data and the urban form, with the population averages. This correlation might suggest that there is direct interrelation between the spatial configuration (syntactic data) and the urban form features, which would facilitate the urban-edge analysis by using the spatial analysis as a base investigation in any early or pilot studies.

The traditional and partially traditional urban fabrics that are directly exposed to the outside modern fabric context, such as the subsections on edge C(3) and B(1), can interrelate positively with their surrounding context, despite the apparent differences in their fabrics; see chart (C) in Figure 7. Traditional inner fabrics have almost the same spatial and urban form features, despite their location and the type of edges that they lay behind; this is obvious inside subsections A(1), A(3), C(1), B(2), and C(2); see chart (B) in Figure 7. Modern urban fabric outside Historic Cairo have higher spatial and urban form values than the outside traditional fabrics, and this is obvious in the outside fabric of Port Said Street in subsections A(1), A(2), A(3), and B(1); see chart (D) in Figure 7. The edges that are exposed to the intersections of major routes tend to have the same spatial and urban form behavior on their edges, such as subsections A(1), C(3), and B(1); see chart (C) in Figure 7.

Historic fabric behind the wall as an edge have the same patterns of spatial and urban form behavior, regardless of the number of entry points (gates) that might connect them with the outer context, for example, subsections C(2) and B(2); see chart (B) in Figure 7. Comparing the results of both different types of physical edges, the defensive historic wall and the main routes, it is obvious that the routes, despite their morphological consistency, are not acting as one homogenous edge along their length. Each part of that route might have different interrelations

with the surrounding context – for example, the route of Port Said Street (subsections A(1), A(2), A(3) and A(4)) – therefore, they cannot be treated as one unit, contrary to the wall's situation. The historic fabrics behind the walls have similar syntactic and urban-feature behavior on the average (macro) scale and when examining the micro-scale.

By comparatively examining the three different positions, in addition to their averages in all the subsections, it is obvious that subsection A(1) has the highest values in every position (average, inside, outside, and on the edge), despite its apparent physical form; see Figure 7. Reviewing the morphology of this subsection, it has a wide street cross-section and huge, modern blocks on its immediate periphery, which conceal the historic patterns behind it. As a result, it should act as a segregating edge; however, it acts otherwise. The reason for this is the typology of the inner fabrics. They generate source- and destination-attractors for pedestrian movement (see Figure 6) based on their commercial and daily usage activities (the A(1) subsection has the highest average land use value; see Table 2). Therefore, the land usage typology has altered the physical form of this part of the Historic Cairo edge.

Finally, the use of a justified graph is to interpret the analytical results recorded, which show the correlation between subsections. The process of arranging the graph by the number of connections is the main description of the term 'justified' (Ostwald, 2011). Therefore, the results would provide a further step beyond highlighting the one-to-one correlation of two subsections to a holistic understanding of the relationship with all subsections. It also spots any correlation with more than one subsection that indicates the existence of repeated patterns.

Reviewing the correlation results (connectivity) of all the positions together in Figure 8, it is obvious that the inner historic fabrics are more correlated with others than the other positions. The most correlated subsections are from sections C and B: C(1), C(2), B(2), and B(1). These results indicate that the inner historic fabrics near to the edges are still homogenous; see the four, five, and six connection levels in Figure 8. Considering their physically segregated locations, concealed either by the historic wall or by cemeteries, they represent repeated patterns having correlated conditions inside Historic Cairo. The subsections that are the least correlated with others (having one connection) are from the on-the-edge position of the historic fabric. They are from the same sections of B and C. This indicates that the edges are unique and not repetitive; they act as one continuous edge. On the other hand, the outside positions of the historic fabrics have some similarities; most of these have two to three similar correlations with other subsections. However, they could not form a pattern with their few connections. Therefore, each subsection outside the historic fabric should be reviewed separately.

By examining each position on a separated base, it is clear that A(1) is more correlated with others, which supports the previous conclusion that it is not a segregated edge. C(1) has the highest number of inside connections (six connections), and it is connected with various typologies of inner fabrics of other subsections, such as B(2), A(4), C(2), and C(3). On the edge of Historic Cairo, three isolated fabrics are not interrelated with other subsections except each other's: A(4), B(1), and C(3). The reason for this might be their common urban form configuration, which is not repeated with the other cases. They are all located on wide streets, where historic and new fabrics are exposed directly to those streets with multiple entry points. They have a mixture of traditional and new architectural features with fewer commercial activities.

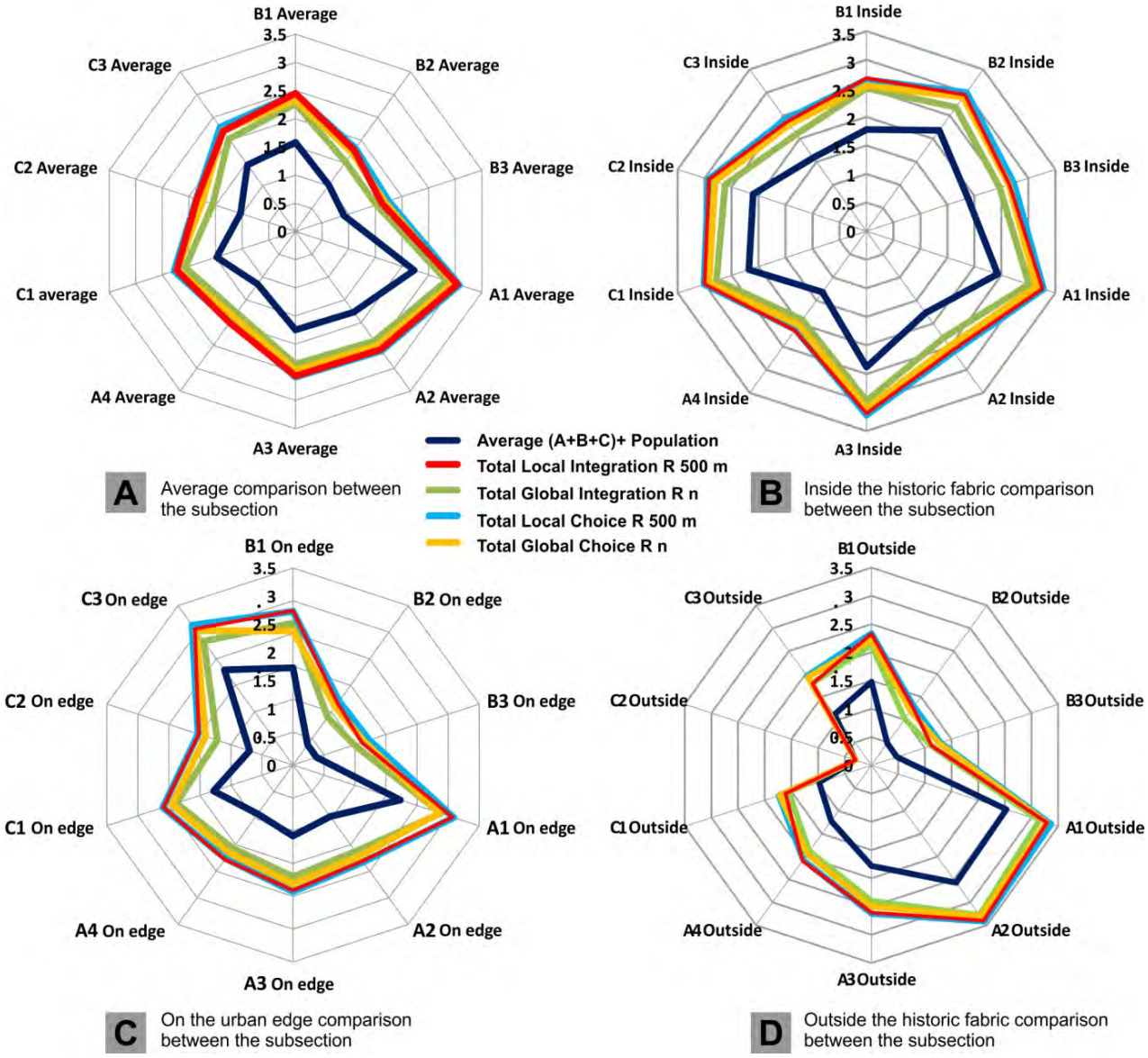

Figure 7 (A, B, C and D) highlights the urban-edge assessment at the three different sections – A, B and C – and their subsections. Each figure includes multivariate average values (local and global Integration, local and global Choice, and the average mean values of the three sections A, B and C, in addition to the population densities) distributed in the three sections. (A) shows the average multivariate values in all subsections. (B) illustrates the distribution of the average multivariate values inside the historic fabric. (C) highlights the distribution of the average multivariate values on the edge of all subsections. (D) shows the distribution of the average multivariate values outside the historic fabric (Source: Author).

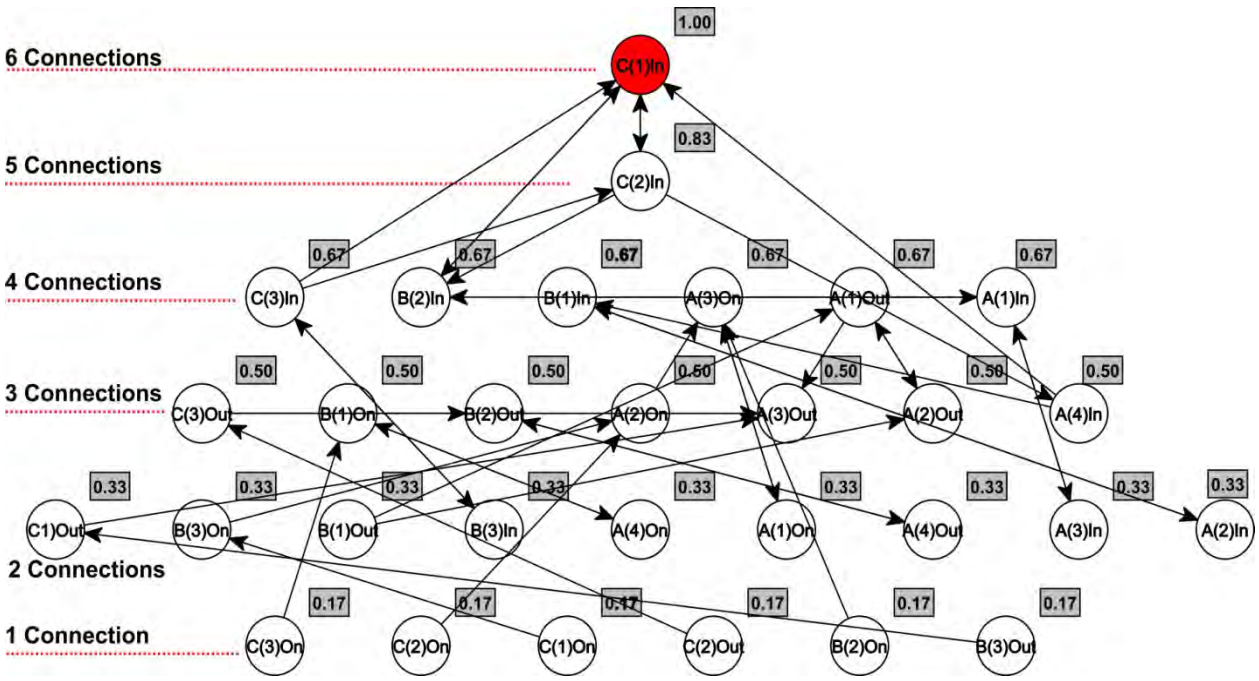

Figure 8 shows the justified graph of all the subsections (inside, outside and on the edge of Historic Cairo of sections A, B and C). It highlights the number of correlations (connections) of each subsection with the others, categorised by the number of connections, which indicates the degree of similarities. The value beside each subsection name is the result of the number of connections that each position has, divided by the maximum number of connections of all cases (in this case six connections) (Source: Author).

CONCLUSION

The paper developed the framework of analysis to understand the urban edges of Historic Cairo. The assessment did not depend on one method only, but rather used multiple techniques, including GIS analysis, space syntax spatial configuration, field survey, and finally, multiple interrelationship analysis. This assessment highlighted the spatial and urban form repetitive patterns that might exist in different locations inside, on the edge, and outside the historic fabric. The following points are the findings of this paper.

Urban edges of Historic Cairo cannot be treated as one unit when considering urban regeneration projects. It is a historic fabric apparently isolated from the surrounding context, by either the historic wall or ring roads, and it has a monotype of spatial patterns. However, this apparent overview contradicts the paper's assessment, which shows its interaction with the surrounding context in specific conditions and locations. It also has different types of repeated spatial patterns of urban form and spatial configurations.

The fabric behind the historic wall (as a physical edge) is not necessarily an isolated urban form or fabric; it depends on how it is linked to other main inner routes as suggested by Bosselmann (2008) and Creighton (2007a). Moreover, the linkage has different features of architecture, land usage, or spatial continuity, as suggested by Kostof (2010). Therefore, the degree of integration with the surrounding context is essential when comparing or adopting other regeneration experiments. It is crucial for researchers to select the appropriate case studies that correlate with their own experiment.

Reviewing the macro analysis of Historic Cairo reveals that a physical barrier exists in many forms. The defensive wall as a physical barrier exists on the northern and eastern sides, along with the spatial barrier of the main route of Port Said Street, with a massive urban form on its edge compared to the inner urban form of the historic fabric. Although these barriers visually

conceal the inner fabric on both sides of the wall or the existing edge (from the field survey and analysing the urban blocks), they do not prevent the interrelations between the inner fabrics with each other and with their edge context. This is obvious in the subsections A(1), C(1), and partially A(4), as they are all former paths of the defensive wall. Despite this, the inner fabrics behind the wall interact positively with their adjacent inner fabrics when connected to the main inner routes (mainly commercial or religious-oriented activities). This point reflects on the first hypothetical question of the paper.

In the detailed analysis of Historic Cairo, despite the location and type of edges that the traditional inner historic fabric lies behind, there are apparent similarities in the spatial and urban form features (see Chart B in Figure 7), which responds to the second hypothetical question. This issue is clear in the justified graph analysis, which reveals that the inner historic fabrics on the edge of Historic Cairo are more highly correlated with each other than the other fabrics. This outcome suggests that the inner historic fabrics on the edges are still homogenous.

The consistent correlations between the syntactical data and the urban form, in addition to the population averages in the comparative assessment of the subsections in the Historic Cairo case study, suggest a direct interrelation between these factors (see Figure 6). Furthermore, this justifies the decision for using spatial analysis as an initial preliminary investigation in the urban edge analysis.

The edges of historic fabric, which are converted in most cases to ring roads surrounding the historic cities, attract more global integration as a potential destination, followed by the values of global choice as possible selectable paths for vehicle movements. This result implies that the route edges do not act as a bypass network, avoiding or isolating the historic city; on the contrary, they interact as potential destinations for longer vehicle trips. If the results of the detailed case study of Historic Cairo are considered along with the previous macro-scale observations, the interaction is found in selectable parts that have attractive commercial or administrative land uses (see Figure 3). Adding to this, on the shorter (pedestrian) trips, choice (through-movement) accessibility is higher in the examined sections than integration (to-movement) accessibility, meaning that pedestrians navigate through these edges and not only on their outlet peripheries. This result would count as quantitative-based evidence of the magnitude of land-use typology over urban edges with regards to the selected case studies. However, in the detailed study of the Historic Cairo subsections at the three different edges, the local accessibility (both integration and choice) is higher than the global accessibility if the urban form assessment is added to the syntactical data. This would imply that urban edges are spatially global destination-oriented, but, when including the other factors, they turn out to be more local-destination attractors.

For land-use typology in general, commercial and public facilities is a key factor in the active interrelation between the historic and modern fabrics, despite the form of the urban blocks and the direct visual exposure to the main modern routes. This result was clear in the subsection A(1) on the edge of Historic Cairo. This is in contrast to the situation of the historic residential activities that are directly exposed to the modern extended fabric on the edges. These are introvert activities, and their active or passive connections depend mostly on their spatial configuration and their degree of visual and accessible exposure to the outer context. This was observable in the residential subsections A(2), A(4), C(1), and C(3) in Historic Cairo. A monotype of activities, particularly residential, tends to act as an interactive barrier on the edge of historic sites. This issue is obvious in subsections C(3), B(1), and A(4). Therefore, understanding the current and suggested land-usage typology is crucial in any intervention projects; they hold economic values and attract more potential movements that play an important role in blending or segregating these urban edges from the surrounding context.

The fabrics in close proximity to the walled edges are less accessible, with lower-quality living conditions. They are, in most examined cases, residential quarters. This result was expected, due to the isolated nature of these fabrics starting from the wall towards the outside

context and from the historic fabric on the inner side. However, the results were altered when the focus of the analysis was oriented towards examining the interrelationship between the peripheral walled fabric and the inner accessible routes. Reviewing the results from the detailed subsections B(2) and C(2) of Cairo reveal that, if the residential walled edges are well connected with the main inner accessible routes, they became accessible by themselves and well interrelated from the inside. The previous result was not considered in the AKTC intervention in Darb Al Ahmar; this represented one of the main obstacles in the project. The project suggested a direct connection between the segregated residential quarters proximate to the historic wall and the outside context of Al Azhar Park. The linkage was not successful because the two segregated entities were not connected with both the inner and outer accessible routes, in addition to the other financial and political problems that led to the disruption of the intervention project.

In walled Historic Cairo, the residential fabrics are the main typology adjacent to the wall. The northern side stands free due to major fabric clearance (from the 1940s until recently in the 2000s), while the eastern side is still attached closely to the historic inner fabric. There are many reasons for the previous demolition action; one was giving the wall, as a monument, a stand-alone vision. Most of the residential buildings have no matching significance. Reviewing this point of view reveals the problem addressed by Daher (2008) and recent conservation charters, in considering which layer of history should be preserved or even considered in regeneration projects (Daher, 2008). The preservation vision should have a holistic contextual vision of the urban edge and not only the beautification or restoration of the outer skin of some buildings, which was one of the problems with the AKTC project.

One of the most important indicators of a walled city's land use is the location of cemeteries. As a result of beliefs and religious considerations, transferring the bodies of the dead or moving cemeteries in general is something very difficult in Arab and Islamic countries. It would need a religious, legitimating 'fatwa' (Islamic religious ruling) permitting that transport, and a long period of time before starting the process. Consequently, the current locations of old cemeteries often define the outer edge of historic walled cities. They limit the interrelation between the inside and the outside fabrics and, in some cases, attract poor living conditions affecting the spatial integration, architectural features, and the surrounding land uses. Therefore, they represent another type of barrier.

To summarize the previous concluding points, they are related to the research objectives, the hypotheses, the findings, and the analysis of the selected case studies as follows:

- Physical and visual barriers do exist in different forms along the urban edges. They can be altered by paying attention to the type of link between both sides of the edge, considering spatial interrelation, architecture continuity, and land-use typology.
- Spatial analysis would be highly beneficial as an initial preliminary investigation in urban edge analysis, particularly if the primary data is not all available.
- Architectural features form a visual enclosure or a stereotypical image and do not alone form an apparent effective physical barrier.
- Land-use typology plays an important role in binding or segregating the urban edges with the surrounding context as it holds economic values and attracts various potential movements.
- A ring road that might surround the former walled path does not act as one homogenous edge. This point would affect the decision-makers' policies in any regeneration intervention.
- There might be related similarities (patterns) in different parts of the urban form features, despite the location and type of edges that the traditional inner historic fabric lies behind.
- The proposed analytical assessment framework is capable of measuring micro and macro levels of analysis in walled cities. It has the potential to become a valuable tool for decision-makers in evaluating the current situation and in measuring the success of their intervention projects.

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URBAN AND RURAL UMAYYAD HOUSE ARCHITECTURE IN JORDAN: A COMPREHENSIVE TYPOLOGICAL ANALYSIS AT AL-HALLABAT

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Abstract

The Umayyad period represents one of the most prosperous periods in the history of Jordan. Most of the studies, however, have long been focused on palatial and luxurious architecture. In Jordan, few examples of Umayyad houses have survived in their entirety. However, the new discoveries at al-Hallabat rural houses allow an architectural enrichment of our knowledge for that period, even from a socio-economic point of view. In contrast with the better-known desert palaces that dominate the evidence for this period, they also assist in establishing the houses' typological patterns. This paper attempts to present and discuss the main Umayyad urban and rural house architecture in Jordan, while addressing al-Hallabat Umayyad houses based on recent unpublished reports and preliminary results of excavations. It aims to present a comparative typological pattern analysis of al-Hallabat houses excavated at two phases (1979-1982, 2002-2006) with parallel examples from Bilad al-Sham. The paper defines three typological patterns; nucleus, courtyard, and complex houses. All have at least one courtyard. The study shows that there were continuity and parallelism in Bilad al-Sham between these types and those used at least in early Byzantine and early Islamic period, such as these at ar-Risha and Khirbet al-Askar in Jordan.

Keywords: *Umayyad houses; nomad village; urban and rural settlement; architectural typology; courtyard house; al-Hallabat; desert palace*

INTRODUCTION: UMAYYAD JORDAN

The debated interpretation and explanation of the process of early Islamic settlement in Bilad al-Sham, based on recent archaeological evidence, is constantly growing, as more dynamic evidence comparing with literary references (Kennedy, 2014: 98). The buildings commissioned by the Umayyad dynasty in Bilad al-Sham, the core of the Umayyad realm illustrate the dynasty's appropriation and adaptation of Hellenistic, Roman, Byzantine, and Sassanian cultural traditions (Haddad, 2009:7; Arce, 2007; Almagro, 1992). Umayyad architecture in Jordan, actually, contains a mixture of eastern and western influences (Warren, 1978: 230; Haddad, 2009:1, 7). In fact, the early Islamic architectural elements were formed to respond effectively to people's physical, environmental, socio-economic and political, as also physiological and religious requirements at their time (Kaptan, 2013:5).

The Umayyad period represents one of the most prosperous periods in the history of Jordan due to its proximity to Damascus and its strategic geographic position which made it an important thoroughfare for pilgrims venturing to the holy Muslim sites in Arabia. Umayyad Jordan has also been the stage for great events that have influenced Islamic history and the Mediterranean region. The land of Jordan hosted the first confrontation between Islam and the Byzantine world in the battle of Mutah near Karak and the decisive battle of Yarmouk.

Perhaps one of the most important events from a political point of view was when the Abbasids launched the movement against the Umayyads using al-Humaymah in southern Jordan as their headquarters to establish their succession in Baghdad. In 750, Umayyad Jordan shifted to the rule of the Abbasids after the revolution that was initiated from al- Humaymah.

Jordan was enriched with some of the finest examples of early Islamic architecture, found anywhere including in caravan stops (caravanserais), bathhouses, and palaces at the eastern Jordanian desert. Interestingly, from a socio-economic point of view, the Umayyad period witnessed an expansion in urban and rural centers illustrated by the castles, the palaces, and the so-called 'Nomad Village', which stretched over great areas of Jordan. According to Kennedy (2014: 96) "there is a rarer site type — a dispersed village, known under various names", which he termed as 'Nomad Village', such as the ruins at Jabal Seys, at Qasr as-Swab, at Ar-Risha, at Hibabiya, and the those at Qasr el-Hallabat, which is the main subject of this paper. Kennedy (2014:107) states that 'Nomad Villages' "are important sites in their own right, revealing evidence for the progressive development of the pre-desert and adjacent desert regions of northern Jordan".

When the Umayyad inhabitants of Jordan were building these 'Nomad Village' complexes on the fringe of the desert/ Badiya, substantial Umayyad large urban towns existed at Jerash, Amman and Tabaqat Fahl (Pella) as also in many other long established towns such as Madaba, Hisban, Umm el Walid, Umm el-Jimal, Umm el-Rasas, and Aqaba (Alhasanat et al, 2012). In fact, the economics of many towns in early Umayyad Jordan became increasingly focused on the manufacture of tradable goods, especially in the eighth century (Walmsley, 2000: 305). In Jordan, the Umayyad achievements are reflected in the ability of the dynamic Muslim culture to expand far beyond urban centres to exploit in a creative management the reward of the agriculture and trade potential of formerly marginal frontier regions.

However, the al-Hallabat settlement provides the opportunity to investigate the rich cultural heritage significance of Umayyad domestic architecture, which is relatively limited in Jordan in comparison to palatial and formal architecture. The 'Nomad Village' settlement at ar-Risha (c. 5ha lies 165 km north-east of the Azraq Oasis and 35 km north of the small Baghdad Highway town of Ruwayshid) also has a collection of minimally preserved structures of individual buildings arranged in parallel lines with a mosque and large formal buildings.

The paper aims to present and discuss the main Umayyad urban and rural house architecture in Jordan, clarifying some socio-economic aspects while addressing al-Hallabat Umayyad houses based on recent unpublished reports and preliminary results of excavations. It attempts to present a comparative typological pattern analysis of al-Hallabat houses excavated at two phases, 1979-1982 and 2002-2006, with parallel examples from Bilad al-Sham.

BACKGROUND TO SECULAR UMAYYAD DESERT PALACE ARCHITECTURE AND PLANNING IN JORDAN: SOCIO-ECONOMIC AND POLITICAL INDICATIONS

Umayyad secular architecture, in fact, is best known from a group of desert palaces (often called Qasr in Arabic sources) constructed of stone and/ or brick in some cases. The so-called desert palaces have developed a unique architectural concept reflected in their location, their density, and their fast spread in a relatively short time (715-750) (Haddad, 2009: 2). Of significance were the events and activities of these early Islamic Umayyad palaces as reflected by their architectural typology while responding to the socio-economic aspects. Their remains were found mainly in the eastern desert of Jordan (Badiya), meanwhile, only a few were built in Syria (Qasr al-Hayr (727- 9), east and west) and a couple in the West Bank (Khirbat al-Mafjar in Palestine).

Such sites in Jordan are distinct from those in Syria; they are comparatively of modest scale and simple construction (Urice, 1987). It is not a mere coincidence that the greater part of the architecture attributed to Jordan corresponds to palaces or private residences and to the new oligarchy who sought to forgo a new image and mark the change of power, as Grabar (1987:

134-135) has pointed out. This peripheral and countryside category was normally the engine of politico-economic activities, and their economic, agricultural and technical innovations were intrinsically linked to urban centers and interregional networks.

These palaces and the other structures of the 'Nomad Villages' from the Umayyad golden age testify to Jordan's identity as a politico-economic center and as a major stop on the caravans' route. They demonstrate a face of the Umayyad life in the Middle East, which is not widely seen elsewhere, and some authenticate a perfect condition of preservation which is quite astonishing taking into account their vast epoch.

Recent results of GIS analysis (Alhasanat, et al, 2012: 343) show that these Umayyad palaces are carefully situated at the routes of transhumance and water sources. The distribution pattern of these prominent structures was strategically placed in the landscape to carefully monitor and protect the routes that led to Damascus. They clustered at the outlet of Wadi Sarhan, and there is, actually, line-of-sight communication between Azraq, Amra, Kharana, Muwaqqar, Umm al Walid, Mushatta, and Qastal. However, Qasr al-Hallabat and Qasr al-Tubah functioned more as two main patrol stations (Alhasanat, et al, 2012: 356-57).

These multi-functional activity structures were imposed by the nature of the emerging early Islamic state to strengthen the power and the economy of the newly established dynasty, but they also demonstrate how deeply the Umayyad culture had penetrated this provincial early Islamic area. Usually, these palaces are square in plan, with semi-circular towers buttressing the exterior walls; meanwhile the flanking entrance portals give the palace a fortified appearance (Fig.1a). The central square courtyard, generally surrounded by porticoes of two stories high, with the upper ground layout following the same guidelines as the lower. In fact, the square layout is not only conceived as a multi-functional space to control all the activities taking place, like trade at the Suqs, religious activities at the mosque, and political functions at the Qasr (Almagro and Arce, 2001: 665), but also as symbol of power, Just as a perfect balanced, stable, clear, and rigid form that reflects the concept of power and strength (Haddad, 2009: 6).

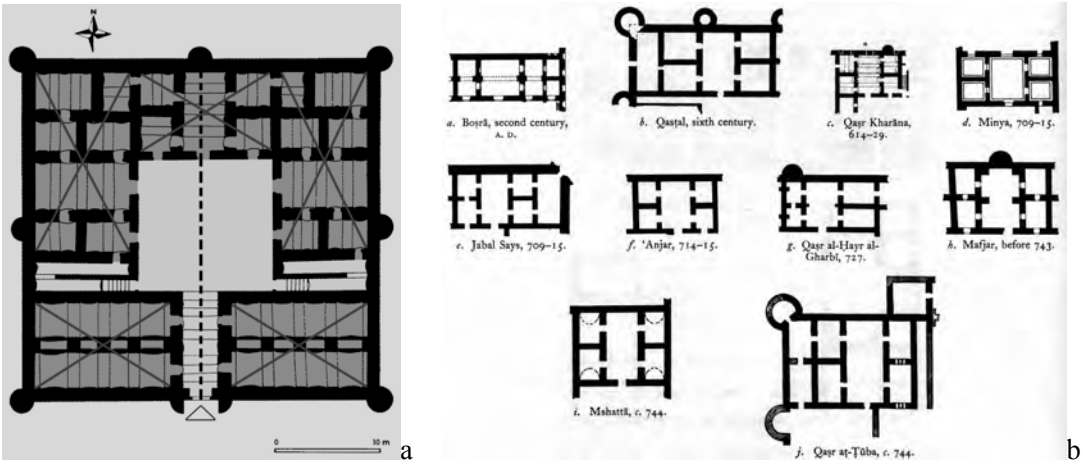


Figure 1. a. lan of Kharana Umayyad desert palace, as a model illustrating the interior symmetrical layout, space distribution, division and the bayts' units (After Haddad, 2009, Fig.5); b. different *bayt* units from Umayyad palaces in Bilad al-Sham (Source: After Creswell, 1989, Fig. 565).

The particularity of these buildings appears from the unity of the internal and external architectural form with the different variation of sizes and scales. They are characterized by clarity, identification, reflecting the image of the power of Islam from the outside, and the luxury from the inside reflecting the new lifestyle of the Umayyad (Haddad, 2009; 1, 7).

The Origin of the Architectural Pattern of the so-called Umayyad 'Bayt': Social Indications

In the early Umayyad architectural context, a bayt (plural buyut) is composed of a central hall flanked by a pair of rooms on either side from which the accessibility is achieved. This is a module frequently repeated in the desert palaces (Creswell, 1989: 516; Almagro, 1987:183; Haddad, 2009: 7) (see Fig. 1).

The bayt of the Umayyad palaces has different typologies that can be established from their architectural patterns; either independent or grouped structures, appearing in more or less compact ensembles. The independent type corresponds to buildings organized around a central square courtyard. Rooms open off the courtyard and are either directly or indirectly connected to it, such as at Qasr at-Tuba. These rooms form secondary spaces arranged around the main hall from which two or four adjacent rooms radiate. For example, at Kharana, other rooms were added to the three or five-room group (Fig. 1a), yet there is no repetition of any particular type of pattern from one case to another (Creswell, 1989).

Socially, this bayt arrangement is considered a more orderly expression of the same pattern seen in the few urban residences. According to Almagro (1992), these structures, which are based on the main hall and two to four smaller-sized adjacent rooms, appear to comprise the simplest type of room-unit, and can be compared to similar 'buyut', not usually found in the urban Umayyad house. Parallels, however, of such a module that resembles a bayt of the Umayyad places were found at the residential structures at Amman citadel, in both households of Building B and the main house over the Museum site (Harding, 1951: 7). This organization is clear in the room that may have functioned as a reception, opening onto two flanked rooms on either side of it, and thus forming a bayt (Fig. 2a).

It has been suggested that the architecture of these 'buyut' may reflect the Bedouin tent, Bayt al-Sha'ar. This theory was adopted by Helms (1990) through his study of the houses at ar-Risha, which was first suggested by Gaube (1979) in terms of a similar development of tents via a circular or square arrangement (dwar), as the design principle underlying the Qusur. However, Ahn (2010) clarified that one could identify the influence of the steppe and reference to the Bedouin tent by the normal Bedouin practice of laying out their tents in staggered rows facing downwind where each is separated from its identical neighbour by an acceptable distance. This scene is still reminiscent of many Bedouin towns today (Kennedy, 2014: 101; Ghrayib and Ronza, 2007: 423). However, only by this frame of Bedouin domestic forms, one can accept that it was derived from the tent, and in this sense, ar-Risha (see Fig. 9c) is a good example of what Bedouins might have built (Kennedy, 2014: 99, Fig. 4).

UMAYYAD HOUSES IN JORDAN: KEY SOCIO-CULTURAL ASPECTS

While the most striking feature of Islamic architecture is the focus on interior space, the most typical expression of this feature is found in the inner space of the Muslim house. However, as the essential value in Islam is the emphasis on the inner aspect of self or thing (Bātin) and the subordination of the external aspect of self or a thing (Zāhir), the courtyard house and its organizational pattern are appropriate for the application of this principle (Hakim, 1986: 95-96). On the other hand, a comparative analysis of Islamic architecture in countries that have different climatic conditions suggests that climate has always been a significant force influencing the design and location of buildings (Toulan, 1980: 75). Therefore, the courtyard type house in Islamic architecture can be considered as a result of the integration of socio-cultural, religious, and climatic factors.

Historically, the courtyard type house, in fact, is a generic domestic form of residence that evolved independently in various ancient and traditional places. It is a product of cultural polygenesis dating at least to the Bronze age, and it has persisted in the Mediterranean area in

the form of the classical atrium and *pastas* house to be adopted by Muslims in the dār al-Islam (Petruccioli, 2007:73). It is additive by nature; the severe and austere facades are presented to the outside world, and because of the darkness of the house interior, it provides secluded open space for all family and most domestic activities in the sunlit courtyard area (Ahn, 2010: 106).

It ensures privacy from outside or adjacent areas while providing a level of interdependence between neighbours with regard to the use and rights of shared walls, maintenance of streets, problems related to rain and waste water (Hakim, 1986: 95-96). It also allows the structure to expand with the growing extended families while it is easy to make additions to the original structures. This type can also be arranged as multi-smaller unit houses, containing several living units on one or more levels of the residence with the courtyard as a shared space (Ahn, 2010: 107).

Umayyad Houses within an Urban Context in Jordan

The purpose of this section is to realize if any typological patterns, wherever possible, have survived in the urban context in their entirety in Umayyad Jordan. This will be achieved by reviewing the basic house layout, its relation to the street, and the function of the household in relation to socio-economic conditions. Umayyad Jordan, Amman, Pella, and Jerash are the most representative of urban town centres. These three respective urban sites will be examined briefly before discussing al-Hallabat rural domestic settlement houses.

Jabal al-Qal'a (Citadel) Umayyad houses in Amman

The Umayyad palace complex, at Jabal al-Qal'a (citadel) in Amman, differs in its layout and architecture from the rest of the desert palaces in Jordan. From a political point of view, it was the administrative center and residence for the governor of the region. Still, the main area of the urban reform, undertaken by the Umayyads, was mainly the public space layout with a new urban concept to accommodate the organization of the newly created architectural elements and also the reuse of pre-existing features (Almagro and Arce, 2001: 662). It also included the construction of separate courtyard house units of a variety of sizes, ranging from two rooms and a courtyard to seven rooms, a latrine, and a courtyard. Meanwhile, the residential units of the palace in one structure have ten rooms, a latrine, a staircase, and a courtyard (Northedge, 1992: 157).

Excavations have uncovered a number of upper-class residences from the 7th to 8th centuries contributing to information on the socio-economic aspects. Although the sudden collapse of the buildings was attributed to the earthquake of 749 (Northedge, 1992: 142), a significant house (380 m^2) over the Museum site is preserved to a height of about 2.5m, built around a closed inner courtyard (Fig. 2a). The courtyard (8.6m wide) has a cistern with a shaft (Bennett and Northedge, 1976: 176). Plastered drains in the north-east and north-west corners of the courtyard conducted water from the roof to the cistern (Harding, 1951: 7). The cistern appears to have been constructed originally in the early Byzantine period.

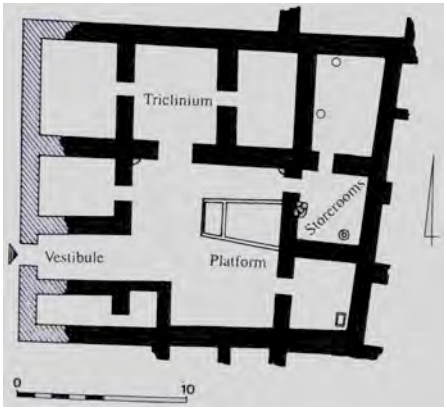
Interesting also is the room that faced the courtyard, with the wide entrance. It was considered by the excavators to be a diwan (a reception room in the tradition of the Roman-Byzantine triclinium) (Bennett and Northedge, 1976). This possible reception room has a laid clay floor. The other lower-storey rooms apparently served as storerooms and workrooms. According to Harding (1951), parts of a mosaic floor were found on the upper storey, which apparently contained the living quarters.

However, Northedge (1992: 143) assumed that the building was apparently single-storey, as no evidence had survived of the roofing technique of a second storey or of a staircase to the roof. He speculated that the roof may have been barrel-vaulted, similarly to another building in the same area. The rectangular shape of the rooms would have accommodated barrel-vaulting, even at the expense of the regular thickness of the walls.

Tabaqat Fahl (Pella) Complex Houses

From a political point of view, Pella was an administrative district in the military province of Jordan in the early 7th century, serving the link between Damascus and Jerusalem: the two most important centres in southern Bilad al-Sham (Walmsley, 2008: 244; 1988: 144). However, the damage and the partial collapse of the domestic quarter of the main mound from an earthquake in 659-60 is evident, as indicated by the complete site destruction as well as from neighbouring sites.

This led to an urban modification translated by a rebuilding program that produced large houses and encroachment on public areas that continued until the end of the Umayyad period (Watson, 1992: 163-164; McNicoll et al, 1982).



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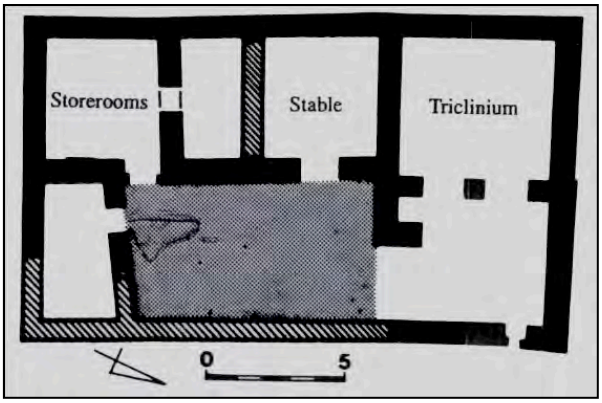

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Figure 2. a. plan of the courtyard house under the Archaeological Museum, Amman Citadel (After Harding, 1951; Hirschfeld, 1995: 84, Fig. 60); b. plan of House 'G' at Pella (Source: After McNicoll et al, 1982),

At least six courtyard structures dating to the seventh and eighth centuries were completely destroyed in the 749 earthquake. From a socio-economic aspect, generally, the houses at Pella represent the mixed-use function at ground floor level of the household: living arrangements accommodating animal stables, storage of foods, workshop production, and some aspects of daily living (cooking, transit accommodation). In the upper floor spaces, much of the social activities take place and perhaps three houses at least with roof-top access. (Walmsley, 2007: 131). The upper floor could be reached through the courtyards by means of stone-built staircases (Walmsley, 2008: 251).

In one of the well-preserved examples of these houses, a two-storied courtyard, house 'G' (230 m^2) (Hirschfeld, 1995) (Fig. 2b), has a corner entrance leading to a simple rectangular courtyard to the east. The rooms on the lower level were also used as storerooms and stables. The presence of carbonized wooden beams suggests that the roofs were made of matting over oak beams sealed with clay (Walmsley, 2007: 130). The upper storey floors may have been carried on timber joists (McNicoll et al, 1982: 131).

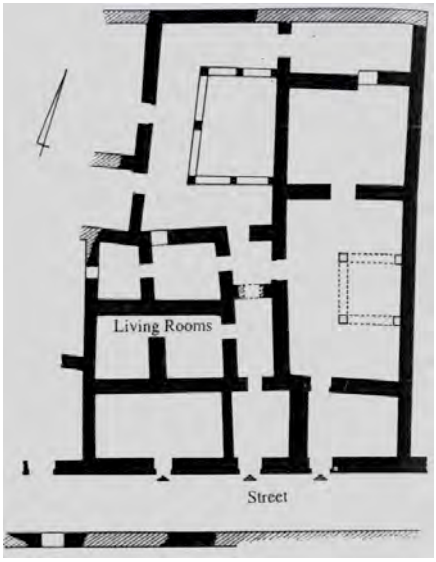
An out of the ordinary house dating back to the late 7th century, destroyed by the severe earthquake of 749, represents a fine example of an urban, but not primarily residential complex. The complete ground plan remains unknown. It was a large complex (560 m^2) with two courtyards. The front façade of the house has three doorways opening directly onto the street (Fig. 3a). The group of living rooms in the west side of the house has accessibility from the main entrance through a small entrance hall. The eastern entrance was used to connect the two courtyards, while in the western side, a separate space was probably also used as a shop (McNicoll et al, 1982).

Socially, the excavators explain the parallel existence of the two courtyards due to the extended family's daily life activities that occupied the house, of which the closest courtyard to the street belongs to the men's wing. The large room built in the outer courtyard was a guest room while the inner courtyard and the rooms surrounding it might have served as the women's wing.

The "Umayyad House" in Jerash

An Umayyad residential quarter was found recently on the north side of the South Decumanus inhabited from 660 to 800 AD (Gawlikowski, 1986: 107-136). Socially, this also large Umayyad structure of about 600 m^2, coexists as 5-6 separate units, belonging to families that shared the same courtyard. The dwelling units laid around a courtyard are with one main entrance through a passageway from the colonnaded street in front of the house, which remains were in use, serving its original purpose along the lines of the shops.

The complex, however, extends northwards behind three shops that directly faced the street south of *decumanus* and formed the façade. The complex does not appropriate the shop space for its residential use (Gawlikowski, 1986: 111, 113). The shops were entirely restored, including the upper foundation courses found in the fill of a cistern without any major change in layout (Fig. 3 b and Fig. c).



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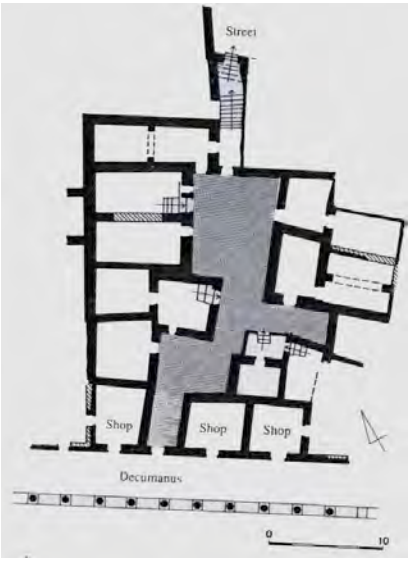

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c

Figure 3 a. plan of the apartment house at Pella, seventh-eighth centuries (After McNicoll et al, 1992; Hirschfeld, 1995: 49, Fig: 25); b. plan of the Umayyad apartment house at Jerash (After Hirschfeld, 1995: 50, Fig. 26), c. 3D restitution views of existing state after restoration (Source: After Gawlikowski, 1986: Fig. 2).

The entrance passage led directly from the street to an irregularly shaped courtyard. In the back of the courtyard, there was another opening that led through a staircase to the street north of the complex. The courtyard's irregular shape was the result of the intersection of the Roman period foundations' walls with the Umayyad period, as it is clear by the room that intrudes into the middle courtyard space (Gawlikowski, 1986: 113).

In this complex, there is no indication of the so-called bayt layout. The rooms are arranged into two wings, to the east and west of the courtyard, where the depths of the rooms of the west wing vary according to the pre-existing conditions that the builders encountered in the area. The eastern wing also is not arranged symmetrically and many rooms are not aligned on the same

axis. The arrangement reflects the concept of the 'day and night' use of the living quarters as rooms are grouped in pairs; there are three sets of two-room suites (Gawlikowski, 1986: 114, 419). The front room earmarked for daily use and the back darker one used for sleeping. The layout of the units/ apartments, however, reflects a homogeneous pattern.

A sewage drain extends from the end of the courtyard to beneath the entrance (Gawlikowski, 1986: 113). This serves as the only sanitary facility in the household. An earlier sewage drain runs from the end of the courtyard and beneath the entrance. Some walls are preserved up to 3m above the floor, though the ceiling could not be lower than about 3.5m. The walls were probably mud-plastered while the roof is supported by wooden beams. An upper storey may have existed, but no evidence of it was found (Gawlikowski, 1986: 114).

In conclusion, comparing the main architectural features of the three previous houses reflecting the different socio-economic and political associations, we can note that the Amman complex example bears several significant differences and has only one main common feature with those of Jerash and Pella: the main façade entrance, which in this case is strongly connected to the courtyard through a vestibule. Also, according to Almagro (1992, 351), in each of these "Umayyad houses", several constants are apparent. He concluded that each has a courtyard, generally irregular in form, which functions as an element of distribution. All of the rooms to the house have either direct or indirect access to the courtyard, where at least one of the main rooms opens to the courtyard directly. Access from outside the house or from the street is gained through one sole exterior door and a series of hallways and small vestibules. However, in the Amman house case, the entrance from the outside to the courtyard is direct, since no L-shaped passages are used to obstruct the vision of the visitor. Another common feature is the hierarchal arrangement in the remaining rooms, of which many are only indirectly connected to the courtyard by way of other rooms.

However, the main difference with the Amman example is that there is a bayt layout at the main unit. According to Northedge (1992, 157), the bayt layout arrangement is directly paralleled by the proto-bayts at Khirbat al-Bayḍā, and the addition of a bayt in both households at Amman may be explained by the fact that these houses correspond to a part of the Umayyad political citadel project, which represents a single planned unit whose elements include the palace, the rebuilding of the fortification circuit, the open cistern, the Stratum V buildings of Areas B, C, and the Museum site. Whatever form and internal arrangements it may have had, it was in substantial use in the seventh and eighth centuries. At the same time, it reflects some socio-economic conditions and relationship with urban domestic architectural traditions of the late Antiquity era of Bilad al-Sham.

Another difference, probably in relation to the extended family's needs, can be seen from their size: at Amman is 380 m^2, at Tabaqat Fahl 560 m^2, and at Jerash about 600 m^2. The Tabaqat Fahl example, in fact, has many features in common with the one at Jerash: façade entrance between shops, no indication of the bayt layout, the ratio of the length of the façade to the length of the house is about 1:1.5, and the main architectural concept layout is the outcome of two units separated also by a forced earlier phase.

On the other hand, the "Umayyad house" in Jerash, given its irregularity, shows that the Umayyads dealt in a creative respectful approach to the potentiality of pre-existing features, achieving the basic religious, socio-cultural, and economic conditions and requirements. All of the windows face the courtyard suggest an inward orientation to maximize privacy, as also the design of the main entrance to a passageway, which turns at a right angle, obstructing direct view into the courtyard space from the street (Ahn, 2010: 106).

The main layout reflected in the architectural concept, in fact, is the result of two opposite approximately triangle-shaped units separated by an irregular forced courtyard. Comparing the Tabaqat Fahl house, which is not primarily residential, to the "Umayyad house" in Jerash given its

irregularity, we can assume that there is a possibility that it might also have not been designed solely a residential house.
Basically, the then present socio-economic conditions played a major role in these urban sites, for there are no modifications in the region's urban living style during the Umayyad period given the eminent sense of religious tolerance inherent to the Islamic faith (Piccirillo, 1984).

THE AL-HALLABAT ARCHAEOLOGICAL COMPLEX AND THE AGRICULTURAL ENCLOSURE

The al-Hallabat archaeological site (Fig. 4) within the complex of the Qasr is located 60km northeast of Amman (Arce, 2007: 325), 25km to the northeast of the city of al-Zarqa on the southeast edge of the modern town of al-Hallabat al-Gharbiyya (Ghrayib, 2003: 65), and about 16km from the Via Nova Traiana (Kennedy, 2000: 90). Al-Hallabat was built on a gently sloping ground dissected by shallow rainwater gullies that drain the land to the south. The site lies on the top of a mound situated in a semi-arid zone with an annual precipitation rate of less than 100mm (Bisheh, 1985: 265).

This unique site was a Roman fortress with a *probable* Nabataean predecessor converted into a desert palace, and was rebuilt several times as attested by several identified phases of development (Kennedy, 2014; Kennedy and Riley: 1990; Bisheh, 1985; Arce, 2007). More analytically, the Qasr history goes back to the Nabataean period when it was a station on the trade routes. During the Roman period, it was a Roman fort constructed in the second or third century AD, as a military station on the road between Bosra and Aqaba (Harding, 1984). Built from black basalt and honey-colored limestone (Kennedy, 2000: 90), it dominated the site to monitor and control a broad area to the southeast towards ‘Azraq from which travellers would be observable for many kilometers while approaching the plateau along the Amman-Busra-Damascus route (Ghrayib, 2003; Jalboosh, 2009).

