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Application of sustainable design principles to urban development: The case of the urban villages of the New Eastern District of Anyang, China

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The case of the urban villages of the New Eastern District of Anyang, China

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Abstract

Contemporary urban design in China seeks to resolve the issues that have emerged from increasing demands for environmentally responsible development within the context of traditional townscapes. That is, with China’s rapid development, the importance of sustainable design and green technology is now beginning to be emphasized. While a lot of effort is being put into promoting sustainable development, a large number of rural villages are still being wiped out and replaced by new development. There has been a transformation to an “urban” look with large blocks and multistory apartment buildings with a great number of farmers becoming urban residents every day. It is, therefore, obvious that the Chinese need to integrate sustainable design with the local vernacular architecture and physical layout. Local factors and identities need to be preserved and enhanced while development occurs. It is not necessary to build new development from scratch. Instead, it is possible to create urbanized versions of rural villages. In this research, the author uncovers relationships between Chinese traditional urban design principles and contemporary ones, and then proposes a set of sustainable design principles for the urban villages of China.

The results of the research are, first, a set of sustainable design principles for China. Then, one urban village is designed using the proposed principles to display the concepts and visualize the results.
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Chapter 1: Introduction

1.1. Problem statement

Today, China is taking giant steps forward in building an ecological future by embracing wind power, building the largest tidal energy project in the world, implementing new automobile fuel efficiency standards, and so much more. Now it is time for it to move into green building and sustainable urban design. According to World Changing (http://www.worldchanging.com):

By the end of 2010, all Chinese cities will be expected to reduce their buildings’ energy use by 50 percent; by 2020, that figure will be 65 percent. Furthermore, by 2010, 25 percent of existing residential and public buildings in the country’s large cities will be retrofitted to be greener; that number will be 15 percent in medium-sized cities and 10 percent in small cities. Over 80 million square meters of building space will be powered using solar and other renewable energies.

If China follows the sustainability plan announced by Minister Qiu, the country will essentially commit itself to reconstructing a sizable portion of its built environment. In fact, China would embark on one of the largest rebuilding projects in world history.

We shouldn't underestimate just how far China has yet to go. With well over a billion people, and an economy that grew 9% last year, China's future is of direct consequence to every person on the planet, and China's current path is deeply unsustainable. It is already one of the world's largest polluters, and faces truly monumental environmental challenges, challenges perhaps too large to be entirely overcome. That said, moves like this make us optimistic that a bright green China is still possible.

China has been developing rapidly in recent years, where the urbanization process is stronger than ever. Today, more than one-third of the population lives in cities, and the proportion continues to increase year by year. Within another thirty year, nearly two-thirds of China’s citizens will live in cities, a rise from approximately 460 million to 900 million (Friedmann, ix).

According to Friedmann, the most dramatic story of China’s urban transformation during the past twenty-five years has been how significant portions of the country’s rural
areas have become “urban” in the many meanings of this term. The result of these changes has been the creation of a new urban form in the urban field (Friedmann, 33).

The Chinese rural villages are most influenced by the urban transition process. Those villages are located either adjacent to or within the new urban areas. With the high density new development next to them, those villages have been transformed not only economically but also socially and spatially. Traditional culture is also affected by the transformation process. The number of such villages is substantial.

In the process of urban transformation, sustainable development has been one of the most important tasks of the Chinese. As the cities are expanding so fast, how to protect the environment and natural resources, improve economic conditions, and protect traditional culture are really significant to the development of every city. The Chinese government especially wants to keep the traditional rural urban form of the rural villages because as the new developments expand and transform themselves, rural traditions are also lost. This research will look at the new urban form – urban village – in urban China, specifically in Anyang.