An Umayyad mosque also dominates the site from the top of the mound and several Umayyad houses remains are still visible on the slopes of the mound and in the valley. The impressive architecture of the Qasr, the mosque and houses, which belong to the same period are unique examples of Umayyad rural Jordan.

The archaeological site covers an area of 50 acres (202342.821m^2) (Ghrayib, 2003: 65; Jalboosh, 2009). However, according to Kennedy (2014: 107, Table 1) the area of the 26 structures is about c.35 hectares (350000m^2) and with dimensions c.850m x 550m= 467500m^2. An agricultural enclosure is located about 400m to the west of the Qasr. The enclosure of about 270m x 220m = 59400m^2 collected the water that reached it from two wadis (Bisheh, 1982: 142). It is irregular and gradually narrows to the lowest point of the ground elevation on the north, the walls of which only one course of stones remains, were built of rubble core of field stones without a foundation trench (Bisheh, 1982: 138).

This Umayyad 'Nomad Village', according to Kennedy (2014: 108), seems to have been placed in a good region for cultivation and probably remained largely based on animal herding. Excavations of a number of sluices and water deflectors, however, confirmed that this was an agricultural settlement (Bisheh, 1980: 70).

The agricultural enclosure associated with the site has an elaborate system of sluices regulating the distribution of water to its plots (Bisheh, 1985: 264-265). It is described by the present inhabitants of al-Hallabat as ‘Huwaytah’ (diminutive of Hait) (Creswell, 1989). ‘Hait’ is a word used in medieval texts to denote cultivated areas or gardens around a town (Grabar et al, 1978). In addition, the evidence of the stone and the basalt objects used for grinding and processing seeds and vegetables attests that the inhabitants of the area were depending on agriculture. The existence of two stones in one of the ruined buildings, to the west of the water reservoir, also suggests that the enclosure was devoted to the cultivation of orchards, containing

mainly olive trees and vines. Actually, agricultural improvements instigated by the Umayyads resulted in the spread of agricultural settlements (Ahn, 2010: 102).
The site is also located in an area of numerous springs and water sources and includes a complex water system with channels; at least five large cisterns and a big reservoir cut in the bedrock down in the valley (Arce, 2007: 325) and an elaborate bath complex (Hammam as-Sarah) display the Umayyad celebration of their water infrastructure and their control over water resources (Alhasanat et al, 2012: 357).

The reservoir (2060m^2, volume of 8000m^3) lies a few hundred meters to the south and the numerous cisterns in the wadi to the north and west and the channels system were probably connected in order to store the water and distribute it to the Qasr, the houses, and the agricultural land (Ghrayib, 2003: 68; Bisheh, 1989: 246; Harding, 1984). These various structures seem to be randomly scattered around the Qasr (44x44m), for the most part facing south and /or east, while the houses were built along very ordinary, seasonally-flooded wadis in an essentially featureless landscape.

The particularity of al-Hallabat settlement is that it has a pre-existing Qasr, located on the top of the mound, and later on was surrounded by the houses and hydraulic system. Looking to other Umayyad settlements in the region, mostly the Umayyad palaces were built on a flat area, without houses surrounding them, such as Qasr Kharana and Mushatta, or we can find a small flat settlement without a palace such as at ar-Risha.

On the other hand, the unexcavated Khirbet al-Askar (c. 33km south-east of Karak and 10km east of Muhai), according to Kennedy (2014: 107, Table 1), has the same area (c.35ha) with dimensions (c. 1100mx350m=385000m^2), but with 45 structures.

An analogous situation, until now, to our case is found at the al-Qastal south of Amman, and Jabal Seys in Syria where the Qasr is surrounded by houses and other installations.

As noted by Kennedy (2014: 99), contradictory to ar-Risha ruins (with an area of c. 5ha, and with dimensions of c. 400x180 m=72000 m^2 (Kennedy, 2014: 107, Table 1) (Fig. 9c), where "some buildings are arranged in short lines and are roughly parallel" and fairly compact, while at al-Hallabat (Fig.4) as also at Jabal Seys,Qasr as-Swab, and Khirbet al-Askar, there "is no order in the layout, and structures are seldom aligned, even with a neighbouring building, and they are widely dispersed" across the site, and in all these three cases shape "an elongated settlement — long and narrow and covering a considerable area" (Kennedy, 2014: 107).

This phenomenon of covering a considerable area at both sites of al-Hallabat and Khirbet al-Askar might be explained due to the similarities of the socio-economic existing conditions at that time. Small farms and garden areas between the houses were the main characteristic feature of the land use formation, similar to that of the farmhouse at Nahal Mitnan (Haiman, 1995, Plan 3) (Fig. 8c). In Nahal Mitnan, a 4km long wadi channel was intensively cultivated by means of agricultural terraces and about two km upstream from its confluence with Nahal Horsha (Haiman, 1995: a:1). The Nahal Mitnan farm consists of the main farmhouse, an agricultural installation, a threshing floor, and a section of the terraced wadi-channel, enclosed by a stone fence (Ahn, 2010: Fig. 44 and Fig. 45).

This might also suggest that we should accept that the two sites of al-Hallabat and Khirbet al-Askar are more suited and specialized for large cultivation centres, but are also more of organized centres compared to ar-Risha (Kennedy, 2014: 101), even as clarified before that al-Hallabat site is a far more developed site than ar-Risha.

Socio-economically, this might also suggest that Bisheh's (1985: 264) identification, that probably those houses were the residences of servants working in the Qasr, was overestimated. One cannot accept that such complex houses, with considerable sizes, such as the well-planned house no. 1 (724m^2) of al-Hallabat, which is far away about 400m of the Qasr, belonged to servants. Furthermore, this house is directly connected to an agricultural enclosure (see fig. 4).

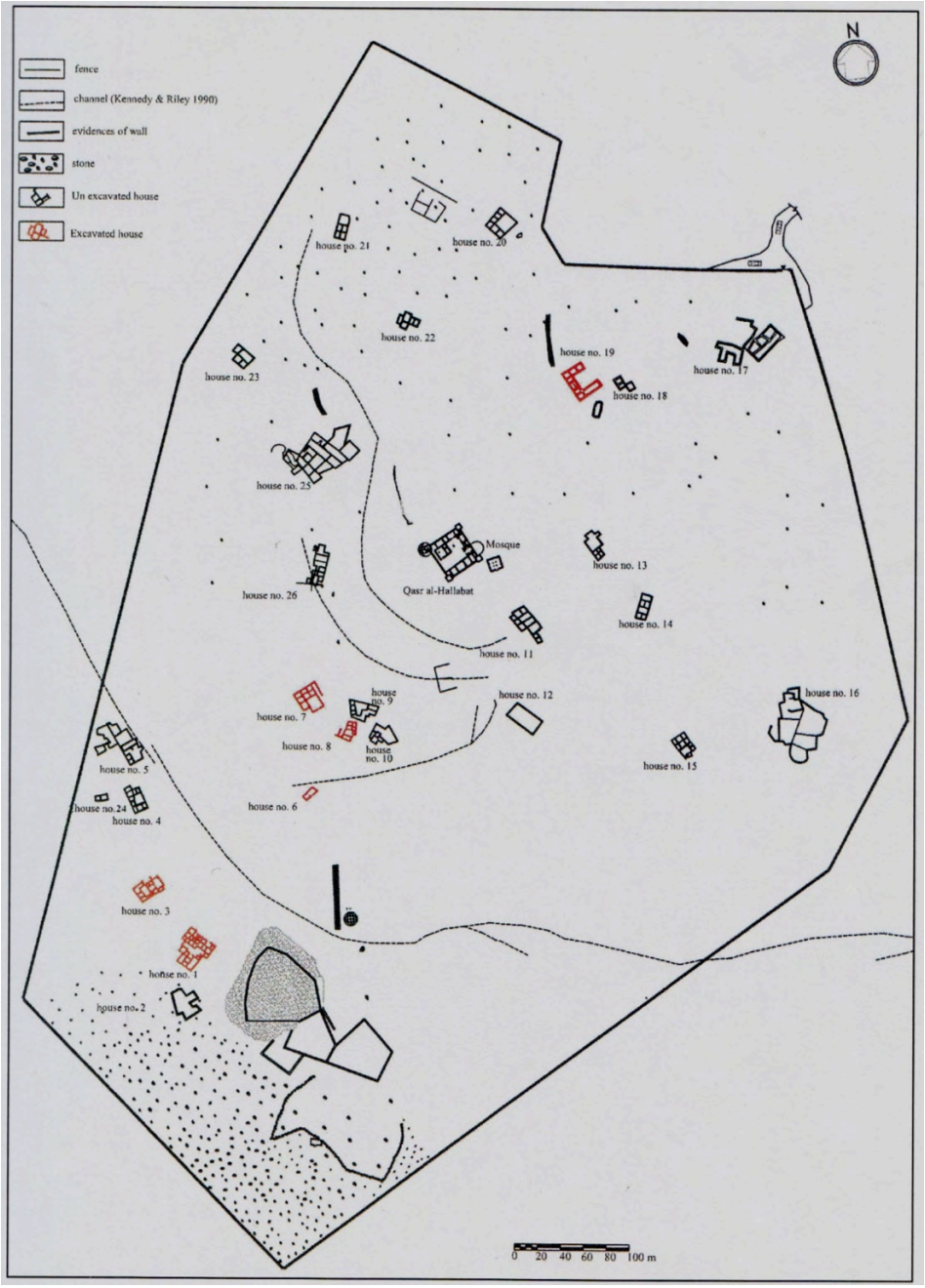


Figure 4. Site plan of the Umayyad houses around the Qasr at al-Hallabat (Source: Authors).

THE UMAYYAD HOUSES AT AL-HALLABAT SETTLEMENT ARCHAEOLOGICAL SITE: SOCIO-ECONOMIC CONDITIONS

The twenty six Umayyad houses/ structures (Table 1, Fig. 5), of which six houses have been recently excavated and the other twenty surveyed, can provide valuable data for establishing some of the socio-economic conditions and needs based on their typological patterns and classifications in relation to the various Umayyad Jordan house-types. The study of pottery confirmed that these belong to the Umayyad period and were built in a limited period of time as proven by the type of vessels, which were reserved for domestic purposes, like cooking pots,

jars, bowls, casseroles, and storage jars (Ghrayib, 2003: 67; Jalboosh, 2009). The following presented data was organized based on unpublished and published reports of these houses, in addition to preliminary excavation results. The twenty six houses have been identified and numbered (Table 1).

In all of these houses built according to the site topography, we can find many similar architectural features. The majority consist of a group of rooms surrounding the open courtyard (Fig. 5) with a well-planned water distribution system, which served the entire settlement. However, many houses had been transformed through the times, since evidence of enlargements has been observed (Ghrayib, 2003; Jalboosh, 2009).

Although they are better built than at ar-Risha (Kennedy, 2014: 101), the layout is almost little randomly scattered on the slopes around the palace and beside the large reservoir, and the well-planned water distribution system served the entire settlement by a thorough network of channels. However, every house had a cistern or a well nearby. Bell-shaped cisterns had been dug into the bedrock and were completely plastered. Meanwhile, the water supply was irregular during the rainy season and where the flow of water was abundant, several protective structures, such as wells and an earthbound, were built around the reservoir to collect the surplus water (Fig. 4).

Table 1: Classification and typological patterns of houses at al-Hallabat settlement.

House No	Area (m^2)	State	Type	Room No	Courtyard No	Function
1	724	excavated	Complex	24	3	Residential
2	517	Un excavated	Complex	23	3	?
3	362	excavated	Complex	11	2	Residential
4	280	Un excavated	Courtyard	9	1	?
5	721	Un excavated	Complex	11	3	?
6	72	excavated	Nucleus	1	1	Storage
7	290	excavated	Nucleus	7	1	Workshops
8	229	excavated	Nucleus	6	2	Residential
9	322	Un excavated	Courtyard?	?	1	?
10	375	Un excavated	Nucleus	?	1	?
11	430	Un excavated	?	9	?	?
12	440	Un excavated	?	?	?	?
13	279	Un excavated	Nucleus	?	?	?
14	222	Un excavated	Nucleus	4	2	?
15	269	Un excavated	Nucleus	8	1	?
16	2200	Un excavated	Complex	25	2	?
17	1435	Un excavated	Complex	8	1	?
18	190	Un excavated	Nucleus	3	1	?
19	633	excavated	Courtyard	8	1	Khan
20	420	Un excavated	Nucleus	6	1	?
21	220	Un excavated	Nucleus	4	1	?
22	190	Un excavated	?	4	2	?
23	230	Un excavated	Nucleus	3	1	?
24	61	Un excavated	Nucleus	1	1	?
25	1558	Un excavated	Complex	27	4	?
26	465	Un excavated	Complex	24	3	?

Al-Hallabat houses were built without foundation trenches, directly on bedrock and gravel surfaces that sloped gently. The building material is a stone of different kinds, mainly limestone and re-used basalt blocks and fieldstone. The most common floor type is compact earth in both

rooms and courtyards. Most of the houses had flat roofs provided with drain pipes and drainage channels dug parallel to the walls of the houses, but archaeological finds suggest also the use of tiles in few houses.

Staircases, actually, to the upper stories were common in the Umayyad period. They formed a vital element in the ordinary house tradition of Hauran. No constructed stone staircase was found, but wooden stairs and ladders may have given access from the courtyards to the roofs, and even to the second storey of living rooms, as will be discussed.

No signs of directing surface runoff were also observed on the ground, although certain structural expediencies in some of the buildings' details suggest that the foundations may have been protected from erosion. All structures were built on about the same absolute level. No building stood any higher, or on remarkably better grounds than another except building no. (19), built in front of the Qasr façade. However, this house has a totally different scale and typology, as shall be shown.

According to Ghrayib (2003), the houses can be divided into two types: residential complex and simple houses. Their typology, however, is featured by two main schemes reflected in their architectural layout; complex houses and isolated houses. The houses, however, reveal primary differentiation between dwellings, ranging from relatively simple one-room structures to complex multi-family dwellings. The rooms include working areas with *tabuns* and other installations, which might have been small open courtyards. The rooms are aligned along an open space that may have provided access to more than one familial unit.

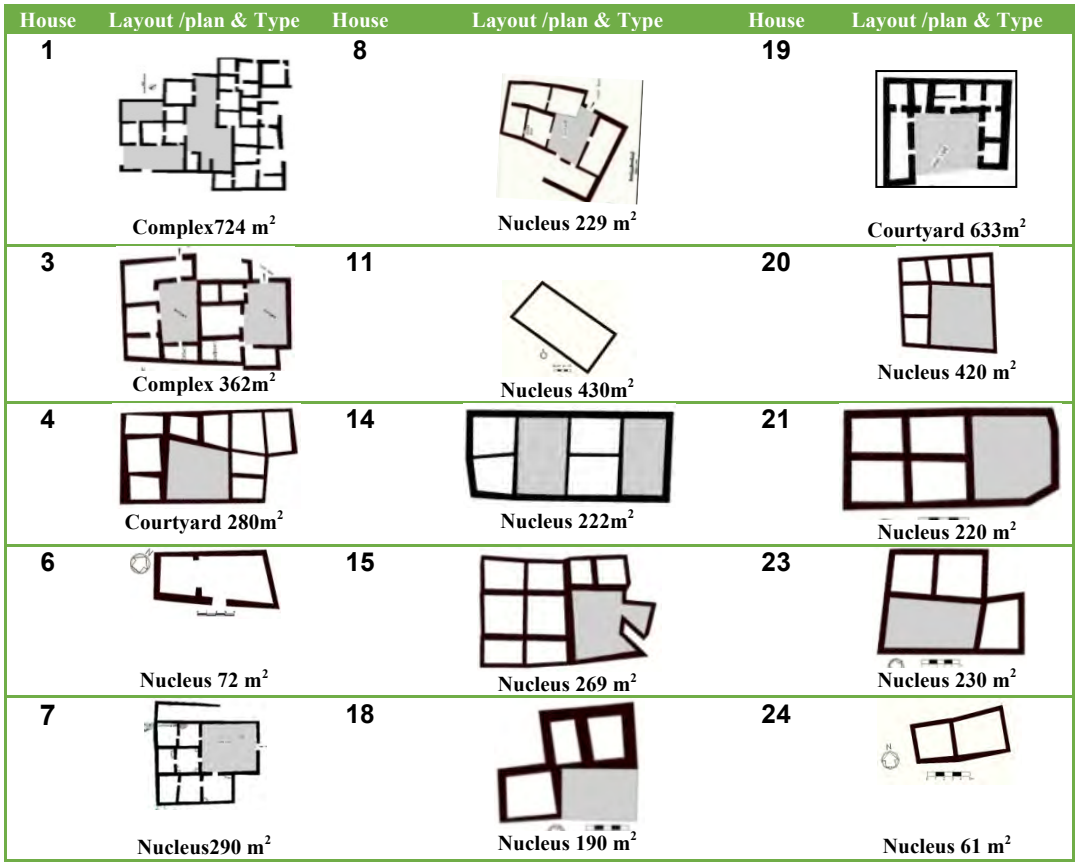


Figure 5. General plans of most of the Umayyad houses around the Qasr at al-Hallabat (Source: Authors).

DISCUSSION AND RESULTS: TYPOLOGICAL STUDY OF AL-HALLABAT HOUSES IN RELATION TO SOCIO-ECONOMIC INDICATORS

According to Petruccioli (2007), the meaning of a rural house can be defined as an expression of a vital, useful realistic architecture that responds to everyday, practical needs, such as shelter, warmth, storage of food, in addition to protection of domesticated animals. He (2007: 68) states that "it avoids gratuitous innovations, uses the simplest techniques to ensure a certain stability, and efficiently meets the most basic of family needs". From a socio-economic aspect, Petruccioli (2007: 68) assumes that, in the early Islamic period, there were many pieces of evidence for a process in which urban houses become ruralized. However, according to Ahn (2010: 101), "the relationship between dwelling and place is first established in a rural setting, though, the first urban building systems are influenced by their rural counterpart".

However, with types of buildings already known in a rural context progressively introduced into the city, Polci (2003: 101) also argued that the rural areas' vitality may have contributed to urban space becoming ruralized. For example, some house unit layouts of rural settings especially in Umm el-Jimal, Subaytah and Msayké features many common elements such as the flanked by rooms central private courtyard used for a variety of functions, with upstairs living quarters reached only by a courtyard staircase (Walmsley 2007:132). Many of al-Hallabat rural settlement complex houses can also sustain this suggested process model as will be shown. Actually, the socio-economic conditions of the Umayyad rural settlement expansion, as can be seen from the al-Hallabat agricultural settlement, may have also created an atmosphere conducive to a process of ruralization of urban space.

On the other hand, the interior courtyard house is an expression of notions of privacy dictated by religious and social norms (Ahn, 2010: 107). According to Hakim (1986: 95-96), the courtyard house creates a physical setting suitable for the religious and social requirements of Islam: privacy, interdependence, and Bātin vs. Zāhir. However, both natural and cultural factors affected directly or indirectly the design layout of these houses. So this section will summarize our understanding of these houses' basic design components: entrance, interior arrangement, and courtyard location.

Based on the architectural layout, the discussed houses at Amman, Jerash, and Pella's urban centers, as also the mentioned early Islamic "Nomad Village" settlement at ar-Risha, in which fifteen buildings extended for some 300m (Kennedy 2014: 99) and al-Hallabat complex archaeological site shall be discussed in the following section. These can be broadly divided into two main categories: the complex house and the courtyard house.

The complex house can be divided into two sub-groups: a) the urban complex house, such as the houses at Pella and Jerash, created by the construction of adjoining dwelling units around a common courtyard with shops, and b) the rural farmhouse, consisting of several dwelling units and wings composed around at least one courtyard. However, these types of houses were mainly found at ar-Risha, Khirbet al-Askar, and at al-Hallabat settlement, as will be illustrated later on. For the complex house of both sub-groups, it is difficult to determine whether the compound was formed gradually or was originally planned as a single complex.

For the courtyard house type, such as in the citadel of Amman, the central courtyard is without pillars, a feature that characterized the domestic urban buildings of Umayyad Jordan. This type provides links to the early Byzantine architectural traditions of the region where the local courtyard type continued up to relatively recent times. However, in Jordan, both the Umayyad courtyard and complex house have several common features. Each has a courtyard which functions as an element of distribution. While all of the house's rooms have either direct or indirect access to the courtyard, at least one main room opens directly to the courtyard.

Accessibility to al-Hallabat houses was usually through a single entrance. This entrance was a vital link between the courtyard and the other spaces of the house, as also a source of light and air. Because of the need to leave the house entrance open sometimes during the day (for light

and ventilation as also for the nature of agricultural works), the entrance to the courtyard was usually positioned at a different axis from that of the main entrance to the units. This arrangement prevented a glimpse by passers-by into the private areas of the house interior. So, in light of the prominence of the house entrance, builders usually took great care in constructing the doorframe. The threshold, doorposts, and lintel formed a sturdy structural unit intended to enhance not only the stability of the house as a whole but also the socio-economic class of the household.

The mixed function of households is also evident in al-Hallabat houses, where living arrangements could also accommodate animals. In particular, the significant evidence for troughs and managers in both urban and rural houses suggest the prevalence of animal stabling in the early Islamic period, as in the main house over the Museum site at Amman, where rectangular and circular limestone troughs were found (Harding, 1951: 9). However, there is little evidence of manufacturing activities taking place in al-Hallabat structures in relation to the evidence of agricultural activities.

In addition, the sewage drains, open drains, and the cisterns of the al-Hallabat houses are concentrated mainly in the area of the courtyard, as can be seen in the urban houses of Amman and Jerash. The courtyard space in the internal organization of most of these houses is corroborated by the layout of the rooms around the courtyard; most of the rooms open directly onto the courtyard. This arrangement is exemplified also by household 'G' at Pella, which is organized around an internal courtyard with five doorways around the courtyard giving access to surrounding rooms (Fig.2 b). The courtyard as the nucleus of the house also dictates that the main entrance leads from the outside to the courtyard.

Table 2. Rooms size classification at al-Hallabat settlement.

House No.	Rooms No.	Large rooms No. (7-10 m length)	Medium rooms No. (5-7 m length)	Small rooms No. (3-5 m length)
Complex no.1	24	4	10	10
Complex no.3	11	2	4	5
House no.6	1	0	1	0
House no.7	7	7	0	0
House no.8	6	1	3	2
Structure no.19	8	8	0	0
Total	57	22	18	17

Generally, the rooms' width from the six excavated al-Hallabat houses range from 2.5-4.5m due to the limited availability of wooden beams for roofing, meanwhile their length range from 3-10m (see Table 2). On average, the rooms are relatively of medium size (3x4m). This is a characteristic element of the Umayyad houses at al-Hallabat. Based on Table 1, which presents the 26 structures' classification, their layout and their courtyard location (Fig. 4 and Fig. 5), we can categorize them into three main types that might also reflect the socio-economic conditions of the settlement householders: nucleus, complex, and courtyard type. The following are their typological features' and characteristics:

The nucleus type (60m^2 - 430 m^2): The common house

Twelve nucleus structures out of the 26 were identified. These are no. (6, 7, 8, 10, 13, 14, 15, 18, 20, 21, 23, 24) (Table 1). However, out of the 26 structures, 3 were not classified. These are no. (11, 12, 22). The five structures (7, 15, 18, 20, and 23) (Figs. 5, 7a, 8a, 8b, 9a) are similar in their (L) shape layout and lies on a different alignment. It is noted that the two buildings (14 and 21) are characterized by the same layout, based on the room numbers (4 rooms), location, and dimensions (220m^2). Another two are with irregular shapes (8 and 10), each with a different

layout built near to each other. Structure no. (8) (12.68mx18.05m= 229m^2) consists of 6 rooms and 2 courtyards (Fig. 8a), located on the south slope mound where the Qasr is located. This building was used for habitation. However, it seems that this house was used in two phases. This, while the west side was built better than the east, in which a new door was opened at the north wall and later was closed, in addition, the east side is higher than the west. Two marble columns were discovered inside the house and could have been brought from the Qasr (Jalboosh, 2009; Ghrayib, 2003). There are also two rectangular stone platforms divided into two squares by a wall in the middle of the two other nucleus structures (6 and 24), with the same approximate dimensions, now preserved as heaps of rubble, but their original function is unclear.

This type is the most basic and is commonly used by the vast majority of the settlement inhabitants. These are generally isolated houses. The basic simple type consists of one-roomed structure or side-by-side units, built either behind or in front of an open courtyard, thus the courtyard is alongside the house.

The floors are of beaten earth and the walls are constructed of stone on the bedrock. The courtyard adjacent to the house was generally spacious and open to light and air. Sometimes, especially in houses built on a slope, the courtyards were placed together between the closely built houses.

From a socio-economic point of view, its advantages are obvious, since the courtyard both created a convenient barrier between the public and private domains and provided an additional out-of-doors working area, usable for much of the year in the generally high temperate climate of the site. A variant of the simple type is the two-wing house. This sub-type has two perpendicular wings, usually built in the northern and western part of the courtyard.

The complex type (360m^2 - 2200m^2): The extended family house

Eight buildings, each with a different layout no. (1, 2, 3, 5, 16, 17, 25, and 26) were identified as complex house types (Fig. 5, 10a, 11a). They can be divided into two groups: a) the so-called "urban apartment house", including several units around a common courtyard, or around several (2-4) courtyards, and b) the estate house, including several units and various wings arranged around a spacious central courtyard. In both cases, the original houses were clearly enlarged to suit the needs of the extended family. They have more than one courtyard and used by multi families and built on the site edges. The main features of these houses can be found in house complex no. (1) (724m^2) (Fig. 10a) located about 30m to the north-west side of the reservoir, and the rectangular complex no. (3) (362m^2) (Fig. 11a) located about 80m west of the complex no. (1), which contains two residential units west and east, in which the east one is built much better than the west. This type is an expansion of the simple nucleus house. It includes several units and various wings. It consists of rows of single rooms and sometimes a pair of rooms, one behind the other as in the urban houses. The units are clustered around three or more sides of series of courtyards, or common open spaces. The units are aligned according to the topography, running roughly north-south along the slope of the mound.

The courtyard type (250m^2 - 400m^2): The public building

Three courtyard structures were identified (4, 9, and 19) (Fig. 5, 12a, 12b). The structures (4 and 9) have different layouts, but with courtyards surrounded by series of rooms from three sides. The building no. (19) (633m^2) (Fig. 12b), located in front of the main façade of the Qasr is also characterized by a (U) shape courtyard, but based on its large size compared with the other houses, we can assume that it is of a special type and had a different function than the others; it could have been used for a public activity of a khan, as will be shown.

COMPREHENSIVE TYPOLOGICAL PATTERNS' CLASSIFICATION ANALYSIS OF AL-HALLABAT HOUSES WITH BILAD AL-SHAM EXAMPLES

The purpose of this section is to identify, based on the comparative study of al-Hallabat houses and other houses, whether there were common typological patterns in the region of Bilad al-Sham, according to their layout, size, and room arrangement around the courtyard. This analysis will also provide a more holistic picture of the socio-economic conditions based on the three housing types at al-Hallabat.

Nucleus House

It should be noted that this type was not always small in scale and in the architectural sense while many are impressive in their size and quality of construction. Such houses measured between 61m^2 (house no. 24) and 375m^2 (house no. 10). Characteristic examples are houses no. (6, 21, 20, 18, and 23).

Figure 6. (a) plan of house no. (6) at al-Hallabat,(b) plan of building at Ein 'Aneva (After Magness, 2004) (c) plan of a simple farmhouse at Nahal ha-'Etz (Source: After Hirschfeld, 1995: 38, Fig.14).

House no. (6) is a rectangular building (12x6 m) with one room and threshold door made from compacted clay (Fig. 6a). The walls (0.76m) are made from large and medium field lime- stones. Analogous exterior shape and size with this house was found in a small rectangular house (6x15.5m) built near Ein 'Aneva (Fig. 6b) at Nahal Zeelim (Wadi Seiyal) about 4km north of Masada. However, it is with two habitation units aligned on the same axis oriented north-south. The floors were made of packed earth, laid over a fill (Magness, 2004).

Interesting enough, there were earlier similar but simple examples of a farmhouse, dated back to the Byzantine period (5th - 6th centuries), found at Nahal ha-'Etz in southern Palestine. The structure is rectangular (67m^2) with two wings used as living rooms (Fig. 7c). Its walls and fence surrounding the courtyard were integrated with the agricultural terraces preserved in the streambed.

Such architectural units often became the core of later enlarged farmhouses of the complex type (Hirschfeld, 1995). An analogous example of house no. (21) (Fig. 7a) was found at Horvat Susiya, southeast of Hebron, dated to the 6th century, and continued in use until the end of the 7th century (Fig. 7b). The structure (160m^2) had one storey with a courtyard (244m^2). It is divided into two symmetrical wings: a northern wing with three living rooms, and a southern wing with one large spacious room. The latter most likely served as the triclinium for family meals and entertainment. Two small shops were built at the back, facing the alley west of the house (Hirschfeld, 1995: 36).

From a socio-economic perspective, the Horvat Susiya and the structure no. (21) at al-Hallabat might suggest that these rural structures were provided with shops for direct goods and trade, as in the case of the Urban houses at both of the Urban centres at Jerash and Pella.

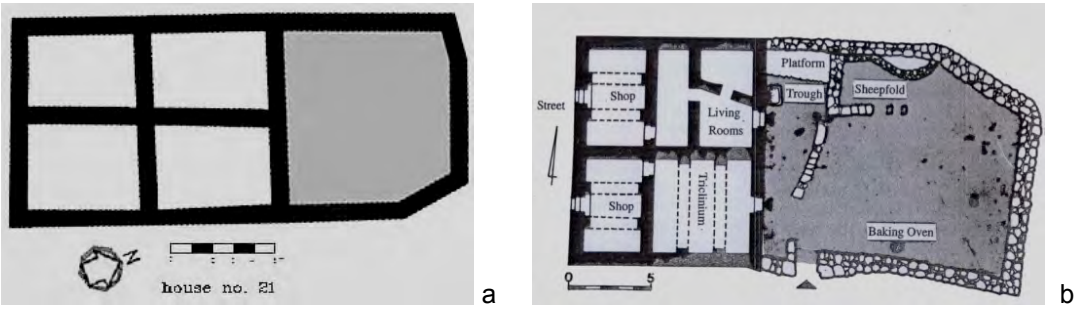


Figure 7. (a) plan of House no.(21) at al-Hallabat, (b) plan of the house at Horvat Susiya (Source: After Hirschfeld, 1995: 3, Fig. 13).

Similar room arrangements in houses no. (18 and 23) (Fig. 8a and 8b) can be seen in the farmhouse at Naḥal Mitnan (Fig. 8c). Archaeological evidence suggests that the establishment and occupation of the farms was a process that continued through the sixth, seventh, and eighth centuries (Magness, 2003: 137). The agricultural system includes an extensive network of terraced wadis, numerous farmhouses, and various agricultural installations (Ahn, 2010: 41).

This farmhouse complex (15x33 m) is composed of three dwelling units, each consisting of one to three rooms and a small courtyard (Haiman, 1995a: 3). However, one can note that there is even less of a physical division between the living quarters and the area for agricultural and stabling activities of the household (Ahn, 2010: 90). The outer courtyards may have been utilized for activities related to the collection of crops before storage or transport, as well as for animals. The two main rooms containing raised beaten-earth platforms, used as beds, functioned as the sleeping quarters. Nevertheless, they constitute one structure farmhouse presumably inhabited by three nucleus families (Haiman, 1995a: 3-4).

Analogous earlier but in a more organized structured layout was found also in the Nahal ha-Ro'a (Fig. 8d), a two-winged farmhouse (270m^2) dated to the Byzantine period (5th-7th centuries) including six rooms surrounding the courtyard from two sides. According to Haiman (1995b: 45), and as we can assume the same for al-Hallabat settlement, during the Umayyad period, the agricultural settlement in the Negev desert was motivated by two reasons: imperial policy that aimed towards protecting the frontiers by encouraging the establishment of agricultural settlements, and state-sponsored settlement of semi-nomads.

Finally, an analogous structure to the house no. (20) (Fig. 9a) seems to be in large use at Khirbet al-Askar, as can be identified from the many structures, such as KS 2, KS 9, KS 10, and KS 38 and others (Kennedy 2014:104-05, Fig. 8,10).

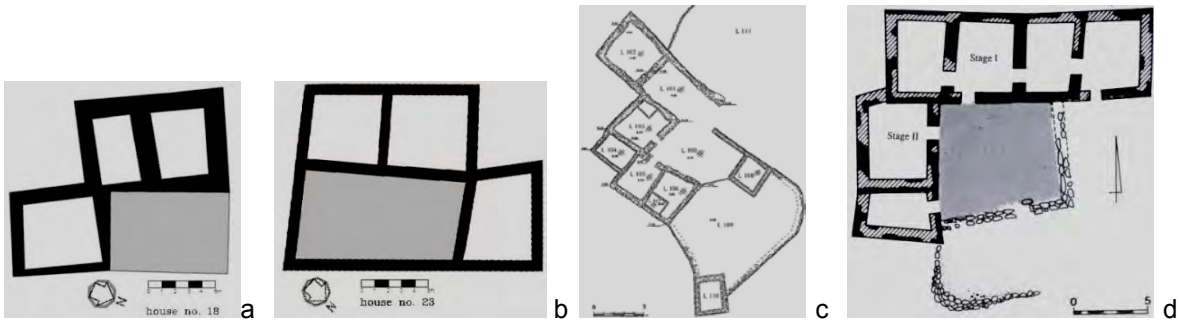


Figure 8. (a) plan of house no. (18) at al-Hallabat,(b) plan of house no. (23) at al-Hallabat, (c) plan of Nahal Mitnan the farmhouse (After Haiman, 1995, plan 3), (d) plan of farmhouse at Nahal ha-Ro'a (Source: After Hirschfeld, 1995: 39, Fig. 15).

Similar to no. (20), which was also found in Structure J at ar-Risha (Fig. 9 b, c), is a two-wing house with a series of rooms built on the north and west flanks, where the courtyard (16x18m) was enclosed by a mud brick wall (average 0.7 m wide) at the east and south. However, no clear entry was visible, but since the east wall is unbroken, almost up to the north-east corner, the doorways into the courtyard must be located on the south (Helms, 1990).

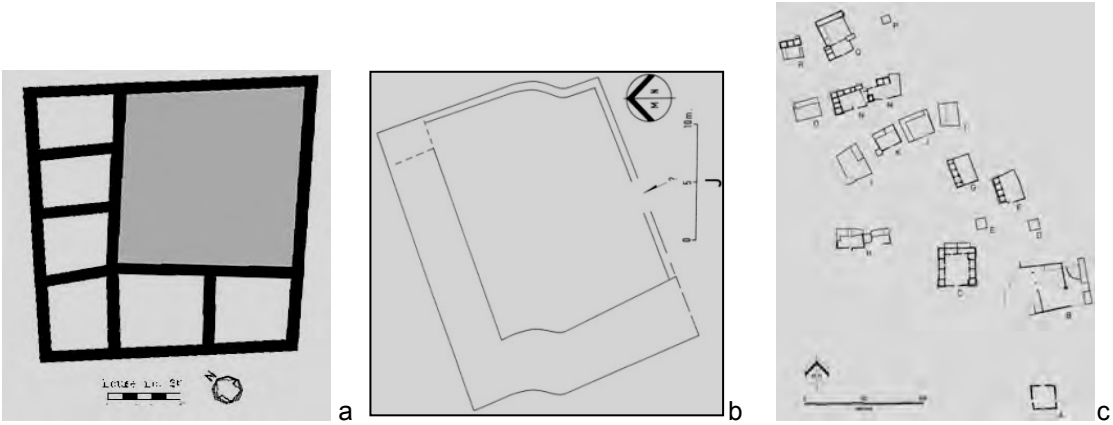


Figure 9. (a) plan of house no.(20) at al-Hallabat, (b) restoration plan of structure J at ar-Risha (After Helms, 1990: 115, Fig. 55), (c) site plan of structures at ar-Risha (Source: After Helms, 1990: 129, Fig. 71 and 129).

Complex House

This house-type, from a socio-economic point of view, whether built to accommodate the members of a growing extended family or built as a result of the enlargement of the owner's property, offered greater privacy and protection for the activities conducted by the inhabitants, mainly in the courtyard. It also offered direct access from the courtyard to the adjoining public area. A characteristic example of this type is complex no. (1) with 24 rooms and three courtyards (Fig.10a), where the external walls (0.6-0.7 m) are made from large fieldstones well set and filled with smaller stones. This house (724m^2) has two residential units west and east. An analogous layout to this complex was found at the domestic houses XII and XIII at Umm el-Jimal (Fig.10b), located almost in the middle of the town, east of the "Cathedral", and west of the Roman reservoir which is also the case of al-Hallabat complex no. (1).

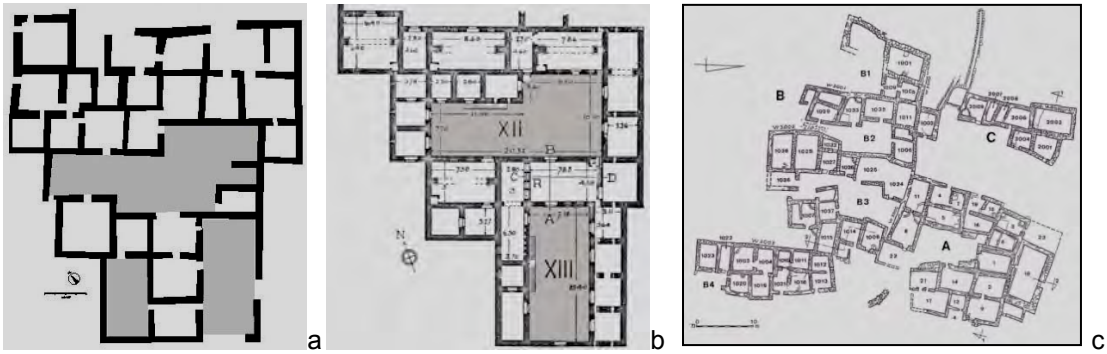


Figure 10. (a) plan of complex no.(1) at al-Hallabat, (b) plans of houses XII and XIII at Umm el-Jimal (after Butler, 1919: 203, Fig. III.182), (c) plan of Khirbet Abu Suwwana (Source: Magness, 2004).

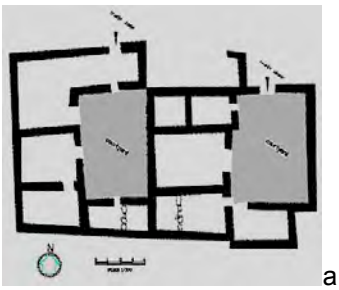
In general, at Umm el-Jimal houses, much of the ground floor space is devoted to the agricultural activity, animals, stables, shops, and domestic activity, as indicated by the presence of the

kitchen. The ground floor often contains wells, cisterns, and in some cases, a room provided with a basic drainage system. Living quarters are situated on the upper floor (De Vries, 1981: 63). According to De Vries (1998: 109), this arrangement of domestic space is not necessarily motivated by the separation of people from animals. The building layouts indicate an intimate sharing of space, with people and animals in constant contact with one another. This seems to be the case of al-Hallabat resident complex no. (1). The same can be said for the courtyard houses at Pella, which resemble the domestic units found at Umm el-Jimal.

On the other hand, to achieve the needed privacy at Umm el-Jimal and Pella, the stairs leading to the upper living quarters were located in the courtyards. This emphasizes the courtyard as a private rather than public space. The ground floor area of the houses at Pella (Walmsley, 2007: 131), as at al-Hallabat, focuses on the central internal courtyard, where much of the interactive daily life of the household takes place (like cooking and care for domesticated animals). This may also lead to an assumption that many houses at al-Hallabat had a second floor, such as in complex no. (1).

Actually, there are many other analogous structures to complex no. (1), such as what was found at Khirbet Abu Suwwana (Fig. 10c), an early Islamic village located near Ma'aleh Adumim, east of Jerusalem. The excavation revealed two types of residential units; one of them has a crowded system of residential units and a mosque, and the second has six residential units of high quality. The mosque could have accommodated up to fifty-four worshipers (Magness, 2004). Somehow, we can also observe similar applications to these houses and at al-Hallabat, such as walls covered sometimes with plaster (house no. 1 and 19). They were also built directly on the bedrock along the topography and most of the floors were of packed dirt and lime. Essentially, the excavations of complex no. (1) is not yet completed, and if further excavation reveals more walls extended from complex no. (1) to complex no. (3) (Fig.11a), then we might have analogous structure layouts such as those found in Khirbet Abu Suwwana.

Rather like complex no. (3), similar conditions can also be observed at the structure N/M located at ar-Risha. It consists of two parts: the western wing (N), and eastern wing (M) connected by the courtyard walls composing one complex (Fig. 11b). The western wing consists of two adjoining cell blocks, but it is more regularly set out, containing four cells each about 4x4m, in which the northern section is with four cells of irregular dimensions (3x3m - 5x5m) built against the western one. Wing M is integrated with wing N, but it is much simpler in the layout. The single cell block (4x4m) was accessed through a narrow door (0.75m wide) from a roofed vestibule (4x5m), which was apparently opening towards the courtyard (Helms, 1990).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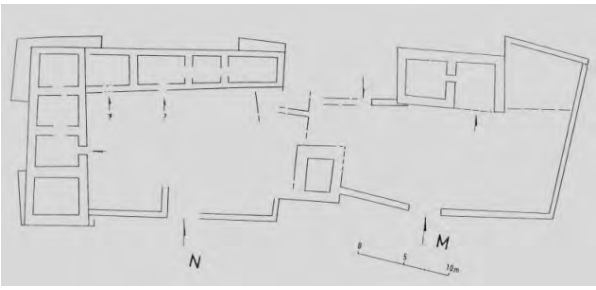

b

Figure 11. (a) plan of complex no. (3) at al-Hallabat, (b): Reconstruction plan of Structure N & M at ar-Risha (Source: Helms, 1990: 120, Fig. 61).

Courtyard House

This type is distinguished by the fact that the courtyard is surrounded on the three sides by the dwelling structures, and it is without a portico supported by pillars or columns as in the case of the palaces and some urban structures. It offers complete privacy for the inhabitants' courtyard activities as well as protection from the wind and the sun. In view of the socio-economic

conditions of the investment required in the planning and size, this house-type seems to have been used exclusively by wealthy families. These were relatively spacious houses (Table 1). However, houses of this type in urban settings, not only protected the occupants from the dirt and noise of the street, but also utilized the limited urban space to the maximum.

Analogous structure to house no. (4) (Fig. 12a) was found in Structure K at ar-Risha (Helms, 1990: 117, Fig. 57). It has a symmetrical layout and consists of a courtyard with the entrance on the north-south axis. One wing of rooms/ cells was set into the north flank, bounded by a stone wall visible in the north and west. A rectangular wing or block of rooms (5x12m) lay on the north flank. The rectangular courtyard (12x19m) has a simple doorway in the south.

Regarding structure no. (19), one of the best constructed and most formal of all al-Hallabat houses (fig.12 b) which lies in front of the main façade of the Qasr, it represents an architectural type which fits into the much-debated category of palace, caravanserai (Khan), and castle (Qasr), with a possible early date (7th or early 8th century). Its large size (633m^2), the thickness of the walls (0.90m) made of large field stones, and location within the overall layout of the site, makes the building a potentially significant one. It has only 8 rooms and an extensive central courtyard (256m^2), with one huge room/ hall on the southeast side without any indication of internal partitions. Some walls were covered by marble and two plastered floor surfaces similar to that in the Qasr were uncovered. Also, the discovery of some glazed tesserae indicates that there was a mosaic pavement. It was probably roof-tiled as indicated by several roof tiles found around and inside the structure. The oval-shape structure located beside it might have been used for storage or animal pen.

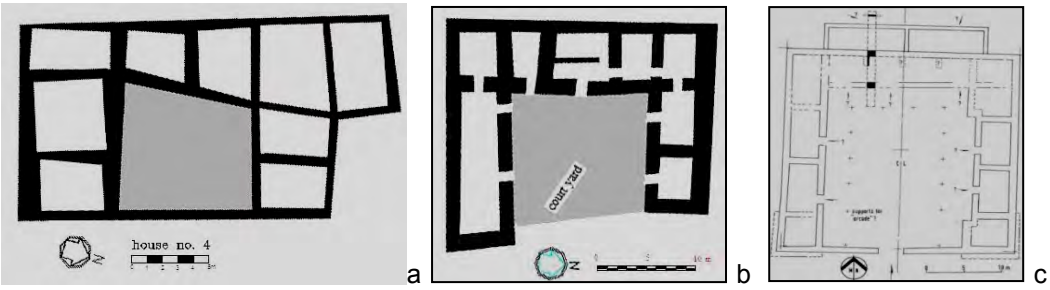

Figure 12. (a) plan of house no. (4) at al-Hallabat, (b) plan of house no. (19) at al-Hallabat, (c) plan of structure C at ar-Risha (Source: Helms, 1990: 85, Fig. 31).

An analogous example for structure no. (19) was also found in the Umayyad structure C (31.90mx31.30m) at ar-Risha (Fig. 12c). Helms believed that structure C is one of the best constructions and the most formal of all structures at the site, because of its square layout and relation with the mosque. The external stone base walls are made of also large field stones, well set and filled with smaller stones. The average width is between 0.80 and 1.20 meters. The building has only one entrance (3.38m wide) on the south side with series of rooms/ cells (4.2m on the east and west, and more irregularly from (4.2m to 3.8m) in the north. A good plaster floor was also found (Helms, 1990). It has also been suggested that while structure C at ar-Risha (Figs. 10c and 13c) may derive from an urban module, the houses at the same site stem partly from more rural origins, much as do the houses of today's recently settled bedouins and long-settled *fallahin* (Ahn, 2010).

The close layout and construction features of structure no. (19) and structure C is similar to the Khan at Qasr al-Hair al-Gharbi, which was originally made of mud brick on a stone base, dating back to about 727 AD. In the Khan at Qasr al-Hair al-Gharbi, however, there are six rooms of varying dimensions and a vestibule at the entrance side. Immediately to the right, while entering the courtyard, there is a block of masonry that served as the staircase to the roof (Creswell, 1989: 136). So probably structure no. (19) and structure C also had two floors, based

on their relatively huge wall thicknesses. An analogous structure to house no. (19) can also be identified by some structures at Khirbet al-Askar, such as KS 3, KS 16, KS 17, KS 20, KS 23, and others (Kennedy, 2014: 104-05, Fig. 8 and Fig. 10). Other analogous parallel and related to ar-Risha structure C and structure no. (19) are found at Qasr al-Sawb (51x51m) at Dawqi/ ura (44x44m), at Jabal Seys/ Building F and G (34x35m), and perhaps also at structure KS10 at al-Risha.

All of these sites were possibly connected by ancient roads, with similar socio-economic conditions. All these examples also shared common features: a central square courtyard with only one entrance (doorway) on the central axis opening to the courtyard. However, the overall dimensions of the not dated Qasr al-Swab, which has an attached outer enclosure, are larger than at al-Hallabat and the other close parallels.

Finally, as mentioned before in all of these rural settlements, having similar socio-economic and political conditions, we can argue that the vibrancy of rural areas may have contributed to urban space becoming ruralized, with types of buildings already known in a rural context gradually introduced into the city (Polci, 2003: 101). At al-Hallabat rural area, some houses, such as house no. 1 and no. 3 can support this argument.

SUMMARY AND CONCLUDING REMARKS

The architecture of the so-called Umayyad desert palaces featured by a central square courtyard formed part of more extensive communities that engaged in a combination of agricultural activities and trade. These also demonstrate how the Umayyad patrons adapted and re-interpreted in a creative approach the military and domestic architectural traditions of late antiquity. Significantly, most of these buildings were abandoned soon after the fall of the Umayyad regime but they remain as evidence of the wealthy achievements of their dynasty.

However, the main architectural characteristic of early Umayyad domestic structures of the so-called rural 'Nomad Villages' and urban setting are also based on enclosing courtyard structures. Each of these Umayyad houses/ structures examined in this study has a courtyard, which functions as the nucleus and as an element of distribution, where most of the rooms have either direct or indirect access to the courtyard.

Al-Hallabat, the Umayyad so-called 'Nomad Village' houses represent and disseminate the nature and solidity of the high status of the socio-economic conditions of the early Umayyad Islamic occupation in Jordan. They might be considered as immediate predecessors of the wealthy rural houses of late antiquity, whatever form of their layout variety, scale, accessibility, and function arrangements.

However, it was possible to reveal a primary differentiation between the dwellings at al-Hallabat, ranging from relatively simple one-room structures to complex multi-family dwellings (Table 1, Fig. 5). Each type consists of at least one courtyard surrounded by a series of rooms or units in different arrangements and typological features, thus reflecting the socio-economic status of the householder. Three typological patterns were identified: nucleus house, courtyard house, and complex house. These types were then used to examine the position of the socio-economic conditions of al-Hallabat settlement in a tentative effort to map other analogous architectural examples based mainly on layout design and scale. In the simple nucleus house, the courtyard is alongside the house. The courtyard house was built around a courtyard from three sides to give greater privacy. The complex house is an expansion of the simple nucleus type, to which additional residential units and courtyards are attached according to the extended family needs.

For the identification of these three type patterns, a general classification rather than a detailed regional approach was adopted. Although it was occasionally dealing with the distinctive characteristics of these buildings of Bilad al-Sham, there are not yet enough systematically excavated houses in other parts of the region to make a workable regional typological pattern of

the domestic Umayyad architecture. However, these three types/ patterns have provided helpful data for creating a general classification of the various socio-economic Umayyad house-types.

An important questioning of the veracity of the term “Nomad Village”, even though it was used in this research, reveals that one should re-examine this term for al-Hallabat settlement. While, as shown, they confirm the continuation of the house types’ used in the early Byzantine period in Bilad al-Sham, the study shows that meanwhile there are many similarities between al-Hallabat houses’ layout and many other Umayyad houses in Jordan, still their main typology occurred in earlier examples found in the region.

What is of interest here is how the socio-economic conditions reflected at al-Hallabat typological patterns can be compared to other patterns found in more luxurious rural settlements, such as Um-el Jimal, and how these patterns evolved to the more distinctive forms that clearly define the attribution of these architectural arrangements to the Umayyad culture. The obvious mixture of urban and rural and rich and poor house architecture in al-Hallabat settlements might suggest that there were association and integration between urban and rural styles, rather than a departure to the countryside or to the city, where a more reciprocate exchange was in progress. Thus obscuring the distinction between the so-called 'Nomad Village' and town.

According to the comparative analytical study between Umayyad urban and rural Jordan, including other early Byzantine and Umayyad sites in the region, and al-Hallabat houses, the following conclusions can be drawn:

- The socio-economic conditions based on the general typological patterns at al-Hallabat layout seem to be very close to that at ar-Risha and Khirbet al-Askar, where their peak was also during the Umayyad period. Therefore, al-Hallabat and the building clusters at ar-Risha and Khirbet al-Askar need further research in relation to their location, space arrangement, typological pattern layout, landscape, and planning. Comparative studies between these sites can enrich our knowledge about the cultural significance for Umayyad Jordan and assist in establishing more accurate socio-economic typological patterns.
- There is an absence of the so-called ‘bayt’ unit in the residential structures of the houses presented in this study, with the exception of the houses at Amman citadel. None of the simple and direct relationship between tent (Bayt al-Sha‘ar) and ‘bayt’ is evident at the early Islamic so-called 'Nomad Villages', such as ar-Risha and al-Hallabat until now. As previously suggested, it seems that the ‘bayt’ as a module is reserved primarily for palatial structures, as its main evidence is mostly found in the so-called desert palaces in Bilad al-Sham.
- None of the main architectural elements and related features of these houses, as also at al-Hallabat, can be considered to be totally new nor inventions of the period. The courtyard house is one of the oldest known architectural forms, particularly prevalent in the Mediterranean area and surrounding regions. The main layout of most of al-Hallabat’s Umayyad modest houses is an inheritance from the early Byzantine and earlier periods. Many houses' layouts can be found during the early Byzantine period and continued to be used with slight changes at al-Hallabat during the Umayyad period. For example, the complex no. (1) at al-Hallabat has the analogous layout with the house at Umm el-Jimal (houses 7 and 8).
- At al-Hallabat agricultural settlement, the architecture of the complex and multi-unit living arrangement reflects a socio-economic aspect conducive to interdependence, with families functioning cooperatively in terms of land ownership, a division of labour and may be sharing working animals. The house layout arrangement is more advanced to what was exemplified at the early Islamic period farm in Naḥal Mitnan, as evident from the courtyard type house at al-Hallabat. This farmhouse type has only three dwelling units, each consisting of one to three rooms and a small courtyard.

Finally, it should be emphasized that the domestic architecture of only these examined sites cannot provide a sufficient basis for reaching comprehensive conclusions about the domestic Umayyad architecture of Jordan. Further detailed studies are required to reconstruct an exhaustive catalogue of housing in both urban and rural sites. Further archaeological research would reveal more convincing facts about how people lived and how they interacted socially and economically. The outcomes can subsequently be linked to the typological and architectural research. The outcome of such examination would also assist to develop a better understanding regarding the planning and the architectural design concepts of the so-called 'Nomad Villages' of the early Islamic period. Given the lack of Umayyad domestic architectural analytical studies, there is a vast need for further research within this area.

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THE EFFECT OF LANDSCAPE ELEMENTS ON WALKABILITY IN EGYPTIAN GATED COMMUNITIES

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Abstract
Walking has always been one of the important modes of transport all over the world. During the second half of the twentieth century, motorized modes, especially private cars, emerged. A situation of overdependence on motorized transport evolved. Recently, the notion of reviving walking as one of the urban transport modes started to emerge, especially in developed countries. Both research work and professional practice now search for ways to rehabilitate urban areas in order to facilitate walking and cycling. The focus has mainly been on macro-scale factors such as land use distribution and street network planning. However, landscape elements, such as micro-scale measures, could play an important role in achieving that goal. This paper addresses the role of landscape elements in enhancing urban walkability. It mainly focuses on gated communities, which are widely emerging types of residential urban areas across the world and also in Egypt. Using statistical analysis, the paper identifies the most important landscape elements that could affect the walkability of gated communities in Egypt.

Keywords: *Walkability; walking environment; landscape; hardscape; softscape; gated communities; accessibility; factor analysis; Egypt*

INTRODUCTION
During the second half of the twentieth century, urban mobility became over dependent on motorized modes. Private vehicles (both cars and motorcycles) use is increasing from year to year. Even short-distance trips are made using cars and motorcycles. As a result, urban settlements are suffering from serious problems as their roads are frequently congested. The physical, temporal, and financial costs of urban mobility are increasing; this negatively affects the quality of life in urban areas. A notable emergence of reviving non-motorized modes of transport is currently taking place. Many cities and states are considering a tangible effort to get people back to walking and cycling. Many research studies therefore pay attention to the notion of walkability to express how urban areas encourage their users to walk and cycle. They mainly focus on urban planning measures, such as street network planning, land use distribution, and population density. Landscape elements have, however, been neglected, despite the fact that these elements are more relevant for walkers and cyclist and directly affect their transport behavior.

The main goal of this research is to recognize the landscape elements that could have an effect on the walkability of gated communities. The paper focuses on the gated communities in the Greater Cairo Region (GCR). The research adopted a quantitative approach to achieve this goal. By applying factor analysis to a set of case studies of gated communities in Egypt, the effects of a group of selected landscape elements are analyzed and evaluated.

This paper is composed of two main parts. The first part, the literature review, introduces walking as one of the urban transport modes. It presents the importance of reviving walking to solve some of the contemporary problems of urban settlements. In addition, it highlights how

urban walkability is measured and how urban planning could play a vital role in encouraging people to walk instead of drive. The second part presents the research which statistically investigates the potential effects of landscape elements on enhancing the walkability of gated communities. A selected set of both hardscape and softscape elements is chosen from a group of gated communities in Egypt. Using factor analysis, these elements are classified and ordered, according to their effects.

LITERATURE REVIEW

As one of the most important non-motorized transport modes, walking has received an increasing interest from both the scientific community and local authorities. Walking is perceived as a solution to the great challenges of contemporary urban mobility. It is very clear that urban settlements are now facing continuous and serious traffic congestions during the day and night. Greater attention is being paid to making urban areas a suitable and encouraging environment for walking.

The benefits of walking are diverse. Many research studies have highlighted the health benefits of walking for human health (Meiro-Lorenzo, Villafana, and Harrit, 2011; Spoon, 2005). The most important benefit is the reduction of obesity (Lopez and Hynes, 2006; US Department of Health and Human Services, 2001). This is because walking is considered to be one of the easiest and lowest-cost physical activities. As a result, it plays an important role in reducing the risks and the problems of many diseases such as diabetes, high blood pressure, heart attacks, anxiety, and depression (Atkinson and Weigand, 2008; Centers for Disease Control and Prevention, 2003). In addition, walking as a substitute for using motor-vehicles, especially for short trips, will help reduce both fuel consumption and harmful gas emissions, which in turn will result in improving the air quality in urban areas (U.S. Department of Transportation, 1999; Westminster City Council, 2004). Some urban benefits could be achieved by adopting walking as a mode of transport from short distances. The main benefits are alleviating both traffic congestion (Lo, 2011) and the increasing demand for car parking. This will indirectly lead to reducing the maintenance cost of street networks and traffic facilities (Litman, 2004). In addition, walkability has been found to be strongly correlated with raising the economic value of offices, retail businesses, and houses (Fisher and Pivo, 2001). Social life will also benefit from walking. As walking means the presence of more people in the streets and open spaces of the urban settlements, both social interaction and social security will be enhanced (Kamel, 2013). Besides, it is one of the important factors to enhance the sense of community in residential areas (Mahmoudi Farahani and Lozanovska, 2014). In sum, walkable urban areas are comfortable places to live in (Shamsuddin, Abu Hassan and Bilyamin, 2012) and are characterized by livability (Al-Hagla, 2010).

Walkability is a term that is widely being used all over the world to describe the urban suitability of an urban environment for walking. Despite the fact that the origin of the term 'walkability' is not clearly documented (Fitzsimons, 2013), many definitions already exist. Following are some of the definitions of walkability:

- "… the extent to which walking is readily available as a safe, connected, accessible and pleasant mode of transport" (Transport for London, 2004);
- "… a measure of the effectiveness of community design in promoting walking and bicycling as alternatives to driving cars to reach shopping, schools, and other common destinations" (Rattan, Campese, and Eden, 2012);
- "… the extent to which the built environment is walking friendly" (Abley, 2005);
- "The core meaning of the term relates to facilitating and encouraging walking trips by providing both attractive routes and destinations and functional paths and routes" (Fitzsimons, 2013).

Consequently, it can be concluded that the term walkability refers to the level that an urban setting encourages its residents to walk while traveling through it. Generally, achieving high levels of walkability will result in creating walkable urban areas and vice versa. These areas facilitate the conversion of automobile communities to walkable communities. Developing walkable environments that prioritize pedestrian transport is considered to be the aim of the new urbanism movement (Dogrusoy and Dalgakiran, 2011).

Searching for the requirements of creating walkable urban environments is one of the priorities of cities' local authorities, especially in developed nations. According to the Transport for London agency (TFL), creating a walkable environment requires achieving 5 Cs. These Cs describe an environment that is convenient, conspicuous, convivial, comfortable, and consistent (Transport for London, 2004). This set of requirements is also adopted by the public transport authority of Australia (Australian Public Transport Authority, 2012). Another study, which was financially supported by the European Union, determined two sets of requirements; the first set contains the same requirements as the 5 Cs and the second set includes permeability, legibility, human scale, functionality, and sense of place (Premier's Physical Activity Taskforce, 2007). Similarly, Portland city in the US identified a set of seven requirements that includes safety, accessibility, connectivity, usability, beauty of places, mixed uses, and economic feasibility (Vanderslice, 1998). The New Zealand transport agency adopted nine requirements of walkability. These requirements are connectivity, legibility, comfortability, convenient routes, pleasant environment, safe crossings, secure places, universal design, and accessibility (NZ Transport Agency, 2009). Table 1 summarizes the adoption of the walkability requirements by different authorities.

Table 1. Requirements of walkability (Source: based on NZ Transport Agency, 2009).

No.	Requirements	Transport for London, UK	Portland City, US	Public Transport Authority of Australia	New Zealand Transport Agency	European Union financed Report
1	Conspicuous / Safety / Security	●	●	●	●	●
2	Convivial / User-friendly / Enjoyable	●	●	●	●	●
3	Comfortable / Suitability / Accessibility	●	●	●	●	●
4	Convenient / Connectivity / Permeability	●	●	●	●	●
5	Consistent / Sustainable	●		●		●
6	Legibility / Ease of use		●		●	●
7	Functionality					●
8	Human scale					●
9	Diversity of activities		●			
10	Economic Feasibility		●			

To achieve these requirements, some urban factors should be addressed. To identify these factors that could affect walkability, some initiatives to numerically measure walkability are progressed. The walkability index that was created by the TFL agency determines a set of factors classified into three orders (Campos et al, 2003). Both ground floor activity and footway accessibility are considered to be the most important factors. This index identifies landscape factors as a second and a third order. WalkScore.com, which is an online measure of residential walkability, focuses on the existence of consumer destinations within a walking distance from a specific location (Duncan et al, 2013). The more destinations of amenities there are, the higher

the scores achieved. The Sydney walkability index adopts four main factors. These factors are residential dwelling density, intersection density, land use mix, and retail floor area ratio (Mayne et al, 2013). Similar to the previous indices, the transport walkability index, developed by the University of Melbourne, measures walkability using three main factors. These factors are residential density, street connectivity, and land use mix (Giles-Corti et al, 2014). Another research study conducted in San Francisco, USA determined five environmental attributes for neighborhood walkability. These attributes are residential density, street connectivity, public transit density, crime density, and land use mix (Pentella, 2009). Research conducted in Australia concluded that walkability is affected by four main factors, which are dwelling density, street connectivity, land use mix, and net retail area (Leslie et al, 2007). According to Carolina transportation program, eleven urban features are consistent with walkability. These features are classified into three main groups: consensus features, encouraging features, and complementary features. The most important features are mixed land uses, destination proximity, pedestrian facilities, and high connectivity (Shay, Spoon, and Khattak, 2003).

Building on this review of the literature, it would seem that the majority of research and practice has focused on macro-scale urban features as the main factors of walkability. Some general agreement exists regarding some factors such as street connectivity, land use mix, and residential density. However, micro-scale features, such as streetscape elements, appear to be frequently neglected. Despite the fact that macro-scale features have a fundamental effect on walkability, the micro-scale ones are easily perceived by users and have a direct impact on the pedestrian. A person walking can more easily recognize the sidewalk characteristics, the planting strips and other streetscape elements more than the mixing of land uses, the density level of dwelling and street network planning of his local urban community. These micro-scale features, therefore, have a role to play in enhancing the walkability of residential communities. Their role is determined in convincing residents that their local environment is walkable and that they can easily walk. In the next part of this paper, micro-scale features of walkability will be addressed and statistically analyzed.

RESEARCH METHODOLOGY

To find out the role of landscape elements in creating walkable paths, this research will apply statistical analysis to a set of landscape related variables that are selected on a theoretical basis. Factor analysis will be used to test these variables to investigate their correlation to walkability. The objective is to rank these variables according to their power.

Variables

A walking path is a strip on the right of way (ROW). It may be a sidewalk on a street or a pathway in a public space. Usually, it is defined by different levels, different floor finishings, or by plants and other furniture elements. A set of 15 landscape related variables that may have a potential role in walkability is identified. The selected variables could be classified into four main groups. These groups are path profile, route anatomy, hardscape features, and softscape elements. The first group of path profile variables describes the general profile of the path. It focuses on the width and the height parameters of the path and its boundaries. The second group of route anatomy represents the main characteristics of the walking route itself and its relation to both motorized transport routes and activities along it. The third group of hardscape features focuses on the hard elements such as flooring, seats, shades, and lighting units. Finally, the fourth group of softscape elements describes the existence of plants in the path, such as trees and ground covers. Table 2 presents the classification of the 15 variables.

Table 2. The selected landscape related variables (Source: Author).

#	Group		Variable	Variable Code
1	Path profile	1-1	ROW width.	V01
		1-2	ROW enclosure ratio.	V02
		1-3	Path width.	V03
		1-4	Walking strip zone width.	V04
2	Route anatomy	2-1	Path-streets intersections.	V05
		2-2	Access points to residential activities.	V06
		2-3	Access points to non-residential activities.	V07
		2-4	Barriers between path and ROW.	V08
3	Hardscape features	3-1	Path-floor height.	V09
		3-2	Anti-slipping level of flooring.	V10
		3-3	No. of seats along path.	V11
		3-4	Shaded area of walking zone.	V12
		3-5	Path illumination level.	V13
4	Softscape elements	4-1	No. of trees and palms.	V14
		4-2	Area of ground cover elements.	V15

In the following, a brief description of each variable is introduced. The description includes how to measure each variable and the measuring scale and unit.

- **ROW width (V01):** It is the total width of the public space where the path exists within it. The ROW is usually enclosed by buildings or fences on both sides. It allows the right to pass through urban components. Besides, it affects the quality of included paths. It will be measured in meters.
- **ROW enclosure ratio (V02):** This variable describes the section view of the ROW. It illustrates how the edges (buildings, fences, trees, etc.) create the boundaries of the ROW. It plays an important role in the spatial perception of the path. It is calculated by dividing the average height of edges by the width of the ROW.
- **Path width (V03):** It is the width of the path itself, which is only a part of the ROW. In case of streets, it would be the width of the sidewalk. It may include some street furniture such as seats, trees, or lighting poles. It is the zone that is prohibited to motorized mobility. The width will be measured in meters.
- **Walking strip zone width (V04):** It is the width of the zone that is dedicated to walking only. It is a part of the sidewalk that is free from all street furniture or elements. It will be measured in meters.
- **Path-streets intersections (V05):** It is the number of street intersections that exist along the path. These zones witness interferences between both motorized and non-motorized transport. Pedestrian have to cross the streets. Intersections are considered to be dangerous spots along paths. It is measured by counting.
- **Access points to residential activities (V06):** This variable counts the number of access points to residential buildings that exist along the path. The access points include gates at fences, doors at buildings, and terraces entrances. At these points, users may stop, waiting to enter the buildings or to meet someone or pick up

something. This may interrupt the walking activity of other users. It is measured by counting.

- **Access points to non-residential activities (V07):** It is similar to the previous variable but deals with non-residential activities. Access points include civic center's entrances, café seating areas, shops display windows, etc. At these points, users may stop, wait to enter, have a look, meet someone, or pick up something. This may interrupt the walking activity of other users. It also may distract pedestrian attention. It is measured by counting.
- **Barriers between path and ROW (V08):** As the path is only a part of the ROW, longitudinal barriers that separate the path and other parts of the ROW may exist. In streets, sometimes sidewalks are separated from the pavement by fences or shrubs. These barriers may restrict the movement of pedestrians as they reduce accessibility. Parked cars also create a barrier. This variable is measured by the percentage of barriers' length in relation to the total length of the path.
- **Path-floor height (V09):** This variable measures the height of the path in relation to the level of the ROW floor. In streets, it is the height of the sidewalk at the curb line. It is measured in meters.
- **Anti-slipping level of flooring (V10):** Anti-slipping is one of the most important characteristics of good outdoor floors. A slippery floor is dangerous and not comfortable to walk on. This variable is measured by a scale of three grades. Zero grade is for smooth flooring, one grade for semi-rough flooring, and two grades for rough flooring.
- **No. of seats along path (V11):** Seating facilities are important street furniture. They are widely used in paths and sidewalks. It includes all types of furniture that could be used as a seat. It offers the opportunity to have a rest, wait for someone, or do other outdoor activities. It is calculated by dividing the number of existing seats by the total length on the path then multiplied by 100.
- **Shaded area of walking zone (V12):** Shading is an important facility in a landscape. It offers shelter from direct sun rays, rainwater, and snow. It includes all types of both hardscape and softscape elements that create shading on the path. Pergolas, tents, cantilevers, and shading trees are all included. It is measured by the percentage of the path area that is shaded in relation to the total area of the path.
- **Path illumination level (V13):** Adequate levels of illumination are an important requirement of a walkable path. Good illumination offers a level of safety that encourages people to use the path at night. Due to measuring constraints, this variable will be estimated. Three degrees of illumination, low, moderate, and high, are determined and translated to degrees of zero, one, and two respectively.
- **No. of trees and palms (V14):** Generally, plants enhance the beauty, air quality, and the image of a path. This variable focuses on the tall plants such as trees and palms. It measures the density of these plants along the path. It is calculated by dividing the number of existing plants by the total length of the path then multiplied by 100.
- **Area of ground cover elements (V15):** This variable is similar to the previous one, but focuses on the ground cover plants. It measures the percentage of path-floor that is covered by ground cover plants. Actually, these areas could not be used for walking.

Figures 1 and 2 present schematic sketches that illustrate the 15 variables of landscape elements in the path.

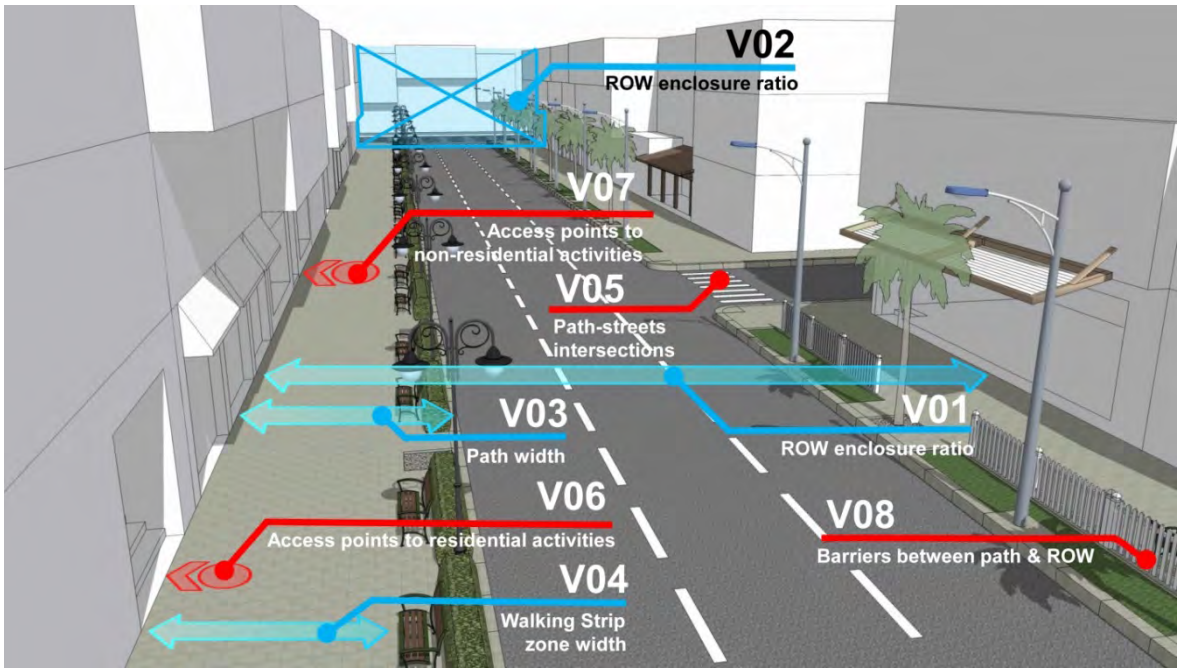

Figure 1. Schematic sketch of proposed landscape related variables - path profile and route anatomy groups (Source: Author).

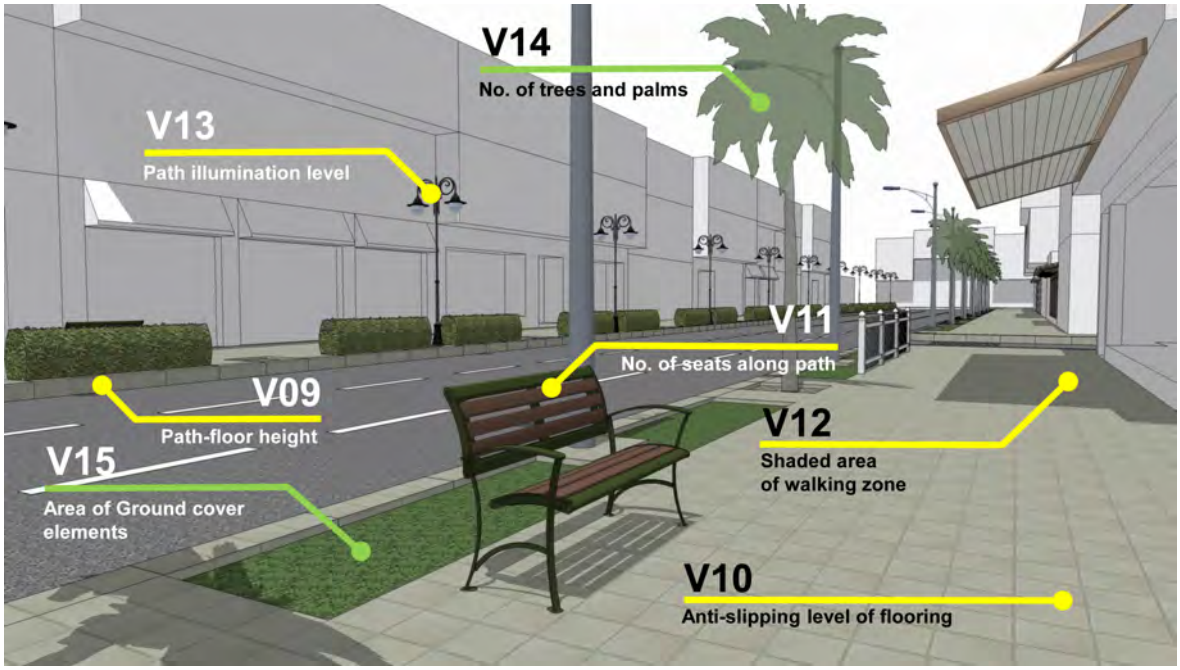

Figure 2. Schematic sketch of proposed landscape related variables - hardscape features and softscape elements groups (Source: Author).

Case Studies

This research focuses on the case of Egyptian gated communities. Forty-five pathways were selected in different closed residential compounds in the Greater Cairo Region (GCR). The selected communities are located in both halves of the region: the eastern extensions (New Cairo

and Kattameya) and the western ones (6th October city and Sheikh Zayed city). The selection process was based on random multiple selections as the researcher asked a survey group consisting of 45 people to choose a pathway in a gated community. The selection criteria were the existence of residents (inhabited residential zone in a compound) and the existence of amenities and services center at one end of the path. Figure 3 shows samples of the selected pathways.

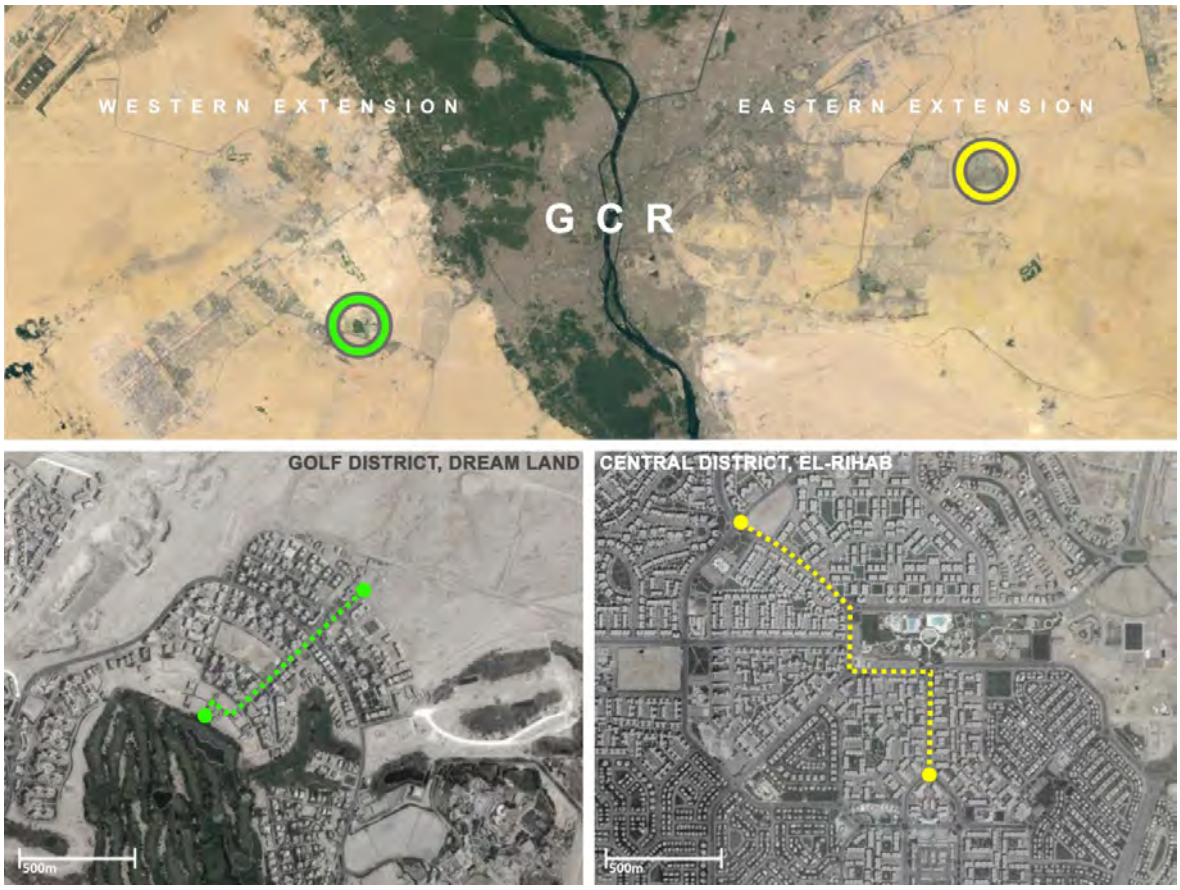

Figure 3. Aerial views of two samples of selected case studies (Source: Author).

FINDINGS

A first round of factor analysis was progressed on 15 variables for the 45 case studies. Only 6 components with initial eigenvalues greater than 1.0 were extracted. Two of them were strong components as they explained the 16.7% and 14.2% of variance respectively. Both of them were, therefore, used to filter the selected variables according to their loadings. The selected cut-off threshold was 0.5. It is worth mentioning that this threshold satisfies most of the cut-off criteria (Matsunaga, 2010; Yong and Pearce, 2013). As a result, 8 variables were excluded as their loadings did not exceed 0.5 in the first two components. Table 3 presents the classification of variables after the first round.

Table 3. Classification of variables after the first round of factor analysis (Source: Author).

INCLUDED variables			EXCLUDED variables		
#	Code	Name	#	Code	Name
1	V01	ROW width.	1	V03	Path width.
2	V02	ROW enclosure ratio.	2	V05	Path-streets intersections.
3	V04	Walking strip zone width.	3	V06	Access points to residential activities.
4	V07	Access points to non-residential activities.	4	V08	Barriers between path and ROW.
5	V09	Path-floor height.	5	V11	No. of seats along path.
6	V10	Anti-slipping level of flooring.	6	V12	Shaded area of walking zone.
7	V14	No. of trees and palms.	7	V13	Path illumination level.
			8	V15	Area of ground cover elements.

A second run was progressed after eliminating variables with weak loadings. Over the two runs, the power of the first two components had been increased from 31% to 58% respectively. After the second run, there were no weak variables. In addition, the results of both two tests of the analysis sample adequacy which are Kaiser-Meyer-Olkin measure of sampling adequacy and Bartlett's test of sphericity (Field, 2005) achieved better scores compared to the previous round. Table 3 presents the evolution of the main results along the two rounds of factor analysis.

Table 4. The evolution of factor analysis results along the two rounds (Source: Author).

Item	1st Run	2nd Run
No. of Excluded variables	8	0
% of variance explained by first 2 components	31%	58%
KMO measure of sampling adequacy	0.39	0.48
Bartlett's Test of Sphericity	206.1	76.0

Finally, only 7 out of the 15 selected variables achieved high loadings in the first two components. These 7 variables could be considered the most influential variables that correlate to path walkability. They could be classified into two main groups; the first one includes three variables. These variables are path-floor height (V09), anti-slipping level of flooring (V10), and the number of trees and palms (V14). These three variables achieved high loadings in the first component only. The second group includes the remaining four variables: right of way width (V01), right of way enclosure ratio (V02), walking strip zone width (V04), and access points to non-residential activities (V07). These four variables achieved high loadings in the second component only. Table 5 presents the two groups of the variables sorted in descending order according to their loadings in the two components. Figure 4 presents a graphical illustration of the result.

Table 5. The extracted variables of walkability sorted in two main groups (Source: Author).

Item	Group 1	Group 2
No. of variables	3	4
% of variance explained	32%	27%
Variables (in descending order)	Anti-slipping level of flooring (0.85)	Walking strip zone width (0.74)
	Path-floor height (0.65)	Right of way width (0.72)
	No. of trees and palms (0.62)	Right of way enclosure ratio (0.55)
		Access points to non-residential activities (0.50)

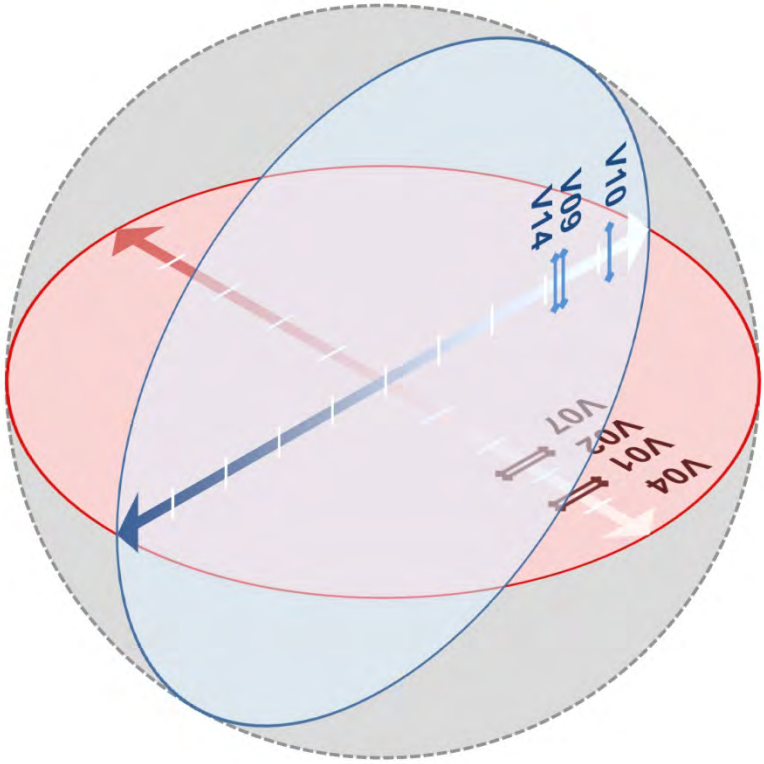

Figure 4. Graphical illustration of the extracted variables (Source: Author).

DISCUSSION

The following part discusses the results of the factor analysis of the walkability variables of selected gated communities in Egypt. The discussion is composed of three main parts. The first part focuses on the variables that affect walkability. The second part compares the main four groups of variables: path profile, route anatomy, hardscape features, and softscape elements. The third part sets out the reasoning for excluding the statistically weak variables.

Walkability variables

According to the factor analysis, only 7 variables have a significant correlation to walkability in the selected gated communities. They could be considered as the most influential variables. These variables are:

- **Anti-slipping level of flooring (V10):** It is the most important variable that is positively correlated to walkability. It describes the characteristics of the walking floor. It mainly focuses on the quality of the finishing layer. According to standards, walking floor should be finished with a material that prevents slipping. Rough textured materials are recommended for outdoor walking floors. It is worth mentioning that this variable has the highest loading compared to the other walkability variables. Its loading scored 0.85 in the second component. This means that the more anti-slipping the walking floor is, the more walkable it will be.
- **Path-floor height (V09):** It is also positively correlated to walkability. Its loading in the first component scores 0.65. According to the factor analysis results, the higher the pedestrian path is from the surrounding ROW, the more walkable it will be. It is important to note the values of the path-floor height in the selected case studies range between 12 cm to 30 cm. In addition, 67% of the values are less than 17 cm (maximum acceptable height of stair riser). The higher path may help in enhancing the safety feeling for pedestrians. This may be perceived as more separated from motorized mobility. However, it should be noted that increasing the height should be within the human limits of vertically moving from one level to another.
- **Number of trees and palms (V14):** focuses on all plants characterized by high-rise such as trees and palms. Its loading in the first component scores 0.62. These plants have important environmental and aesthetic roles to play. They are considered as fresh air generators. At the same time, they enhance the image of the path. In addition, they may be used to create shaded areas along the path.

The three previously mentioned variables together combine to form a single group that affects walkability in a certain way. Statistically, they form the first and strongest component of walkability. The other four variables also strongly correlate to walkability and combine in another group that also affects walkability, but in a different way than the first group. They form the second component. These variables are:

- **Walking strip zone width (V04):** It determines the walking capacity of the path. The walking zone width is more important than other dimensions in the path, such as ROW width or the total width of the path. This is because it directly affects the flow of pedestrians. Sometimes, wide street sidewalks exist, but are full of street furniture and planting elements, so that pedestrians can hardly walk. As a result, it is important while designing a pedestrian path to make the walking zone as wide as possible and to make it clear without obstacles. Street furniture, plants and required areas for residential and non-residential activities should be clearly separated from the walking strip. Maybe some visual aids could be used such as different flooring, finishing materials, or colors. The loading of this variable in component two scores 0.74. It could be considered the second strongest variable affecting walkability.
- **Right of way width (V01):** It is also strongly correlated to walkability. Its loading in the second component is 0.72. It describes the total width of the right of way that includes the path. It determines the geographic boundaries of the path. It affects pedestrian perception of the path surroundings. It includes other components than the path, such as pavement for motorized transport or open spaces and landscape activities.

- **Right of way enclosure ratio (V02):** It is positively correlated to walkability. It describes the enclosure degree of the ROW as the ratio between the boundaries (buildings elevations, fences, etc.) height and ROW width. High enclosure degrees help in defining the boundaries of the ROW and enhancing the visual perception of the path surroundings. The loading of this variable in component two scores 0.55.
- **Access points to non-residential activities (V07):** It is the last and least strong variable that affects the walkability. It describes the existing non-residential (commercial, entertainment, cultural, etc.) activities along the path. Usually such activities result in people gathering in small groups in front of the access points. These groups of people enhance both the livability and safety of the path. In addition, these activities create attraction points in the path.

Groups of walkability variables

The 7 walkability variables belong to the 4 groups of path profile, route anatomy, hardscape features, and softscape elements. Three variables were classified as path profile. They are the walking strip zone width (V04), right of way width (V01), and right of way enclosure ratio (V02). One variable belongs to the route anatomy group. It is an access point to non-residential activities (V07). It is important to remember that these four variables are already combined in a separate component, namely the second component. On the other hand, the 3 remaining variables belong to hardscape and softscape groups and also combined in one component. Figure 5 presents a tree diagram illustrating the classification of the 7 variables of walkability.

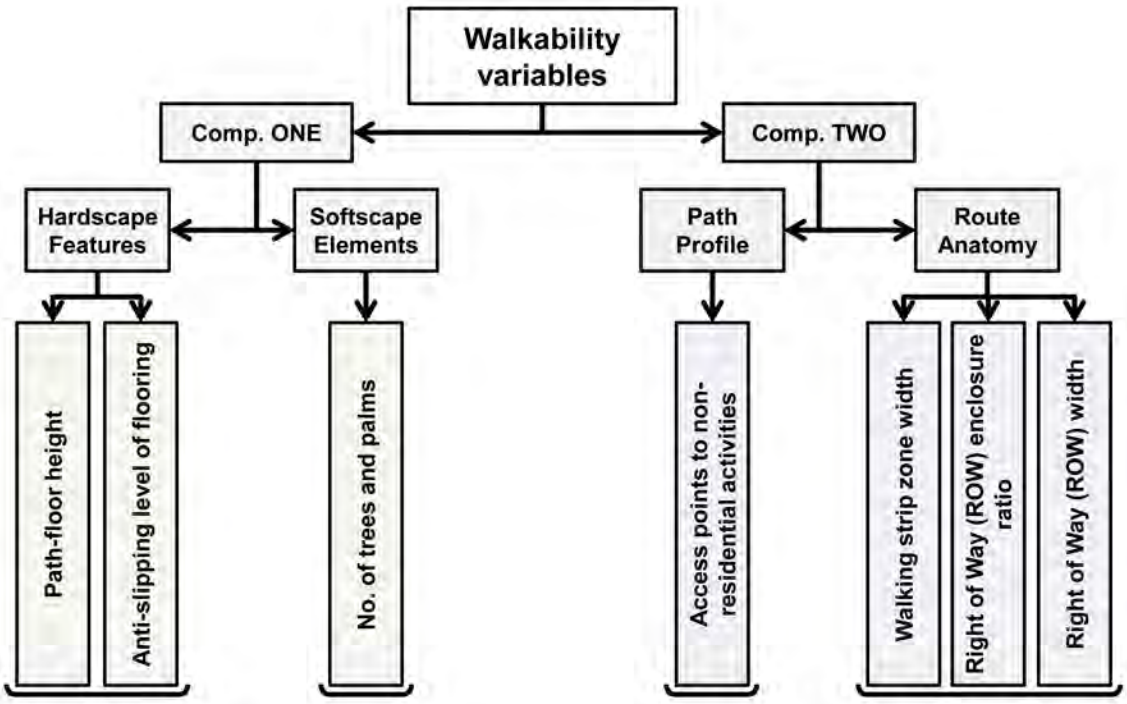

Figure 5. Tree diagram classifying the extracted variables of walkability (Source: Author).

The first and strongest extracted component includes variables that only belong to both hardscape and softscape elements. Then, the two groups of route anatomy and path profile come as their variables create the second component. Figure 6 presents a circular diagram that illustrates the cumulative power of each of the 7 walkability variables (at radial axis).

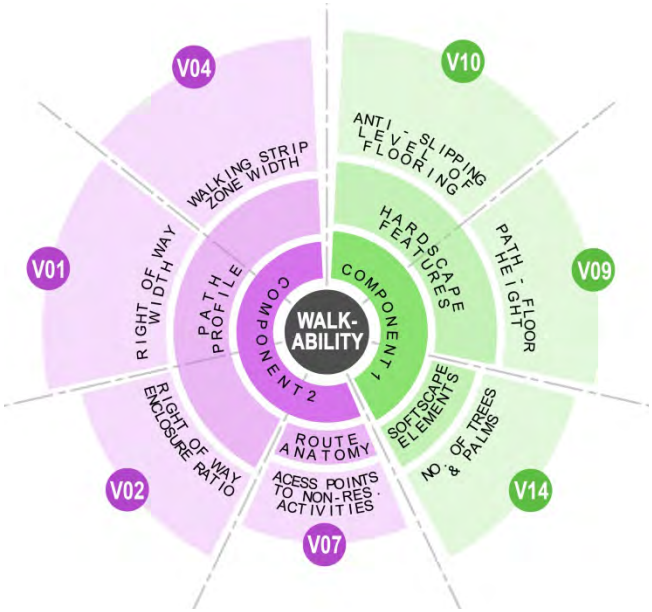

Figure 6. Circular diagram of cumulative power of walkability variables (Source: Author).

The excluded variables

According to the results of the first run of the factor analysis, 8 variables have been excluded, as their loadings did not exceed the cut-off threshold (0.5) in both components 1 and 2. Six of these variables had very low loadings in both components while each of the other two variables had loadings between 0.45 and 0.49 in one component only. The 8 variables are:

- **Path width (V03):** It describes the total width of the path. It had a weak correlation with walkability. It is worth mentioning that both ROW width and walking zone width were included in the list of walkability variables. This exclusion could be interpreted by the fact that the total path width includes all other hardscape and softscape elements and not restricted to walking activity. The width of the walking zone is more relevant and directly affects the walking flow.
- **Path-streets intersections (V05):** They represent the intersections between the motorized transport on the pavement and the walking activity on the pathway. This variable has the second least score in the loadings of the two components. This may be due to the special nature of case studies, as the motorized traffic in gated communities is more limited than in cities. So, its role could be neglected.
- **Access points to residential activities (V06):** This variable captures the existence of residential buildings along the path. It depends on the fact that some types of different activities may occur in front of the entrances of residential buildings. However, the variable did not achieve high loadings in the two components. Maybe this is also due to the nature of case studies as the population density and household activities are somehow limited in gated communities compared to mass housing and high-rise residences.
- **Number of seats along path (V11):** This variable captures the existence of one of the main types of street furniture. It counts the number of seats along the path. It had low loadings scores that range between 0.2 and 0.3. Maybe the reason of such weak correlation is due to the relatively short lengths of paths in gated communities and as a result pedestrians do not require a break while walking.
- **Path illumination level (V13):** It describes the level of illumination in the path at night. This variable has the least score in the loadings of the two components. It was

selected because good illumination helps in raising the safety of pedestrians. There is no clear explanation for excluding this variable; especially since the sample had a good variety of different levels of illumination.

- **Area of ground cover elements (V15):** Compared to the other softscape variable (number of trees and palms), this variable has a poor correlation to walkability in both selected components. Its scores did not exceed 0.35 in the components loadings. It was selected because green ground cover has a role in enhancing the aesthetics of urban spaces.
- **Barriers between path and ROW (V08):** This variable represents a type of path accessibility from the surrounding ROW. It is worth mentioning that it achieved a score in component 1 loading that is a little bit below the cut-off threshold. It achieved -0.43 which is only 0.07 less than the cut-off. In addition, the weak correlation is negative. This means that the less the barriers, the better the walkability will be.
- **Shaded area of walking zone (V12):** This variable is similar to the previous one. It also has a loading score of -0.48 which is only 0.02 less than the cut-off threshold, but in component 2. The negative correlation is somehow unexpected. It means that the smaller the shaded area in the path, the more walkable it will be. Maybe this result somehow depends on the local environment and the climate. It may also be because Egypt, in general, and GCR, in particular, have a climate that is warm in the winter and moderate in the summer without heavy rains and even no snow. Therefore, while walking, people prefer sky exposure and usually do not need shelter.

CONCLUSION

Walkability is one of the important characteristics of pedestrian pathways. It is a notion that emphasizes the importance of creating paths that encourage people to walk. This type of non-motorized transport is very important to sustainable communities. Previous research focused mainly on macro-scale factors that affect walkability. These factors, such as land use distribution and street network planning, belong to the field of urban planning. On the other hand, micro-scale factors, such as path profile and anatomy and landscape elements, are more realized by pedestrian and directly affect them. This research highlights the importance of micro-scale factors in gated communities in Egypt. It applied factor analysis on a set of 15 variables for the 45 selected paths. According to the statistical results, 7 variables are strongly correlated to walkability. These variables are classified into two main groups. Group 1 is the landscape qualities and group 2 is the path characteristics. Despite the fact that the two groups are strongly correlated to walkability, each one has its own impact. Group 1's effect is relatively more powerful than group two. Three variables are included in group 1: the quality of floor finishing, the path rise from the surroundings, and the density of trees and palms. Four variables are included in group 2: walking strip width, ROW width, ROW enclosure ratio, and access points to non-residential activities. Other factors turned out to not have an effect on walkability in Egyptian gated communities, such as intersections with motorized transport, barriers between path and ROW, and access point to residential activities. This may be due to the nature of gated communities which are generally characterized by limited motorized traffic and the dominance of residential activities. In addition, other landscape factors such as shading intensity turned out to be insignificant. This is a result of the moderate climate in Egypt. It is important to note that this result may be changed in other case studies in different climate zones.

Architects and urban designers are advised to pay special attention to qualities of walkway flooring, vertical separation from ROW, and number of trees and plants. These factors can achieve direct enhancement of path walkability.

Three main areas of research could be identified for the future. The first one is verifying the landscape factors that affect walkability in gated communities. This research executed an

exploratory factor analysis aiming at finding these factors through selected case studies. For further accuracy, another research that adopts confirmatory factor analysis is imperative. In this research, the sample size should be larger and cover various types of gated communities. The second area is numerical measurement of walkability. As previously mentioned in the literature review, there are a number of initiatives to measure walkability, but most are focused on urban factors rather than landscape factors. Setting a numerical index of walkability that measures the level of walkability in gated communities based on a comprehensive set of both macro and micro-scale factors will help in evaluating these communities and could then be used for ranking it periodically. Such an index could be utilized in the real estate market in Egypt as an evaluation tool. The third area is analyzing the pedestrian perception of walkability in gated communities. It is important to spot the light on the gated community resident who will use the paths and walk. Identifying how people experience the walking path and how they create their mental image of the gated community landscape is a corner stone in developing the design of its urban components.

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EVALUATING NATURAL VENTILATION PROVISIONS AND OCCUPANTS' VENTILATION BEHAVIOR IN FIVE TERRACE HOUSING TYPES IN PUTRAJAYA, MALAYSIA

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Abstract
This study investigates the natural ventilation provisions of residential buildings in the hot-humid climate of Putrajaya as well as the occupants' utilization and overall satisfaction of these provisions. Five terrace house design types were selected for the study and natural ventilation (NV) provisions were identified through acquired building documents. Computer simulations were carried out on all house types to determine the ventilation rates delivered by the NV provisions. Furthermore, a total of 298 households from the selected house types were surveyed. Two house types were found not to comply with the Uniform Building By-Law (UBBL) governing NV provisions in Malaysia and those house types that complied were found to exhibit higher ventilation rates. Occupants' level of satisfaction when utilising NV was found to be significantly related to opening sizes complying with UBBL, longer duration of opening windows, and occupants' means of achieving comfort. This paper informs designers on the importance of complying with the required law governing NV in residential buildings. It also highlights the need for a strict effective enforcement of UBBL compliance for the purpose of building approvals.