Much research has been carried out to investigate the urban transition and sustainable development in China. The work mainly discusses issues related to the sustainable development of the new planned and old urban area in general. However, the task given by the Anyang officials is very specific, and it needs specific guidelines as well as a design. This is a sustainable site design for the urban villages with respect to the traditional urban form. Reserving the traditional urban form is also a significant task in preserving the traditional culture.
The revitalization of livable, environmentally healthy and prosperous rural villages is a priority for China.

This research determines how the goals of those urban villages can be achieved through sustainable site design. The research does not look at all the three dimensions of sustainable development (environmental, economic, and social and cultural issues), but focuses on how sustainable site design can help the villages sustain themselves within the urban conditions of Anyang. The thesis focuses on the contemporary sustainable design principles for the built environment, with regard to issues such as density of new development, landscape and ecology, form and layout of development, the affect of sunlight and shade...etc.

1.2.Background

Anyang is situated in the north edge of Henan province and at the junction of Shanxi, Hebei, and Henan provinces. The Anyang administrative area is 7,413 square kilometers with a population of 5,338,000. Anyang city has a built-up area of 95 square kilometers and urban land of 72 square kilometers with a population of 826,000.

In the master plan for Anyang for the year 2020, the city expands to the east. The New Eastern District of Anyang will be developed with a population of 300,000 over approximately 27 square kilometers in area.

The city of Anyang is planned to expand mainly toward the east with the modest development to the west. In 2007, the City of Anyang hired the School of Planning, University of Cincinnati, to work on a conceptual plan for this Eastern New Town of Anyang, to be located over a rural area. In the planned new development, all the existing villages could
be wiped out and replaced by new development. However, the Anyang officials do not want to totally replace the villages. As sustainable development is the theme for the new development, they want to keep the traditional urban form of the villages so that the social and cultural life of the villages will be preserved. As discussed in many meetings between the Anyang officials and the School of Planning, the requirements of Anyang officials are: sustainable development/ green development; preserving traditional urban form of the rural villages; creating a smooth transition between urban and rural areas by rural village design; and replacing existing buildings with new buildings using green technology.

In this context, this thesis topic “Application of sustainable design principles to urban development: The case of the urban villages of the New Eastern District of Anyang, China” is derived from the ideas of the Anyang officials. It is to promote sustainable development while preserving the local vernacular and culture.

1.3. Significance

In the book *Urban Design Future* by Malcolm Moor, it is said that we are now moving toward the third urban design future. Before this future, we will have gone through different theories and approaches. The first generation, according to Moor, is “democratic urban design”. The second one is the “urban design of traditional value”, which concentrates on physical aspects. In the third generation, urban design will seek solutions to resolve the issues between the increasing demands for environmentally responsible development and traditional townscape. In UK, for example, many local governments have started to demand major changes in energy efficiency from developers proposing settlements, while at the same time, requiring adherence to local vernacular identities. New sustainable design principles
such as solar orientation, different material resources, or the use of sustainable elements like solar panels, however, require new morphologies and typologies for sites and buildings. The challenge for urban designers is obvious: establishing the balance between sustainable design and traditional and vernacular urban design and architecture to create a new townscape. (Moor, 187)

It is also stated in *Urban Design Future* that the ground rules of urban design are now changing. Urban design no longer follows a traditional agenda and set of design rules. The new agenda for urban design is uncertain and challenging. That uncertainty, according to Moor, however, is an “interesting issue”, because “whereas the concept of branding is about creating certainty and uniformity, the dissection of layers of the city and their interdependencies, promote uncertainty, and the need for flexibility” (Moor, 187). Urban design today requires a more dynamic approach, which explores issues of changes and still preserves the local identities. This approach requires urban design to have a flexible guiding set of principles depending upon the local.