Keywords: *Hot-humid climate; indoor air quality; occupants' satisfaction; residential buildings; Uniform Building By-Law; ventilation rates*

INTRODUCTION
Adequate ventilation is needed in order to achieve the desired thermal comfort for occupants. This is particularly necessary in regions characterized by high temperature and humidity all year round. In a hot-humid climatic region such as Malaysia, occupants of residential buildings are reported to depend highly on mechanical cooling technologies to achieve this aim (Kubota et al, 2009; Toe and Kubota, 2015). However, numerous studies have revealed that people in hot-humid climatic regions can accommodate high temperatures and, in fact, adequate comfort can be achieved through natural ventilation (Cândido et al, 2010; Wei et al, 2011; Yau et al, 2011; Nguyen et al, 2012). Although these studies were able to prove the adaptive ability of people in hot-humid regions to high temperatures, their dependence on mechanical cooling is still very high. For example, in Malaysia, residential is among the largest electricity consuming sectors, mainly due to the use of air-conditioning (Chan et al, 2009; Energy Commission Malaysia, 2010).

Attempts to improve the energy efficiency of residential buildings have led to houses being built to be air tight to prevent leakage of cool draft through the building's skin (Nielsen and Drivsholm, 2010; Lee et al, 2012). This air tightness in buildings leads to limitation in the passage of air in and out of the indoor environment thereby causing a reduction in ventilation rates (Nantka, 2006). Studies have shown that reduction in ventilation rates could result in the poor indoor air quality (IAQ) which has been reported to lead to various health related issues such as sick building syndrome, occurrence of asthma, and other respiratory diseases (Aizat et al, 2009; Fisk et al, 2009; Lee et al, 2012; Mentese et al, 2015).

In Malaysia, studies have shown that naturally ventilated residential buildings are found to exhibit indoor climatic (temperature and humidity) conditions and contaminant levels that are not acceptable within the recommended range for acceptable IAQ (Ahmed et al, 2004; Muhamad-darus et al, 2011; Jamaludin et al, 2015; Kubota and Toe, 2015). Consequently, less satisfaction levels on the part of occupants were recorded despite the fact that most of them opened their windows to ventilate their homes (Kubota and Ahmad, 2005; Kubota, 2006; Kubota et al, 2009). These studies indicate that, despite the benefits of natural ventilation, naturally ventilated buildings in Malaysia are still in poor IAQ conditions and the fact that occupants' regular practices of opening their windows have yet to be translated into improved satisfaction levels on their indoor conditions. This raises the questions of whether the provided natural ventilation provisions are actually adequate and whether they are fully utilized by the occupants.

This study therefore aims to address these uncertainties. The specific objectives of this study are as follows: 1) to identify natural ventilation provisions in selected residential houses in Malaysia, 2) to determine the ventilation rates delivered by the natural ventilation provisions, and 3) to assess occupants' utilization of those provisions and their level of satisfaction with indoor ventilation while utilizing these provisions. It is anticipated that findings from this study will inform designers on the importance of the required law governing the natural ventilations in residential buildings. Such law is stipulated in the Uniform Building By-Law (UBBL) 1984 Law 39 (1) that says, "Every room designed, adapted, or used for residential [purposes]...shall be provided with natural lighting and ventilation by means of one or more windows, having a total area of not less than 10% of the clear floor area of such room and shall have openings capable of allowing a free uninterrupted passage of air not less than 5% of such floor area" (Laws of Malaysia, 2008).

The paper first explains the key theories and research in this area, followed by the stages of methods used in the study. It then presents and discusses the results of the study before concluding with some recommendations for future research.

LITERATURE REVIEW

The necessity of introducing outdoor air for ventilation to ensure good IAQ in buildings has been acknowledged for more than 150 years (Janssen and Hill, 1982). The overall measure of the rate of outdoor air being supplied for ventilation in an indoor space, which is referred to as the air exchange rate (ACH) or ventilation rate (ASHRAE, 2007), includes intake of air through intentional or unintentional openings. Marr et al (2012) argued that this ventilation rate is influenced by natural ventilation through window openings, the total area of window opening provided, as well as the frequency of opening the windows. Ahmed et al (2004), Yamamoto et al (2010), and Muhamad-darus et al (2011) also expressed similar views. Yamamoto et al (2010) asserted that natural ventilation through window openings and doors was more likely to increase the ACH in residential buildings. Ahmed et al (2004), on the other hand, revealed that the most significant parameters that influence IAQ and ACH of a home were room sizes, existence of ventilation outlets, and occupancy rate, whereas Muhamad-darus et al (2011) indicated these factors as household activities, ventilation system, and the location of a house. However, Yamamoto et al (2010) asserted that ACH could be reduced when air-conditioning was used as a means of attaining comfort.

In relation to ACH and air-conditioning usage, a study conducted by Guo et al (2008) found that the highest ACH value was recorded when the air-conditioner and fan were turned on and all windows were left opened in a mechanically ventilated classroom. The study was conducted to find out the influence of ACH on a particular contaminant. At the end of the study, a relationship was found between ACH and the indoor concentration of the measured contaminant. It was revealed that the higher the ACH value, the lower the concentration level of indoor contaminant, the same conclusion reached by Zuraimi and Tham (2008) in their study on indoor pollutants concentrations in child care centers.

To achieve adequate ACH for ventilation and contaminant control, Hassan and Ramli (2010) stated that the maximum openings on the building walls should be considered, as this will create a high air intake into the house, hence, causing an increase in the indoor ventilation rates. This could be achieved when the provided opening area on the building walls is not less than 40% of the total floor area (Tantasavasdi et al, 2001). Although an opening area is essential for outdoor air intake, occupants' usage of the provided opening (known as occupants' ventilation behavior) is more important (Lee et al, 2012). Lee et al (2012) described the occupants' ventilation behavior as the relationship between occupants and their window openings in relation to the frequency and duration of which they are utilized to admit outdoor air.

In summary, these studies have revealed that insufficient ventilation can result in the deterioration of IAQ. Consequently, a large opening area is necessary for adequate ventilation for easy exchange of air from the outdoor to the internal environment. It is therefore evident from the literature that, for effective natural ventilation, acceptable IAQ and thermal comfort levels, occupants' satisfaction, adequate openings that provide sufficient ACH, and proper occupants' ventilation behaviour are highly important. The theoretical framework of the study is illustrated in Figure 1.

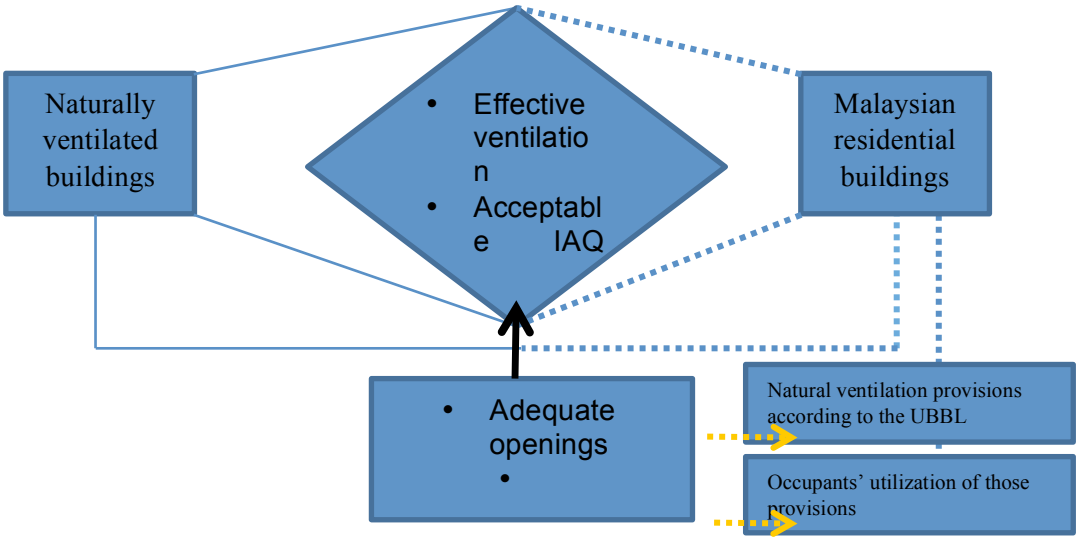

Figure 1. Theoretical framework (Source: Authors)

Based on the aforementioned discussion, it is hypothesized that the window opening area, the occupants' means of achieving comfort (AC ownership), the occupants' demographic characteristic (total number of occupants, years of occupancy), and the duration of opening windows contributes to the occupants' level of satisfaction with indoor ventilation when utilizing natural ventilation.

However, to understand natural ventilation in Malaysian residential homes, the provided natural ventilation provisions (openings) need to be viewed with respect to the Malaysian UBBL, a standardized building regulation that governs all Malaysian residential buildings. Two studies (Hanafiah, 2005 and Ahmad et al, 2011) have been conducted to investigate the adequacy of natural ventilation provisions in Malaysian terraced houses in accordance with the UBBL. However, the studies were carried out on renovated houses; hence, the conformity of the houses' original opening design (sizes and types) to the UBBL cannot be ascertained since the original design has been altered.

This highlights the need for natural ventilation and natural ventilation provisions in Malaysian residential buildings to be further investigated. Studies have been conducted on Malaysian residential buildings in relation to natural ventilation and occupant satisfaction (Kubota and

Ahmad, 2005; Kubota, 2006; Kubota et al, 2009; Mohit et al, 2010; Talib, 2011; Teck-Hong, 2012; Zainal et al, 2012). However, the question of whether or not the provided natural ventilation provisions are adequate remains unanswered. As a result, the link between regulatory compliant provisions and improved natural ventilation in residential buildings has not been successfully established, especially within a hot-humid climatic condition.

Also, these studies failed to consider the relationships that may exist among all the above-mentioned three issues as a whole (i.e. natural ventilation provisions, occupants' ventilation behaviour, and occupants' satisfaction). Nor was there any effort to look into other factors that may particularly influence occupants' satisfaction than the one focused in Kubota and Ahmad (2005), Kubota (2006), and Kubota et al (2009), i.e. the length of time of which windows were left open. This study therefore aims to fill these gaps by investigating the present condition of natural ventilation provisions in Malaysian residential buildings. By doing this, their adequacy with respect to the UBBL requirements will be confirmed. Furthermore, by considering UBBL compliant natural ventilation provisions as an influencing factor alongside occupants' ventilation behavior, occupants' satisfaction with indoor ventilation will be clearly understood.

METHODOLOGY

This study adopted a case study approach with multiple sources of data to achieve its objectives. The first objective was fulfilled through document analysis and observations, whereas the second objective was achieved by conducting computer simulations. Lastly, a questionnaire survey was conducted to achieve the third objective. The document analysis and observation was needed in order to identify the natural ventilation provisions (for this study, these provisions are limited to window openings and other unobstructed openings within the living spaces as specified by the UBBL) in existing residential buildings. Computer simulations were carried out to reveal the influence of UBBL compliant openings on the ACH, and subsequently, establishing the link between regulatory compliant provisions and improved natural ventilation. On the other hand, the roles that these provisions play in increasing occupant satisfaction were examined through a questionnaire survey. The survey was also conducted to reveal the occupants' utilization of these provisions, which is necessary to understand the relationship that exists between occupants and these provisions. This study is limited to these three data collection processes.

Description of selected house types

Statistics indicate that terrace houses are the largest housing type built in Malaysia (National Property Information Centre, 2013); hence, this housing type was chosen for the study. Specifically, five terrace house design types in Putrajaya precincts 11 and 14 were selected after site visits were conducted to identify different terraced house designs with varying window types, sizes, patterns, and locations. Putrajaya (Federal Capital Territory of Malaysia) has residential zones constituting the second largest major land use, thus making it suitable as the study area. Precincts 11 and 14 were chosen as they contain the largest number of terraced housing units with a variety of designs compared to other twelve precincts available in Putrajaya. Moreover, houses in Putrajaya are fundamentally kept in their original conditions as the local authority places constraints on renovations to maintain the consistency of the general designs. This guarantees that all units under each house type chosen for the study have comparable qualities.

Figure 2 (Figure 2a - 2e) shows the perspectives and floor plans of the selected house types. They were all double-storey terraced houses, constructed with veneer brick wall, concrete frames, and roof tiles. Each unit of house types 1, 2, 3, 4, and 5 had a built up area of 105.16 m^2, 93.94 m^2, 153.30 m^2, 129.93 m^2, and 166.44 m^2 respectively. All house types had a floor-to-ceiling height of 3.30 m for the ground floor and 3.10 m for the first floor. The ground floor accommodated a living/ dining area, a kitchen, and bedroom 3, whereas the upper floor contained three bedrooms i.e. master bedroom, bedroom 1, and bedroom 2. Among all of the

house types, only type 5 had an internal courtyard. The living spaces of all house types were provided with casement window types of varying sizes; in some cases, awning window types were installed at the top of each casement window. Apart from architectural design, the difference between these house types was in the ratio of their operable openings for ventilation provisions and wall area, as required by the UBBL.

Figure 2a. House type 1

Figure 2b. House type 2

Figure 2c. House type 3

Figure 2d. House type 4

Figure 2e. House type 5

Figure 2. Perspectives and floor plans of selected house types (A represents the ground floor; B, the first floor; and C, the perspective view) (Source: Authors).

Identifying natural ventilation provisions

Since natural ventilation provisions in Malaysian residential buildings are governed by the UBBL, this study identifies ventilation provisions in the selected house types in accordance with this law. Relevant drawings were sought from relevant organizations and these include: site and location plans, floor plans, roof plans, elevations, sections, and schedules. Subsequently, the sizes of window openings in all living spaces (living/ dining, kitchen, and all bedrooms) as well as the total floor area of all living spaces of each house design type were recorded. Then the total area of window openings was calculated for each living space. This calculation includes both operable window openings and unobstructed openings that allow uninterrupted passage of air as required by the UBBL. The window/ floor area percentage was then calculated using the following formula:

$$\text{Percentage of window/ floor area (\%)} = \frac{window\ area\ (m^2)}{floor\ area\ (m^2)}\ X\ 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Determining the ventilation rates delivered by the natural ventilation provisions

This stage involved a computer simulation process to determine the ventilation rates delivered by the existing natural ventilation provisions (window opening area) in each living space of all the studied house types. The modeling tool chosen for this purpose was Integrated Environmental Solution (IES<VE>) software version 2012. A comparison of available simulation softwares revealed IES<VE> as the most acceptable environmental simulation software (Attia et al, 2009; Attia and De Herde, 2011; Behrendt et al, 2011). The validity of using IES<VE> for different building simulations has been widely studied (Azhar et al, 2008; Crawley et al, 2008; Leng et al, 2012) and IES<VE> has been widely adopted in numerous building and environmental studies (for example, Mohammadi et al, 2010; Chinnayeluka, 2011; Sadrzadehrafiei et al, 2011; Nikpour et al, 2013a; Nikpour et al, 2013b). Furthermore, it has been declared that IES<VE> meets relevant standards such as: ASHRAE 140: 2001, 2004 and 2007, BEST TEST, CIBSE TM33 (Integrated Environmental Solutions Limited, 2014). To ensure the reliability of the simulation results, three sequential stages of procedures were completed, namely:

1. Geometry generation: This requires all building components (e.g. openings, floors, partitions, and roofs) to be drawn using “ModelIT” IES<VE> interface. Furthermore, information such as site orientation, site location, and weather data were entered into the system. For the purpose of this study, weather data from the Kuala Lumpur/ Subang weather station was selected as it is the closest weather station to the study area.
2. Natural ventilation analysis: This was performed using the Macroflo IES<VE> module. It involved specifying relevant opening characteristics such as opening types, opening angle, duration, and direction in the MacroFlo ‘opening types manager’ interface.
3. Running the simulation: At this stage, the mode and required space for simulation, output parameters, and simulation duration (1st January to 31st December) were assigned and the simulation was run using the IES<VE> ApacheSim.

One intermediate house unit of each house type was selected for the simulation as it perfectly represents a terrace house unit. Surveys conducted by Kubota and his co-researchers (Kubota and Ahmad, 2005; Kubota, 2006; Kubota et al, 2009) revealed that the majority of Malaysia’s residential building occupants left their windows opened mostly during the daytime (from morning to evening) and very few occupants left their windows opened for 24 hours a day. Therefore, the two scenarios simulated in this study were the times when: 1) the windows were left opened during the daytime only (6:00 AM to 10:00 PM every day), and 2) all windows were left opened at all times (24 hours every day). Thus, the difference in air flow introduced by the openings under these two different scenarios was discovered.

Assessing the occupants’ utilization of the natural ventilation provisions

In order to understand a building’s indoor performance, the building occupants are definitely the major source of information as they can independently share their comfort and satisfaction levels,

as well as the overall building performance (Peretti and Stefano, 2011). As such, surveys, questionnaires, and observations are among the methods often used to seek these kinds of information. These methods could either be used independently or in combination with physical measurements, as there are currently no standardized methods to survey building occupants (Peretti and Stefano, 2011). Questionnaire surveys have been used to gather responses in related studies (such as Kubota and Ahmad, 2005; Kubota, 2006; Andersen et al, 2009; Frontczak et al, 2012; Lee et al, 2012) and the main issues addressed were the occupants' means of achieving comfort, their ventilation behaviour, and reasons for opening or not opening their windows. Therefore, the questions set in the questionnaire form for this study were based on these main issues. Also, it was considered relevant to include the occupants' level of satisfaction with the natural ventilation in their homes.

A questionnaire survey was conducted among 300 occupants who lived in 300 intermediate units. These 300 intermediate units were randomly selected from the total units of 649 and they made up 60 representative units of each of five house types. At the end of the survey, responses from 298 house units were realized, representing 46.0% of the total house units in all five house types.

Overall, this part of the study sought to test the study's hypothesis stated in the Literature Review section. Hence, the questionnaire form is divided into four parts and was designed to efficiently allow for the hypothesis to be tested. The first part consists of questions designed to obtain occupants' demographic information as well as the number of occupants and the period of occupancy. The second section includes questions formulated to understand their means of achieving comfort. Specifically, occupants were requested to indicate whether or not they were using AC and/ or an electric fan in each of their living spaces. Responses to this particular question are appropriate to facilitate the examination of whether these variables have any possible influence on occupants' satisfaction with the ventilation in their homes while utilizing natural ventilation.

In the third section, which was based on occupants' ventilation behavior, occupants were asked to select the period(s) in which they normally opened their windows, and also the period in which AC in each living space was normally operated. Occupants who opened their windows were further asked to choose the duration for which their windows were left opened based on six options: less than 1 hour, 1 to 5 hours, 6 to 10 hours, 11 to 15 hours, more than 16 hours but less than 24 hours, and 24 hours. Responses to this question provide a better understanding on the usage pattern of the natural ventilated provisions. The final question in this part sought information on the respondents' main reason(s) for opening and not opening their windows.

In the last part of the questionnaire, occupants were asked to rate their level of satisfaction with ventilation in their homes while utilizing natural ventilation. This section was scored on a five-point Likert scale, where a score of 1 represents "very unsatisfactory" and 5 represents "very satisfactory". Responses from this section act as a dependent variable (DV) for the tested hypothesis and also provide the avenue for respondents' preferences and expectations to be understood. Since the climatic conditions in Malaysia are relatively uniform all year round, respondents were asked to provide a general evaluation.

A pilot study was conducted on similar house types before the main survey in order to test the validity of the survey questionnaire. Since the assumption for validity was not met (Cronbach alpha < 0.7), relevant adjustments were made and final Cronbach alpha is 0.78. The main survey was conducted in October 2012. The respondents were requested to give their answers based on the time when their house was occupied. All questionnaires were self-administered.

Data analysis

The completed questionnaires were analyzed with SPSS statistical analysis program (version 21) using relevant statistical analysis i.e. descriptive analysis, cross-analyses, and regression

analysis. Descriptive analysis was carried out to describe all the variables in the questionnaire, whereas cross tabulation was carried out to determine any relationships between variables. An ordinal regression analysis was completed to test the study's hypothesis; the DV identified from the hypothesis was occupants' level of satisfaction, which was scored on a five-point Likert scale (ordinal scale). The independent or explanatory variables (IVs) were window opening area, means of achieving comfort, total number of occupants, years of occupancy, and duration of opening windows in the living spaces, which are in both nominal and continuous scales. The means of measurement adopted for all the IVs (except window opening area) have been explained in the previous section. For window opening area, house types were grouped according to the adherence of their window opening area with the UBBL window/ floor area percentage for natural ventilation provision requirements. So, the window opening area could be either UBBL compliant or non-compliant.

Generally, when dealing with ordinal DVs, the modelling approach can be executed in three ways: 1) treated as a continuous variable, 2) grouped into a nominal variable, and 3) modelled as it is (in its original form) using ordinal regression analysis (Ananth and Kleinbaum, 1997; Strand et al, 2012). From among all options, only the third option allows for a model that incorporates the ordinal nature of the DV to be applied. Although the other approaches cannot be considered incorrect, they often cause the loss of information due to the ignoring or collapse of the order and categories of the responses (Ananth and Kleinbaum, 1997; Strand et al, 2012). Numerous studies have broadly employed the ordinal regression model for analysing ordinal DVs in different fields of study, some of which are Bonhomme et al (2010), Košak and Poljšak (2010), Ombui et al (2011), Citko et al (2012), Strand (2012), and Khalaf et al (2013).

RESULTS

Natural ventilation provisions in accordance with UBBL 1984 Law 39 (1)

Relevant documents were analyzed and site visitations and observations were conducted to identify the existing natural ventilation provisions in all of the studied houses. Table 1 gives the detailed information on the present provisions for natural ventilation (window opening area and window/ floor area percentage) in all of the studied house types. House type 1 was found to have the largest total window/ floor area percentage (16.03%), followed by house type 5 (11.27%), 3 (10.33%), 2 (8.50%) and lastly 4 (9.06%). It is important to note that only house types 1 and 5 were provided with window opening areas that complied with the UBBL. It was surprising to note that only house type 5 had unobstructed openings; however, its window/ floor area percentage of 1.41% was still below the 5% required by the UBBL. This highlights the fact that the UBBL requirements were not strictly adhered to in the studied house types.

Table 1. Window/floor area percentage of the studied living spaces in each house types (Source: Authors).

House types	Total living spaces (m^2)	Provided opening area m^2 (%)	Living/dining room m^2 (%)	Master bedroom m^2 (%)	Bedroom 1 m^2 (%)	Bedroom 2 m^2 (%)	Bedroom 3 m^2 (%)	Kitchen m^2 (%)	Total m^2 (%)	UBBL compliant
1	101.07	Provided window opening	3.78 (10.60)	3.78 (23.74)	2.16 (12.59)	2.70 (20.83)	3.78 (39.54)	-	16.20 (16.03)	Yes
		Unobstructed opening	-	-	-	-	-	-	-	No
2	88.97	Provided window opening	1.44 (5.00)	1.80 (9.24)	1.44 (11.86)	1.44 (10.41)	1.44 (28.85)	0.36 (4.03)	7.56 (8.50)	No
		Unobstructed opening	-	-	-	-	-	-	-	No
3	106.53	Provided window opening	0.72 (2.00)	2.7 (12.96)	2.7 (16.66)	1.8 (15.46)	1.44 (16.16)	1.44 (11.09)	11.00 (10.33)	Yes
		Unobstructed opening	-	-	-	-	-	-	-	No
4	86.78	Provided window opening	1.08 (3.56)	1.80 (13.98)	1.44 (11.88)	1.44 (11.22)	0.90 (12.03)	1.2 (11.09)	7.86 (9.06)	No
		Unobstructed opening	-	-	-	-	-	-	-	No
5	102.21	Provided window opening	3.60 (11.51)	2.70 (14.48)	1.80 (11.39)	2.16 (13.04)	0.36 (4.88)	0.90 (7.17)	11.52 (11.27)	Yes
		Unobstructed opening	1.44 (4.61)	-	-	-	-	-	1.44 (1.41)	No

Table 2. Ventilation rates delivered by Openings in all living spaces (Source: Authors).

				Windows left open at all times (24 hrs)		Windows opened only between 6AM to 10PM	
		Room volume (m3)	Total opening Area (m2)	Airflow in (m3/h)	ACH	Airflow in (m3/h)	ACH
HOUSE TYPE 1	Living room	117.61	3.78	936.32	7.96	615.38	5.23
	Master bedroom	42.32	3.78	766.58	18.12	530.42	12.54
	Bedroom 1	53.20	2.16	419.65	7.89	283.00	5.32
	Bedroom 2	40.18	2.70	543.74	13.53	368.24	9.17
	Bedroom 3	31.55	3.78	733.82	23.26	511.27	16.21
	Kitchen	39.93	-	0.50	0.01	0.36	0.01
	Total	324.78	16.20	3400.63	10.47	2308.68	7.11
HOUSE TYPE 2	Living room	97.65	1.44	161.17	1.65	104.364	1.07
	Master bedroom	60.42	1.80	358.45	5.93	233.676	3.87
	Bedroom 1	37.63	1.44	262.62	6.98	173.34	4.61
	Bedroom 2	42.87	1.44	264.20	6.16	174.168	4.06
	Bedroom 3	16.47	1.44	235.19	14.28	158.868	9.65
	Kitchen	29.47	0.36	149.22	5.06	98.208	3.33
	Total	284.51	7.56	1430.86	5.03	942.62	3.31
HOUSE TYPE 3	Living room	118.67	0.72	165.42	1.39	107.53	0.91
	Master bedroom	64.57	2.70	525.42	8.14	347.33	5.38
	Bedroom 1	50.25	2.70	508.61	10.12	339.05	6.75
	Bedroom 2	36.08	1.80	360.43	9.99	237.56	6.58
	Bedroom 3	29.4	1.44	254.95	8.67	170.68	5.81
	Kitchen	42.83	1.44	286.52	6.69	190.98	4.46
	Total	341.81	11.00	2101.36	6.15	1393.13	4.08
HOUSE TYPE 4	Living room	100.19	1.08	279.65	2.79	179.68	1.79
	Master bedroom	39.90	1.80	334.94	8.40	221.98	5.56
	Bedroom 1	37.57	1.44	253.48	6.75	168.52	4.49
	Bedroom 2	39.77	1.44	253.44	6.37	168.59	4.24
	Bedroom 3	24.68	0.90	195.34	7.91	128.34	5.20
	Kitchen	36.70	1.20	239.94	6.54	158.94	4.33
	Total	278.81	7.86	1556.78	5.58	1026.04	3.68
HOUSE TYPE 5	Living room	103.19	5.04	1190.74	11.54	900.14	8.72
	Master bedroom	57.82	2.70	919.69	15.91	690.01	11.93
	Bedroom 1	48.98	1.80	785.74	16.04	589.18	12.03
	Bedroom 2	51.34	2.16	387.11	7.54	255.92	4.99
	Bedroom 3	24.35	0.36	62.57	2.57	41.94	1.72
	Kitchen	41.42	0.90	198.22	4.79	130.00	3.14
	Total	327.091	12.96	3544.06	10.84	2607.19	7.97

Ventilation rates delivered by the natural ventilation provisions

Computer simulations were carried out to reveal the influence of UBBL compliant openings on the ACH. Table 2 shows the simulated ventilation rates delivered by these openings in all living spaces. It is apparent from this table that house types 1, 3, and 5 have their total window/ floor area percentages in accordance with the UBBL (see Table 1), exhibited higher ventilation rates (10.47, 6.15 and 10.84 ACH respectively when windows were left opened at all times, and 7.11, 4.08 and 7.97 ACH respectively when windows were opened only between 6:00 AM to10:00 PM) than the remaining two house types that are non-UBBL compliant. It can also be noticed that amongst these three house types, house type 5 has the highest ventilation rate of 10.84 ACH, probably due to its inclusion of unobstructed openings, as required by the UBBL. This indicates that higher ACH values could also be recorded in other house types if unobstructed openings were included in their design. These results establish that the provisions' compliance with the regulation plays an important role in improving the natural ventilation.

It can also be noticed in Table 2 that there was a significant difference in the overall ACH values between the scenario when windows were left opened at all times (column 6) and when windows were opened only between 6:00 AM and 10:00 PM (column 8). Specifically, the ACH values obtained for house types 1, 2, 3, 4, and 5 (10.47, 5.03, 6.15, 5.58, and 10.84 ACH respectively) when the windows were left opened at all times were generally higher than when windows were opened only between 6:00 AM to10:00 PM (7.11, 3.31, 4.08, 3.68, and 7.97 ACH respectively).

Occupants' utilization of the provided natural ventilation provisions

This section presents the results from the questionnaire survey, which was conducted to understand the relationship that exists between occupants and the natural ventilation provisions. They are grouped under occupants' demographic characteristics, their means of achieving comfort, their frequency and periods of utilizing those provisions, their level of satisfaction, and factors that influence their satisfaction, as explained below.

Demographic characteristics

The household size and occupancy period in each house type were investigated to evaluate occupants' demographic characteristics. Table 3 presents the characteristics of the 289 respondents, representing 289 house units of five house types. The average occupancy period was 3.46 years while the average household size was 4.51 persons.

Table 3. Occupants' demographic characteristics (N = 298) (Source: Authors).

	Occupancy period (years)		Household size (person)	
House types	Mean	Std. deviation	Mean	Std. deviation
1	4.67	2.72	4.73	1.60
2	6.34	3.23	5.12	1.68
3	2.79	1.04	4.40	1.63
4	3.11	1.87	4.87	1.63
5	.37	.12	3.45	1.28
(n= 298)	3.46	2.91	4.51	1.67

Means of achieving comfort

This part of the survey presents other means that the occupants employed to attain comfort besides opening their windows and their pattern of usage. The survey reveals that 157 (52.7%) of the house units had at least one AC unit installed. The remaining 141 (47.3%) house units relied solely on natural ventilation and utilized electric fans as a means of achieving comfort. The study also found that all house units installed electric fans in all of the living spaces. This corresponds

to the fact that those respondents who owned an AC also used electric fans in all of their living spaces. Figure 3 illustrates the distribution of AC ownership in the living spaces of all house types. It shows that the master bedroom was the most preferred space to be installed with an AC (51.2%), whereas fans were mostly preferred to achieve the desired comfort in bedrooms 1, 2, and 3. Also, house types with the highest percentages of AC ownership were type 1 (56.7%) and type 3 (56.9%), as shown in Figure 4. Surprisingly, house types with the highest percentages of AC ownership (types 1 and 3) were among those that complied with the UBBL 10% window/ floor area percentage.

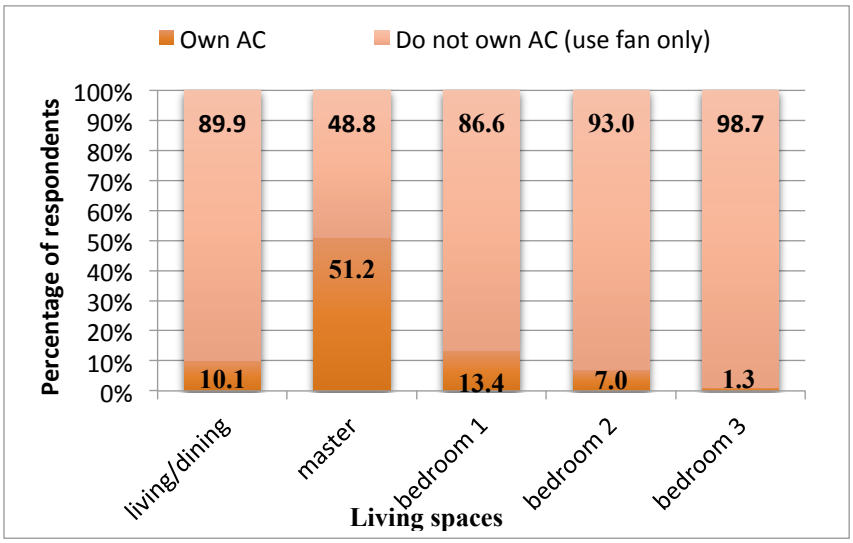

Figure 3. AC ownership in living spaces (N=298)

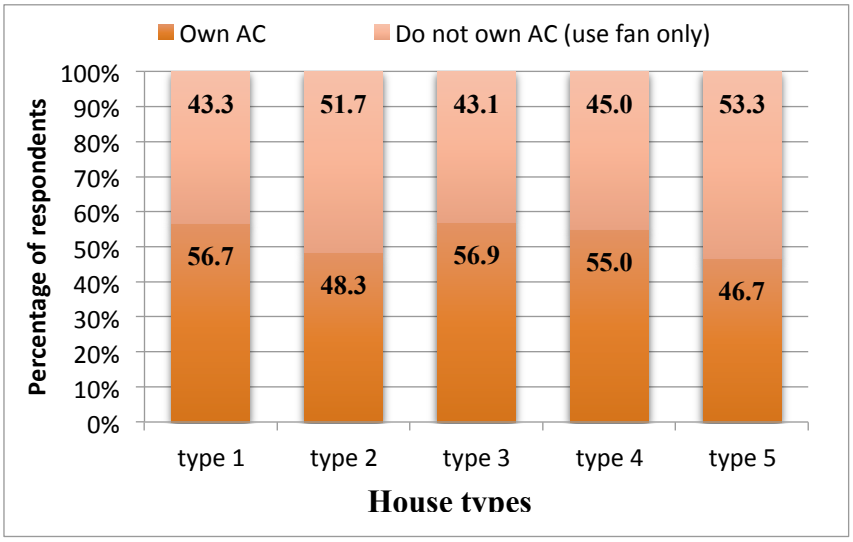

Figure 4. AC ownership in each house types (N=298) (Source: Authors).

Figure 5 shows the periods of the day in which the AC was normally operated in all living spaces. It indicates that the AC in all living spaces was mostly operated only at night. Since they were mostly installed in master bedrooms, 74.5% of the respondents who installed an AC in their

master bedrooms operated it only at night, while the remaining 25.2% operated it at various times in the day. This demonstrates that the AC was mainly installed for use during sleeping hours.

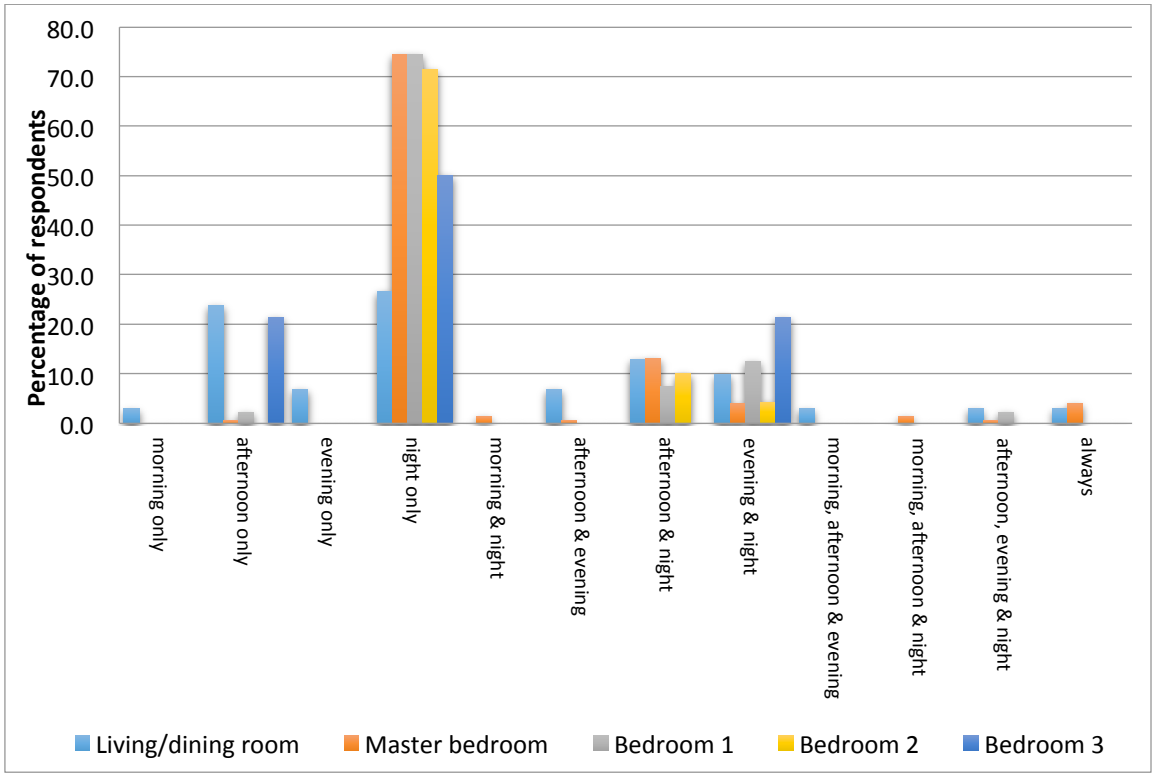

Figure 5. Periods of the day in which AC was operated in all living spaces (N=157) (Source: Authors).

Frequency and periods of utilizing natural ventilation provisions

This subsection presents the occupants' usage pattern of the window openings. Figure 6 shows that the majority of the respondents opened their windows in the living/ dining rooms (93%), kitchens (86.2%), and master bedroom (72.5%). Hence, it is apparent that these three spaces were the most naturally ventilated spaces in the studied houses. Furthermore, a comparison between Figures 6 and 3 reveals two important results. First, 72.5% of the total respondents opened windows in the master bedroom, although 51.2% of them had AC installed in this space. This shows that the idea behind the AC installation was not to eliminate the use of windows for attaining comfort but rather to serve as a means to improve their comfort level mainly during sleeping hours. As mentioned earlier, the AC was purposely installed for achieving comfort during sleeping hours. This is apparent in Figure 7, which reveals that windows were mostly opened in all living spaces during the daytime (i.e. morning, afternoon, and evening) and they were rarely opened at night times. Second, despite the small percentages of respondents who installed an AC in bedrooms 2 and 3, windows were less frequently opened in these two rooms. This indicates that these two bedrooms were mostly not occupied.

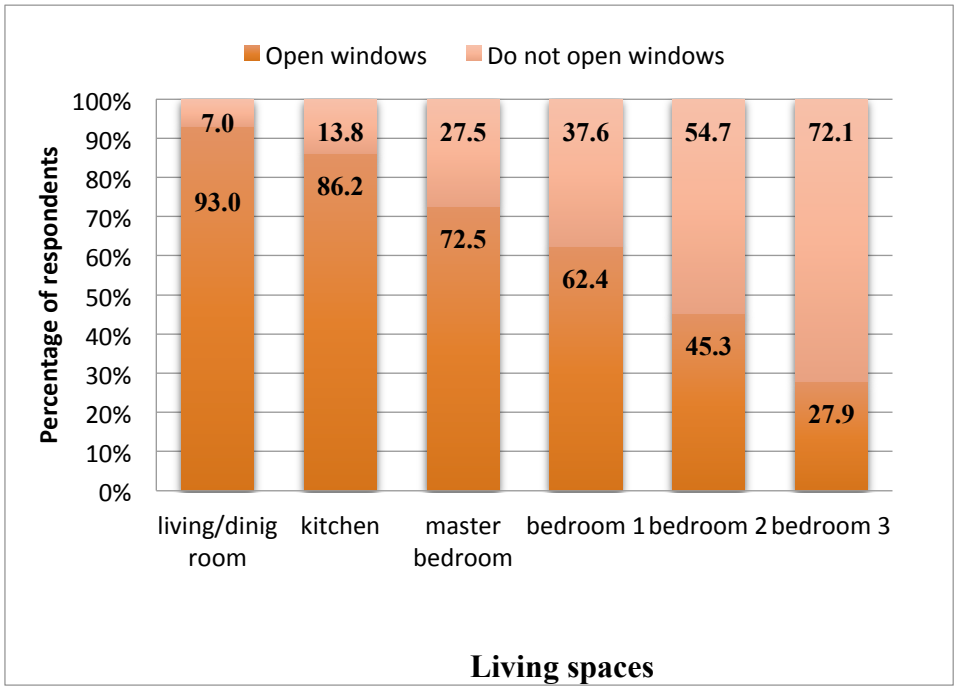

Figure 6. Percentage of respondents that open windows in all living spaces (N=298) (Source: Authors).

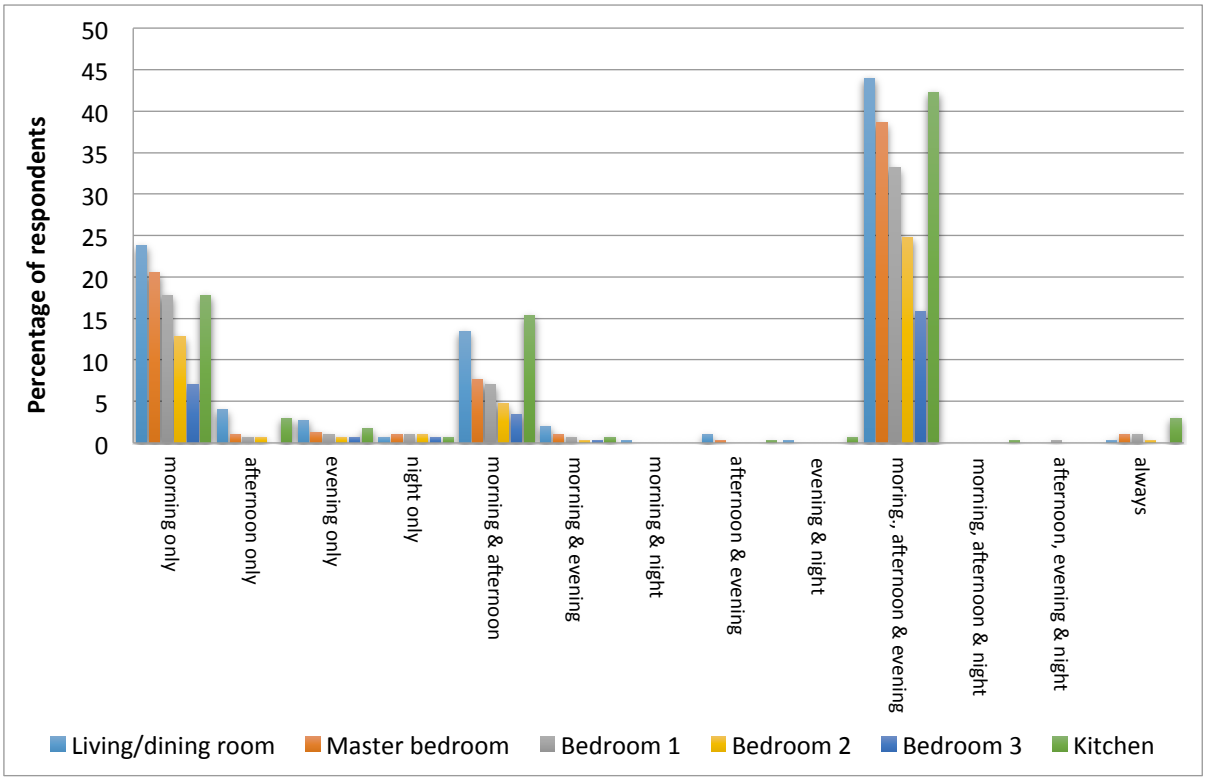

Figure 7. Periods of the day in which windows are opened in all living spaces (N=298) (Source: Authors).

Table 4 shows the duration in which windows were left opened in all living spaces. It reveals that the majority of the respondents (44.3%, 42.6% and 40.6% in living/ dining room, kitchen, and master bedroom respectively) who opened their windows left them opened within the mean duration of 6-10 hours per day. In terms of reasons for opening and not opening windows, Figure 8 shows that respondents chose capture breeze (29.4%), capture daylight (23%), and release heat (22%) as the three main reasons for opening their windows, while Figure 9 shows that security (27.8%), insects (21.6%) and dust (20.5%) were the three main reasons for not opening their windows.

Table 4. Percentage distribution of respondents by duration of opening windows in all living spaces (Source: Authors).

Duration per day	Living/dining room (%)	Kitchen (%)	Master bedroom (%)	Bedroom 1 (%)	Bedroom 2 (%)	Bedroom 3 (%)
Never open	7.0	13.8	27.5	37.6	54.7	72.1
Less than 1 hour	9.4	7.4	6.4	4.7	3.7	1.0
1-5 hours	34.6	29.9	22.1	17.8	12.8	9.4
6-10 hours	44.3	42.6	40.6	36.9	26.8	16.4
11-15 hours	2.7	2.3	1.7	1.3	1.0	.7
More than 16hr < 24hrs	1.0	1.0	.7	.7	.7	.3
24 hours	1.0	3.0	1.0	1.0	0.3	0

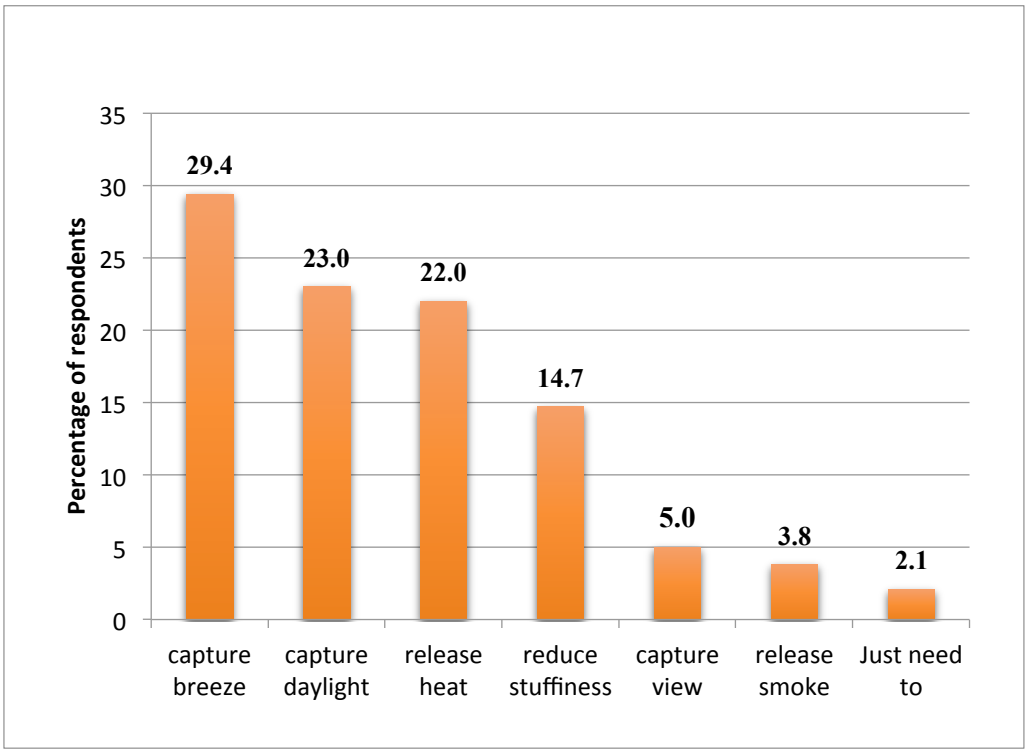

Figure 8. Reasons for opening windows (Source: Authors).

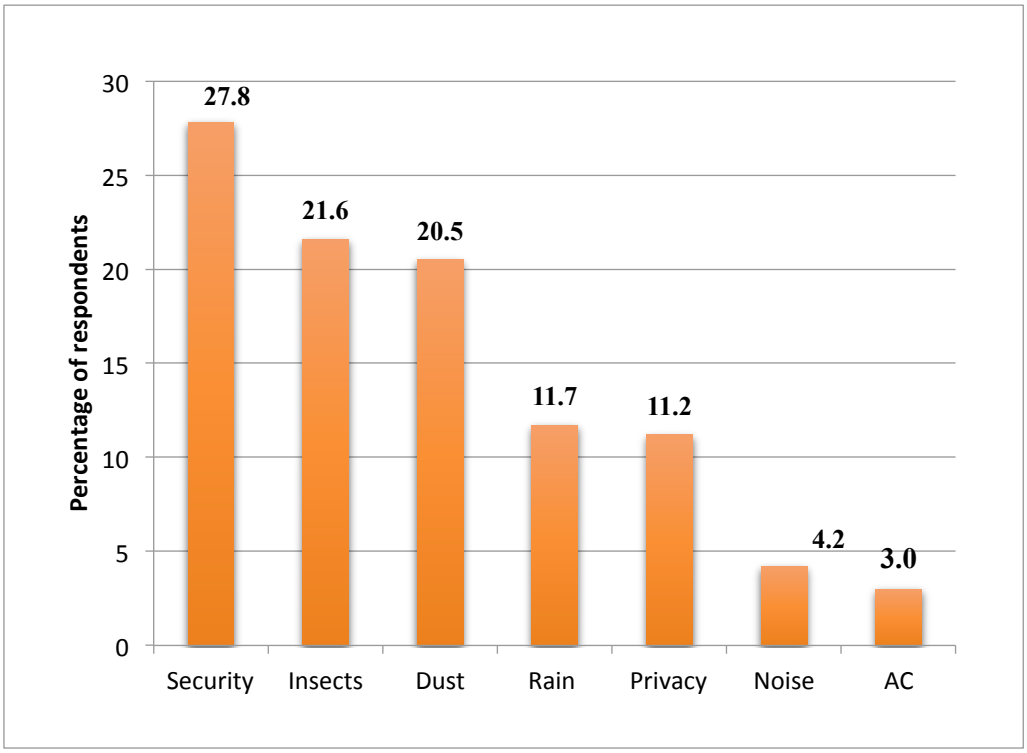

Figure 9. Reasons for not opening windows (Source: Authors).

Occupants' level of satisfaction while utilizing natural ventilation

Occupants' perception of their level of satisfaction with indoor ventilation while utilizing the provided natural ventilation provisions was scored on a five-point scale, where a score of 1 represents "very unsatisfactory" and 5 represents "very satisfactory". From the analysis, the result shows that the majority (57.7%) of the respondents were neither satisfied nor unsatisfied i.e. just felt "OK" (Mean = 2.95).

Factors that contribute to the occupants' level of satisfaction

To test the study's hypothesis that window opening area (UBBL compliant and non-UBBL compliant), occupants' means of achieving comfort (AC ownership), occupants' demographic characteristic (total number of occupants, years of occupancy), and the duration of opening windows contribute to occupants' level of satisfaction with indoor ventilation when utilizing natural ventilation. Table 5 represents the result of the regression analysis where only three IVs (duration of opening windows, UBBL compliancy and AC ownership) were found to significantly influence occupants' overall level of satisfaction. However, the other two IVs (total number of occupants and years of occupancy) showed no significance. The fifth column in Table 5 represents the odd ratios ('OR') derived from the exponent of the estimate values. The OR value for the duration of opening windows, which is 2.34, indicates that with a longer duration of windows being left opened, respondents were likely to be 2.34 times more satisfied with indoor ventilation when utilizing natural ventilation than those who opened less. Consequently, respondents who occupied house types with windows complying with the UBBL requirement were 1.69 times more satisfied than those who occupied houses with non-compliant windows. Furthermore, the result shows that respondents who owned one or more ACs in their homes were 1.80 times more satisfied with indoor ventilation than occupants who did not own any AC. Therefore, the hypothesis that the duration of opening windows, UBBL compliancy, and AC ownership influence

occupants' overall level of satisfaction was supported while the hypothesis that the total number of occupants and "years of occupancy influence occupants' overall level of satisfaction was rejected.

Table 5. Ordinal Regression for occupants' level of satisfaction

Parameter Estimates					
Variable	Parameter	B	SE	OR	
Threshold (base= very satisfactory)					
	Very unsatisfactory	-1.07	.57	-	
	unsatisfactory	1.30	.49	-	
	Ok	4.64	.57	-	
	Satisfactory	8.33	.91	-	
Household size		.09	.08	1.10	
Occupancy period		-.04	.05	0.96	
Duration of opening windows		.85	.13	2.34	***
UBBL compliancy (base= non-UBBL compliant)	UBBL compliant	.52	.26	1.69	**
AC ownership (base= do not own AC)					
	Own AC	.59	.24	1.80	**
	Model	-2 Log Likelihood	Chi-Square	df	Sig.
Model-fitting information					
	Intercept Only	574.65			
	Final	517.27	57.39	5	.00
Goodness-of-fit table					
	Pearson		764.45	927	1.00
	Deviance		479.67	927	1.00
Test of parallel lines					
	Null Hypothesis	517.27			
	General	498.99	18.28	15	.25
Pseudo-R^2 measures					
	Cox and Snell	.307			
	Nagelkerke	.352			
	McFadden	.179			

Note: Nagelkerke pseudo R^2 (.352) = 35.2 % (Ganguly et al. (2010) confirms R^2 values between 0.2 and 0.4 could be considered.) This indicates that 35.2% of the variation in occupants' level of satisfaction was explained by all of the predictor variables entered into the regression model.
**p< .05, ***p< .01. B= Estimate; SE= Standard error; OR= Odd ratio (exponent of B)

DISCUSSION

This study has revealed the current scenario of natural ventilation provisions in five different house design types as well as occupants' usage of these provisions. The design review revealed that out of the five studied houses types, only house types 1, 3, and 5 were provided with window openings in accordance with the UBBL 10% window opening area requirement. Furthermore, none of the houses included the 5% unobstructed openings as required in the UBBL, except house type 5 where 1.41% (1.44m^2) of the total living space area was provided in the living/ dining room. This is unsurprising as Hanafiah (2005) and Ahmad et al (2011) reported that some Malaysian residential buildings are provided with window openings that do not fulfil the UBBL

requirements. This could be due to the rising attempt at increasing energy efficiency with the use of mechanical cooling in buildings. According to Nielsen and Drivsholm (2010) and Lee et al (2012), increasing energy efficiency with the use of mechanical cooling results in houses built to be air tight to prevent leakage of cool draft. This air tightness would be an added advantage only for those occupants that rely on AC as a means of achieving comfort in their homes, whereas those who rely only on natural ventilation would be at disadvantage, as any possible avenue for air infiltration would be welcomed. Also, those windows openings that do not conform to the UBBL requirements are smaller in size compared to those that complied. And this has an implication on the ACH delivered into the indoor space, as wider window openings have been revealed to allow higher ventilation rates in naturally ventilated spaces (Hassan and Ramli, 2010). In fact, Tantasavasdi et al (2001) recommended an opening area of not less than 40% of the floor area while Mohd Firrdhaus and Cristina (2015) recommended 15% to 20% for effective ventilation in the Malaysian climate in order for occupants to attain maximum occupant satisfaction. These are in contrast to the 10% imposed in the UBBL. Mohd Firrdhaus and Cristina (2015) argued that a 10% opening is too small to allow maximum air movement under the Malaysian climate. If that is the case, then it can be argued that the 5% unobstructed openings specified in the UBBL represents an additional 5% to the provided 10% window opening/ floor area, making a total of 15% of total floor area dedicated for an opening in a specified space.

Although a larger window area contributes to a higher ACH, a high ACH would not have been achieved if window openings were not efficiently utilized. This was evident in the simulation results, which demonstrated higher ACH values when windows were left opened for a longer duration (24 hours) compared to when they were left opened for a shorter period. In addition, the regression output from the questionnaire survey responses clearly shows that respondents who opened their windows for a longer duration would be more satisfied with their indoor ventilation than those who opened less. These results support Lee et al (2012) and Marr et al (2012) who agreed that an increase in the frequency and duration of opening windows in residential buildings would lead to an increase in the rate of ventilation and thus resulting in a healthier indoor air quality. Indeed, this supports the hypothesis that the duration of opening windows, UBBL compliancy, and AC ownership influence occupants' overall level of satisfaction.

Nonetheless, the survey results also revealed that the majority of the respondents utilized window openings, despite the fact that the majority of the studied house units had at least one AC unit installed. This usage pattern was also reported by the findings from Kubota and Ahmad (2005), Kubota (2006) and Kubota et al (2009). Kubota (2006: 5) stated that "whether or not the households owned air-conditioners, they tended to open their windows…" In fact, respondents' main reasons for opening windows were capturing breeze and releasing heat. However, windows were mainly opened in the daytime while the AC was mostly operated in the night time, which is in line with the argument made by Kubota et al (2009). However, it was expected that the AC would be utilized more during daytime since the outdoor and indoor temperatures in Malaysia are usually high during the day (Zain et al, 2007; Kubota et al, 2009). Also, since Malaysia's outdoor temperature is normally lower at night, it was expected that the respondents would embrace night cooling (Kubota et al, 2009). This twist of results could be due to the fact that the houses surveyed were mostly not fully occupied during the daytime (office working hours). And, since security and insects were the two main reasons that the respondents chose for not opening their windows, this could also explain why they found it less necessary to open their windows during the night.

CONCLUSION AND RECOMMENDATIONS

In this paper, natural ventilation, openings, and occupants' ventilation behavior were studied. This was done by first investigating natural ventilation provisions of five different residential house design types in accordance with the UBBL. A further study was then carried out to reveal the

effectiveness of these provisions. Finally, occupants' patterns of relationship with these provisions were investigated.

Results have shown that the majority of occupants installed an AC in their homes and the AC popularity could potentially explain the absence of the 5% unobstructed openings in all of the studied house types as air-conditioned buildings need to be air-tight to be more energy efficient. However, the UBBL non-conformity of some of the house types in relation to the 10% opening requirement is likely due to the negligence on the part of building designers. This negligence has an impact on the indoor ventilation rates. For example, house types with window/ floor area percentage less than UBBL requirement have shown to exhibit lower ACH values. Contrastingly, those with window/ floor area percentage in line with UBBL requirement exhibited higher ACH values. Not only did these house types enjoy higher ventilation rates, they also recorded higher occupants' satisfaction. Another interesting discovery is that higher satisfaction with indoor ventilation was recorded among occupants who owned an AC than those who did not. A possible explanation for this result could be that those who own an AC also utilize window openings and operate ceiling fans. In such a situation, they have the advantage of switching from one means of comfort to another, whenever they are not satisfied. Thus, these occupants have an added advantage over those who relied solely on window openings and electric ceiling fans.

In summary, although some house types conform to the UBBL 10% window opening requirement and these houses enjoy higher ventilation rates coupled with the fact that majority of the respondents frequently open their windows, occupants are generally not fully satisfied with their indoor ventilation. So, is it due to the fact that the provided natural ventilation provisions are inadequate or the occupants themselves are not really utilizing these provisions? Undoubtedly, residential buildings should strictly adhere to the UBBL requirements for natural ventilation provisions, both the 10% opening/ floor area and the 5% unobstructed opening. However, the 5% unobstructed opening is mostly ignored. Otherwise, a huge difference would have been seen in the ACH (i.e. higher values) of all the studied houses. Therefore, it is highly recommended for the 5% required unobstructed opening to be incorporated in all house designs in Malaysia. With regards to occupants' utilization of the provisions, a longer duration of opening windows is recommended. Also, occupants need to embrace night ventilation as the outside temperature is considered more favourable at this particular time of the day, and this will allow for cool breeze to be admitted into the indoor space. The combined effect of UBBL compliant openings (both 10% and 5%), frequent and longer usage of window openings, and night ventilation by occupants will eventually lead to improved natural ventilation and high occupant's satisfaction with natural ventilation in Malaysia homes.

This study highlights the need for a strict effective enforcement of UBBL compliance for the purpose of building approvals. It is recommended for local authorities to exercise such enforcement not only for approval purposes during the design and construction stages but further extended into the completion stage. Findings from this study inform designers on the importance of the required law governing the natural ventilations in residential buildings.

As this research is only based on a small house sample in Putrajaya and focuses only on terraced house types, a more comprehensive study is recommended to assess the general ventilation provisions in the Malaysian housing sector at large. Due to other limitations of this study, the following studies are also recommended:

1. Additional behavioral factors that could influence occupants' level of satisfaction with regards to natural ventilation provisions and their effectiveness,
2. Other architectural features and environmental factors (e.g. building orientation, wind flow, and directions) that could improve natural ventilation in residential buildings,
3. Review of window opening designs that incorporate devices to resolve the issue of security, insects and dust (the main reasons that prevent occupants from opening their

windows) without jeopardizing the benefits gained from utilising natural ventilation (e.g. to capture breeze and daylight and also to release heat), and

4. Considerations of the micro-climates of the study area (collecting physical environmental data), particularly the characteristic of the natural wind flow, wind directions, and wind velocity, and subsequently compare the results with those derived from this study.

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ABANDONED HOUSING PROJECTS IN MALAYSIA: RISK MANAGEMENT CAPABILITIES DURING REHABILITATION

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Abstract
Rehabilitation is a key-initiative undertaken to overcome a prevailing problem in Malaysia that is the abandonment of housing projects during construction. However, rehabilitation is a complex process and involves various parties. The purpose of this paper is to identify critical risks during the rehabilitation process and to evaluate capabilities of main stakeholders in managing these risks. To achieve this objective, a questionnaire survey was used and targeted three groups, namely authorities, builders, and liquidators. The data were analyzed using Relative Importance Index (RII) and Chi-square to determine top ranking risks and risk categories. The results showed 18 risk variables and indicated Managerial Risk as the top risk category. The results also showed feeble risk management capabilities of the three groups. The findings of this paper attempt to fill a significant gap in the literature pertaining to this subject. The identification of the risks and capabilities pitfalls is expected to provide invaluable information to facilitate the rehabilitation process to complete the abandoned projects successfully.

Keywords: *Housing projects; relative importance index (RII); risk management capability measurement; risk ranking*

INTRODUCTION
An abandoned housing project is defined as a project under the construction stage but not completed, thus not ready for occupation. This problem can also be observed in other developing countries such as Nigeria (Olayiwola et al, 2005).The causes of abandoned housing projects are related to developers of housing projects (e.g. business termination or bankruptcy, misuse of deposits, fraudulence, and over production), conflicts and feuds among stakeholders, and non-conformance with construction specifications (Khalid, 2010). Other general causes include economic, financial, legal, and managerial deficiencies in the current selling system (Dahlan, 2011a, 2011b; Dahlan and Aljunid, 2011; Rameli et al, 2006).

The Malaysian housing sector has been suffering from this problem since early 1980s up to date. For instance, in 2014 only there were 68 abandoned housing projects in the Peninsular Malaysia (excluding Sabah and Sarawak), comprising 24,726 housing units and 17,468 buyers (KPKT, 2014). To overcome this problem, the Malaysian government has undertaken four main initiatives: (1) rehabilitation (reviving) of current abandoned projects, (2) changing the current off-the-plan selling system to a new selling system (such as build-then-sell), (3) encouraging project delivery success through some approaches such as public-private partnerships, and (4) amending the Housing Development Act of 1966 (Abdul-Aziz and Kassim, 2011; Dahlan and Aljunid, 2011; Yusof et al, 2010). The Housing Development Act amendment attempted to provide additional rights for homebuyers so they can take legal action against developers (or liquidators) who fail to deliver the housing projects. Among these initiatives, rehabilitation remains

the main initiative to overcome this problem (Abdul-Rahman et al, 2013) as it provides an actual solution to the existing abandoned projects. Other initiatives may mitigate this problem from occurring in future.

Rehabilitation can be defined as the process taken by several parties to resume construction work and complete the project. This initiative is probably the only way to preserve the rights of homebuyers who are committed to pay monthly installments to their lenders to avoid any legal prosecutions. In addition, numerous housing projects have already been abandoned and rehabilitation seems the only applicable solution. According to the Ministry of Urban Wellbeing, Housing, and Local Government, there are 53 projects that are under rehabilitation or are scheduled for rehabilitation (KPKT, 2014). However, the overall number of abandoned housing projects is higher than this figure because this statistic does not include the accumulated abandoned projects, projects in East Malaysia, or projects that have been abandoned for a long time and are considered not feasible for rehabilitation.

According to Khalid (2010), not all projects under rehabilitation are guaranteed to be completed successfully. Rehabilitation is a difficult process involving various stakeholders, such as new or original developers, contractors, consultants, creditors, liquidators (who will assume the role of the original developers after a project is terminated), the Malaysian Department of Insolvency (MDI), homebuyers or their associations, local authorities, and the Ministry of Housing (which acts as a facilitator between these parties) (Dahlan, 2011a). Once rehabilitation is approved, construction work can be commenced. However, during this process various risks and uncertainties may arise, putting the entire process and project delivery at stake. This paper attempts to identify the critical risks involved during the rehabilitation process and to assess the capabilities of main stakeholders in managing the perceived risks. The next section presents a list of potential risks and risk management capability framework, which has developed from the literature of risk management in the construction field.

POTENTIAL RISKS OF PROJECT REHABILITATION

Construction projects involve a high level of uncertainty and risk because they are complex, take long time, and involve numerous participants. Risk is defined as a variable in a construction project that brings uncertainty to the final cost, duration, and quality of the project (Boykin et al, 1984). Exposure to risk during the rehabilitation of abandoned projects may influence completing the remaining construction work successfully. As such, several risks are anticipated to create unfavorable conditions, thus affecting the rehabilitation process. Empirical studies on risks involved in the rehabilitation process are still lacking. However, a limited number of studies have indicated potential risks, which can be grouped under four categories, namely legal and regulatory, financial, managerial, and technical risks.

Dahlan (2011b) indicated the following risks pertaining to abandoned housing projects: unsettled legal actions, risks related to the new selling system, lack of developers' liabilities, contractors' capacity to deliver the project, lack of appropriate funding resource, developer's failure to sell all bridging loans, and inadequate homebuyers. These risks can be regarded as legal and regulatory as well as financial risks. In addition, Dahlan (2011b) highlighted other potential risks, which can be categorized as managerial risks, namely construction delay, project not considered abandoned anymore if auctioned off to other parties or the application for reviving the project is rejected (project not viable for rehabilitation), lack of compromise and collaboration (e.g. consultant with holding necessary information about the projects), and problems related to the ownership of land. Lastly, technical risks include soil conditions and landslides, lack of complete sets of information about the abandoned project, price increase of building materials, poor building quality, and shortage of manpower (Dahlan, 2011b; Jamaludin and Hussein, 2006; Sulaiman et al, 2012).

Beside the aforesaid risks, projects under rehabilitation may expose other types of risks, which normally occur in construction projects in general. These include two general groups: natural and human risks (Edwards and Bowen, 1998). Natural risks involve those related to weather, geological systems, and natural disasters (Fayazi and Lizarralde, 2013). By contrast, human risks include social, political, economic, financial, legal, health, management, technical, and cultural risks. Risks also can be categorized into internal or macro (related to the company or project) and external or macro (related to the market or third parties) (El-Sayegh, 2008; Zayed et al, 2008). Thus, potential risks associated with abandoned housing projects can be categorized into managerial, financial, construction-related, technical, economic, political, legal and regulatory, and environmental risks. Exhibition 1 shows individual risks under each category.

Exhibition 1. Risk classifications and individual risk variables (Source: Dahlan, 2011b; Edwards and Bowen, 1998; El-Sayegh, 2008; Jamaludin and Hussein, 2006; Sulaiman et al, 2012; Zayed et al, 2008)

Risk Categories/ Variables
1. Managerial Risks: Termination of contractors or consultant/ Project delay in design and regularity approval/ Staff turnover/ Shortage of skilled staff/ Delay in approval processes of the Government/ Delay in approval processes from the owner/ Delay in construction because of a third party/ Cost overrun of the project/ Incompetency of contractors, sub-contractors, or consultants/ Inadequate original documents of the project/ Late approval of project details/ Lack of technical knowledge of staff/ Unreasonably imposed tight schedule
2. Financial Risks: Tax increase or change in policy/ Changes in interest rate/ Liquidity of owner/ Liquidity of contractor/ Bankruptcy/ Funding withdrawn or delayed/ Delayed payment to the contractor/ Difficulty in claiming insurance/ Adequacy of contingency and profit margin/ Sale of the house
3.Technical Risks: Deficiencies in material quality/ Defective design/ Estimation errors of the project cost/ Inappropriate assessment of an abandoned project/ Equipment and system failure/ Lack of infrastructure of the project and technology/ Specification incomplete or misleading/ Technical standards or regulations unclear/ Fatigue of materials due to the effect of corrosion/ Deterioration of material and building structure
4. Construction-related Risks: Changes in design or scope of works/ Rework potential/ Unforeseen ground conditions/ Delay of material supply to the site/ Shortage in manpower (workers) availability/ Shortage of special equipment/ Low productivity/ Poor performance/ Change in construction procedures/ Clashes between design and construction/ Workmanship negligence and malicious/ Poor construction
5. Economic Risks: Shortage of material in the market/ Market volume and competitors/ Market risk/ Inflation or devaluation/ Changes in monetary policies/ Currency exchange rate
6. Political Risks: Political instability in the country/ Suspension of foreign exchange/ Local disruption and disturbance/ Labor strikes
7. Legal-and-regulatory Risks: New government policy/ Contractual disputes/ Delay in resolving contractual disputes/ Disagreement over evaluating the revised contract price/ Conflicts of interests/ Breach of contract/ Criminal acts and civil torts/ Conflicts due to differences in culture or religion
8. Environmental and Force Majeure Risks: Force majeure and suspension/ Pollutions and other environmental effects/ Environmental regulation obstructs construction/ Fire or explosion/ Collision and accidents/ Lightning strike/ Storms and hurricanes/ Heavy rains/ Floods and water-induced damage/ Earthquakes, landslides, and rock falls

RISK MANAGEMENT CAPABILITY

The measurement of risk management capabilities is important to ensure project success through risk identification, analysis, and response. In fact, high-quality risk management requires sufficient capability, competency, and experience (Ward et al, 1991). According to Morgan et al (2000), organizations must consider several alternative categories for ranking risks because this practice allows extensive systematic thinking about risks that must be categorized and ranked. Thus, risk management can be measured through the rigorous development of the risk process, which consists of risk management planning, recruitment, and resource allocation. As shown in Figure 1, the most common risk management model in construction projects consists of four essential processes, namely risk identification, analysis, response, and monitoring and control (Edwards and Bowen, 1998; Flanagan and Norman, 1993; Mills, 2001; Wang et al, 2004). An

organization can manage risks only when it is aware of these processes. Organizations should also have the basic tools and techniques for managing risks through these processes. The generic risk management framework can be a useful tool to measure risk management capabilities of main parties involved in the rehabilitation process.

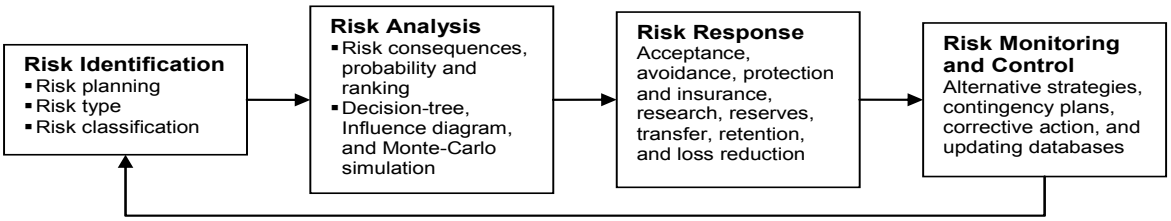

Figure 1. General framework of risk management (Source: Authors)

RESEARCH METHOD

A quantitative approach was used to identify the risk of the rehabilitation of abandoned housing projects and to evaluate the capabilities of stakeholders involved directly in the rehabilitation process. This approach, which includes a questionnaire survey among other methods, enables the generalizability of the results (Zikmund et al, 2012) and provides comprehensive findings about the risk and capabilities from different perspectives.

The questionnaire survey was developed based on the risk taxonomy and risk management capability framework presented in the previous section. The questionnaire consisted of 75 statements representing potential risk variables and was measured through a Likert scale, with scores one to five representing no risk, low risk, moderate risk, high risk, and very high risk, respectively. In the questionnaire, risk was defined as the probability of an event to occur, which would have a negative effect on the revived project.

The questionnaire also consisted of seven questions to evaluate risk management capabilities. The first, second, and third questions respectively asked whether the organization has a special unit or division for managing risks, a professional risk analyst, and a health and safety professional. The remaining four questions, which were in multiple-choice format, evaluated the practices of organizations in identifying, analyzing, responding to, and monitoring risks (refer to Table 1).

The participants in this study are classified into three groups, namely authorities, builders, and liquidators. These groups include the following parties: (1) local authorities (such as the Selangor State Development Corporation and the Municipality of Subang Jaya), (2) the rehabilitation unit in the Ministry of Housing, (3) the National Housing Company Limited (*Syarikat Perumahan Negara Berhad – SPNB*), (4) the MDI, (5) contractors, (6) project consultants, (7) liquidators, and (8) creditors.

Table 1. Risk management capabilities measurement (Source: Authors).

Question	1=Yes	2=No	3=Don't Know
1. My organization (company) has a special division or unit to manage risk	1	2	3
2. My organization (company) has risk analyst professional	1	2	3
3. My organization (company) has a professional in health and safety	1	2	3
4. Do you (or your organization) use any technique to identify potential risk?	1	2	3
If yes, then which techniques are being used (please tick (√)):			
a) Meetings and brainstorming ☐			
b) Documents review ☐			
c) Checklist of risk ☐			
d) Cause-and-effect diagram (e.g. Fishbone) ☐			
e) Analogy with similar projects ☐			
f) Other ----------			
5. Do you (or your organization) use any technique to analyze risk?	1	2	3
If yes, then which techniques are being used (please tick (√)):			
a) Direct judgement ☐			
b) Risk scoring matrix (e.g. probability-impact grid) ☐			
c) Weightage or percentage of risk probability ☐			
d) Statistical techniques ☐			
e) Decision tree analysis ☐			
f) Monte Carlo simulation ☐			
g) Other ----------			
6. Do you (or your organization) use any technique to respond to the risk?	1	2	3
If yes, then which techniques are being used (please tick (√)):			
a) Range estimates of QS ☐			
b) Contractual agreements (among stakeholders) ☐			
c) Other ----------			
7. Do you (or your organization) use any technique to monitor and control risk?	1	2	3
If yes, then which techniques are being used (please tick (√)):			
a) Risk audits ☐			
b) Risk reviews (reporting risk and consequences) ☐			
c) Variance and trend analysis ☐			
d) Other ----------			

DATA ANALYSIS: RANKING OF RISK VARIABLES

This study used the Relative Importance Index (RII) to rank the critical risk during the rehabilitation process. The relative importance method refers to "quantities that compare the contributions of individual explanatory variables to a response variable" (Soofi et al, 2000, p. 596). Numerous studies have used the relative importance method in construction to rank different variables, such as important skills (Odusami, 2002), project delay factors (Kumaraswamy and Chan, 1998; Sambasivan and Soon, 2007), and critical risks (El-Sayegh, 2008). Ranking of individual variables as well as group variables can be determined using the following equation (Baltes et al, 2004):

$$RII = \frac{Sum\ of\ Risk\ Scores}{Highest\ Score * N} \qquad (1)$$

For this study, the sum of risk scores is the total score for each risk variable (from 1 to 5). The highest score is the highest value on the scale, which is 5 in this paper. N represents the sample size. The RII of a particular category can be determined by calculating the average sum of all individual variables under this category (Aibinu and Jagboro, 2002; Chan and Kumaraswamy, 2002). The value of RII ranges from 0 to 1, where a higher RII indicates that a particular variable is more significant than those with relatively low RIIs. No threshold for a significant RII has been proposed. However, some studies used 0.60 to 0.70 or above to indicate the most significant factors (Park, 2009). The current study suggests using 0.70 or above to identify the critical risk variable among the numerous variables proposed in the framework. Chi-square (x^2) test can indicate the significance of the ranked variables in line with the population's attributes to be significant or otherwise (Al-Tmeemy et al, 2012), using the following equation (Field, 2009):

$$x^2 = \frac{\sum(O_i - E_i)^2}{{E_i}^2} \qquad (2)$$

Where O_i is an observed frequency, E_i is an expected (theoretical) frequency, and *i* is a response category index.

RESULTS AND DISCUSSION

Response rate and demographic information

Out of 250 questionnaire forms distributed to the three groups (authorities, builders, and liquidators), 57 forms were satisfactorily completed. This accounts for a response rate of 22.8% only. Table 2 shows the distribution and demographic information of the respondents. Most of the responses came from to the authority group. Only a few were from the liquidators group. All the respondents had more than three years of experience in their field and the majority of them held a Bachelor's degree.

Table 2. Respondents' profile (Source: Authors).

Category	Respondents	
	Frequency	%
Group		
Liquidators	6	10.5
Authority	39	68.4
Builders	12	21.1
Education Level		
Diploma	17	29.8
Degree	22	38.6
Master	7	12.3
PhD	2	3.5
Other	9	15.8
Experience (year)		
Less than 3 years	0	0
Between 3-10	39	68.4
Between 11-19	11	19.3
Between 20-30	3	5.3
More than 30	4	7.0
Total	**57**	**100.0**

Ranking of risk based on groups

Table 3 shows the ranking of risk variables based on the three groups (liquidators, authorities, and builders). The result indicates different priority of risk among the three groups. For example, the liquidators group regarded "new government policy enforcement" as the top risk variable. While the authority and builder groups regarded "project delay" as the most significant risk. This divergence indicates that risk variables vary and prioritized differently. The average RIIs for all risk variables in the entire sample permitted ranking of risks based on their categories. The result shows the following risk categories (ranked from highest to lowest): managerial, financial, legal and regulatory, construction-related, technical, political, economic, and environment and force majeure risks (corresponding to 0.70, 0.67, 0.67, 0.66, 0.64, 0.63, 0.62, and 0.55 of RIIs, respectively). The respondents did not consider environmental risks as a priority during the rehabilitation. This finding is consistent with that of El-Sayegh (2008), who reported a low relative index for natural risks. The ranking of risks by categories can assist the stakeholders to choose which type of risk should be prioritized. This is important to mitigate risk and develop appropriate response method. The next step in the analysis is to identify critical individual risks and their correlations.

Table 3. Results of priorities of risks based on group category (Source: Authors).

Ranking	Liquidators		Authorities		Builders	
	Risk Variable	**RII**	**Risk Variable**	**RII**	**Risk Variable**	**RII**
1	New government policy	0.93	Project delay	0.67	Project delay	0.83
2	Unforeseen ground conditions	0.93	Termination of contractors or consultant	0.61	Disagreement over evaluating the revised contract price	0.78
3	Project delay	0.90	Bankruptcy	0.61	Inappropriate assessment of an abandoned project	0.78
4	Bankruptcy	0.90	Shortage in manpower (workers) availability	0.60	Delay in construction because of a third party	0.77
5	Funding withdrawn or delayed	0.90	Cost overrun of the project	0.59	Delay in design and regularity approval	0.75
6	Inadequate original documents of the project	0.90	Delay in approval processes of the Government	0.58	Delay in approval processes of the Government	0.75
7	Changes in design or scope of works	0.87	Delay in construction because of a third party	0.58	Contractual disputes	0.73
8	Breach of contract	0.87	Inadequate original documents of the project	0.58	Estimation errors of the project cost	0.73
9	Liquidity of owner	0.87	Poor performance	0.58	Rework potential	0.72
10	Liquidity of contractor	0.87	Poor construction	0.58	New government policy	0.70

Table 4: Results of critical risk variables and their correlations (Source: Authors).

Risk Variable	Rank	RII	X^2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Project delay	1	0.84	23.63**	1																	
2. Delay in approval processes of the Government	2	0.75	24.49**	.29*	1																
3. Delay in construction because of a third party	3	0.74	17.46**	.23	.38**	1															
4. Termination of contractors or consultant	4	0.74	23.26**	.30*	.31*	.21	1														
5. Bankruptcy	5	0.74	18.00**	.18	.07	.13	.26	1													
6. Inadequate original documents of the project	6	0.74	14.84**	.03	.22	.23	.15	.19	1												
7. Liquidity of contractors	7	0.73	27.12**	.28*	.27*	.43**	.30*	.56**	.30*	1											
8. Contractual disputes	8	0.73	23.44**	.08	.35**	.24	.35**	.29*	.38**	.25	1										
9. New government policy	9	0.73	5.95	.35**	.46**	.13	.34**	.31*	.26	.36**	.30*	1									
10. Inappropriate assessment of an abandoned project	10	0.73	5.95	.21	.49**	.44**	.25	.18	.49**	.49**	.34**	.34**	1								
11. Delay in design and regularity approval	11	0.72	15.02**	.36**	.56**	.09	.38**	-.06	.17	.16	.22	.36**	.31*	1							
12. Cost overrun of the project	12	0.72	22.91**	.46**	.39**	.32*	.37**	.28*	.40**	.33*	.44**	.22	.44**	.29*	1						
13. Estimation errors of the project cost	13	0.71	9.74*	.22	.22	.35**	.09	.24	.32*	.35**	.31*	.13	.47**	.15	.38**	1					
14. Shortage in manpower (workers)	14	0.71	16.59**	.26*	.43**	.06	.46**	.27*	.16	.36**	.22	.42**	.23	.28*	.15	.20	1				
15. Delay in resolving contractual disputes	15	0.71	20.63**	.14	.19	.35**	.42**	.37**	.51**	.57**	.59**	.26	.53**	.16	.33*	.38**	.38**	1			
16. Liquidity of owner	16	0.71	20.98**	.25	.46**	.52**	.29*	.50**	.31*	.69**	.43**	.46**	.51**	.14	.38**	.47**	.34**	.63**	1		
17. Delayed payment to the contractor	17	0.71	38.88**	.25	.64**	.19	.19	-.07	-.04	.10	.14	.10	.14	.43**	.33*	-.06	.27*	.004	.30*	1	
18. Poor construction	18	0.71	12.2*	.13	.32*	.22	.49**	.39**	.50**	.35**	.48**	.41**	.44**	.21	.53**	.30*	.48**	.59**	.55**	.19	1

*Significant at the 0.05 level
**Significant at the 0.01 level

Critical risks

The critical risks, identified from the entire sample based on RII values of 0.70 or above, are shown in Table 4. All risk variables except two showed significant chi-square values. The risks of "new policy of the government" and "inappropriate assessment of the abandoned project" may not occur during the rehabilitation process as hypothesized. The results show that the most critical and common risk is delay. Different forms of delay may be encountered during rehabilitation, including "project delay", "delay in the approval processes from the government", and "delay in construction because of a third party". The word delay also appears in the item ranked 11th in the table, that is, "delay in the design and regularity approval". Two other variables related to delay are also present, namely "delay in resolving contractual disputes" and "delayed payment to the contractor" (ranked 15th and 17th, respectively). Delay is obviously the most significant risk expected to affect rehabilitation projects. Dahlan (2011b) indicated construction delay as one of the issues involved in the rehabilitation. The fear of project delay might be justified because eventually a project will be declared as abandoned after considerable time of delays. There are specific factors that cause project delay, such as financial problems, poor site supervision and management, inadequate building materials, resource availability, errors during construction, slow decision making, lack of experience and communication, and incomplete project documents (Alaghbari et al, 2007; Sambasivan and Soon, 2007). To overcome delay in construction projects, Abdul-Rahman et al (2006) recommended the following activities: coordination and site meetings, increasing productivity, and rescheduling or utilizing additional resources. The fourth most critical risk is "termination of contractors or consultant". It seems that contractors and consultants are often exempted from their service in this kind of projects. This situation probably occurs because of the complexity of rehabilitation and unsettled previous issues pertaining to the abandoned project. Other significant risk variables include "bankruptcy", "inadequate original documents of the project", "liquidity of contractors", and "dispute".

The correlations of critical risk variables, shown also in Table 4, indicate a correspondence among these variables. For example, a significant correlation was found between "liquidity of contractors" and "bankruptcy" (0.56**). Similarly, a high and significant correlation was observed between "delay in resolving contractual disputes" and "poor construction" (0.59**). This finding can explain the causes of top critical risks. For example, "project delay" is associated with and is probably caused by other risk variables, such as "new government policy enforcement" and "delay of design and regularity approval". In addition, the risk variable "inadequate original documents of the project" probably causes "poor construction", "disputes", "inappropriate assessment of the abandoned project situation", and "cost overrun".

Risk management capabilities

The second objective of this study was to assess the risk management capabilities of the three groups involved in the rehabilitation. Frequency analysis results indicate that stakeholders exhibited poor practices and possessed limited resources regarding risk management. In particular, 63.2% of the respondents had never been engaged in any risk management activity. The respondents were asked about the availability of a professional risk analyst as well as health and safety professional. The majority of the respondents reported the absence of risk analysts as well as health and safety professionals (63.2% and 43.9%, respectively). This finding indicates that stakeholders have limited risk ownership, which is an important capability.

Further to this finding, Table 5 shows the frequencies of risk management processes and techniques. In risk identification, several respondents (36.8%) revealed that they (or their organization) did not use any technique to identify risks. Simple techniques used for identifying risks included meetings, brainstorming sessions, and checklists of risks. Few respondents indicated the use of more advanced techniques, such as document reviews, cause-and-effect

diagrams, and analogy with similar projects. In addition, 38.6% of the respondents revealed that they did not use or did not know if their organizations are using any techniques for risk analysis. The rest of the respondents mentioned common techniques for risk analysis, including direct judgment, weighing risk probabilities, and risk scoring matrices.

Besides, more than half of the respondents did not use or did not know if their organizations used techniques to respond to, monitor, and control risks. This trend implies that although organizations can identify risks, they do not use appropriate measures to respond to such risks, as Li et al (2004) also noticed. The results also show that range estimation of Quantity Surveying (QS) was extensively used by authorities to respond to risks, whereas contractual agreements were more commonly used among liquidators. Lastly, the result shows the common techniques used by the authorities to monitor and control risk including risk reviews and risk audits. A minimal number of liquidators and builder organizations adopted risk reviews and risk audits.

Table 5. Results of risk management techniques used (Source: Authors).

RM Processes	Risk Technique	Frequency	%
Do you (or your organization) use any technique to **identify** potential **risk**?	Meetings and brainstorming	26	44.83
	Documents review	8	13.79
	Checklist of risk	11	18.97
	Cause-and-effect diagram (Fishbone)	2	3.45
	Analogy with similar projects	3	5.17
	Others	1	1.72
	All the listed techniques	7	12.07
	No technique (blank answer, no, or don't know)	*21/57*	*36.84*
Do you (or your organization) use any technique to **analyze risk**?	Direct judgement	23	37.70
	Risk scoring matrix (probability-impact grid)	9	14.75
	Weightage or percentage of risk probability	18	29.51
	Statistical techniques	5	8.20
	Decision tree analysis	4	6.56
	Monte Carlo simulation	0	0.00
	Others	0	0.00
	All the listed techniques	2	3.28
	No technique (blank answer, no, or don't know)	*22/57*	*38.60*
Do you (or your organization) use any technique to **respond** to **risk**?	Range estimates of QS	13	44.83
	Contractual agreements (among stakeholders)	9	31.03
	Other	1	3.45
	All the listed techniques	6	20.69
	No technique (blank answer, no, or don't know)	*32/57*	*56.14*
Do you (or your organization) use any technique to **monitor** and **control risk**?	Risk audits	14	31.11
	Risk reviews (reporting risk and consequences)	20	44.44
	Variance and trend analysis	8	17.78
	Others	0	0.00
	All the listed techniques	3	6.67
	No technique (blank answer, no, or don't know)	*31/57*	*54.39*

CONCLUSION

This study identified critical risks during the rehabilitation of abandoned housing projects and assessed risk management capabilities of the main parties involved in this process. Project delay, contractors or consultant termination, bankruptcy, lack of project documents, liquidity of contractors, and disputes are among the critical risk variables. In addition, most risks associated with the rehabilitation process are managerial, financial, legal and regulatory, and construction-related factors. Managerial risks, such as "project delay" and "delay in process approval", have a

significant effect on the success of rehabilitating abandoned projects. Financial risks also have a direct influence on rehabilitation projects. For example, contractors without a healthy cash flow and consistent funding from financial institutions will experience financial difficulties in starting or continuing the project. This situation can delay the project. Meanwhile, political, economic, and environmental risks are considered as the least significant during rehabilitation. Thus, stakeholders of abandoned housing projects should extensively examine managerial and financial risks during the rehabilitation of abandoned projects.

The ability to manage risk by those involved in the rehabilitation process seems feeble. In fact, all stakeholders use simple techniques in managing risks. Risk management activities, particularly risk response and monitoring, are scarcely used by the main organizations involved in rehabilitation of abandoned housing projects. Furthermore, stakeholders often resort to judgment methods to mitigate and manage risks in project implementation. This may cause a deficiency in managing this type of projects. Thus, contractors and local authorities in particular need to allocate additional resources and focus on developing risk management practices in all aspects. They have to take into consideration risk variables and categories highlighted in this study. Then, they have to develop appropriate managerial activities for risk analysis, response or mitigation, and risk monitoring and controlling during rehabilitation. This is important to ensure efficient rehabilitation process and subsequently lead to a successful completion of the abandoned projects.

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JUER HUTONG NEW COURTYARD HOUSING IN BEIJING A REVIEW FROM THE RESIDENTS' PERSPECTIVE

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Abstract
Set within the theoretical framework of cultural sustainability, this in-depth case study examines the Juer Hutong new courtyard housing prototype built in the inner city of Beijing, China, whose phase one was completed in 1990 and phase two in 1994. Juer Hutong (Chrysanthemum Lane) is located in the area of the celebrated Nanluogu Xiang (Gong and Drum Lane South), in proximity to the historic Drum and Bell Towers. It was a typically decayed traditional courtyard house neighborhood that urgently needed remodeling. After a decade of research and design led by Professor Wu Liangyong, and a group of students at the School of Architecture of Tsinghua/ Qinghua University, phase one of the project has won six awards, including the 1992 World Habitat Award. However, its proposed phases three and four were suspended from construction. This study elucidates the residents' views of the completed two phases and offers four lessons and two new courtyard garden house design models for discussion and future practice.

Keywords: *Courtyard housing; cultural sustainability; architectural culture; Juer Hutong; Beijing; China*

FOUR PILLARS OF SUSTAINABLE DEVELOPMENT

Scholars admit that sustainable development consists of four pillars: environmental responsibility, economic viability, social equity, and cultural vitality. The root of the word 'sustainability' is from the Latin *sustinere* (*tenere*, to hold; *sus*, up). Dictionaries provide more than 10 meanings for 'sustain,' the main ones being to 'maintain,' 'support,' or 'endure' (Dictionary.com, 2016; Onions, 1964, 2095).

Since the 1980s, sustainability has been used more in the sense of human sustainability on planet earth, resulting in the most widely quoted definition of sustainable development, that of the Brundtland report *Our Common Future* (1987) published by the United Nations World Commission on Environment and Development: "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (p. 8). Since then, the concept has evolved and was presented in the Rio Declaration on Environment and Development, also known as the Rio Earth Summit (UNCED, 1992), that states, "the right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations" (UNCED, 1992, article 3).

However, the U.N. definition is not universally accepted and has undergone various interpretations (EurActiv, 2004; International Institute for Sustainable Development, 2016; Kates, Parris, and Leiserowitz, 2005). The 2005 World Summit acknowledges that sustainability requires the reconciliation of environmental, social, and economic demands known as the 'three pillars': environmental responsibility, economic viability, and social equity (Bell, 2003; OECD, 2001; United Nations General Assembly, 2005). The United Cities and Local Governments (2006a, 2006b, 2006c, 2006d, 2009, 2010) share the view that culture is the fourth pillar of sustainable development, a notion popularized by Jon Hawkes' book *The Fourth Pillar of Sustainability:*

Culture's Essential Role in Public Planning (2001) to square the sustainability triangle. Sustainability has now been commonly recognized as having four pillars, including cultural vitality.

Writers, such as Darlow (1996) and Wheelwright (2000), have observed that sustainable development is largely a cultural task since it seeks a change in attitudes and lifestyles. Judy Spokes, the executive officer of Cultural Development Networks, asserts that "culture is both overarching and underpinning" (Hawkes, 2001, 3). As such, Brand (2005, 76-81) and Nurse (2006, 36-38) argue that culture should be placed at the front and center of the sustainability framework and fully incorporated into the other three pillars because it is a basis for questioning the implication and practice of sustainable development at its heart. Creative City Network of Canada (2005, 1) likewise contends that "culture is a core dimension of vibrant and sustainable communities" because the character of a place is inseparable from its traditions and culture as they are lived and expressed in the activities and social life of the community; this quality of a city is one of its most salient features for making it a desirable place to live, work, study, or visit.

COURTYARD HOUSING CONTRIBUTING TO CULTURAL SUSTAINABILITY

Cultural sustainability is the theoretical framework of the study because it considers architecture as a cultural artifact and evaluates both archi-cultural and socio-cultural aspects of courtyard housing in China. This study defines cultural sustainability as the adaptation and transmission of the beneficial parts in a nation's material (tangible) and immaterial/ spiritual (intangible) culture that are conducive to the development of their present and future generations. It encompasses such notions as cultural vitality, cultural diversity, and cultural activities (Zhang, 2013, 17, 31).

The Chinese have lived in the courtyard type of houses for several thousand years. The earliest courtyard house unearthed by archeologists so far was built during the Middle Neolithic period, represented by the Yangshao culture (5,000-3,000 BCE) (Liu, 2002). The ancient Chinese favored this housing form because enclosing walls helped maximize household privacy and protection from wind, noise, dust, and other threats; and the courtyard offered light, air, and views, as well as acting as a family activity space when weather permitted. A traditional Chinese courtyard house would normally host an extended family of three or four generations (Knapp, 2005; Ma, 1999; Zhang, 2013, 2015a).

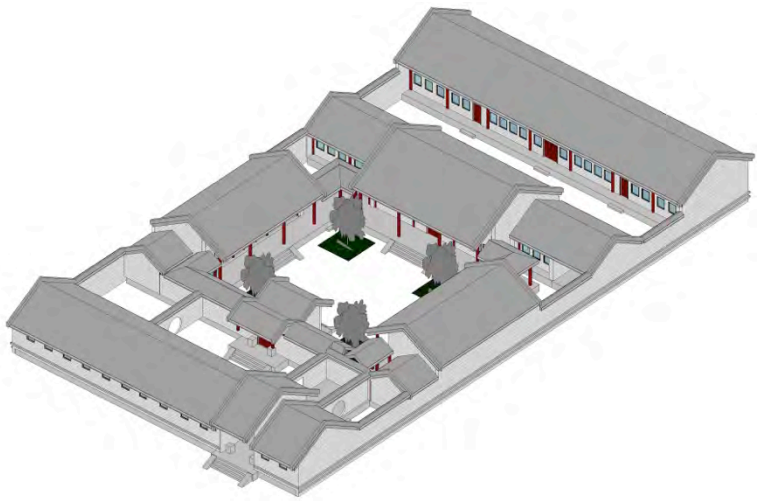

Figure 1. A typical Beijing *siheyuan* traditionally housed an extend family (Source: Author).

Classical courtyard houses of Beijing, known in Mandarin as *siheyuan* (Figure 1), had been the City's primary architectural form since the antiquity, because this housing form is in harmony with Chinese philosophy and cosmology (Chan and Xiong, 2007; Knapp, 2005; Ma, 1999; Xu, 1998; Zhang, 2011, 2013, 2015a, and 2015c). However, due to manifold factors, *siheyuan* have undergone gradual decay and massive demolition in the 1990s. To preserve this cultural heritage, the Beijing municipal government experimented with *two* new courtyard housing projects in the inner city. One was constructed at Juer Hutong((菊儿胡同 "Chrysanthemum Lane"), and the other at Nanchizi (南池子 "South Pond") (Zhang, 2013, *forthcoming*). This article documents the findings from Juer Hutong residents' lived experiences of the new courtyard housing, which may offer valuable discussions and lessons for future housing design and development.

The Juer Hutong new courtyard housing occupies a land area of 8.28 hectares (Wu, 1999, 114) in inner Beijing's Eastern District (Figures 2 and 3). It was a housing renewal experiment in a dilapidated traditional courtyard house neighborhood called *Nanluogu Xiang* ("Gong and Drum Lane South"). *Nanluogu Xiang* is a small lane near the Bell and Drum Towers recently evolved into a commercial street filled with exotic shops, bars, and restaurants (Figure 4), which have attracted foreigners working in Beijing to live nearby, to enjoy a lively night life (Davey, 2000).

Figure 2. Map of Beijing showing the case study location of Juer Hutong new courtyard housing (A3), in proximity to the Drum and Bell Towers of Beijing (Source: http://www.orangesmile.com/common/img_city_maps/beijing-map-4.jpg, 2015).

Figure 3. Map of the Juer Hutong community (Source: Author).

Figure 4. *Nanluogu Xiang* ("Gong and Drum Lane South") neighborhood gate (Source: Author).

Juer Hutong (438 m long and 6 m wide) intersects with *Nanluogu Xiang* to the east; it was formerly home to Ronglu, a governor during the Qing dynasty (1644-1911). It was a typically decayed area that urgently needed remodeling, with a terrain of 80-100 cm below the street level due to road reconstructions. The courtyards were filled with improvised extensions and two-third of the households could not receive sunlight. However, nearly 800 people lived there with an average floor space of only 7.8 sqm per person. There was one water tap in each courtyard, one sewer exit, and a public toilet 100 m away (Wu, 1991c).

Since 1978, Professor Wu Liangyong and his students at the Institute of Architectural and Urban Studies of Tsinghua/ Qinghua University spent a decade researching "organic renewal" for historic cities, and designed Juer Hutong new courtyard housing, or "quasi-courtyard housing" (Figure 5). Phase one (4 courtyards with 46 units) was completed in 1990 and phase two (11 courtyards with 164 units) in 1994. A flexible courtyard system was adopted to fit in between the houses in good condition and those whose owners were unwilling to participate in the project.