Coming to the case of China, the importance of the integration between sustainable design and the local vernacular is obvious. As the urban development in China is getting stronger and occurring faster, a large amount of rural villages have been transformed into an “urban” look with large blocks, and multistory apartment buildings. This transformation can destroy the social and cultural identity of the rural villages. While providing housing and promoting development, China has forgotten its vernacular identities. Trying to apply sustainable technology alone is not enough for sustainable development. Local factors and identities need to be preserved and enhanced. That is real sustainable development, and that is what Moor called the future of urban design.
The future of urban design will be the integration between culture and sustainability. In China, new developments have been replacing rural villages. The big question is whether to wipe out rural villages for new developments or to incorporate them. The answer is that the rural villages can be fixed. Constructing new developments does not necessarily mean to build from scratch. The traditional urban design principles of the rural villages still can be applied to the new developments to create an urbanized version of the rural villages. This is what the author tries to do in this research.

This research tries to bring a new look at urban form for those urban villages. Those villages still can develop following new development, but still keep the traditional form and sustainable development. In the future, planners who are carrying out urban design/planning project in China can look at the sustainable design principles for the built environment for the urban villages for reference. Also, the application of this type of design for one urban village helps in visualizing the concepts and principles.

In term of significance, this research can be considered as an application of the principles of the new urban design generation. According to Moor, the environmentally responsible development and traditional townscape are of balancing importance. They need to be put together in a design, and urban designers should be responsible for all of that.

1.4.Methodology

The methodology used in this research is mostly qualitative.

In order to achieve the anticipated results which are the proposed sustainable design principles for the urban villages of Anyang, a literature review is conducted and case studies are reviewed. Literature review will provide the basis knowledge of sustainable design
principles and the traditional townscape, form, and typologies of the rural villages of China. It is composed of two main parts: a discussion of traditional urban form of the rural villages of China (Chapter 2); and a review of the contemporary sustainable design principles and standards in an urban context (Chapter 3).

Chapter 2 focuses on the traditional urban form of the rural villages of China. The layout, size, form and building typologies of the rural villages are investigated. The urban design principles behind them are researched in order to understand the factors that contribute to create the traditional townscape. Data and documents for this part are derived from both literature and visual analysis of the urban villages through maps and images.

Chapter 3 researches contemporary sustainable site design principles in general. The issues looked at are the sustainable principles for density, form and layout, energy, water, landscape and ecology... Data and documents for this part are derived from literature.

After the literature review, case studies which focus on the sustainable design of some communities in US, UK, and China provide more details about the actual design framework, successes as well as lessons from the designs. This part researches sustainable design projects that have been carried out in different parts of the world in order to bring a more international view of sustainable design to the thesis. Village Homes in US, Telford Millennium Community in UK, Longju Sustainable Village and Huangbaiu Village in China will be investigated in Chapter 4.

In chapter 5, the relationship between traditional urban design principles and contemporary sustainable design principles are analyzed in order to find the appropriate principles to be applied in the case of Anyang. All the elements that contribute to the traditional townscape of the rural villages of Anyang are listed, and so are the ones of
contemporary sustainable design principles. It is useful to compare those elements in order to find out what traditional factors can be kept and what should be adjusted to fit in the new sustainable urban context. A set of proposed design principles is the anticipated result and is presented in this chapter.

In Chapter 6, an application design is presented, applying all the proposed design principles from the previous chapter. One village of Anyang is designed according to these principles to visualize them. The site of the urban village is chosen based on the design of the Anyang Urban Studio in School of Planning. Data are collected from both literature and project documents of the City of Anyang planning office and the School of Planning. This design demonstrates that the principles can work well and still provide the traditional aesthetic value for the new development.

The overall methodology can be illustrated by the following diagram:

*Figure 1: Methodology Diagram*
Chapter 2: Research on the traditional form of the rural villages in Anyang

The result of this thesis is a proposal for a set of sustainable design principles for the urban villages of Anyang. Those principles are able to guide the local government or urban designers practicing in Anyang toward sustainable development while preserving the local vernacular and identities. In order to do so, the first thing that needed to be looked at is the traditional from of the rural villages. In this chapter, the identities and features of the rural villages of Anyang based on its local context are discussed. Then, the traditional urban design principles – how the Chinese got their urban and building forms – are investigated and discussed. Those principles are as important as contemporary ones because they are local knowledge which has been experienced by local residents over a long period of time. This kind of knowledge is very helpful for modern urban design and can assist in preserving the identity of a place.