This prototype has 'borrowed' the composition principles of large mansions in Suzhou's vernacular architecture and applied it to Beijing by having 2-3-4-storey walk-up apartments grouped along the horizontal and vertical circulation lines, with a series of courtyards developed from the south to north, and a row of courtyards from the east to west, forming a basic residential block to satisfy the demand of multi-household residence.

The integration of housing with the site is thus maintained due to the compatibility between the old and the new courtyard systems in the City (Figure 6), meanwhile, the old trees and the *Hutong* have also been preserved. The infrastructure and the physical living condition have been improved by providing each unit with privacy and spaces for utilities (kitchen, bathroom, balcony, and terrace) that did not exist in traditional courtyard houses, at the same time achieving a relatively high density and plot ratio (Table 1) (Wu, 1991a, 1991b, 1991c, 1991d, and 1999).

The Juer Hutong new courtyard housing was the first of its kind built on existing traditional courtyard houses site and was an official task supported by the Beijing municipal government at the time. Its phase one has won six awards, including the 1992 *World Habitat Award* (Wu, 1999). Phases three and four were designed but construction was suspended due to the rising land value, the loss of government subsidies, and the developer's concern about a lack of profit.[1] The problem lies in funding issues beyond the scope of architecture (Chen Zhijie, Professor of Tsinghua/ Qinghua University, interview, 2007; Liu Wenjie, Project Manager, interview, 2008).

The Juer Hutong project was intended to have one-third (or 33 percent) returning residents to maintain the original community structure (Liu Wenjie, Project Manager, interview, 2008; Wu, 1991c, 1999). However, when its phase one was completed in 1990, only 25 percent of the original households could afford to return (Wu, 1999; Table 1), although the 2007 field survey finding indicated merely 10 percent (Chen Zhijie, Professor of Tsinghua/ Qinghua University and Resident at Juer Hutong, interview, 2007).

Figure 5. Aerial view of the Juer Hutong new courtyard housing (Source: Information Center, previously Resources Center, School of Architecture, Tsinghua/ Qinghua University).

[1] The Beijing municipal government requires that for a housing regeneration project, at least 1/3 of the original residents have to be re-accommodated on site, but this regulation will not be profitable enough for developers (Chen Zhijie, interview, 2007).

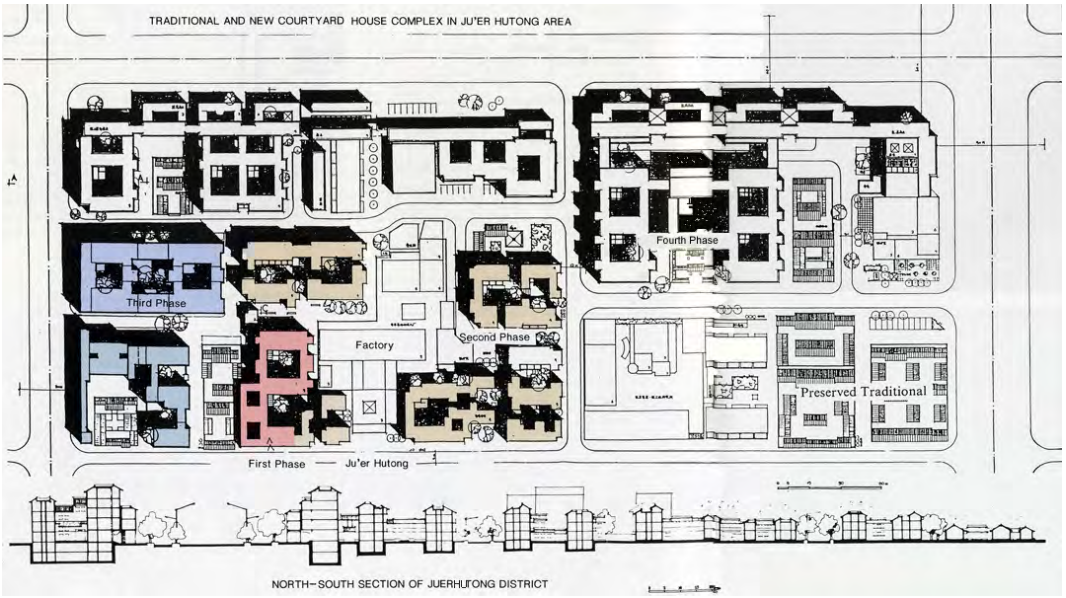

Figure 6. Plan of the Juer Hutong new courtyard housing four phases and preserved traditional courtyard houses (Source: Information Center, previously Resources Center, School of Architecture, Tsinghua University).

Table 1. Comparison of before and after Juer Hutong phases one and two experiments (Source: Calculations by the author based on Wu, 1999, 218-219).

	Before	After	Notes
Land use	11,450 sqm	11,450 sqm	
Floor area	6,785 sqm	15,543 sqm	
Floor-area ratio	0.56	1.53	
Number of floors	1	3.22	2.98 above ground
Number of households	245	210	
Average floor area per person	9.68	23.5	
Average floor area per household	26 sqm	69 sqm	
Population density (persons/ha)	590	573	Calculation includes road area
Plot ratio	1:2.73	1:1.32	
Return rate of original households		25% (61 households)	This number contradicts the author's 2007 field survey that it was 10%

METHODOLOGY

The Juer Hutong new courtyard housing prototype was the author's first case selection for her doctoral study (2006-2012) because her master's research (1994) investigated this case by conducting Heliodon[2] experiments using architectural simulation models at 1:500 scale, in a lab at Oxford Brookes University (Zhang, 2006, 2011). To obtain a better understanding of the project's human dimension, the author felt it necessary to obtain views from the residents because housing is ultimately built for the people, and the two studies findings may strengthen future courtyard housing design and development (Zhang, 2013).

This in-depth and detailed case study has applied 'combined strategies' (Groat and Wang, 2002) or a 'mixed method' (Creswell, 2002) where both qualitative and quantitative data collection and analysis have been carried out to explore the complexity of the issues and to acquire sensitivity about the context, process, and causations. The architectural culture study as a branch of social sciences and humanities may be enhanced by the implementation of a greater number of good case studies (Flyvbjerg, 2006). Moreover, the research took on the six approaches to vernacular architecture as outlined in Oliver (1997): architectural, historical, aesthetic, spatial, anthropological, and behavioral. Data collection included onsite surveys, interviews, observations, drawings, and photos, among others.

The fieldwork at Juer Hutong was conducted in November 2007. The author/ researcher was permitted to hand out and collect the surveys by the gate. This location enabled her to both observe activities in the courtyards and talk to passers-by for one whole week until all questionnaires were accounted for. Juer Hutong yielded 56 survey questionnaires (16 from foreign residents). The 37 respondents who provided contact information enabled the researcher to later carry out semi-structured interviews with 17 residents (four with foreign residents) by phone and via email in 2008; and two interviews with architects, one of whom was the Project Manager, Liu Wenjie,[3] and the other, Wu Chen, son of Professor Wu Liangyong.

To put the interviewees at ease and encourage them to talk freely on sensitive issues, no tape-recording was used. Notes taken during telephone interviews were transcribed on the same day and translated into English by the researcher. On average, each telephone interview lasted about 28 minutes, with the longest spanning 60 minutes, and the shortest 5 minutes. The following three tables show the demographic composition, education levels, and occupations of the sample population (Tables 2-4).

Table 2. Composition of residents in the study area (Source: Author).

Residents Information		Beijing Juer Hutong New Courtyard Housing Residents (n=56)
Age (average)		43
	Male	43%
Gender	Female	50%
	Not known	7%
	Single	32%
Marital status	Married	45%
	Divorced/Widowed	13%
Years of residency (average)		8
Household size (average)		2.75

[2] Heliodon: A mechanical device, used in architecture, for demonstrating the sun's motion relative to a building (Science Fair Project Dictionary, 2005).
[3] Liu Wenjie was a Master of Architecture student at Tsinghua/Qinghua University (1988-1991) when the Juer Hutong phase one experiment was implemented. He worked for the China National Real Estate Development Group Corporation at the time of the interview (2008).

Table 3. Education level of residents in the study area (Source: Author).

Education Level	Beijing Juer Hutong New Courtyard Housing Residents (n=56)
1. Primary School	5%
2. Junior Middle School	7%
3. Senior Middle School	7%
4. College Certificate	0%
5. College Diploma	14%
6. Associate Degree	16%
7. Bachelors Degree	32%
8. Masters Degree	14%
9. Doctoral Degree	0%

Table 4. Occupations of residents in the study area (Source: Author).

Occupation	Beijing Juer Hutong New Courtyard Housing Residents (n=56)
1. Legislators, senior officials and managers	4%
2. Professionals	21%
3. Technicians and associate professionals	14%
4. Clerks	5%
5. Service workers and shop and market sales workers	7%
6. Skilled agricultural and fishery workers	0%
7. Craft and related trades workers	2%
8. Plant and machine operators and assemblers	13%
9. Elementary occupations (e.g., street vendors, domestic helpers, cleaners and launderers, building caretakers, window and related cleaners, messengers, porters, doorkeepers, garbage collectors, etc)	0%
10. Armed forces	0%
11. Other	30%

The following sections discuss findings of the study in relation to several key areas of concern: form and environmental quality, space and construction quality, social cohesion, and cultural activities.

FORM AND ENVIRONMENTAL QUALITY

The Juer Hutong new courtyard housing was designed so that the new insertion would take into account the old scale of the city to create harmony between the two. For its exterior colors, the designers used colors common in southern China: white walls, black-tiled roofs, and light-brown gables to symbolize wood. Although traditional wall colors in Beijing are grey and red, grey would seem depressing in the small housing while red would look too strong. Hence, the designers chose white as a neutral and bright color for the exterior concrete walls (Liu Wenjie, Project Manager, interview, 2008).

The new courtyard housing design has incorporated the gradual privacy from semi-public (alleys, paths, and courtyards) (Figure 7) to semi-private (stairwells and corridors) (Figure 8) to private (apartments) (Figure 9) that offers territorial surveillance if trespassers enter the semi-public space (Liu Wenjie, Project Manager, interview, 2008).

When asked “how does the form (such as exterior appearance, gate location, sunlight, ventilation, roof design, etc.) of the new courtyard housing help or hinder your daily/ cultural activities?”, three of 17 interviewed residents commented positively that the new courtyard form is good, irregular, and attractive; they also found the structure nice, staggered, intricate, and unique. Since not all the original residents moved away at once, the design was carried out piecemeal, resulting in such “staggered and intricate” shapes. One resident praises the design:

The exterior appearance is good. As a first group of original residents, I was deeply attracted by its Minzhou cultural characteristics exhibited: white walls and black-tiled roofs… Juer Hutong new courtyard housing represents a unique architectural model by combining historic Beijing hutong and siheyuan culture with southern Chinese vernacular architecture. It has straddled local cultural traditions to maintain Chinese cultural roots.

The new, classical-style street lighting is also assessed by a resident:

The newly installed street lamps look classical and more elegant than the old ones, but they are too low – about 2 m high that can easily be vandalized by children, which has happened before. It may take a long time for the City to come to replace a bulb if that happens.

Figure 7. Juer Hutong new courtyard (Source: Author).

Figure 8. Shared stairwell in a Juer Hutong new courtyard decorated with traditional red lanterns (Source: Author).

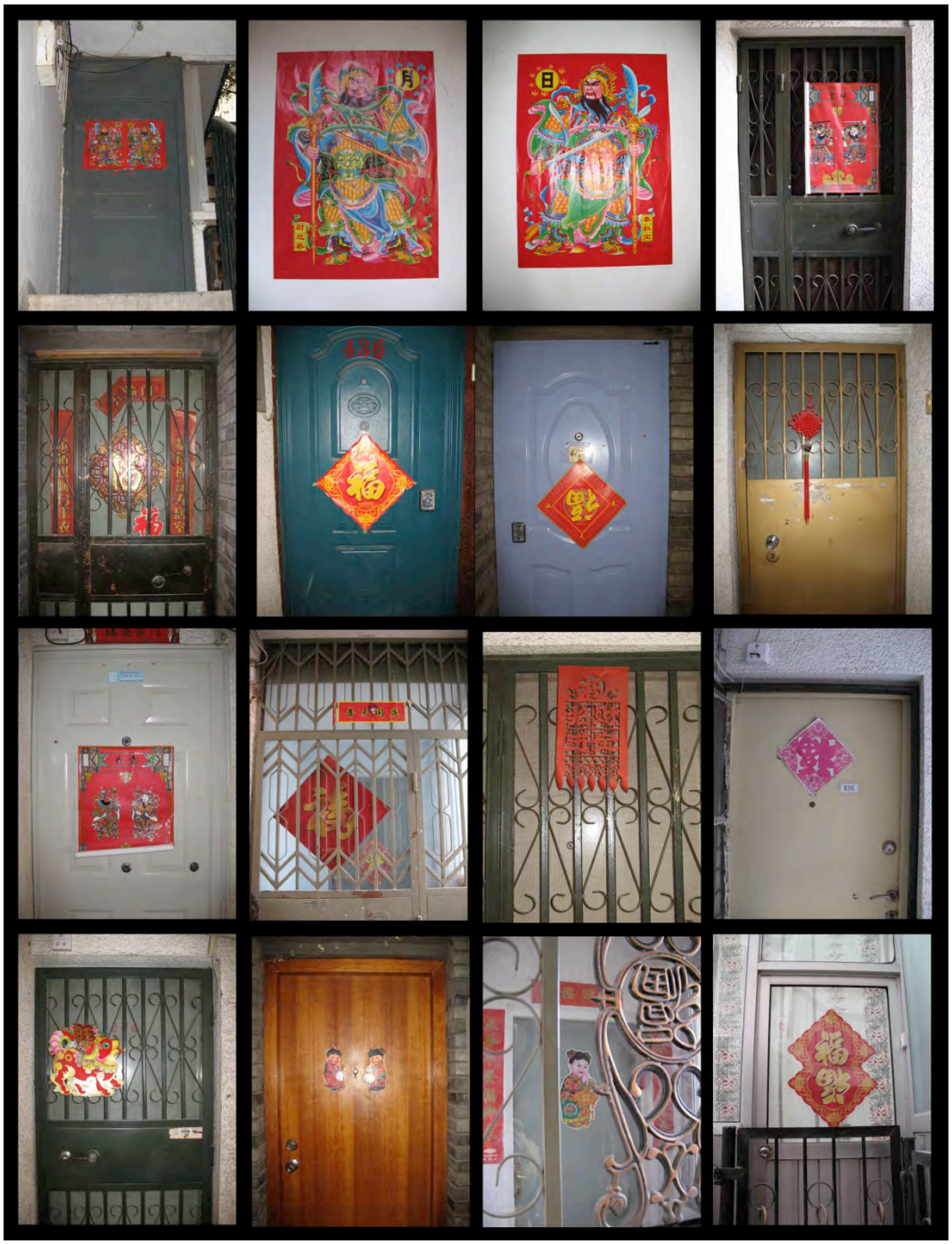

Figure 9. Apartment doors decorated with 福 ("good fortune") or its inverted form, door gods, or paired lucky dolls, Juer Hutong new courtyard housing (Source: Author)

The other 14 (of 17) interviewed residents did not comment on the exterior appearance, but have addressed other issues related to the form (gate location, sunlight, ventilation, roof design, etc.) via an open-ended question. During the week of handing out and collecting survey questionnaires, the author observed four groups of visitors taking great interest in the exterior appearance of the housing; one said that Juer Hutong was listed in her Guidebook as an attraction site of Beijing.

However, five of 17 interviewed residents frowned on the new courtyards' numerous passageways that result in much wasted spaces and lost household belongings, with bicycles in particular, when all the doors are unlocked. Although there is a second gate, it cannot be locked because foreign residents tend to come home after midnight, and some with visitors. A resident argued that while the courtyard should be accessible in all directions, some doorways were deliberately sealed up by residents and did not function as gateways. This result complies with the survey conducted by Tsinghua/ Qinghua University in 1992 that 89 percent (n=31) of its participants found it necessary to lock the courtyard gate at night (Wu, 1999, 169).

Two of 17 interviewed residents were satisfied with their windows on all four sides (east, west, south, and north) providing plenty of light, all of which could be opened to give full ventilation. However, three residents mentioned that only rooms directly next to the courtyard have good natural air circulation while other rooms do not ventilate well. Some units receive sunlight only after 3 pm and the windows on the setbacks of the façade have poor sunlight (Figure 7). Residents also complained that 2nd-floor balconies block sunlight to windows on the 1st/ ground/ main floor. The north-facing balconies are unsuitable for Beijing's climate. The units without balconies are inconvenient for the residents.

One resident revealed that although his apartment faces south, it does not get much sunlight; while design regulations require that sunlight should reach 1.5 hours on Winter Solstice (December 21-22), the apartment has clearly not met this criterion. Five residents also complained that the 1st and 2nd floors have poor sunlight, especially for north-facing windows on the 1st floor, due to a close distance between the buildings. Many windows have also installed security grills that resulted in further reduced sunlight. Two residents pointed out that the units in the east and west wings are not as enjoyable as those in the south and north wings because west-facing windows bring in hot air in the summer and cold air in the winter, with their observations similar to common speculations in China and *Feng Shui* ("Wind and Water") theory.

The new courtyards have varied sizes. Phase one has built a pair of larger courtyards of 13 m × 15 m, each shared by about 15 families in 3-storey apartment buildings (Figure 10), and a pair of side yards (*kua yuan)* of 6.5 m × 7.5 m, each shared by about 4 families in 2-storey apartment buildings. Two of 17 interviewed residents commented favorably that the new courtyard is good, easy to access, and fresh and green in the summer with many plants. The new courtyard is larger than a traditional one, but also intimately hidden and reserved only for the residents. The children can freely run around and play there, as if on the street, but without the dangers of traffic, cars, and strangers who may harm them.

However, three of 17 interviewed residents criticized the larger courtyards for being too small, and the (11 m) distance between buildings in phase two for being too close. As one resident describes:

> *Our private courtyard is about 4-5 sqm with a tree in it, but it fences off sunlight. As the courtyard faces east, sunlight time is very short in the winter, and is only suitable for growing plants that do not need much sun, such as ivy, but overall, the sunlight is insufficient.*

This finding conforms to Zhang's (1994) Heliodon experiments on Juer Hutong simulation models, as well as that of Liang and Zong (2005). Professor Wu Liangyong (1999, 124) explained that to raise the floor-area ratio, the courtyard size had to be reduced to result in a far from ideal form. Thus, density and plot ratio have negatively impacted on the courtyard design.

To achieve the same amount of sunlight as in a classical Beijing *siheyuan*, the ratio of building height to courtyard width must be at least 1:3 (Zhang, 1994, 2006, 2011, and 2013). This would mean a minimum courtyard width of 18 m if the surrounding buildings are 6 m high. The Juer Hutong project clearly did not meet this criterion and residents could not make adequate use of the small courtyards provided.

One of 17 interviewed residents revealed that her roof terrace has leaked in the rain for over 10 years, but it cannot be fixed because it is a design flaw. Another resident said that her roof is only

pitched on one side, with a big, deep hollow like a swimming pool, although aesthetic but impractical, as a few tree leaves can block the drainage when it rains. Moreover, all the rooms on the roof level are hot in the summer.

Two residents have enclosed their private yards, balconies, and roof terraces to increase living space (Figure 11). A Residents Committee member recalled that when Professor Wu Liangyong regularly visited Juer Hutong a few years ago, he was disappointed by the balcony enclosures, building extensions, and so on, because these additions have altered the original design and made the housing look disorderly.

Figure 10. A new courtyard at Juer Hutong (Source: Author).

Figure 11. Although the roof-level enclosure adds interior space, it creates visual disorder, Juer Hutong new courtyard housing (Source: Author).

SPACE AND CONSTRUCTION QUALITY

The Juer Hutong new courtyard housing spatial design complied with China's Building Standards in the late 1980s, so the apartments in phase one are generally small, ranging from 40-60 sqm, the biggest unit is 120 sqm in phase two, with more than half at 80-90 sqm. The concept of "hall" (*ting*) was a "cross hall" (*guo ting*) at the time, but not the "living room" (*ke ting*) as commonly understood today (Liu Wenjie, Project Manager, interview, 2008).

When asked "how does the space (interior and exterior) of the new courtyard housing help or hinder your daily/ cultural activities?", three of 17 interviewed residents observed that some units spatial design is irrational since each unit has a different layout except those in the north and south corners. Five residents noted that the units of 40-60 sqm are too small with 5-6 doors leading to the hall (Figures 12 and 13), but no living room in some units, making it difficult to arrange furniture.

The bedrooms are tiny, since one has to sit on the bed as soon as entering the room. The 2-sqm kitchen is too small for a fridge and the 2-sqm bathroom is too cramped for taking a shower or installing a washing machine (4/17 respondents). Rooms facing the small side yards (*kua yuan*) are shaded all year round, humid, and uncomfortable (3/17).

Nevertheless, the Juer Hutong new courtyard housing did fulfill residents' basic living requirements at the time, although it may no longer suffice. Current living requirement in inner Beijing is that each unit must be 100-180 sqm, which far exceeds the standards back then (Liu Wenjie, Project Manager, interview, 2008; Wu Chen, Architect, son of Professor Wu Liangyong, interview, 2008).

The survey results showed that most Juer Hutong residents preferred to live on the 4th floor (71 percent; n=56), followed by the 3rd floor (43 percent), 2nd floor (29 percent), and 1st floor (21 percent). This finding contradicts the author's three-case study in inner Beijing that residents mainly preferred the 1st (53 percent; n=167) and 2nd (24 percent) floors, and had less preference for the 3rd floor (16 percent); beyond that level, their preference radically dropped (3 percent) (Zhang, 2013, 219). This discrepancy is likely because the close building distances at Juer Hutong have resulted in "the lower the floors, the poorer the sunlight".

The 2.5m-high ceiling at Juer Hutong creates a feeling of constraint while 2.8m- to 3m-high would have been better (4/17 respondents). The floor is too thin as even a tiny pin drop on the 2nd floor can be heard on the 1st floor. Such noise affects residents' health, especially those with heart disease. Some duplex apartments on the 3rd and 4th floors have staircases located right in the middle of the hallway, causing both a waste of space and awkwardness for arranging furniture. The stairs are steep, which can be dangerous for both children and the elderly. Besides, the duplex apartment bedrooms are upstairs without a bathroom, which is inconvenient at night (4/17).

The basic facilities at Juer Hutong new courtyard housing are either crude or missing. Unaesthetic and unsafe pipes are exposed in each unit. Although hot water comes from underground, four of 17 interviewed residents complained that their heating system is neither functional nor reparable due to a backwater design flaw. The rooms can get frigid in the winter, especially the north-facing ones.

Moreover, there is no space for installing an energy-efficient solar heater (2/17 respondents). Due to their narrow diameters, the 1st-floor kitchen and bathroom pipes often get blocked, with backed-up sewage and annoying sounds of water running in the pipes (3/17). With no gas pipes installed in these buildings, residents have to refill gas tanks on a regular basis.

One of 17 interviewed residents noted cracks on the exterior walls that cause the interiors to be cold in the winter. Some units also have poor soundproofing. A resident complained that they could hear almost everything the next-door neighbor is up to. While weak sound barriers compromise music practices, mobile/ cell phone signals can be undetectable. Liang and Zong

(2005) also found that Juer Hutong's substandard construction quality has rendered it to rapid decline.

The property management and maintenance is inadequate. Although the Residents Committee assumes some of its maintenance jobs, it is far from enough. As Juer Hutong was redeveloped at the time (1989) when there was no such thing as "property management" or "maintenance fees", it was not a problem then. Right after completion, homeowners paid a property fund deposited to a bank account. However, this fund is prohibited from withdrawals because there are no official property management services. In the beginning, the cost for repairing leaking roofs came from the maintenance fund, but as many other shortfalls such as the garage being occupied by private individuals, are overlooked, the property management exists only nominally, with neither maintenance fees collection nor services for residents.

Figure 12. One side of a hall with two doors leading to it, Juer Hutong new courtyard housing (Source: Author).

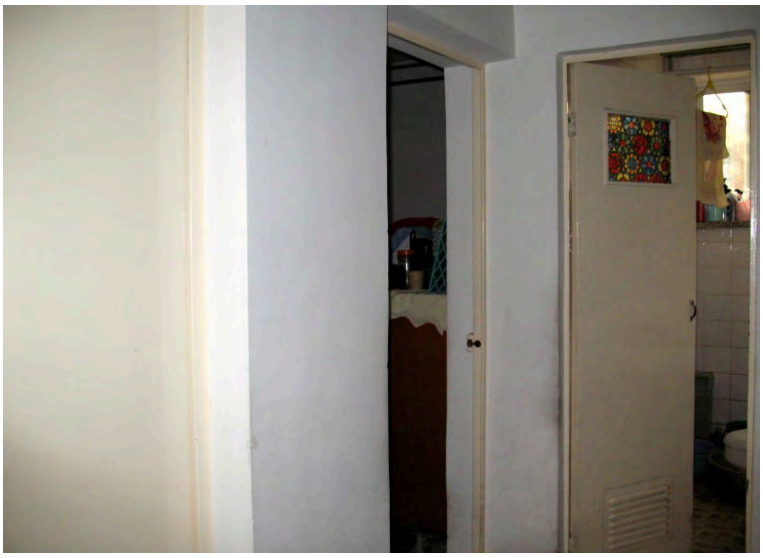

Figure 13. The other side of the hall with three doors leading to it, Juer Hutong new courtyard housing (Source: Author).

However, if all the residents at Juer Hutong were asked again to submit maintenance fees, they would undoubtedly be unwilling to pay, rendering it difficult for the Residents Committee to collect. The only service available is from the Environmental Protection Group that employs ground sweepers and garbage collectors each day. Meanwhile, the Residents Committee is planning to establish a "Homeowners Association" to solve some public maintenance issues (Chair of Residents Committee, interview, 2008).

Due to a lack of maintenance and management, three of 17 interviewed residents complained that the courtyards have lost their functions. For over 10 years, nobody has taken care of the courtyards; although the trees still stand, nobody maintains them. At one time, there were plants, flowers, and grass in the courtyards, but they all died because no one watered them. Later, grass in the courtyards was replaced with patio stones. This finding is consistent with that of Liu Wenjie (1992). However, Architect Wu Chen contended that the architect should not be blamed for poor property management because it is not a design issue.

Parking design at Juer Hutong was restricted by China's economic conditions in the late 1980s because there were few private cars and no parking design standards at the time. The designers did not anticipate such a rapid development of ownership of private cars in China (Liu Wenjie, Project Manager, interview, 2008). From the residents' perspective, the shortage of parking spaces at Juer Hutong has affected the housing's overall function.

As the local government sublets the basement to non-residents, they nightly park their tricycles used for collecting recyclable materials or garbage in the *Hutong*, making it look messy and untidy. This finding conforms to that of Liang and Zong (2005). When cars run on both sides of the *Hutong*, walking becomes dangerous for the elderly who are left with no courtyard for sitting or walking, especially when an increasing number of cars in the area was seen in 2005-2007 (5/17 respondents). One resident in Courtyard A (*Jia Yuan*) cynically commented: "fortunately the courtyard gate is narrow or cars would drive in."

As some patio stones outside the courtyard gate are tilted under the weight of cars (Figure 14), some elderly people have tripped and fallen a few times. At the time of the survey (2007), the road of Juer Hutong was being reconstructed, but gas pipes were still uninstalled. Whenever the City installs new service pipes, the *Hutong* grade level is raised higher than the courtyard level (Figure 15), forcing rainwater to flow back into the courtyards, which is slippery for residents to walk on (Residents Committee members, interview, 2007).

Figure 14. Private cars parked at a gate of Juer Hutong new courtyard housing (Source: Author).

Figure 15. The road of Juer Hutong after reconstruction is higher than the courtyard level, forcing rainwater to flow back into the yards (Source: Author).

SOCIAL COHESION

The Juer Hutong new courtyard housing survey results indicate that 57 percent (n=56) of the respondents are homeowners who still live there. The Heating Supply Manager affirmed that there are 207 units, of which 40 belong to three organizations; 80-90 (43 percent) are rented out. Two residents revealed that due to socio-economic differences, only old neighbors socialize with one another, but rarely with new neighbors in the courtyards. Professor Chen Zhijie of Tsinghua/ Qinghua University who lives at Juer Hutong observed that personality affects social relations. He says:

> *My apartment has an enclosed private courtyard with no interaction with other neighbors. There is no difference with other apartment buildings. Neighbors whom we did not know are still strangers; we only have contacts with old neighbors. This has much more to do with personality than whether the stairwell is enclosed or not.*

Nonetheless, the survey shows that the presence of the courtyard facilitates social interaction. In answering the question, “which space helps your relationship with other families in the courtyard housing?”, 70 percent (n=56) of the respondents chose “courtyard” followed by “public corridor” (23 percent).

During subsequent interviews, three of 17 interviewed residents reported favorably that their communal courtyards increase neighbors’ likelihood of personal encountes, and that their homes cultivate social relations more than other housing forms. They also found that their collective home gives a sense of “traditional courtyard house”, and that the neighbors have better chances to meet as soon as they come out to chat in the courtyards, especially in the summer when they can sit and enjoy the cool air. The neighbors may help each other when in need, while their apartments can offer them privacy. With a full sense of “human touch”, the neighborly relations are perceived to be harmonious (7/17 respondents).

This finding confirms that of Tsinghua/ Qinghua University in 1992 that 60 percent of 31 households said that they knew their neighbors primarily through encountering them in the courtyards and that they enjoyed stronger social relations around two larger courtyards than do residents with two small courtyards in the phase one experiment (Wu, 1999, 169-170). However, Tsinghua/ Qinghua University researchers interviewed five residents 15 years later and found that nearly all the original residents had sold or sublet their units to urban elites or foreigners. Gentrification has gradually occurred due to market pressure and transiency of residents. The

new courtyards seldom facilitate neighborly communications because of the changes in social structure and the insufficient sunlight in the small yards discourages residents to linger (Liang and Zong, 2005). Thus, courtyard size may impact on social relations.

Some residents use the bigger communal courtyards for holding parties at night or on weekends with music. An unpleasant incident occurred when a chef who worked for a hotel in Beijing invited a group of friends to a barbeque on his roof terrace. A neighbor reported the noise and smoke to the police, but the police let the cookout continue because the meat was already in the cooking process and it would have been a waste to throw it away. Since then, no one has barbequed on roof terraces because the smoke and flames disturb other residents. A resident stated that it is inappropriate to have social activities in residential courtyards because the noise infringes on other people's rest; neighbors have different schedules for retiring and rising, so respect, tolerance, and reciprocity are important qualities for maintaining harmonious social relationships in the communal courtyards.

Soon after Juer Hutong new courtyard housing phase one was occupied, the Residents Committee organized singing and entertaining activities in the communal courtyards. But no one leads these pastimes now, even if they may rehearse perfunctorily for such events as a singing contest for the 2008 Beijing Olympics, or other political activities. The only planned social activity for the elderly is a singing group every Wednesday afternoon in the public activity room at the Community Center. Two residents have proposed plenty of exercise equipment, a ground for ball games, a swimming pool, and other such facilities. Still, several residents managed to exercise at a district Sports Center where they found skating, yoga, and other fitness programs.

As Juer Hutong new courtyard housing phase one experiment won the 1992 *World Habitat Award*, many foreigners like to live there for its reputation, proximity to cultural streets (*Gulou Dong Dajie*, *Nanluogu Xiang*) and ancient relics (Bell and Drum Towers), and for learning local customs through Chinese neighbors. Thus, Juer Hutong is nicknamed "United Nations"; about 40 of 207 units (20 percent) were rented to foreigners, with 16 of them participating in the survey.

Several foreign residents commented that this new courtyard housing facilitates social interactions among neighbors more than a "modern" Western-style apartment building because of its form. The neighbors frequently come across each other in the courtyards, see one another on balconies or roof terraces, and subsequently make friends. Nevertheless, the courtyards do not have benches or chairs. An American resident observed:

> *The courtyard and stairwells are where social interactions happen as I frequently meet people there. If it is a weekend or an evening, people are often outside and occasionally chatty. On occasions, the courtyard structure has allowed me to have social gatherings larger than what my apartment can hold.*

Thus, the new, communal courtyards appear to have positively supported social interaction and relations with foreign neighbors.

Whereas other Chinese residents seldom communicate with their foreign neighbors, except with those who can speak some Chinese, and where both groups will just say "hi" when seeing each other in the courtyard. When they need to pay bills, some foreign residents will ask their Chinese neighbors about maintenance issues in the absence of property management.

An Italian-French resident indicated that the new communal courtyard is not as conducive to social interaction as a traditional one because too many households are sharing it. He contends:

> *I don't think my courtyard is particularly designed for socialization. A good friend lives a few doors away in a traditional courtyard in Juer Hutong with only four families, and her interaction with neighbors is much better. I usually talk with only one lady who always collects garbage outside and is the "guard" of both the courtyard and Beijing's memory. But there are too many people and too many buildings within the new courtyard to facilitate any real social connections.*

These comments suggest that high population density may have negatively impacted on the use of the new communal courtyards.

Many foreign residents enjoy night life in the area that their Chinese neighbors cannot get used to. For example, some foreign residents only come home at 2-3 o'clock at night. They wake up other residents when they climb the stairs as these buildings' public spaces have poor sound insulation.

Five of 17 interviewed residents stated that only foreign residents like to hold parties in the courtyards on weekends with mainly foreign guests, and that only Chinese residents who speak English or French well may be included. They light candles and play musical instruments that can be messy and noisy. An unpleasant incident occurred when a high-school student in a Chinese family was preparing for his term exams, but noise from a party was so loud that he could not concentrate on his studies and subsequently called the police. Although the party host apologized when the police came, the party resumed afterwards. Thus, mutual consideration and understanding is needed between Chinese and foreign neighbors.

In the eyes of some foreign residents, however, their Chinese neighbors are not very sociable because they rarely hold parties in the communal courtyards. In their view, communal courtyards are appropriate places for social activities. An American resident said, "My neighbors and I are cordial but not overly social. I have been invited once or twice to social events by them, both times by non-Chinese residents. My Chinese neighbors sometimes smile and say 'hi,' but rarely more." Thus, language barriers, differences in cultural backgrounds and lifestyles may affect the use of communal courtyards.

Four of 17 interviewed residents shared their positive experience of indoor-outdoor visual interaction in the communal courtyards. For example, a resident watched the children play shuttlecock or badminton in the courtyard and kept the door open all summer for fresh air and children's voices. Although each household is independent in their apartment, communal courtyards give neighbors visual connections so that they share a sense of belonging to the courtyard (3/17 respondents).

Another resident recounted that when her grandson was little, he played with five or six other children in the courtyard while some elderly people watched them either in the yard or through their windows at home. The children were noisy and would disturb other neighbors who wanted to rest. Now the children have grown up, they seldom play in the courtyard. Yet another resident revealed that some children use the courtyard for activities on weekends and some children from nearby neighborhoods will also play in the courtyard during summer vacations because their parents think it is the only open space available in the area that is safe, unlike the streets full of cars. However, these activities can also cause damage, such as once when children used the gate eaves as a basket ball net, they smashed them with the ball.

CULTURAL ACTIVITIES

Since 43 percent of the homeowners rented out their units, with renters mostly working or studying during the day, not many people, and certainly even fewer activities, are seen in the courtyards. The survey results further reveal that the residents' main focus at home is the television (55 percent; n=56), followed by the computer (48 percent), the dining table (25 percent), and lastly, their children (23 percent). This outcome discloses how modern technologies have changed lifestyles in Beijing today.

Six of 17 interviewed residents complained about a lack of public or recreational facilities, such as benches and seats, in the courtyards for cultural activities. If stone tables and stools were placed in the courtyards, elderly residents could sit, sip tea, or play games. Four of 17 interviewed residents also criticized that because their communal courtyards are small and cramped by erratically parked bicycles and amid hung laundry, they do not enjoy much sunshine in them and find it unpleasant to partake in any cultural activities. During the author's visit at 2-3

pm on a Thursday afternoon in September 2007, no one was using the courtyards except two to three elderly ladies sitting by a gate chatting and enjoying the sun.

A resident explained that his courtyard was originally 40 sqm where his family could raise fish in it. To solve the problem of small living space, he added a room in the courtyard, reducing it to 20 sqm, which can only be used for storing flowerpots, not for activities.

The provisions of balconies and roof terraces for upper-floor apartments have considerably reduced the pressure to use communal courtyards on the 1st/ ground/ main floor (Wu, 1999, 165-169). The residents indicated that the south-facing balconies receive such abundant sunshine that some balconies are equipped with an umbrella. Three of 17 interviewed residents mentioned that they often have breakfast and tea on their balconies in the summer; it is also a good place to read in summer days and evenings.

When asked "what traditional Chinese cultural festivals do you celebrate at home and how do you celebrate them?", the most common survey answer is Spring Festival (or Chinese New Year: the first day of the first lunar month). A resident noted that more households let off firecrackers on their balconies in 2007-2008 than in the past. A Chinese resident recounted that once during Spring Festival, some foreign residents served a feast in the courtyard in very cold weather wearing thin clothes. They seemed to endure the cold well and like to join the festive atmosphere of the City.

Mid-Autumn Festival (or Moon Festival: the fifteenth day of the eighth lunar month) is the second most celebrated festival among the survey respondents. Twenty-one percent of the 17 interviewed residents spend the festival at home watching the full moon from their windows, while another 21 percent go boating in Beihai or Shichahai Lake District. Hardly anyone is in the courtyards that evening except several children at play. This interview result confirms the author's observation on the Mid-Autumn Festival in 2007 (September 25) when two boys played in Courtyard A (*Jia Yuan*) from 6-7 pm (Figure 16), but no one sat in any of the courtyards.

An elderly resident noted that the new communal courtyards are unlike traditional extended-family courtyards where every family member would come out to enjoy the full moon. Another elderly resident revealed that he had just moved in 2 weeks previously with his family, and found that except for his two grandchildren who sometimes play in it, the communal courtyard is so strangely quiet during the day and even on the night of Mid-Autumn Festival. Thus, private ownership of a courtyard may enhance its usage for cultural festivities.

A resident who has lived at Juer Hutong new courtyard housing since its inception noted that no one holds a wedding ceremony in the courtyards, either. If a marriage occurred in the housing estate, the newlyweds would send wedding candies to neighbors after the ceremony. Thus, a traditional ceremony in the courtyard is almost a lost ritual, possibly because the courtyards are too small, and in most cases, not a private space anymore for intimate events as such.

As community/ city parks/ gardens are more usable than courtyards, the survey shows that they have become the most common sites for cultural activities (46 percent; n=56), followed by balcony/ roof terrace (27 percent). This finding is confirmed by the interviews. When asked where they partake in cultural activities, if not in courtyards, three of 17 interviewed residents walk or exercise regularly in Beihai and Jingshan parks in the morning where they can dance to music, an activity inappropriate in communal courtyards for fear of disturbing others.

Street gardens in Beijing are now important places for cultural activities as they are more public. On a Tuesday morning in early November 2007 and on the way to Juer Hutong from the Gulou (Drum Tower) subway station, the author observed two elderly men playing a game of chess on a wooden bench in the street garden along Beijing's northern second ring road (Figure 17). On the way to the Andingmen (Peace Gate) subway station in the same evening, the author noted a group of (about 10) people singing old (perhaps 1950s') songs and dancing together. On the Friday morning that week, the author saw a small group of elderly ladies chatting on wooden

stools in the street garden (Figure 18), while another group of elderly women practiced traditional dance (Figure 19).

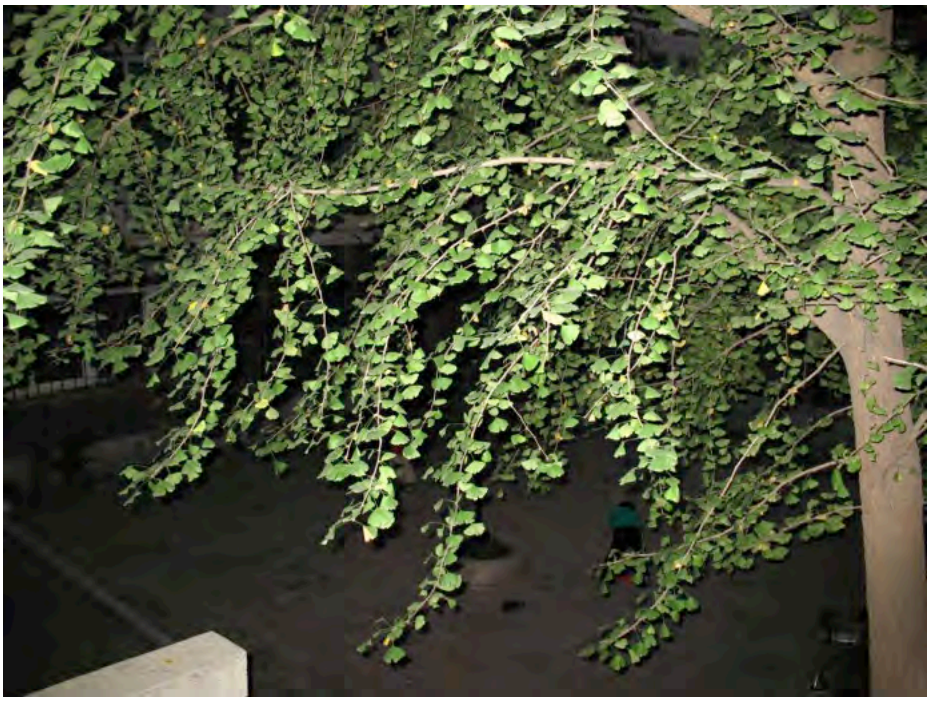

Figure 16. Two boys playing in a communal courtyard on Mid-Autumn Festival, Juer Hutong new courtyard housing (Source: Author).

Figure 17. Two elderly men playing chess in a street garden near Juer Hutong new courtyard housing (Source: Author).

Figure 18. A small group of elderly ladies chatting in a street garden near Juer Hutong new courtyard housing (Source: Author).

Figure 19. A group of elderly women dancing in a street garden near Juer Hutong new courtyard housing (Source: Author).

FOUR LESSONS FROM THE REDEVELOPMENT

The research findings reveal that the Juer Hutong new courtyard-housing prototype is largely unsuccessful. During the author's fieldwork in Beijing in 2007, a professor of architecture at Tsinghua/ Qinghua University indicated that there had been talks about demolishing it and rebuilding a new one on site. The Nanchizi project, being the second of the two such experiments constructed in inner Beijing, is also mostly unsuccessful (Zhang, 2013, *forthcoming*).

Nevertheless, the two pioneering projects offer useful discussions for academics and valuable lessons for architects. The Juer Hutong case study results do not necessarily suggest that architectural conservation or regeneration is an inappropriate approach in another context nor that the courtyard concept is flawed. Generalization or summarization is often undesirable and incorrect with any case study (Flyvbjerg, 2006). Some difficulties are obviously related to China's political, economic, social, and constructional factors at the time, and the designers' inexperience with such undertakings, which have negatively impacted the courtyard housing forms and functions. Four lessons may be learned from the Juer Hutong redevelopment.

First, the courtyard form should maintain the original proportion as in classical Beijing *siheyuan*, as the smaller and much shaded new courtyards reduce their functions as meaningful outdoor spaces for residents' daily/ cultural activities.

Second, the interior space of new courtyard housing units should be designed with rational sizes and layouts, capable to accommodate residents' daily/ cultural activities, with their health and safety in mind.

Third, social interaction takes place more easily and often in communal courtyards than that in apartment buildings without a courtyard. If a communal courtyard is to be used for social gatherings/ parties, approvals should be obtained from the Community Center or Residents Committee.

Fourth, cultural activities and festivities can be conducted more freely in private courtyards and community/ city parks/ gardens than those in communal courtyards. Nevertheless, providing tables, stools, or benches in communal courtyards may encourage their usage for cultural activities/ festivities.

Since a house is a fairly permanent structure, once built, it cannot be changed easily to accommodate newer demands or higher standards. Therefore, housing designs should not be compromised for less than stable requirements in density, plot ratio, or floor-area ratio because while a population may fluctuate with time, a housing form may be less flexible. It is actually more environmental and economical to build for the long-term than to demolish and rebuild at a later time. Sustainability is thus viewed as more of a cultural task in changing our attitudes and approaches to rehabilitating old cities and planning new ones to enhance social and human development (Zhang, 2013, 2015c). The author has proposed two design models of new courtyard garden houses for ordinary citizens or middle-income families in Beijing or elsewhere, as illustrated in Figures 20-22.

Figure 20. Beijing new courtyard garden house compound based on a system of 60 m × 60 m standard block size, a communal courtyard of 26 m × 26 m shared by eight nuclear families, with each household enjoying a private garden at the back. Each housing unit measures 6 m × 10 m (total 180 sqm) with a semi-basement and 2 ½ storeys (Source: Design and cardboard model by the Author).

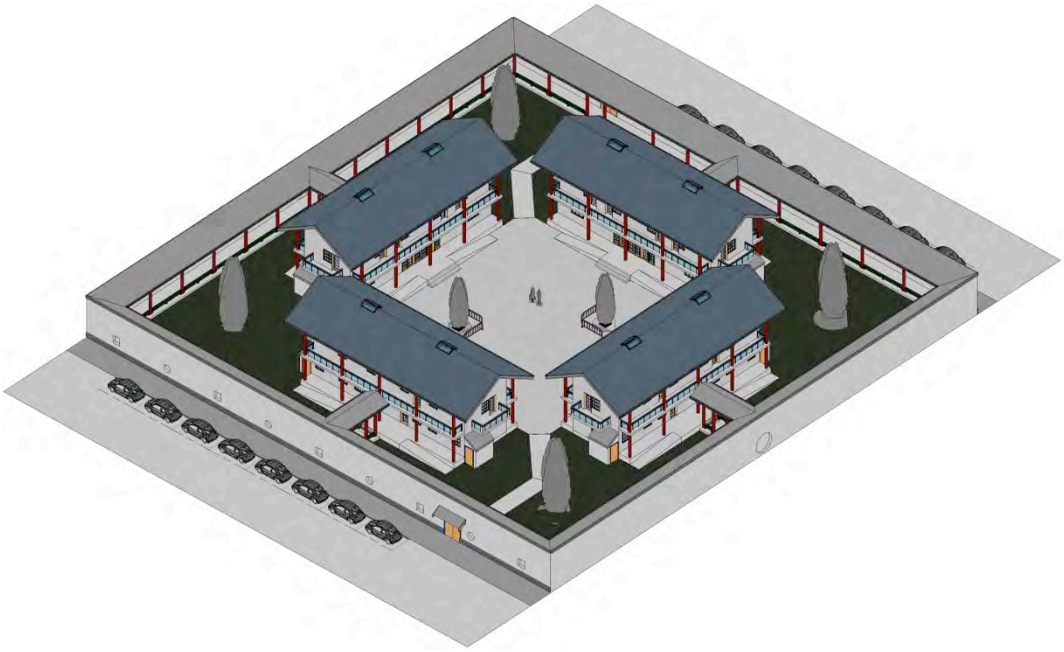

Figure 21. Beijing new courtyard garden house compound based on a system of 60 m × 60 m standard block size, a communal courtyard of 26 m × 26 m shared by eight nuclear families, with each household enjoying a private garden at the back. Each housing unit measures 6 m × 10 m (total 180 sqm) with a semi-basement and 2 ½ storeys (Source: Design and computer model by the Author).

Figure 22. Beijing new courtyard garden house compound based on a system of 78 m × 78 m standard block size, the communal courtyard is 26 m × 26 m shared by eight nuclear families, with each household enjoying a private garden of 12 m × 6 m at the front and the back. Each housing unit measures 10 m × 12 m (total 240 sqm) with a semi-basement (Source: Design and computer model by the Author).

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AN EXPLORATORY STUDY FOCUSED ON MOVEMENTS AND INTERACTIONS IN THE WORK ENVIRONMENT

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Abstract
This study explores how the interior layout of the workspace can affect employees' number of steps and face-to-face interactions. Eighteen participants were recruited for the study and the data was collected over ten business days. The participants completed self-report forms to report the number of steps and interactions they had daily. A positive relationship was found between distance and the number of steps and interactions. A negative correlation was found between depth, a construct of the space syntax theory, and the number of steps and interactions. The findings further examined whether the results support a social ecological model with the relationships between distance, depth, the number of steps and interaction, and moderate variables (personal, environmental, and organizational factors). Findings indicated that the number of steps, as a function of human behavior, was affected by distance and depth (as environmental factors), age and years of working (as personal factors), and work hours (as an organizational factor).