2.1. The context of the rural villages of Anyang

Geographically, China is a very big country. Therefore, the environmental and cultural landscapes of Chinese villages are very diverse and varied throughout the country. It is said that even when passing a province, the villages can be very few and far between in some places, but more populous and entirely changed in others. Villages are usually dense and large near the river or canal (Knapp, 1). Diversity is a feature of rural villages in China. Rural villages can be very large and compact in some regions and isolated in others. The definite regional patterns of the rural villages have a long history and reflect the physical and social diversity of China. (Knapp, 13). According to Knapp, the landscape of China includes three
main systems, among which there are several sub-regions. The criteria to divide Chinese rural settlements into regions include: (1) elements of settlement structure: settlement patterns, scale, density, housing forms, and general sociocultural characteristics; (2) the relationship between settlements and the natural environment; and (3) economic functions of the village settlements, especially their relationships to land use and agriculture production. (Knapp, 20)

Using these criteria, we can see that Anyang belongs to the North China Plain Rural Settlement Region. The characteristics of the settlement system are the following:

- Major house types: houses with flat roof and courtyard (kang).
- Scale: small, medium, large.
- Density: generally dense.
- Major form: compact.
- Environment: continental, and
- Agriculture: wheat and hardy grain. (Knapp, 22).

The North China Plain Rural Settlement Region is one of the oldest regions in China (Knapp, 25). The characteristics of the climate of this region are hot summers and cold winters, with precipitation about 800 millimeters. Dryland crops, mostly wheat and hardy grains, and cotton, are the most dominant agricultural products (Knapp, 25). Villages throughout this region are large and very compact.

Villages in the North China Plain Rural Settlement Region are mostly agriculture villages. However, non-agriculture activities also play important roles in the formation of settlements. The large scale villages have a farm-based economy but commercial sector is also growing and becoming a substantial one. Commercial activity is usually located along both sides of a street. Shops are open daily. Another distinctive characteristic of rural villages is that the fair are held periodically. (Knapp, 14)
2.2. Village size, form and shape

The layout of the rural villages of China ranges from a tight cluster to isolated dwellings. Two identified morphological forms are the nucleated villages and dispersed villages. The rural villages of Anyang have the compact form, which is one of nucleated form types.

Within the nucleated villages, buildings (residential and nonresidential) are built close together to form a compact settlement cluster. This form is really compact. The compactness can be observed through the absence of green spaces and even space between dwellings. There is almost no space between buildings. All buildings are close together and just when one gets out of the village one can see the rural farmlands and green space. The roads are narrow and there is no separate sidewalk. The above characteristics can be seen in Figure 2. The first image in Figure 2 shows the entire plan of an existing village of Anyang. One can observe the density and the orientation of the village. The second image shows a closer view with a main road running in an east-west direction, while other internal roads are very small and alley-like. There is no open space in-between. One can also see that most of the houses in the rural villages are either courtyard housing or uncompleted courtyard housing facing south.

According to Li Wei (Knapp, 14), the compact villages have a generally circular shape that may appear as an irregular polygon. Usually, the east-west axis is the main, longer one, and the north-south axis varies a little in length. The villages are always located near the center of cropland. This is the most common rural settlement of China.
Compact villages have some advantages as well as disadvantages. The advantages are that people live very close to each other. Houses and roads are compactly organized. The spaces between buildings can serve as community spaces. This form is very relevant to new urbanism in the sense that it encourages compact development, and thus saves a lot of land for the villages. However, the disadvantages are that the villages are overcrowded and the distance from farmland, in the case of large villages, is far. Also, those villages grew spontaneously in an organic form without planning; their internal arrangement is often in disorder. The most important problems are ones of ventilation, sunshine, and drainage, and also the disputes among neighbors caused by those problems. (Knapp, 15)