Keywords: *Work environment; physical activity; face-to-face interaction; job satisfaction; social ecological model*

INTRODUCTION

More than one third of adults in the world's industrialized nations are not active enough to receive physical health benefits (U.S. Department of Public Health Service, 1996; World Health Organization, 2011). However, based on a report by the City of New York (2010), the reality is that the majority of people spend almost 90% of their time working indoors (Tezgelen and Karaman, 2014). As their jobs are mostly sedentary, the notable problem is inactivity among workers (Stokols, Pelletier, and Fielding, 1996). Researchers have examined how the spatial form of buildings can affect human behavior and activities (Furlan and Faggion, 2016). From a multidisciplinary perspective, there are some factors that hinder physical activity in working environments besides spatial layouts. Since office chairs are designed for comfort and ergonomics, fewer movements are made, such as shifting or repositioning oneself while sitting in a chair (Wells et al, 2007). Therefore, employees can be easily observed doing these actions: they send emails instead of visiting a coworker's cubicle and roll across the room to reach something instead of standing up (Wells et al, 2007).

Undeniably, a well-designed and activity-friendly office layout can provide employees with hidden health benefits, since people's movements are largely affected by the spatial layout. Hence, countless studies about understanding the behavioral determinants of physical activities in various environments, and the effects of interventions, have been examined (Bauman et al, 2002; Dewulf et al, 2012; Sallis et al1998; Wells et al., 2007; Zimring et al, 2005). Placing commonly used areas, such as restrooms, cafeterias, copier rooms, mailrooms, and meeting rooms, in pleasant walking distances from individual workstations can also promote walking or travel in office environments (City of New York, 2010).

Therefore, this study investigated how the interior layout of the workspace can affect employees' number of steps and face-to-face interactions. This paper builds on current literature by studying how the interior layout of the workspace can affect employees' number of steps and face-to-face interactions. The study explored whether the increased distance and depth between an employee's workstation and other destinations increases the number of steps they walk and the number of interactions they have. In the presence of positive relationships among the variables, this study investigated if the personal, environmental, and organizational factors played a moderating role on the relationships. Finally, the study examined whether the findings support the social ecological model.

LITERATURE REVIEW

Layout and Movement

Numerous studies have found that among the fundamental impacts of physical activity are positive health benefits (Paffenbarger Jr et al, 1986; Prodaniuk et al, 2004; United, 1996; World, 2011) and a positive correlation between spatial layout and movement (Penn et al, 1999; Rashid et al, 2006; Wells et al, 2007; Zimring et al, 2005). Among the building elements, stairs have the highest potential to impact physical activity, since most buildings have them and people can use them easily. For example, based on the benefits of physical activity, the City of New York (2010) developed guidelines for both architects and interior designers to consider ways to include stairs in the building layout to promote more movement among workers. There has been also an increasing interest in the effects of this kind of intervention for encouraging physical activity in working environments among researchers (Grzywacz and Fuqua, 2000; Prodaniuk et al, 2004; Wells et al, 2007; Zimring et al, 2005).

Notwithstanding the positive effects from physical activity, an individual's intention, among other personal factors that play a moderating role, is the most significant factor in determining one's movements. Zimring et al (2005) define three different types of activity: 1) recreational physical activity is the byproduct of activity for recreation or pleasure as a purpose such as working out at gyms, 2) instrumental physical activity is routine activity without any pleasure purposes, such as walking to a bus stop, and 3) hybrid physical activity is choosing to be active, even though the choice is not the primary goal, such as walking instead of driving a car. Hybrid physical activity is the most ideal type of activity, but it requires some degree of intention to perform it. Therefore, to encourage hybrid physical activity, designers need to acknowledge the relationship between layout and personal intention. Even though most individuals prefer to follow along the most direct and shortest line, there are always available choices to choose a path, depending on the preference of the individuals.

Movements in different environments have been studied for the last couple of decades. For example, technology has been developed during the past 100 years to make everyday burden at home as well as in the working environment easier (Wells et al, 2007). Bassett, Schneider, and Huntington (2004) explored the relationship between technology and physical activity and found that the Amish walk roughly 2.5 times more than Americans, on average, Amish men walk 18,425 steps per day, and Amish women walk 14,196 steps per day. Another example is a guideline for the optimal distance between the stove, sink, and refrigerator, which is known as the "Cornell kitchen triangle" or "kitchen work triangle" to minimize the steps for housewives (Child, 1914; Fischer et al, 1989). However, what is paradoxical here is that, even though people want to ease the burden by reducing steps, now this view has changed by realizing that having more steps can be beneficial in many ways. Undoubtedly, a shorter path is not always the best. For example, the path through a museum can be designed to be long because people might want to appreciate every masterpiece in that museum. Furthermore, for retail environments, the longer the customers' path, the higher the chance they would be exposed to goods, which could lead to

higher sales. In short, the notion about and relationship between layout and movement can be changed, depending on the function of the space.

Movement and Interaction

Interactions generally take place when at least one person shows his or her availability for conversation when someone is passing by (Penn et al, 1999). People tend to look straight ahead while walking and keep their heads down while working to indicate their unavailability and intention not to be disturbed. However, as soon as people turn to look at the common work area or other people, or even look up, they can be considered to be available for interaction. Individuals talk to roughly 65% of all other available people, regardless of the distinction of different types of interaction (Peponis et al, 2007). Additionally, interaction can typically be defined as formal planned meeting conversations and informal unplanned interactions in office organizations (Penn et al, 1999). Work-related and social interactions are the highest common interaction (Peponis et al, 2007). Over 80% of work-related conversation was observed as unplanned conversation by Backhouse and Drew (1992). In terms of the duration of interactions, more than 70% of conversations lasted less than 30 seconds and 90% of conversations lasted less than two minutes (Penn et al, 1999).

After studying ongoing interactions at four different offices, the result indicated that the majority of interactions take place within the individual's workspace (Rashid et al, 2006). Moreover, Hua, Loftness, Kraut, and Powell (2010) found that workers perceived high support and low distraction from work environments having a longer distance between the workstation and amenities. Ultimately, the study suggested that having a shared service and amenity area in working environment can play a significant role in encouraging workers to engage in spontaneous encounters, leading to interactions for socialization, information exchange, and creative development (Hua et al, 2010).

There are several other factors determining the pattern of interaction in working environments. Density of occupation and the average of spatial integration, which is a spatial characteristic, play an important role in defining levels of interaction (Hillier et al, 1993). Furthermore, the notion that information exchange and communication, which eventually influence job productivity, can be affected by design and layout is supported by a flow model and a serendipitous communication model (Peponis et al, 2007). Based on the serendipitous communication model, people can come out of their workstations for visiting the places that serve as informal interaction nodes, such as cafes. Hence, frequent unplanned interaction can make workers' range of communication rather broader (Peponis et al, 2007). Furthermore, visibility, openness, accessibility, and hierarchy can either support or restrict chance encounters that make meaningful interactions (Rashid et al, 2006). For example, people who are in the more accessible spaces in the building are greatly visible and reachable because a person's location can determine the possibility of interaction with others (Penn et al, 1999).

Rashid et al (2006) found that, even though the offices offered collaborative workspace to encourage interaction outside the individual's workspace, most interactions occurred in the workstation, based on the analysis of four different large offices' spatial layouts and behavior patterns. However, there was a considerable difference between other locations' supporting interactions, such as the corridors and other common areas, depending on the different spatial cultures of interaction in the office organization (Rashid et al, 2006). The spatial culture of interaction was a crucial factor, since the other locations for interaction were largely affected by the spatial culture of interaction. Those factors can drive workers to prefer having face-to-face interaction in individual workstations as well. The authors emphasize that organizational function and culture are factors substantial in determining the pattern and the goal of interaction, by providing plentiful evidence in terms of accessibility, visibility, and organizational hierarchy through a space syntax analysis (Rashid et al, 2006).

THEORETICAL FRAMEWORK

Social ecological model

The social ecological model formed the theoretical framework for this study, by explaining how humans' behavior is affected by their surroundings. The social ecological model was originally developed from the ecological perspective; significant progress in mostly health-related practices has been made due to this perspective (Green and Kreuter, 2005). According to the social ecological model, physical and social environments characterize the ecological view interdependently (Stokols, 1996) with multidimensional and multilevel standpoints, which are personal, organizational, and environmental factors (Green and Kreuter, 2005; Grzywacz and Fuqua, 2000). The social ecological model has been adopted to explain the multiple relationships of physical activity with those multidimensional factors (Grzywacz and Fuqua, 2000; Prodaniuk et al, 2004; Sallis et al, 1998; Zimring et al, 2005). Based on the article of Zimring et al (2005), environmental factors, such as urban design, site design, and building spatial design, have a direct relationship with physical activity. However, both personal factors (e.g., demographics, health variables, and attitudes) and organizational factors that might support or impede physical activity (e.g., social structures, organizational supports, and philosophies) can moderate the environmental factors' roles (Zimring et al, 2005).

The social ecological model demonstrates complex and associative correlations among individuals and environments as rather more comprehensive understandings and highlight the importance of behavioral influences from the three multiple levels (Grzywacz and Fuqua, 2000; McNeill et al, 2006; Sorensen et al, 2003; Zimring et al, 2005). The most important point of the social ecological model is the fact that behavior is affected by environmental factors and individual factors at the same time (McNeill et al, 2006). Therefore, a social ecological perspective suggests an interaction that is individual as well as social within a physical environment and states the need to increase the concept of a "person-environment fit" (Stokols, 1996).

However, personal, environmental, and organizational factors can be too broad and ambiguous to conduct research, especially when they are considered together. Indeed, Sallis, Johnson, Calfas, Caparosa, and Nichols (1997) declared that such a broad range of factors, like biological factors having effects on physical activity, might lead to insignificant correlations between physical activity and the environment. Hence, Grzywacz and Fuqua (2000) argued that, before conducting research, there is a need to define personal, organizational, and environmental factors specifically, and to acknowledge the fact that possible contributors such as various individual characteristics, can produce different results on physical activity. Researchers can obtain the benefits of a social ecological perspective by narrowing and defining these three factors. In this way, more unequivocal implications about the relationships among variables can be created and these specific implications can help researchers to apply the findings further (Grzywacz and Fuqua, 2000).

Owing to these advantages of social ecological perspectives, there has been a tendency to conduct studies to find out the potential working environmental factors to encourage employees' physical activity, based on an ecological approach (Stokols et al, 1996; Wanzel, 1994). Due to the fact that the environments where people interact are the key interest of the ecological model, to scrutinize a wider spectrum of a person's life surroundings having an intervention, the ecological approach has been utilized (Gauvin et al, 2001). To summarize, when researchers examine the environmental influence on physical activity, the environmental factors should be included (Prodaniuk et al, 2004).

Hypothesis

Based on the social ecological model, the following two hypotheses were developed for this study.

- Hypothesis 1: The increased distance and depth between an employee's workstation and other destinations will increase the number of steps they walk and the number of interactions they have.
- Hypothesis 2: The personal, environmental, and organizational factors will play a moderating role on the relationships.

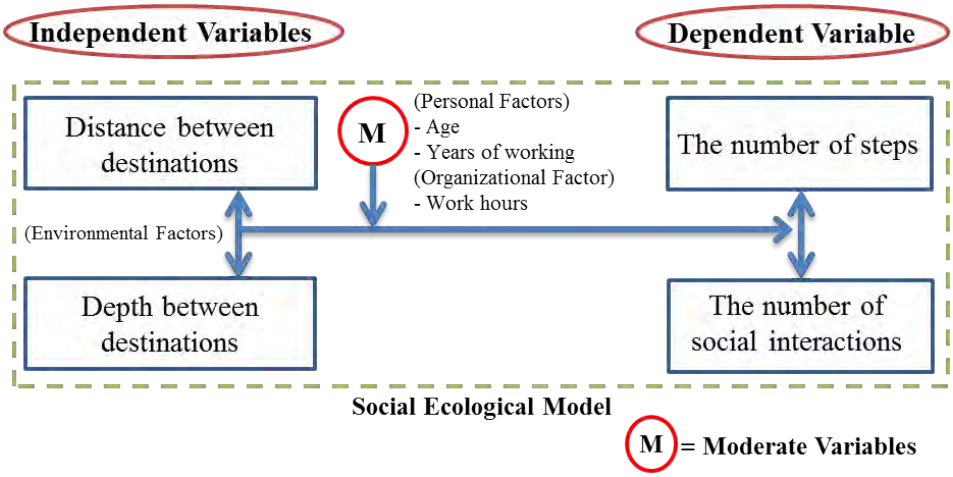

Figure 1. Conceptual model (Source: Authors).

METHODOLOGY

Eighteen voluntary participants (6 males and 12 females) at Office A, a local architecture company located in St. Paul, Minnesota, were recruited for the study. Participants' ages ranged between 18 and 45 years old. No specifically established criteria for participation in this study were required. The study was conducted upon receiving IRB approval and the data were collected during 10 working days. According to the previous literature on open offices (Ashkanasy et al, 2014; Brennan et al, 2002; Oldham and Fried, 1987; Oldham and Rotchford, 1983), Office A can be regarded as an open office environment, since no partition exists between workstations that are side by side and the overall partitions between workstations that are facing each other are low (3'6").

A research package, containing a self-report form with instructions, a device to count his or her steps, and one questionnaire asking basic demographic information, was distributed to every participant. At the beginning of the data collection, a training session was held to help participants fill out the self-report forms correctly. Participants were required to complete the questionnaire at the beginning because the data needed to be tracked for data analysis, such as correlation between their steps and/ or interactions, and they were asked to submit it with their initial self-report form within a sealed envelope.

The data for the number of steps and interactions were collected daily through self-reports by participants. A floor plan was given every day. Every single trip the participants made was to be reported on the daily floor plan. The participants were asked to put on a pedometer for the entire work hours, excluding when they were out of office (e.g., off-site meetings or lunch). A participant needed to mark a shape of a star representing an interaction, whenever they had a face-to-face interaction while walking through the paths in the office. The location where the interaction occurred did not need to be exact because the number of the social interactions was focused on. Only face-to-face interactions were counted.

Variables

The distance was calculated by analyzing the actual distance based on a floor plan from each participant's workstation to 12 most frequently visited places reported by the self-reports. In a similar way of defining distance, depth was determined by counting the number of axial lines from the participant's workstation to the 12 zones. Depth is one of the six constructs in space syntax theories (e.g., openness, depth, connectivity, accessibility, the degree of control, and visibility) (Hillier et al, 1993; Zeisel, 2006). Based on previous literature, people prefer to choose the shortest route (Seneviratne and Morrall, 1985; Weinstein et al, 2008). The shortest routes were used to define both distance and depth. The number of steps were regarded as an outcome: a function of human's behavior. Gender, age, and years of working at Office A are analyzed as personal factors, job title, and work hours are regarded as organizational factors. The distance and depth are considered environmental factors as well as independent variables.

Statistical Analyses

The data for this study were analyzed by using R Studio, by using a linear mixed effect model and correlation. Lmer (abbreviation of linear mixed effect regression) is one of the methods of regression in R. A linear mixed model has more flexibility of fitting in and could be extended for use in generalized linear mixed models (Bates, 2005). Specifically, the general assumption of this study is that the following effects on the steps and interaction would be changed as well, if the distance and/ or depth are different. As independent variables, distance and depth should be fixed in order to investigate the potential influence on the number of steps and interactions. More importantly, the linear mixed effect model considers random effect, so the difference between participants would be examined. Despite of the different number of self-reports of each participant, participants are regarded as a random factor by being calculated each participant's characteristics randomly.

FINDINGS AND DISCUSSIONS

To demonstrate the hypothesis, at first, correlations between distance and depth and the number of steps and interactions were examined. After that, whether or not they had a moderating role among variables was explored. A main function of a moderate variable is either supporting or hindering a relationship between other variables. As the social ecological model suggests, personal, organizational, and environmental factors were developed. For this research, personal factors were gender, age, and the number of years of working at Office A; organizational factors were job title and work hours; and, environmental factors were distance and depth, which were independent variables as well. However, job title was excluded for further analysis because some of job titles only had one participant.

To analyze the effects of distance and/ or depth on the number of steps, three different linear regression models with a random effect of the participants were developed. According to the mixed effect models, distance and depth of their workstations simultaneously had influence on the number of steps they walked. As Table 1 describes, distance ($p=.010$) had a positive relationship for determining the number of steps with statistical significance. This finding is supported by the social ecological model notion that environmental factors, such as urban design, site design, and building spatial design, have a direct relationship with physical activity (Zimring et al, 2005). In this study, the distance between workstations is a part of the building spatial design. On the other hand, depth had a negative correlation with steps ($p=.015$). In this study, depth indicates the degree or the number of spaces people have to pass through from one space to another, which means the degree of isolation of the zone (workstation). Therefore, the negative correlation might be a result of participants' tendency to avoid passing through multiple zones.

Secondly, the effects of distance and/ or depth on the number of interactions were analyzed. Like the effect on the number of steps, distance ($p=.029$) and depth ($p=.084$) had statistically

significant effects on the number of interactions when they were applied simultaneously. This finding is also supported by the social ecological model because both distance and depth are related to environmental factor (Figure 1). However, distance and depth did not have statistically significant correlations with the number of steps as well as the number of interactions when they were applied independently (Table 1). This finding suggests that consideration of distance and depth simultaneously might have a stronger relationship with the number of interactions than when they are considered independently. Therefore, hypothesis 1 can be restated based on the findings as follows: The increased distance and the decreased depth between an employee's workstation and other destination increase the number of steps they walk and the number of interactions they have.

The moderate variables used for this linear model were gender, age, years of working in the corporation, job title, and work hours. However, since some of job titles had only one person, a comparison among different job titles would not have been accurate. Therefore, further analysis of job title as one of moderate variables was not conducted. According to Table 2, distance and depth had positive correlations with the number of steps, and the degree of the slope was statistically significant (p=.017). However, depth had a negative correlation with the number of steps (p=.009). Work hours also accounted for statistically significant differences in steps (p=0.012).

Table 1. Linear mixed effect models for the each effect of distance and/ or depth on the number of steps and interactions (Source: Authors).

DV	IV	Estimate	SD. Error	t-value	P-value
The Number of Steps	Intercept	477.66	1197.14	0.35	.731
	Distance	3.44	2.48	1.38	.180
	Intercept	3720.26	1543.24	2.41	.025 *
	Depth	-35.55	32.21	-1.10	.282
	Intercept	2787.12	1376.68	2.03	.056 .
	Distance	7.55	2.67	2.83	.010 *
	Depth	-91.26	34.15	-2.67	.015 *
The Number of Interactions	Intercept	0.225	8.610	0.02	.979
	Distance	0.026	0.018	1.49	.150
	Intercept	15.832	10.201	1.55	.132
	Depth	-0.060	0.203	-0.29	.770
	Intercept	9.993	9.682	1.03	.312
	Distance	0.050	0.021	2.38	.029 *
	Depth	-0.432	0.238	-1.82	.084 .

Note. DV=Dependent Variable, IV=Independent Variable, SD=Standard Deviation, '.' p<.1, * p<.05, ** p<.01, *** p<.001

Based on the linear effect model (Table 2), ANOVA test (Table 3) was conducted to see how much each variable has influence on the number of steps accompanying with the effect of distance. Referring to Table 3, the three moderate variables show that differences existed among the groups such as age, years of working, and work hours, when the model was considering the effect of distance on the number of steps. In other words, each variable had a relationship with the steps. The model itself explained that different distance (p=.043) and depth (p=.002) had an influence on walking more or less and it is greatly supported statistically. The heterogeneous groups of age (p=.045) and years of working (p=.024) at the corporation differed in the number of steps. Besides those findings, work hours also had significantly supportive statistic value on the

difference for the number of steps (p=.039). However, based on the findings from the linear mixed effect model and the ANOVA test, different gender does not differ in steps with statistical significance. This finding show consistency in a positive relationship between distance and the number of steps and a negative relationship between depth and the number of steps when considered with personal factors (age and years of working) and organizational factor (work hours). This finding is supported by the social ecological model idea that environmental, personal, and organizational factors affect human behavior (Zimring et al, 2005).

Table 2. A linear mixed effect model for the effects of distance, depth, age, years of working, and work hours on the number of steps (Source: Authors).

	Estimate	SD. Error	t-value	P-value
Intercept	504.80	1669.82	0.30	.767
Distance	6.07	2.24	2.71	.017 *
Depth	-97.29	32.60	-2.98	.009 **
Age: 26-35 yr	947.29	1145.79	0.83	.422
Age: 36-45 yr	713.91	1005.60	0.71	.489
Y of W.: 2-5 yr	615.83	918.12	0.67	.513
Y of W: 6-10 yr	-712.83	769.00	-0.93	.369
Y of W: 11-20 yr	-715.78	669.42	-1.07	.303
Work Hours	355.82	156.87	2.27	.039 *

Note. Y of W=Years of Working, SD=Standard Deviation, '.' p<.1, * p<.05, ** p<.01, *** p<.001

Table 3. ANOVA test for the effects of distance, depth, age, years of working, and work hours on the number of steps (Source: Authors).

	Df	Sum Sq.	Mean Sq.	F-value	P-value
Distance	1	2723775	2723775	4.92	.043 *
Depth	1	7838849	7838849	14.17	.002 **
Age	2	4289588	2144794	3.88	.045 *
Years of Working	3	7079978	2539993	4.27	.024 *
Work Hours	1	2845248	2845248	5.14	.039 *
Residuals	14	7742820	553059		

Note. Df=Degree of Freedom,'.' p<.1, * p<.05, ** p<.01, *** p<.001

The potential effects of moderate variables on the relationships between distance and/ or depth and the number of interactions were further analyzed. The moderate variables applied to the models are gender, age, years of working at the corporation, and work hours. However, unlike the models used for the number of steps, none of the models showed that the moderate variables have a statistically significant effect on the relationships among distance, depth, and the number of interactions. In the present study, the number of steps in the social ecological model was the only variable that was influenced by personal, environmental, and organizational factors (Figure 2). Therefore, hypothesis 2 can be restated based on the findings as follows: The personal, environmental, and organizational factors play a moderating role on the relationships of distance and depth only when considering the number of steps.

Specifically, distance and depth together had a relationship to the number of steps. There was no significant difference in the number of steps based on gender. However, different ages and years of working influenced the number of steps the participants made. The older the participants were and the longer they had worked for the corporation, the less number of steps

they were likely to walk. In terms of organizational factors, work hours had not only a very strong positive correlation with the number of steps, but also had a statistically significant value.

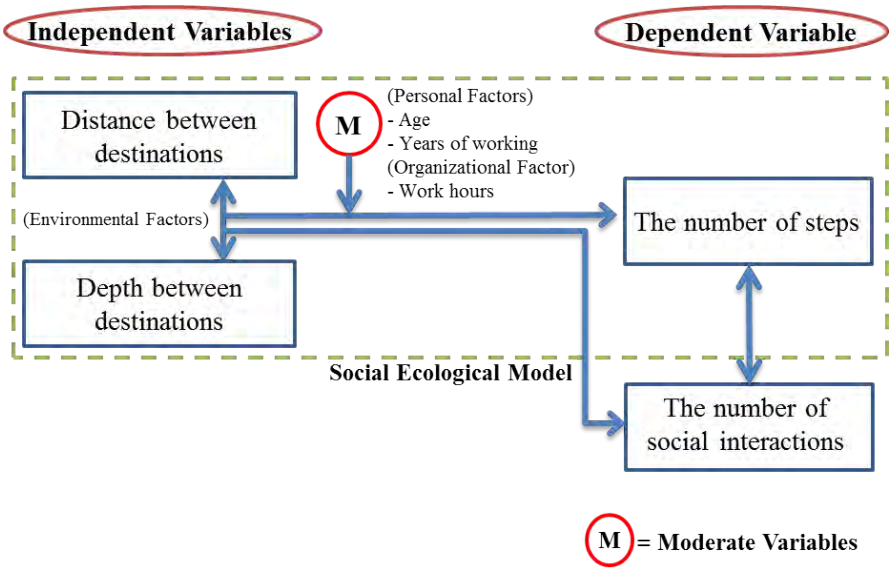

Figure 2. Conceptual model based on the findings (Source: Authors).

The overall effects on the number of steps were investigated by considering all the moderate variables together at the same time. When considering the independent variables as environmental factors, distance, depth, age, years of working, and work hours showed relationships to the steps through the linear mixed effect model (Table 2). Thus, the number of steps as a function of human's behavior was affected by distance and depth (as environmental factors), age and years of working (as personal factors), and work hours (as an organizational factor), according to the social ecological model. In short, since all three factors influenced the number of steps, this study supports the social ecological model. This research further examined the effect of moderate variables on the number of interactions, since interactions can be viewed as human behaviors and can be greatly influenced by the participants' individual differences. However, the moderate variables did not influence the relationship between distance and depth and the number of interactions.

The results from this study were greatly tied with the social ecological model (Figure 2). In terms of the social ecological model, the number of steps, which was the outcome of people's behaviors, was affected by personal, environmental, and organizational factors. All three types of factors from the social ecological model played a moderating role on the results of people's movement and communicating behavior. In conclusion, this research provides supportive implications to the social ecological model.

CONCLUSION

This study supports the social ecological model. The results indicated a correlation among distance, depth, the number of steps and interaction, and moderate variables (personal, organizational, and environmental factors). Results showed that the number of steps, as a function of human's behavior, was affected by distance and depth (as environmental factors), age and years of working (as personal factors), and work hours (as an organizational factor). The limitation of this research was the small sample size, where only 18 participants' data were examined. For example, some of the job titles included only one person. In other words, making

comparisons between different job titles would not have had solid justifications because those differences might be a result of various personal characteristics or other factors rather than of the diverse job titles.

Another limitation of this research is its low reliability. Because the data collection was largely dependent on participants, the reliability of the study might be questionable due to human error. To put it another way, since the majority of the data were self-reported, the data might have low reliability.

The high possibility of changing the participants' behavior is another limitation of this research. The fact that they knew that they were participating in the research and needed to report some information every day might have simply and easily changed their behavior. In addition, they likely understood the main interests and goals of this study as they completed the self-reports and questionnaires.

Finally, the distance was determined based on the assumption that the path participants reported would be a shorter route. However, the assumption that participants would use a shorter route might not have been accurate because their paths could have been longer routes or they could have had multiple destinations. The distance calculated for this research might not have been a strong independent variable affecting the total number of steps.

The following recommendations for future research can address some of the limitations of the present study. Since using self-reports can result in low reliability, an objective measurement would improve reliability. If an objective measurement were used for collecting routine data such as steps or interactions, then the participants' natural behavior would not be interrupted because they would not have to put any efforts on reporting their behaviors.

By conducting a triangulation method consisting of an objective measurement and self-reports for collecting data of physical activity, the research can be more reliable because each measurement would then compensate for the limitations. In addition, by comparing data from self-reports with ones from an objective measurement, researchers can investigate whether the general perception towards walkable distance corresponds with the actual walking distance. Workers' satisfaction and their perceived comfort with the walking distance and the spatial layout can additionally be examined within the research.

Studying more than two different workplaces would also make future research suitable for making comparisons among them, especially with regards to environmental and organizational factors. For instance, future research would be able to examine the differences in employees' behaviors between the office which has open-plan or private offices and/ or the height of partitions (examples of environmental factors), the office which has flat or hierarchical work environments, retention of employees, and/ or flexible or rigid work schedules (examples of organizational factors). In addition to that, by recruiting a large sample size, the spectrum of the participants would be broader.

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NEIGHBORHOOD REGENERATION AT THE GRASSROOTS PARTICIPATION: INCUBATORS' CO-CREATIVE PROCESS AND SYSTEM

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Abstract
Incubators of Public Spaces is a funded JPI Urban Europe project aiming to support the self-organization of places by enhancing the factors that motivate, encourage, and enable the urban actors to reach common understandings in order to coordinate their actions by reasoned argument, consensus, and cooperation rather than strategic thinking only. By catalyzing citizens' willingness to 'do their bit' for improving spaces, it provides the means to grow and care for places. The paper is organized into three main sections. The first section offers a theoretical underpinning on the roots of self-organization and co-creation in urban interventions. After a brief introduction about the project's aims, the second section deals with incubators' co-creative process and system. It describes the running of the scenario workshops and provides an overview of the web platform and its inherent features. The third section presents the results of the application of the incubators method in the regeneration of an Italian neighborhood. It provides some general information about the area, and foresees a set of interventions for both built and open spaces. Conclusions offer early remarks concerning the ongoing experimentation in Incubators.

Keywords: *Stakeholder self-organization; urban co-creation; crowdsourced placemaking; design actions; scenario workshop*

INTRODUCTION
There is no doubt that European urban areas share some common features: when traveling across Europe, the recurrence of some peri-urban forms of settlement is apparent. The accumulation of family houses, shops, business districts, and industrial areas over time has given rise to a mix of forms that may vary a little from place to place, but whose visible outcomes ultimately look alike.
Anywhere, private buildings, infrastructures, facilities, and public spaces have been planned and, in most cases, designed according to the administrative and normative systems from their time at the national and/ or local level. And yet, a multitude of actors has interpreted those plans and codes in view of their individual interests and personal cultures, with results widely different from those intended by the norms.
In the making of places, an important role is played both by a family that settles its own house or a corporation that builds a shopping mall. But this is not all about placemaking; the cumulative result of the many individual initiatives is equally important, and unpredictable. The ensemble of the parts produces a comprehensive image, which differs both from the owners' meanings and the governments' plans. A variety of buildings and spaces overlap and blend in anonymous places that are common to many countries.
This general trend is well depicted in the film *Chain*, directed by Cohen (2004). The anonymous places where it was shot (shopping malls, single-family houses, business premises, parking lots, etc.) were filmed in seven different countries – in Europe and elsewhere – but they blend together so well that this becomes apparent only in the end credits. Part documentary and part fiction, the

film makes use of a modular plot; the sections of narrative are interchangeable and can be rearranged by the spectator to make new sequences, even new films. Places are not only the background to the film's characters, but are characters themselves. And urban interventions are the means available to reimagine their role in the 'plot of space'.

Figure 1. Frames from the film *Chain* (Source: Cohen, 2004).

THEORETICAL PERSPECTIVE

Looking back to the 20th century history of urban interventions, Allmendinger and Tewdwr-Jones (2002), Campbell and Fainstein (2003), Geertman (2006), Hall (1975), Parker and Street (2015), and Pelzer et al (2014) identify an evolution towards the involvement of people in design practices, moving from the 1950s-60s rational paradigm, also known as 'master planning', to the 1960s-70s procedural paradigm, i.e. 'process planning', the 1970s-80s strategic paradigm, i.e. 'long-term visions' and 'short-term processes', and finally the 1980s-90s participatory paradigm, which entails that "effectiveness is the degree to which the affected people support the proposed policy and the degree to which they are involved in the implementation of the plan" (Geertman, 2006). According to Meijer at al (1981), citizens' participation dates back to the mid-1960s in Scandinavia and the Netherlands.

Self-organization in urban interventions

The aim of participation is to enable actors to contribute to decisions by communicative consensus-oriented actions (Kensing and Blomberg, 1998; Brandt, 2006; Pløger, 2001; Ehn, 2008; van Abel et al, 2014). To our understating, an ongoing advancement is towards 'self-organization', in which actors take the lead for realizing bespoke and sustainable urban interventions.

According to early academic research, self-organization is a process of entropy reversion within a system (Allen and Sanglier, 1981; Eigen and Schuster, 1979; Maturana and Varela, 1991; Nicolis and Prigogine, 1989; Prigogine, 1980). In urban design, self-organization means that the urban actors are enabled to contribute to the shaping of their places by themselves; it is not simply to give them a voice, but to enable them to take responsibility and action for their places, by their own contributions, in bottom-up grassroots processes. "Participatory planning proposals remain controlled by public government, and that public government seems not to be very adaptive to initiatives that emerge from the dynamics of civil society itself, and thus is unable to address the

growing complexity of present-day society. This challenges us to explore the theoretical background for a radical alternative view on social embedded spatial planning, which would be able to interact with these growing complexities: […] self-organization in urban development" (Boonstra, 2011).
In this matter, we understand self-organization as a progress over participation, as it can involve a wider array of actors: *people* (i.e. citizens who want to solve their real-life problems), *utilizers* (enterprises that want to develop their businesses in the area), *enablers* (public-sector actors, developers), and *providers* (domain experts, e.g. universities, consultants, technicians) (Juujärvi, 2013).
Nevertheless, the extent, the outcomes, and the methodologies with which urban self-organization can be managed are largely debated (Bond and Thompson-Fawcett, 2007; Campbell and Marshall, 2000; Innes and Booher, 2004; Van Meerkerk et al, 2013). Chaskin and Garg (1997), Chaskin (2003), Chaskin et al (2012), Hasanov and Beaumont (2016), Lepofsky and Fraser (2003), and Martin (2004) consider the challenges to put into action urban initiatives from non-governmental actors. Edelenbos (2005), Healey (2006), Kathi and Cooper (2005), Smith (2010) examine the difficulties of making effective collaborations with local administrations or agencies to pledge the implementation.

Co-creation and Self-organization

Consistent with the aims of self-organization, co-creation, and its subcategory, co-design (Dubé et al, 2014),can be understood as a means to give shape and actuation to urban interventions, in which "users, citizens are at the heart of the creation of societal knowledge in a context of global development" (Roy, 2011). The European Design Leadership Board defines co-design as "a community centred methodology that designers use to enable people who will be served by a design outcome to participate in designing solutions to their problems" (Thomson et al, 2012). Co-creative processes are the outcome of a shift in urban design; they move from experts towards giving actors the capability to directly contribute their experience (Sanders and Stappers, 2008).
In practice, co-design approaches vary greatly from being close to consultation and information gathering to facilitating people in generating their own ideas and solutions. For example, scenario techniques can be used to identify the interests of different stakeholders, enabling them to participate in different stages of planning and design (Tress and Tress, 2003). To 'accommodate a non design orientated population', the use of visualization co-design techniques is well documented (Al-Kodmany, 1999; Sanches and Frankel, 2010). Co-design processes have also been known to fail, for example, 'the process failed at the stage of active participation of the citizens' due to unimaginative methods to engage citizens in the co-design of an urban square in Ypzgat, Turkey (Dede et al, 2012; Cruickshank et al, 2013). A further research strand centers on how to map co-created interventions into an institutional planning system (Munthe-Kaas, 2015).
The positive co-creation and self-organization synergies result in a grassroots process of local information and knowledge, aimed at improving places and driven by actors' lived experiences. Co-creation methodologies aim to enable people, laypersons as well as experts, with a very broad range of knowledge and know-how to have a creative contribution to the design processes (Sanders, 2002). We understand the public insight in and co-creative contribution to the making of a place as an application of local knowledge that, after Yanow (2003), is in turn understood as the lay experience of places in everyday life.
Fuchs and Hofkirchner (2005) consider the construction of social knowledge to be the means to achieve self-organization. This construction develops along a threefold dynamic process of (1) cognition, (2) communication, and (3) cooperation, which means:

- "Cognition: Mechanisms of opinion formation that allow a plurality of information sources and in which every recipient can also be a sender that is heard and taken seriously by others.
- Communication: Mechanisms of rational public discourse that are open and accessible for all citizens and enable humans to acquire the resources and capacities they need for active, knowledgeable, informed participation.
- And finally, on the cooperative level, institutions of decision taking and enactment that are directly controlled by and responsible to all citizens" (Fuchs, 2007).

A self-organized co-creation requires individuals' and groups' autonomy and interaction among all three layers of the process.

For instance, 'eParticipation' is an emerging framework of methodologies, tools, and practices of using ICTs to inspire cognition, communication, and cooperation processes for constructing shared social knowledge. The leading innovation is in the role of the individual: from passive user to active creator of knowledge, from uninformed to informed, from isolated to connected. "In eParticipation processes, ICTs empower humans, groups, and society, that is, they provide individuals with capacities and resources for changing organizations and society according to their will, they provide groups and organizations with capacities and resources for changing society and better including individuals, and they provide society with capacities to better include groups and individuals" (Fuchs, 2007). "The idea is to recast state – citizen relations, to promote civil society and to empower citizens to help themselves (Wells, 2011), especially in deprived urban areas. This trend is reflected in conceptions such as the 'Big Society' and 'localism' (United Kingdom), the 'participation society' (The Netherlands) or 'do-it-yourself urbanism' in the United States and other countries around the world (Iveson, 2013; Finn, 2014; Sawhney et al, 2015)" (Kleinhans et al, 2015).

INCUBATORS OF PUBLIC SPACES

Incubators of Public Spaces is a funded JPI Urban Europe project, aiming to support the self-organization of places, by enhancing the factors that motivate, encourage, and enable the urban actors to reach common understandings in order to coordinate their actions by reasoned argument, consensus, and cooperation rather than strategic thinking only. It is a method that intends to link an agreed vision for the positive change of an urban area - the term 'vision' being understood as the purpose of the design process (Carmona, 2014) - with the combination of individual self-interest driven actions on that area.

By catalyzing citizens' willingness to 'do their bit' for improving spaces within a certain community, it provides the means to grow and care for places. Since what makes a place is the integration of spatial forms, built and open, which fosters the interactions of people as they inhabit those spaces, the incubators project advances 'crowdsourced placemaking' practices.

As far as the project is concerned, crowdsourcing, or the act of outsourcing tasks to a large group of individuals, is seen as a chance for people to have a real say on the future of the places where they live and work. In this regard, the 'crowd' represents a place-based asset, rooted in its specific context, and worthy of being involved because it is a holder of wisdom that would otherwise be hard to develop from scratch (Surowiecki, 2004; Erickson, 2010). Engaging different kinds of stakeholders as active co-creators and co-producers, it calls them to contribute with their considerable knowledge and valuable expertise to the community vision-making and scenario-building process.

Incubators' co-creative process

Within this framework, the incubators project has been designed as a multiple-step process that takes place in the form of public face-to-face and/ or remote workshops for the development of multi-stakeholder design-oriented scenarios. Using methodologies presented by Cox et al (2014)

and Oswald and Baccini (2003) as a base, this project aims to deploy an additional method for shaping places in relation to the expectations of a broad array of stakeholders, whilst limiting as much as possible the risk of getting stuck in ideological or positional conflicts (i.e. the so-called Not In My Backyard syndrome).

When dealing with public consultations, it is fairly common that the presence of divergent or even confrontational purposes and aspirations undermines citizens' natural motivation to participate in the shaping of their daily life environment. By contrast, through providing them with the possibility of easily creating a plurality of scenarios for a given place, the *Incubators* is likely to make them focus their attention on the development of a 'what will happen if' approach, instead of bluntly assessing 'what will happen'.

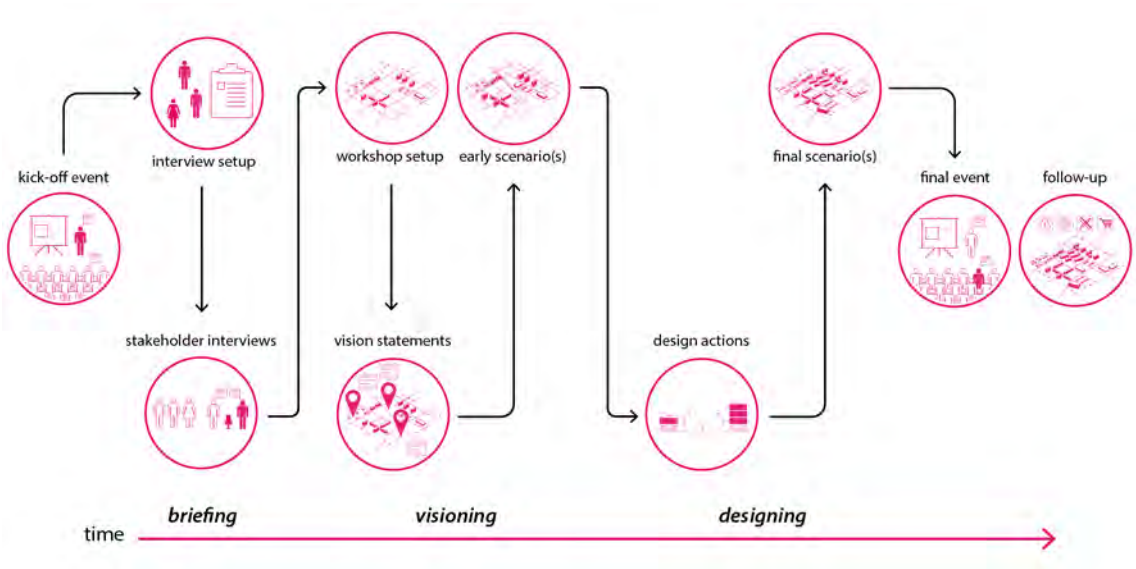

Figure 2. *Incubators* multiple-step process (Source: Authors, 2016).

To reach this goal, the process runs through three main phases, all of which are based on the interface between two groups that can be roughly referred to as 'experts' - the *Incubators* team (made up of researchers and practitioners encompassing areas of expertise such as urban design, planning, participatory design, etc.) - and 'non-experts' (the local stakeholders).

Interviews set the point of departure for the process. These were held with a selected group of key agents, such as decision-makers, opinion leaders, and members of local organizations, on the basis of semi-structured questions primarily meant to collect qualitative data. Responding to open-ended questions for about 45 to 60 minutes, each interviewee is asked not only to outline the current situation and its possible/ desirable future states, but also to suggest actions that could lead from the present state to those future states.

In order to elicit both verbal and visual information, the text of the interview is paired with a number of images (e.g. photographs, maps, drawings) that illustrate specific indoor and/ or outdoor spaces, on which the interviewer intends to focus attention. By bringing abstract questions down to a very tangible level, the pictures give the opportunity to reach a deeper understanding of the issues that need to be addressed intuitively, capturing habits and reflections otherwise easily overlooked and difficult to characterize.

After the interviews were completed, and meaningful data synthesized and interpreted by experts, the workshops could start. These cover both the visioning and the designing phases, but with different purposes and modalities.

In the first case, brainstorming and social storytelling techniques were used to 'open the discussion', with most of the time allotted to narrative descriptions of future visions. In the second one, evaluative and deliberative activities were carried out to 'narrow the discussion', with most of the time allotted to qualitative and quantitative explorations of design actions. In the middle, the scenarios developed by the *Incubators* team were the means that the facilitators have available to guide this shift from vision statements to concrete actions.

Regardless of the phase during which the workshops take place, these are run as group sessions and involve up to 20 targeted participants with different tasks to perform. On the one side, the *Incubators* team is asked to do the foundation work for providing inputs to the local stakeholder workshops, while on the other side, the local stakeholders are involved in various hands-on activities and games producing outputs to be further developed during the following *Incubators* team workshop. In front of the difficulty to manage workshops with too large a number of participants, the alternating movement between right and left columns is seen as a good way to ensure proper communication and interaction between the two groups, but without overloading the overall process.

In order to facilitate the attendance, different participants correspond to different workshop durations; while the workshops engaging local stakeholders lasted a few hours (no more than 3), those dedicated to the *Incubators* team were organized in the form of *charrettes*, lasting several days. Therefore, it is worth noting that the workshop process is not done once and for all, instead iterated a number of times, usually three or more. Thanks to this iteration, the exploration of the set of assumptions driving the generation of every personal scenario raises awareness about the relationships between the individuals' and groups' issues, planned actions, and foreseen outcomes.

Two public events, one at the very beginning of the process and the other one after the last workshop, are conceived as opportunities for an enlarged discussion and communication. Follow-up activities are also required in order to provide up-to-date information about the progressive implementation of the agreed scenario(s). Post-workshop feedbacks and meetings are crucial in reinforcing the development program turning good intentions into real actions and outcomes.

Incubators' co-creative system

Thanks to the active collaboration of experts and non-experts, shared strategies and ideas are expected to result in a co-created set of micro-design interventions. This set collects the design options that are made available on the *Incubators* digital platform and from which the users can draw to propose their personal scenarios.

The system is designed to look at ways to gather proposals from different contributors, following a collaborative approach. It is made up of a collection of (re)design interventions, applicable either to individual buildings or to built/ open spaces, to some extent similar to those that can be found in other manuals of urban design (Tachieva, 2010; Nouvel et al, 2009). The main difference is that, in *Incubators*, interventions are defined thanks to a bottom-up approach to the urban design issues. Urging the stakeholders to work together for the regeneration of an urban area, it creates the conditions that enable citizens to express their needs and wishes and negotiate solutions in a constructive way.

Stakeholders' expectations do not necessarily match reality; rather, they could point to reality as a 'would/could be' process. The three-dimensional visualization, supporting the intuitive expression of these expectations, ties them to the reality of the morphology of the places and exploiting a visual mean makes the interaction easy and clear. In particular, inhabitants can contribute to a place as 'experts of their experiences' (Sleeswijk Visser et al, 2005). We understand the public insight in and co-creative contribution to the making of a place as an

application of local knowledge: “the very mundane, but still expert, understanding of and practical reasoning about local conditions derived from lived experience” (Yanow, 2003).

The work carried out so far has led to the creation of a prototype web-platform (accessible at: https://polytechnic-egrid.polito.it/viewer.php), a static version of the dynamic system that the *Incubators* project is developing (see Figure 3).

Using the *Trimble SketchUp* software, a realistic urban setting has been modelled as a composition of different typologies of urban tissues. As a whole, these typologies represent a large part of the urban fabric that can typically be found in the outskirts of many contemporary European cities. Ranging from low-rise single-family houses to mid- and high-rise multi-family dwellings, from residential to commercial and production buildings, from roads to green open spaces and facilities, the digital 3D model combines uses and densities to be representative of a multitude of urban fabrics.

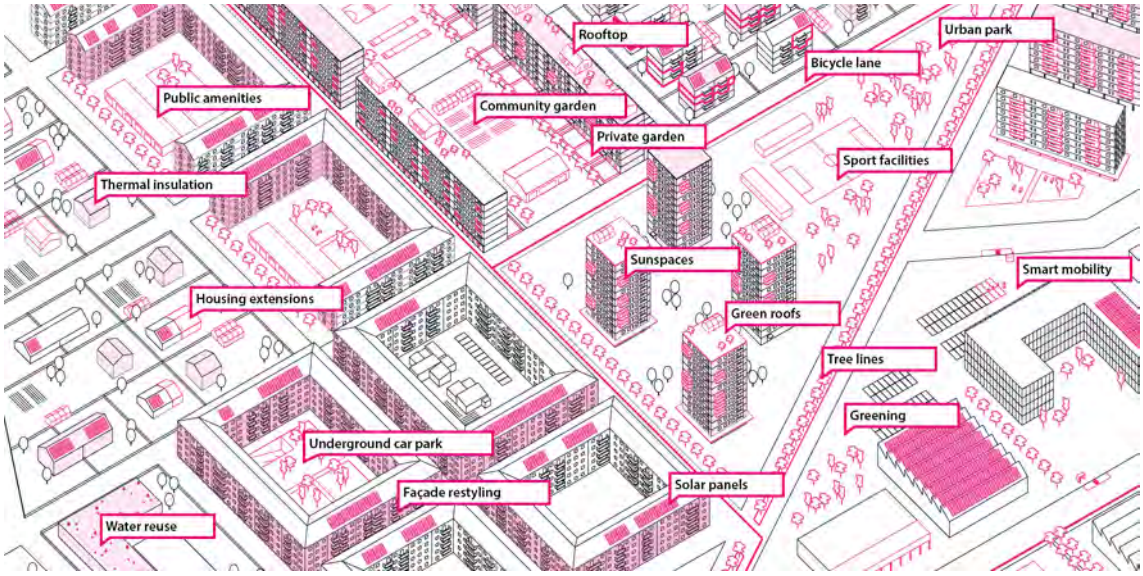

Figure 3. *Incubators* micro-design interventions (Source: Authors, 2016).

On the base model, many typologies of interventions have been identified and grouped according to different criteria. Indeed, the drop-down menus provide an overview of the main rationales that can underlie an effective regeneration process, classifying items according to the corresponding field of intervention (i.e. energy efficiency, built form, open space), the ownership status of the space implied (i.e. private, common, or public), and the most likely funding sources (i.e. energy savings, owners or community investments).

By switching on and off the various options, the website allows the generation of a wide range of scenarios which, in a way, simulate the outcomes that we expect to result from the *Incubators’* co-creative process. The objective here is that to trigger participation, to inspire users providing them with some parametric solutions, which employ basic concepts that are highly adaptable, flexible and scalable.

Of course, not all the suggested interventions are possible, or at least advisable, in every context; feasibility must be checked on a case-by-case basis in order to avoid steep realization costs and/ or paltry environmental benefits. This is also why, in its final version, the platform will include assessment tools to assist participants in their screening.

The Case-project section of the paper comes to the early findings arising from the Italian case-project, providing further details about the actual implementation of the *Incubators* method when dealing with a specific urban fabric.

Incubators' platform features

Drawing on these issues, the tasks that have to be performed by the *Incubators* platform in order to properly support a co-creative process, as the one described above, comprise:

Site modelling: Creation of a virtual 3D model of the area formed from an assembly of sub-elements that, to a certain extent, can be treated as autonomous parts, such as an apartment, a roof, a parking lot, a façade, a garden, a road, and the like.

Action modelling: Collection and prefiguration of a set of actions to transform the just mentioned model parts, by means of basic operations (e.g. additions/ subtractions, transformations, extensions/ reductions).

Scenario building: Definition of an array of scenarios that do not require stakeholders to converge towards a unique or unifying design but that, instead, understands the regeneration as an incremental process, made possible by the combination(s) of several small-scale actions.

Agreed scenario(s): Assessment of feasibility, convenience, and mutual compatibility for both single and multiple actions and selection of the most wanted scenario(s). Once all the local stakeholders agree on the scenario to be pursued, a further obstacle that can prevent it to be achieved is a lack of financial resources.

(Crowd)funding: In order to overcome the budget constraints of most municipalities and the conjunctural shortening of private partnerships, the *Incubators* platform also deals with innovative means of financing. Microfinance and crowdfunding tools, in particular, seem the most appropriate alternatives to be investigated, mainly for their capability not only to pool fresh money for a project, but also to build an active consensus around it. After a proposal is published online, any user can support it by either funding it or adopting it. Adopting means taking charge of someone else's idea, as if it were one's own.

Since the input features to every scenario proposal are accessible online, a user can co-creatively contribute his or her knowledge and expertise to a specific idea, thereby progressing it. In this regard, the *Incubators* platform implements the next step in co-creation: co-ownership, which gives to the virtual proposal creators a means to confer 'crowdfunding inheritance' from the ancestor idea(s).

Because often a main bottleneck for realizing an urban project is the lack of support, relevant know-how and capital and the inheritance mechanisms provide users an effective and intuitive way for both co-creating and co-funding projects that are meaningful to a specific community. Only ideas that raise the required target amount are realized; no one pays if nothing happens.

CASE-PROJECT

The *Incubators'* co-creative process and system will be experimented with three different case-projects, respectively located in: (a) London, *Queen Elizabeth Olympic Park*: a 125 ha site, part of the larger Olympicopolis education and cultural district, where the new UCL East university campus is planned; (b) Brussels, *Josaphat Ancienne Gare*: a zone of regional interest whose strategic development plan envisages the transformation from a 25 ha disused railway yard into a mixed-use quarter; (c) and Turin, *Quartiere Mirafiori Sud*, the latter having been chosen as test ground for the early phase of the project.

The Partners of the *Incubators of Public Spaces* project are Politecnico di Torino (coordinator), Innovation Service Network GmbH, Katholieke Universiteit Leuven, Neurovation GmbH, University College London, and Città di Torino.

Quartiere Mirafiori Sud

The aforementioned Quartiere Mirafiori Sud is a public housing neighborhood located in the southern outskirts of the city and built by Gestione Case Lavoratori since the mid-sixties

(Ges.Ca.L, 1966), when the primary need was to quickly provide the largest possible number of dwellings in response to a pressing demand for housing.

The outcome is a very poor urban layout, characterized by the uniform arrangement of blocks and streets, suitable to simplify the design process and to reduce construction cost and time. Buildings are made of panels of precast reinforced concrete and host only three types of apartments (3, 4, or 5 rooms). Their total number is about 1300 units, located in multi-family complexes ranging from 7 to 8 storeys high and spread across a total area of around 32 hectares (see Figure 4).

Originally designed to accommodate a different population demographic (mainly low to middle class families), Mirafiori Sud confronts today many of the challenges that characterize similar post-war housing estates (van Kempen et al, 2005). Besides the simplification and the repetition of a limited number of architectural elements, the low energetic performance of the existing buildings is among the main problems that affect the settlement today.

Property fragmentation (due to subsequent sell-off programs) and low spending capacity have so far severely constrained the chances to take action. The question at stake is how to take advantage of the innovative approaches and technologies brought by the *Incubators* project to finally produce change in the neighborhood.

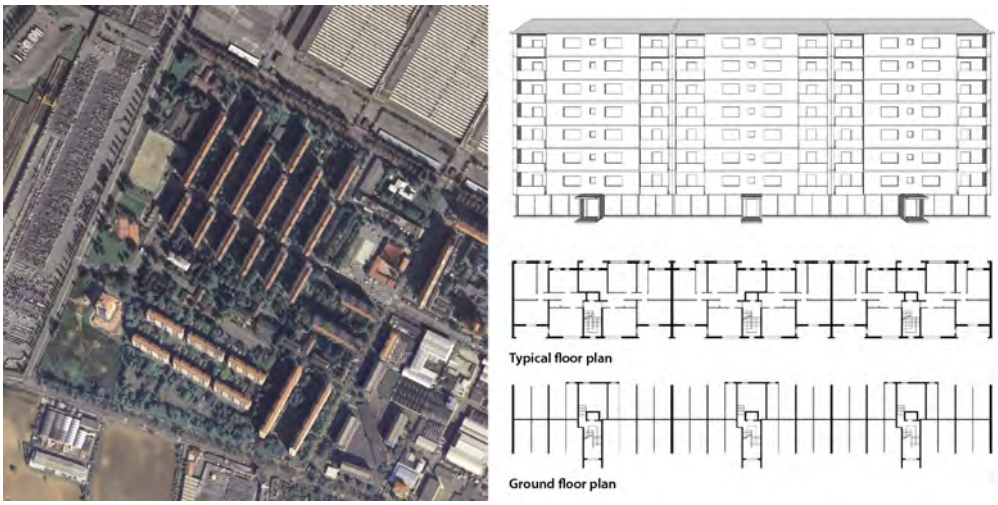

Figure 4. Quartiere Mirafiori Sud: (left) aerial view and (right) sample building façade and floor plans (Source: Authors, 2016).

As a first step in the experimentation, a reference ‘urban space’, which is an open space bounded by built forms, was selected as the most appropriate unit of interest in order to compare and combine several options for intervention. Usually defined as an empty surface enclosed by filled volumes, on the contrary, we understand it as a hollow space, not a void, as a living space determined by the relationships that connect rather than separate the buildings that stand at its edges.

Under this perspective, the object of the investigation becomes to identify the technological and spatial solutions that can make a difference in how the site is lived and perceived by its inhabitants and users. From a preliminary survey, the list of possible interventions on the residential blocks comprises, in ascending order of complexity, includes:

- Loft and wall insulation and windows replacement to increase the energy performance of the buildings envelope and renovate façades;
- Loggias closures and attached-sunspaces as well as solar greenhouses/ winter-gardens to achieve energy savings/gains and upgrade balconies;

- Apartments layout optimization to mix housing types/tenures and introduce new functions at the ground floors.

Also of importance is the chance to match the interventions on private buildings with other interventions on the related common and public open spaces. Since the spatial characteristics of an urban environment can significantly impact its climate (Kleerekoper et al, 2012), design strategies are deployed to redesign buildings' surroundings.

Dealing with Mirafiori Sud, the presence of extensive, and often underused, unbuilt areas makes possible the implementation of interventions, such as:

- Collective space reconfiguration to create privately owned gardens and lower shared maintenance costs (i.e. condominium fees);
- Paved surfaces treatment to influence the local microclimate and reduce water runoff.

Figure 5 shows, the possible outcomes of a combined application of the interventions mentioned; Figure 6 displays the diagrammatic sequences of steps for the realisation of two of the suggested design interventions.

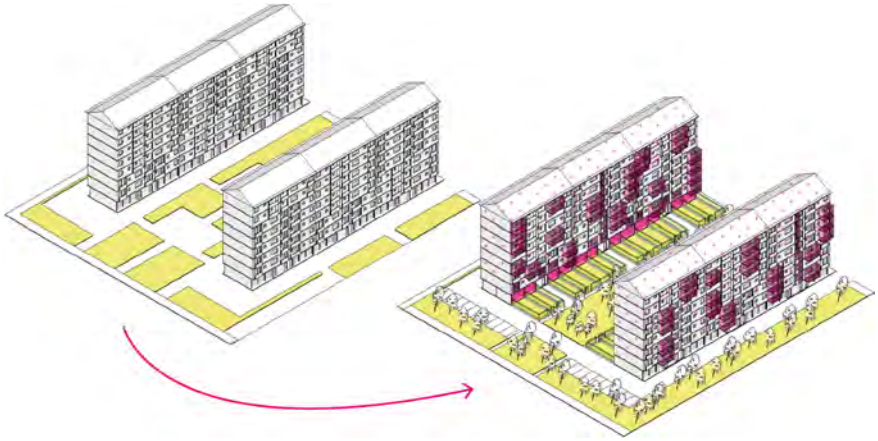

Figure 5. Quartiere Mirafiori Sud: (left) present state and (right) future scenario (Source: Authors, 2016).

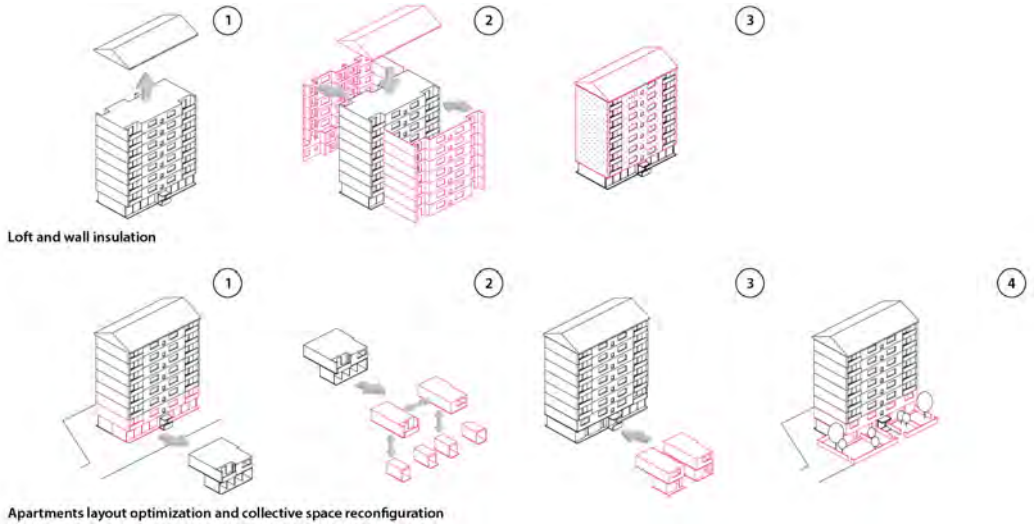

Figure 6. Quartiere Mirafiori Sud: design interventions step-by-step (Source: Authors, 2016).

ANALYSIS AND RESULTS

Analyzing specifically the environmental and economic benefits that, besides the architectural ones these kinds of intervention can produce, two different degrees of intervention can be envisaged: (a) standard interventions, which require the homeowner a lower intensity of investment, and achieving a minor degree of performances, and (b) advanced interventions, with a higher intensity of investment and better performances. Table 1 shows the cost variations of refurbishment interventions on the envelope, in particular:

- Application of insulation material on walls to reach the U-value of 0.33 W/(m^{2}K) for the standard refurbishment and of 0.25 W/(m^{2}K) for the advanced refurbishment;
- Application of insulation material on floors and roofs (or ceilings) to reach the U-value of 0.30 W/(m^{2}K) for the standard refurbishment and of 0.23 W/(m^{2}K) for the advanced refurbishment;
- Replacement of windows and doors to reach the U-value of 2.00 W/(m^{2}K) for the standard refurbishment and of 1.70 W/(m^{2}K) for the advanced refurbishment.

Table 1. Cost of standard and advanced interventions (Source: Authors and ANCE Torino, 2016).

Intervention typologies	Standard interventions		Advanced interventions	
	Transmittance target value	Cost range	Transmittance target value	Cost range
Roof insulation	U>0.80	70-100 €/m^2	U>0.70	120-160 €/m^2
External walls insulation	U>0.33	100-150 €/m^3	U>0.25	90-120 €/m^2
Floors or ceilings towards unheated zone insulation	U>0.30	40-60 €/m^2	U>0.23	50-70 €/m^2
Windows and doors replacement	U>2.00	370-470 €/m^2	U>1,70	600-720 €/m^2

Depending on the degree of intervention, the levels of energy consumption, CO_2 emissions, and related heating costs vary considerably (see Figure 7), ranging from a minimum reduction of 55% to a maximum reduction of 85% compared to the initial levels.

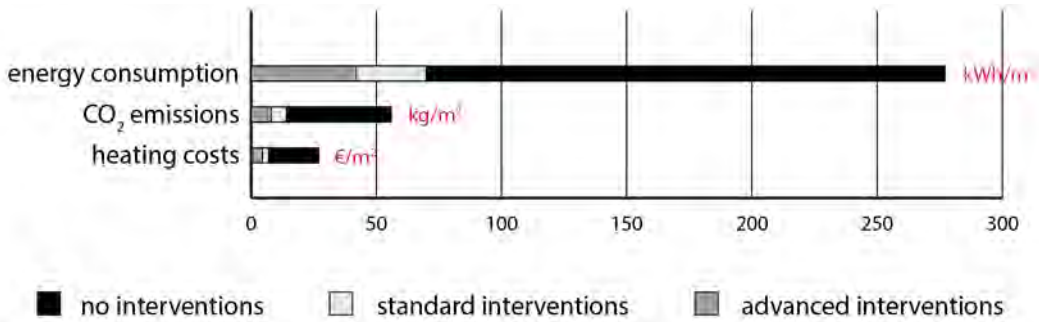

Figure 7. Annual reduction of energy consumption, CO_2 emissions and heating costs in case of standard and advanced interventions (Source: Authors and ANCE Torino, 2016).

Coming back to the case-project, among those cited in the previous paragraph, the refurbishment measures that have been considered the most likely to find application are (1) loft and wall thermal insulation, and (2) the insertion of sunspaces. This is mainly for two reasons: the architectural and structural features of the buildings and the cost-benefit balance of the interventions.

Figure 8 summarizes the energy and money savings potentially achievable by applying the mentioned measures to one of the buildings situated in Mirafiori Sud. As it is possible to see,

sunspaces are a typology of intervention that does not involve significant energy and money savings; the advantage lies in the opportunity to increase the floor area of the apartment. On the contrary, the amount of the savings resulting from the retrofit of the envelope is quite relevant, about 40% less than the initial consumption.

Loft and wall insulation has already proven effective in improving the energy efficiency of buildings at no costs for the owner. Typical pay-back times are about 12 years. This time-scale is medium, considering the pace of the construction sector, but it tends to long, considering consumer habits, for instance, on the directions that the market will follow or technological innovation.

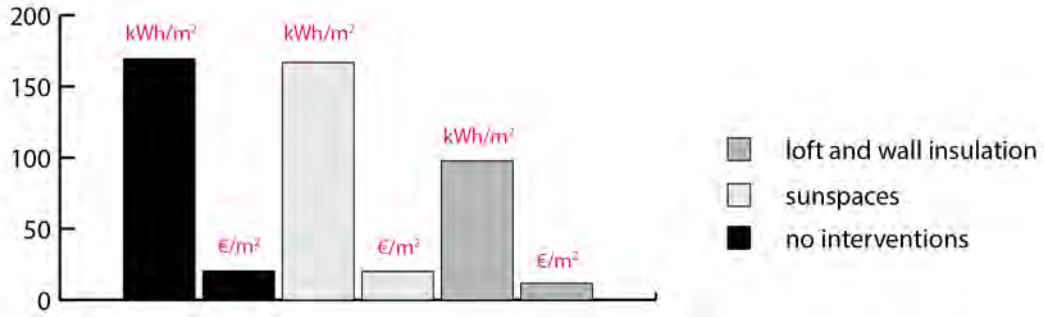

Figura 8. Quartiere Mirafiori Sud: interventions and potential annual energy and money savings (Source: Authors, 2016).

Pay-back times and initial investments raise questions about the economic attractiveness of these interventions. In a neighborhood where most of the inhabitants are in unskilled employment (ISTAT, 2011), a big part of the challenge consists of making the renovation attractive.

CONCLUSIONS

The experimentation is ongoing, so, it is premature to draw any final conclusion from it. This is espcially because in the making of places, besides space, time is the key element of the process. In Quartiere Mirafiori Sud, like in most suburbs, the public participation, the co-creative contribution to the making of the places evolves and layers in the course of time. The span is usually long to give the inhabitants the capability to metabolize it: the memory of a place is the legibility of layered actions over time (Larco, 2003).

Incubators of Public Spaces aims to catalyze the process, depositing more public actions into the built and open spaces. *Incubators* aims to spark the creativity of the stakeholders as 'experts of their experiences' (Sleeswijk Visser et al, 2005) and aims to provide those spatial preconditions and practices that create the potential for meaningful placemaking. In our understanding, the project fosters the collective creativity of subjects, their propensity to discover ways to adapt spaces to whom a use is effectively given.

Incubators has confidence in the co-creative contributions of the inhabitants and stakeholders, in their knowledge of ways to use the spaces that they are living and experiencing. The project aims to give the collective the means to create places out of the spaces that are given. The architects' role is to make the spaces for that public, producing the conditions where the co-creativity can freely be practiced. It is something that cannot be simply put in place as the outcome of a top-down process.

Foucault (1995) clearly considers that "freedom is a practice"; "I think it is somewhat arbitrary to try to disassociate the effective practice of freedom by people, the practice of social relations, and the spatial distributions in which they find themselves. If they are separated, they become impossible to understand. Each can only be understood through the other".*Incubators*

placemaking aims to create the practices, both social and morphological, to positively give the community the capability to express itself in the places.
The co-creative methodology, put in place in the case-project, can be further improved in the interplay between expert and non-expert workshops, to give the architects a better and deeper understanding of the community's and individual's knowledge and expertise with regard to a specific idea. In this, the system is expected to be developed to give a greater contribution. And conversely, the community can benefit from acquiring a more direct experience with and familiarity of the designerly practices. This can probably be achieved blurring the boundaries between expert and non-expert workshops, and keeping public track of the work done in the workshops with the system.

ACKNOWLEDGEMENTS

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ANALYZING THE CRITICAL ROLE OF SKETCHES IN THE VISUAL TRANSFORMATION OF ARCHITECTURAL DESIGN

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Abstract
Through sketches, designers can seek and create more desirable and sustainable forms by transforming previous images through various techniques like visual additions, deletion, and modifications. Transformative skills in the form of freehand sketches appear to induce creative, explorative, open-ended environments that are conductive in dealing with the ill-structured nature of design activities. This study compares sketching and design transformative skills (DTS) between 3rd and 5th year architectural students as measured throughout the discernible levels of diagrammatic, preliminary, refinement, and detail designing. Fourteen architecture students from the University Technology Malaysia (UTM) were observed, with seven respondents each from the third and fifth year student cohorts. The objective of the observation was to capture and analyze the students' sketches as they design a gallery within the stipulated two-hour period. The research instrument included a set including an HD video camera, drawing instruments, and a brief outline of the design tasks. The Mann-Whitney test was used to determine if there were differences in design transformation activities between third and fifth year students throughout the period of observation. The results reveal significant differences in vertical move transformation between third and fifth year students within the preliminary, refinement, and detail phases of designing.

Keywords: *Sketching; design transformation skills; design expertise*

INTRODUCTION

Freehand sketching is helpful for designers because of imagining and recognising many drawing alternatives. Sketch has the crucial role of supporting the mind in converting descriptive information into depiction. Fish (1996) mentions that sketch aids artist to think and support short-term memory. Sketch aids designers in considering problems and is a beneficial technique for communicating ideas to others (Myers et al, 2008). Some of the research in design recognizes that sketching is an effective instrument for conceptual designing. In addition, it can serve as a storage solution as external memory and appear to be important in understanding conflicts and possibilities (Akin, 1978). Therefore, sketching has an important role in design training and it can be beneficial for design development and design creativity.

Transformation is the mechanism that shows the way new designs are generated from unambiguous representations and the prevailing products. Moreover, this is the design that seeks to create desirable and sustainable changes in form (Tovey, Porter, and Newman, 2003). In order to transform descriptions into depictions, the designer employs a set of quick sketches. In this manner, images are generated in mind by sketches, by which the embodied themes in the design are developed. Sequentially, this directs the designer to transform the former image through additions, deletions, and modifications (Tovey et al, 2003). Indeed, transformation moves from unstructured drawing to further detailed and precise illustrated representations.

This study uses retrospective protocol analysis to compare design transformation in four levels of detailing: diagrammatic, preliminary, refinement, and detail designing between third and fifth year students. The contribution of this study is to aid in understanding the difference of design transformation between two levels of design expertise. It is expected that this study will be beneficial for design education and design learning.

LITERATURE REVIEW

Transformation is the capability of pattern modification in images and is significant in design generation. This transformation occurs in different context, which will be explained later as a decomposing process. Sketching manipulation takes place for transforming image, situation, and drawing types that result in evaluating design solution (Do et al, 2000).

Transformation

Design transformation is the progression from unstructured form to structured form which occurs for creating, modifying, and developing design elements and the design idea. Goel (1995) argued that design is the process from ill-defined problems to the well-defined design problems. It consists of some moves that start from the preliminary phase (unstructured sketch) and the refinement phase of design to detail design (explicit and precise design). Goel (1994) stated that lateral and vertical is transformation, whereas duplication is repeating. A lateral transformation is identified as “movement… from one idea to a slightly different idea”. They are essential for broadening the problem space and the assessment and improvement of kernel ideas. A vertical transformation is identified as “movement… from one idea to a more detailed version of the same idea”. It causes the problem space to deepen. Lateral transformations mostly take place in the initial design stages and are related to unstructured drawing while vertical transformations take place throughout the refinement and detailed design stages and are related to more precise and detailed design.

Van der Lugt (2000) investigated features of design transformation that occur in idea links. He defined ideas as three subclasses in a link: supplementary, modification, and tangential links. The supplementary link shows auxiliary and small change on the same version of the idea; the modification link relates to changes in the structure of ideas, however keeping the current line of thought; the tangential link indicates a radical and fundamental change from the earlier idea. He describes that a higher tangential link showed that design ideas have rich novelty whereas a higher supplementary link and modification link indicated development in the idea. Van der Lugt (2000) also mentioned that a creative process consists of a balance among link types. Similarly, Rodgers, Green, and McGown (2000) mention that the balance between vertical and lateral transformation results in good design.

Abdelmohsen and Do (2007) investigate the concept development of two Ph.D. students that had two and six years of professional experience. They evaluate the development of the concept based on vertical and lateral transformation in three seasons: creating design options in schematic design, developing and refining design options, and detailing the revised design. A protocol analysis was used for studying concept development in the schematic and refined stages of design. Moreover, they decompose the design process to three meaningful strokes, namely: transferred, blocked, or added. Abdelmohsen and Do (2007) extended the notion of design transformation by defining processes described as vertical promotion and lateral promotion and cross propagation. Indeed, they evalute design transformation by meaningful strokes in the macro level.

Differences between two levels of design expertise

Different studies have emerged that offer contradictory finding about differences in design expertise. Suwa and Tversky (1997) compare the design thoughts of two groups, advanced students and practicing architects, during the sketching of a museum. A retrospective protocol analysis was considered for this issue. The authors observed that the whole process of design consisted of two groups of segments, the alone segment which they named the isolated segment and the contiguous segment which is set in one block that the authors named the dependency chunk. The isolated segment and the initial segment of the dependency block shows that designers focus on previous thought and shift to an alternative topic, item, or space. Suwa and Tversky (1997) name these segments by means of focus-shift that corresponds to lateral transformation; in addition, with the exception of the initial segment, they name further segments located in the dependency chunk as continuing segments that relate to vertical transformation. The authors concluded that practicing architects used dependency chunk longer and more than advanced students.

Kavakli and Gero (2001) investigated the cognitive processes of novice and expert designers in which the expert designers produced 7 alternatives whereas the novice students had 2, thus they conclude that alternative interpretations' perception and spatial relations' organization may consume more time for the novice than expert designers (Kavakli and Gero, 2001). They described that the main difference in their sketches is that there was more intensity in the representation of design ideas as seen in the expert's design alternatives (Kavakli and Gero, 2001). Moeover, Atman et al (2005) gathered verbal protocols from first year engineering students (freshman) with fourth year engineering students (senior) while they worked on two design problems. They define that, in contrast to the senior students, freshmen considered less alternative solutions, gathered less information, and transitioned less frequently between types of design activities. By comparing literature, it is obvious that the "expert is more productive than the novice" based on the quantities of alternatives and pages created; practicing architects utilized vertical transformation more and longer than advanced students.

Sketch

In the primary phase of the design process, sketch has a crucial role among the traditional mediums and is the elementary depictive action that is performed by designers during the design process. Garner (1990) mentions that sketching fundamentally affects the development, creation, evaluation, and distribution of ideas. Moreover, Goel (1995) suggests that being "syntactically" and "semantically" unclear and ambiguous, the sketches influence the heuristic, creative, open-ended stage of problem-solving. Some researchers like Fish and Scrivener (1990), Goel (1995), and Goldschmidt (1991) came to the conclusion that rough and untidy sketching allows the designer to work quickly, suspending judgment on polished features. Moreover, it could help in generating new ideas. Purcell and Gero (1998) state that in design perception research, a considerable number of studies have focused on the roles of sketches in the conceptual design process and their relationship to designer's cognition. Indeed, for simplifying the existing ideas and developing new ones, sketching can be helpful.

Decomposing Process

Several attempts have been made to decompose the whole design process into three different components for analysing and measuring it: context, chunk, and move (Figure 1).

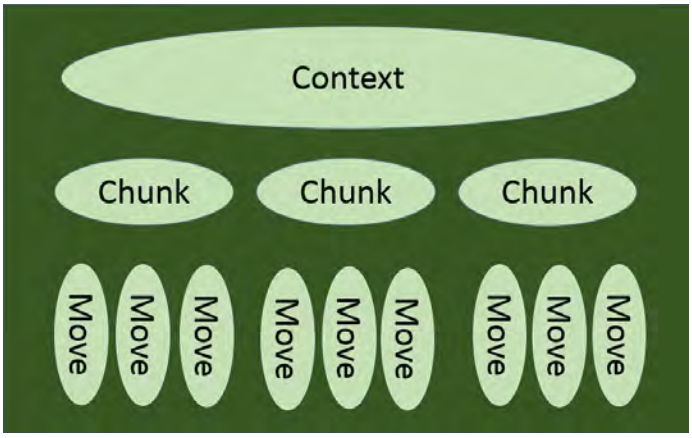


Figure 1. Decomposing design process to context, chunk, and move

Context

The Ddsigners change their focus in design and refine the domain knowledge by the context of sketch (Cai, Do, and Zimring, 2010). Gross and Do (1996) argue a similar drawing symbol might have a different sense in a different context. Do et al (2000) stated that transformation can occur in design and context trough manipulating shape and changing drawing types and viewpoints. Previous studies have classified context in the design process based on design development, the level of abstraction, and presentation types.

The first type of context is classified based on design development, Goel (1994, 1995, and 2014) categorized the development of design into the four subcategories: (1) problem-structuring, which arranges the problem, (2) preliminary-design, which creates some solution options and idea cores, (3) refinement-design, which improves the current sketch by transformation, and (4) detail-design, which presents the design product. Similarly, Abdelmohsen and Do (2007) classified seasons of design into three phases. In the first phase, several solution options are created in schematic plan drawings. In the second phase, designers refine and improve options. In the third phase, they improve refined drawing to the product of design and organization elements (Table 1). Although diagram has an important role in design thinking and sketching types, design development of Goel do not include diagrams. For Goel, diagrams are more related to function, whereas preliminary design is related to form conceptual design. It seems that it may however be more useful to add diagram to design development.

The second type of context is the abstraction level. Designers use abstract diagrams and unstructured forms in early phases of the design process, while they utilize detailed and structured representations in later phases of the design process (Purcell and Gero, 1998). Fish and Scrivener (1990) categorize the element of pictorial representation from description to spatial depiction and argue that sketch has an essential role in supporting the mind by interpreting the “descriptive propositional information” to depiction. Goel (1995) in “Sketch of Thought” mentioned that the design process contains some movement from ambiguity and vague shape, which is important in the early phase of design to more structure form in detailed design. Consequently, this is a process of developing from unclear sketch to detailed form; he notes that the design transformation process moves from abstraction level to convention document. He (1995) describes drawings as “external symbol systems for representing the real world artifacts”. He (1995) familiarizes some drawing from graphic thinking of Laseau (2001) and classifies them as the symbolic system. Goel (1995) lists them as bubble diagram, layout diagram, conceptual sketch, first sketch of floor plan, schematic of floor plan, quick freehand perspective and some detail. Cai et al (2010) classified stimuli for inspiration sources regarding levels of abstraction demonstrated different contexts. These stimuli are adapted from “Frank Lloyd Wright’s Robie

House". They categorize these stimuli as "keyword, diagram, plan, sketch rendering, and precedent photo" (Table 1).

Last, the third type of context is presentation. Do et al (2000) and Bar-Eli (2013) pointed out several types of projection (presentation types) like elevation, plan, elevation, section, and perspective (Table 1).

Table 1. Three different context in design process

Context	Author	levels
Design development	Goel (1994, 1995, 2014)	(1): Problem-structuring, (2): Preliminary-design, (3): Refinement-design and (4): Detail-design
	Abdelmohsen[1] and Do[1] (2007)	(1): schematic design phase, (2): refine design phase and (3): detail design phase
Abstraction level	(Purcell & Gero, 1998)	Unstructured form to structure representation
	J. Fish and Scrivener (1990)	Description to spatial depiction
	Goel (1995)	Bubble diagram, layout diagram, conceptual sketch, first sketch of floor plan, schematic of floor plan, quick freehand perspective and some detail.
Presentation types	Do et al. (2000) and Bar-Eli (2013)	Plan, section, elevation, and perspective

Chunk

Goldschmidt (1992) recognized that chunk consists of some moves and the relationships between them. She defined chunk as "the block of links among successive moves that link exclusively among themselves and [are] barely interconnected with other moves". Goldschmidt (1992) restricts chunk according to design moves with the large number, whereas Suwa and Tversky (1997) structured them based on segments with the smaller number. Chunk is often used in linkography, as opposed to other methods.

Move

Goldschmidt (1990) decomposes the design process into small parts of "design moves" by using linkography. Goldschmidt defined a movement as "a step, an act, an operation, which transforms the design situation relative to the state in which it was prior to that move" (Goldschmidt, 1995b) or can be separate as "the smallest coherent operation detectable in design activity" (Goldschmidt, 1992). Goldschmidt (1995a) mentions that considering design move can result in analyzing and assessing the design process. Moreover, Goel (1995) defined three design movements: vertical and lateral, which are transforming, and duplication, which is repeating.

It seems that design development of Goel is more relevant to design transformation and idea development. However, diagram plays an essential role in design thinking and the lack of diagram in the previous classification of levels of detailing can be seen. Therefore, the current study improves the design

development model of Goel (1994) as design transformation model and categorizes it based on four levels of detailing namely, diagram, preliminary design, refinement design, and detail design. The current study aims to measure design transformation based on movements in levels of detailing (design development).

METHOD

Data Gathering

Most design researchers used protocol analysis to measure cognitive activity that take place in designing and the process of design. The protocol was divided into two subclasses: concurrent protocols and retrospective protocols (Ericsson and Simon, 1993). Concurrent protocols are obtained from the explanation of a designer's thinking during their sketching. Retrospective protocols are obtained from the explanation of a designer's thinking after they completed their sketching. Design researchers used two types of protocol based on the nature of the problem in research design. Process-oriented design studies associated with concurrent protocols, whereas content-oriented design studies related to retrospective protocols (Dorst and Dijkhuis, 1995). Design researchers did not find any research methodology that was suitable for different goals and diverse situations (Goldschmidt and Weil, 1998). The think-aloud protocol is not used in this study because previous studies suggested that talking aloud concurrently may limit the perception of the participant during their drawing activities (Ericsson and Simon, 1993). This effect may be a weakness in our study since our aim was to investigate transformation difference between two groups. We interviewed the participants after they finished their design task as a retrospective protocol. We observed 14 undergraduate architecture students of the University of Technology Malaysia in separate individual design activities. All of the students worked on designing a gallery of seashell and stone.

Segment

Previous design researchers decomposed the verbal protocol into small parts as segmentation. Segmentation is defined according to different events. The first is verbalization actions such as intonations, pauses, and syntactic signs for complete sentences and phrases (Ericsson and Simon, 1993; Gero and Mc Neill, 1998; Goldschmidt, 1991). The second is defined according to the "subject's intention" (Goldschmidt, 1991; Suwa and Tversky, 1997). For instance, Goldschmidt (1991) determined a segment as design move, which is defined as "an act of reasoning which presents a coherent proposition pertaining to an entity that is being designed". A change in the designer's thought contents, their action, and their intention in a subject for the sign for the start and the end of the new segment. Therefore, one segment sometimes contains many sentences and sometimes only one. Moreover, Chiu (2003) analyzes design activities of designers in equal time sequence. We use the latter approach, which means that segmentation in the current study employed equal segments for measuring design transformation in ordinal scale. Since two movements have different time periods, this study divided design process into 30-second equal segments. By considering equal segments, we can measure design transformation more exactly in ordinal scale. It means that one movement can consist of one segment or more than one segment.

Coding

In design studies, coding schemes are needed for defining different action categories in protocol analysis. There are a variety of developed coding schemes depending on the purpose and the scope of every study. The retrospective protocol analysis method applied in this study is based on a content-oriented approach. This section proposes a unique method for tabulating transformation activities. It follows earlier suggestions that each complete segment is encoded with relevant attributes (in bracket) under the following three categories: (1) transformation type

(lateral or vertical), (2) presentation types (ground floor, first floor, section, elevation, and perspective), and (3) levels of detailing (diagram, preliminary design, refinement design, and detail design). These attributes then populate a table referred to as the matrix of design transformation. The tables were created using Microsoft Excel. The following sections highlight the basis for the current tabulation format (Table 2).

Table 2. Sub codes of presentation types, transformation types and levels of detailing in DTM

PRESENTATION TYPES	TRANSFORMATION TYPES	PHASES OF DETAILING
GF: Ground floor	V: Vertical	DI: Diagram
FF: First floor	L: Lateral	PR: Preliminary design
SE: Section	0: No movement	RE: Refinement design
EI: Elevation	O.M: Another movement that is not transformation like duplication	DE: Detailing design
PE: Perspective		

Design Transformation

As mentioned before, Goel (1995) used the term transformation in describing the movements of ideas: a lateral transformation indicates a “shift from one idea to a different idea”, while vertical transformation suggests a detailed development of the same idea.

Levels of Detailing

This study updates the design development model of (Goel, 1994) as a design transformation model and categorizes it based on four levels of detailing namely, diagram, preliminary design, refinement design, and detail design. In the diagrammatic phase of the design process, designers evaluate functions, position, and relationships between spaces as in a bubble diagram. That is consistent with unstructured drawing and abstract schematic. In the preliminary phase of the design process, designers try to generate shape, concept, and kernel ideas. They keep alternatives open and prospects broad. That is the early effort to produce shape. In refinement design, designers develop and revise kernel idea or early generated design idea. In detailing design, designers take the final shape of the form of the idea that consists of precise and structured forms of dimensioned drawing and straight line (Table 3).

Design Protocol Measurement

Khaidzir and Lawson (2013) propose a Cognitive Interaction Matrix (CIM) framework for examining the intricate nature of design studio interactions. CIM illustrates encoded cognitive segments for each design tutorial meeting recorded for the aim of the study. The CIM multi-coding framework offers an inclusive and systematic cognitive description for each protocol segment. This study uses a multi-coding matrix in a different content, as a design transformation matrix (DTM) to code and insert data. This matrix converts qualitative data to quantitative data (Table 4).

Table 3. New model of design transformation in levels of detailing based on Goel’s framework (Goel, 1994).

Design oriented	Design development	Feature	Sketch	Levels of detailing

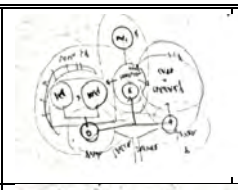
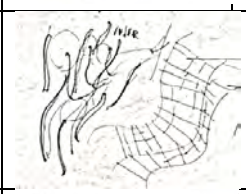
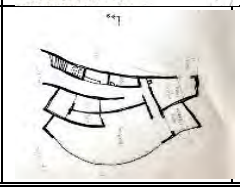
Unstructured	Core Of Idea and New Generation	In the diagrammatic phase of the design process, designers evaluate functions, position, and relationships between spaces such in bubble diagram. That is consistent with unstructured drawing and abstract schematic.		Diagram
		In the preliminary phase of the design process, designers try to generate shape, concept, and kernel idea; they keep alternatives open and prospects broad. That is the early effort to produce shape		Preliminary Design
	Idea Development	Designers develop and revise kernel ideas or early generated design idea in refinement design.		Refinement Design
Structure	Fixation and Detailing	In detailing design, designers take the final shape of the form of the idea that consists of precise and structured forms of dimensioned drawing and straight line.		Detail Design

Table 4. Design transformation matrix (DTM), organized based on the equal segment.

Segment No	Time Duration	Sheet	Presentation Types	Transformation Types	Phases Of Detailing
59	0:29:00	5	GF	L	PR
60	0:29:30	5	GF	L	PR
61	0:30:00	5	GF	L	PR
62	0:30:30	5	GF	L	PR
63	0:31:00	5	0	0	0
64	0:31:30	5	GF	L	PR
65	0:32:00	5	GF	V	PR
66	0:32:30	5	GF	V	PR
67	0:33:00	5	GF	O-M	PR
68	0:33:30	5	0	0	0
69	0:34:00	5	GF	V	PR
70	0:34:30	5	GF	V	PR

Scope

The University of Technology Malaysia has two architecture programmes for undergraduate architecture students, the old one is five years, and the new one is three years. This study compares undergraduate students in the two groups. As such, 14 undergraduate architecture students at the university technology Malaysia (UTM) are involved in this experiment, 7 third and 7 fifth year students. They were asked to complete a design task in two hours. The research instruments include a video camera, a set of drawing tools, and the design task.

Analysis

All statistics are analyzed using the Mann-Whitney U-tests (Clark-Carter, 1997) through SPSS statistical analysis software. Mann-Whitney U-tests are used to test the differences between two independent samples. (Mann-Whitney U is the non-parametric equivalent of a t-test and compares the ranked scores of the two groups).

FINDINGS AND DISCUSSION

In this part, the null hypothesis is that the period of transformation of both groups is equal in four levels of detailing, so if the result is significant, the null hypothesis is rejected. The Wilcoxon-Mann-Whitney test was applied on the ranked using the period of transformation between third and fifth year students. Table 5 shows the periods of transformation that were produced by third and fifth year students. For this experiment, the Wilcoxon-Mann-Whitney test was chosen to establish if third and fifth years students hold similar (null hypothesis) or different (alternative hypothesis) statistical distribution in design transformation. It can be seen from the table, in the diagrammatic phase of detailing, the vertical (P=0.40) and lateral (P=0.72) p-values were beyond the 0.05 level. Therefore, the Mann-Whitney test failed to establish significance beyond the 0.05 level in the difference of transformation between two groups in the diagram. In preliminary and detail design, the p-values are 0.015 and 0.034 respectively. This indicates that third year students spend more time for vertical transformation in these two levels of detailing.

On the other hand, fifth year students use vertical and lateral more than third year students in refinement design; this is indicated by p-values below 0.05, and the significance of vertical and lateral is 0.015 and 0.045 respectively. Thus, although third year students have more activity in idea development in preliminary and detail design, fifth year students spend more time during idea development and modification of their idea in refinement design.

Table 5. Significant of design transformation difference in 4 levels of detailing

Levels Of Detailing	Transformation	Significant	Ranks	
			3th Years	5th Years
Diagram	Vertical	0.40	46	59
	Lateral	0.72	50	55
Preliminary Design	Vertical	0.015	71.5	33.5
	Lateral	0.14	64	41
Refinement Design	Vertical	0.015	33.5	71.5
	Lateral	0.045	37.5	67.5
Detail design	Vertical	0.034	69	36
	Lateral	0.21	43	62

CONCLUSION

The aim of this study was to evaluate differences in design transformation between third and fifth-year undergraduate students in 4 levels of detailing. Findings indicate some significant difference of transformation between the two groups. By considering time segments, it is obvious that third-year student use vertical transformation longer than fifth years in preliminary design and detail design, while the third year students utilize vertical and lateral for less time than fifth year students in refinement design. Thus, third year students spend more time generating each alternative solution and kernel idea than do fifth year students in preliminary design. On the other hand, fifth year students utilize vertical (convergence thinking) and lateral (divergence thinking) more than third year students in refinement design. In other words, fifth year students develop in-

depth and revise kernel ideas more in this phase. Finally in the detailing phase, third year students develop their idea more than fifth year students. Therefore, fifth year students fix their design in refinement design more than third year students. This finding indicates how students use different Design Transformation Skills (DTS) among levels of design detailing. The results of this study are expected to be beneficial for the distinction of design expertise levels. We plan to compare further the result of equal segments (ordinal scale) with real time (ratio scale) to understand differences between them.

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RETHINKING THE QUALITY OF URBAN ENVIRONMENTS: BOOK REVIEW OF 'GOOD URBANISM: SIX STEPS TO CREATING PROSPEROUS PLACES' BY NAN ELLIN (AUTHOR). ISLAND PRESS, WASHINGTON DC, 2013, 164 PAGES, ISBN 978-1-61091-364-5

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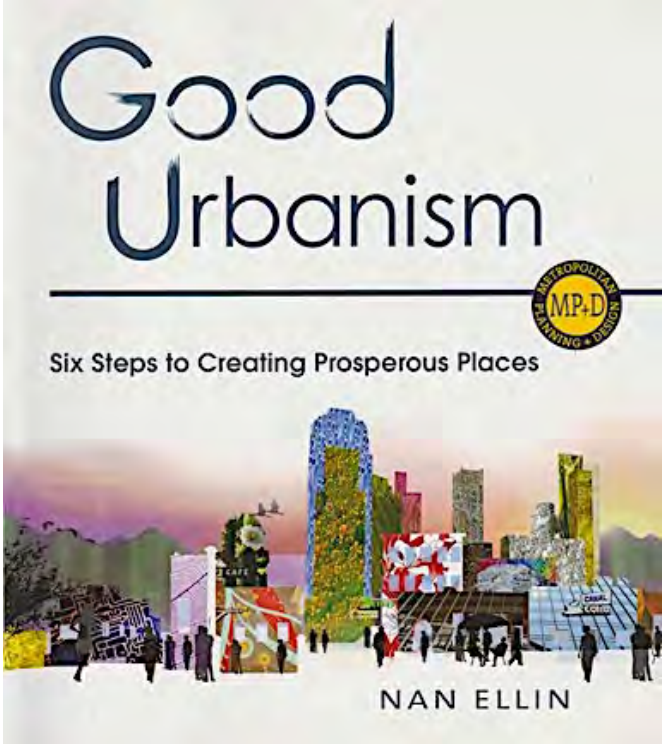
Professional and academic advancement regarding the special link we have with our spaces and its effects on our wellbeing has been a journey of advocacy and knowledge over past decades. Some notable publications in this field include Jacobs (1961); Habraken (1998); Alexander (2002); Thwaites, Porta, Romice & Greaves (2007); Salama & Wiedmann, (2013); and Porta & Romice, (2014). This book not only sits in this cadre, but is set to expand its debate by addressing head-on, the issue of people-place-prosperity.



The author's objectives with this book are primarily two. First, to highlight how urban designers[1] have to some extent, supressed their urban 'instinctual' capacities towards enabling places that allow us to fully prosper. This according to Ellin has to do with continuing divisions in the built environment industry that can make adequate problem identification and appropriate intervention difficult. Other related challenges are also discussed in the book (these include inclinations to focus on problems rather than positive and forward looking solutions in urban research; and those design practices that are product, rather than people-centred). As such, despite recent approaches in urbanism towards supportive and sustainable places, including availability of intellectual, political, and practical resources and tools, making real life impact has been difficult.

[1] The author poses the question 'we know where we want to go, but cannot reliably get there. Why not?' (P. 2). She makes a note of the pronoun 'we' as specifically referring to urban designers; including the reference material (notably Scheer, (2010) where the question was initially posed.

The book's greatest contribution to urbanism is in meeting the second objective; a proposed flexible six-step 'path' towards creating prosperous places, as a guiding framework for all professionals in urbanism. This target is met through a functional approach (covering the philosophy, practice, and implications of this proposed path) that combines principles from several disciplines including ecology, sociology, and economics. The author's discourses can be related to ideologies discussed in for example, 'The Nature of Order' (Alexander, 2002); 'The Structure of The Ordinary' (Habraken, 1998); 'The Three Ecological Principles of Economic Sustainability' (Ikerd, 2013); Gunderson, (2011); and 'Social Cohesion and Economic Prosperity' (Dayton-Johnson, 2001).

Overall, the book is structured in 9 chapters including the introduction and conclusion; there are 2 appendices that summarise functions and features of good urbanism and a good urbanist character checklist respectively. Case studies (primarily from the United States of America) are presented in chapters 3 through to 6, to highlight real life implications of aspects of the author's proposed path to prosperity.

The path is outlined in the chapter 2 'Urban Desiderata: A Path towards Prosperity' and comprises six steps. (1) Prospecting, to identify personal, collective, and place potentials; (2) Polishing these potentials; (3) Proposing plans for designs and policies in order to amass added value economically, socially, and environmentally; (4) Prototyping is then employed to obtain feedback and enhance proposal's capacities; and (5) Presenting to stakeholders in place management, to realize it and take it forward. Chapter 3, 'The Tao of urbanism' is a reiterative passage highlighting the relevance of prospecting in urbanism; founded on the Taoist tradition of appreciating ourselves and resources at our disposal in order to be our best. Evaluated simply, prospecting involves making latent assets evident; capturing the past to better the future; voicing the bad to transform for better; protecting valued aspects and enhancing its deficiencies with what needs to be added. These, the author stresses are important aspects of good urbanism labelled PEA; 'Protect-Enhance-Add'. There are two case studies in this section; the New York city High Line, and the Canalscape in Phoenix.

The fourth chapter 'Co-Creation: From Ego-System to Eco-System' further explores collective and place prospecting. The author's emphases here are on trans-social recognition, partnerships, participations, and stakeholder collaboration in urbanism practice. The urban professional should ideally be an entrepreneur for proactive and dynamic processes that integrate government, business, and civil society. What is more, we are continuously reminded about culture; a shared and vibrant life characteristic that includes our use of space and forms of communication. The New Orleans civic center case study in this section shows how Candy Chang uses communication tools to encourage collaboration and knowledge sharing in urban design.

The next chapter (5) 'Going with the flow: The new design with nature' contains reminders that nothing in this world exists in isolation; we are, in our diversities, inherently related to each other and the environment. Here, Ellin discusses relevant functions for polishing place and collective potentials and making proposals for achieving integrated urban fabrics. These include hybridity; connectivity; porosity; authenticity; and vulnerability. Chapter 6 headlined 'The Art of Urbanism' then guides the reader from the theory that defines the 'path to prosperity' to an action process. It considers not only physical and social space, but incremental. The VIDA approach; Visioning-Inspiring-Demonstrating-Advocating, incorporates the six steps to prosperity into an activity palette that engages stakeholders in a continuous process toward change.

Moving on to chapter 7, the author analyses subtle shifts 'From Good to Great Urbanism' occurring in various disciplines; including notable protagonists, urbanist movements, and powerfully allied community organizations. The next steps suggested are to accelerate these strides in moving from sustainability to prosperity. In this context, a sort of reverse but complimentary pyramid process to the *Maslow scale of needs* (Maslow, 1943) is presented.

Instead of the pyramid declaring '*I need/want'* it alternatively presents '*I have/can use'*. Chapter 8 'Sideways Urbanism: Rotating the Pyramid', features a quasi 'scale of needs' process, but rotated at a ninety-degree angle to show dynamism, and representing a collaborative process that is neither top-down or bottom-up.

This book, by my assessment is a recommended read for all those interested in the livelihood and prosperity of our environments. As a philosophical endeavour, prosperity is multifaceted and broad; plus, its perceptions could be relative and subjective (Shah, 2012; see UN-Habitat, 2013), but all indicative of vibrancy in life. The book works about this basic principle, advocating for change in practice clearly and simply regardless of one's academic level. However, this type of advocacy is paramount in now Developing Cities[2] where sustainable interventions are an imperative in the face of challenges posed by rapid urbanization; and most relevant in slums. I would have liked to see the book extend its scope to these more vulnerable urban contexts, further than the brief mention in chapter 6; and it could be an extra dimension that follows from it. For these cities to prosper there have to be appropriate urban planning and design initiatives that bring together social diversities and physical integration at the human scale (UN-Habitat, 2013); and these initiatives need to be consistent to local realities (see Elshater (2014)) if they are to make positive and valuable impact. The reader more inclined towards advocacy in this area is presented with a robust array of tools to use, but not the necessary contextual guide. Nonetheless, the book provides the reader necessary and multidisciplinary background, principles, theories, strategies, examples, and engaging discussions to nourish creative and adaptive capacities towards prosperity practice. It does not propose an ultimate, rather a recommendation for lively places. Ellin presents additional justification to support this reviewer's view that issues on prosperity should generally be part of social [sciences] philosophy and practice; not only in principle, but likewise in content.

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[2] Also referred to as Global South cities. The term Global South was initially used to refer to countries south of the equator; it is now generally used as a term for the Developing (in terms of industrialization, political and economic stability, and health) Nations of Africa, Latin and Central America, and most of Asia.

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