Villages in China are different not only in shape but also in size, mostly because of topography. Li Wei outlined that small villages have a population less than 200, medium-size villages between 200 and 1000, and large size villages have a population excess 1000. Large villages are usually located in the north plain region. The large villages often have from 200 to 300 household, and sometimes exceed 500 households. Each household has five to six people. Such a large village usually conforms to an administrative unit. Within the villages,
one can find a number of commercial uses with a limited variety of shops and services, and also an elementary school.

Figure 3: Some images of rural villages of Anyang
(Source: School of Planning, University of Cincinnati)
Looking at Figure 3, which shows the typical images of the existing rural villages of Anyang, one can see that the rural villages are considered as gated communities with their own entrances. The pictures also show different types of roads within the rural villages. All the roads, even the major ones, are quite narrow compared to those within the city. They all have no sidewalk. All vehicles, including cars, motorbikes, bikes, and even pedestrians, use the same spaces to travel. However, the narrow alleys bring the neighborhood closer; and the roads with two rows of big trees and landscape along the two sides look very nice and peaceful. They have contributed to creating a sense of place for the rural villages of Anyang. In developing guiding principles, it is important to consider all the above aspects.

2.3. Village dwelling form

The dwelling form of Anyang villages is characterized by Siheyuan, a quadrangle with buildings on four sides surrounding a large courtyard (Knapp, 26). The buildings are oriented toward the south. Each complex is quite symmetrical and has a clear axis. The main building in the complex is the one in the rear facing south. Each building is broader than it is deep.
Usually it is divided into three bays (*jian*). Nevertheless, because of economic conditions, many of the village dwellings have just a simple rectangle shape with no courtyard, or the courtyards are not completed.

*Figure 4: Aerial image and bird-eye view of courtyard housing in North China*

*Source: www.synotrip.com/forum/getattachment?attach=378*

### 2.4. Village Fengshui principle

Fengshui, which is a set of theories and practices, has been used in China to probe the landscape and to create the built environment through the assessment of the configuration of mountains and waters. Fengshui has shaped not only cities but also villages, every human settlement in China. This section explores the fundamental ideas and structure of Fengshui as it has shaped the patterns and forms of the rural villages and has a significant role in the Chinese built environment.

How can we make communities, buildings, and landscapes more socially and environmentally responsive has always been the question of urban designers and architects through time. Contemporary urban design solutions include urban infrastructure, increasing population density, and conserving open space...; or considering natural processes as a model
for human action. This growing question actually had been answered by the Chinese in early time. Throughout their history, the Chinese have always thought of the relationship between human destiny and the natural environment, and tried to balance that relationship. The built environment – or the human-made environment – should impact as little as possible on the natural environment and, if the construction brings negative impacts to nature, there will be possibly negative consequences on human society.

Early Chinese were engaged mainly in agricultural production, and viewed the city as a marketing and administrative center. They viewed the entire city as a whole and cohesive monument. Throughout their history, the Chinese have applied their distinct philosophical and practical views of the human-made and the natural environments. Since Chinese society was traditionally agricultural, natural environments were a significant factor in the life of the whole society. Historically, Chinese culture viewed humans and nature within a unity of one system. The Chinese believed that the survival of humans depended on the survival of nature. The sense of nature was significantly important in urban design and human-made objects. Natural forms and environments existed in harmony, and contributed to a feeling of tranquility and, therefore, enhanced the quality of social life. (Golany, 35)

Unlike the Western views of environmental design, which suggest detachment form the immediate natural environment, Chinese urban design emphasized that a society attached by proximity to the local natural resources necessary for its survival must be concerned with the well being of its natural environment, evolving with it but not against it. While modern Western architecture and urban design are imposed upon and are alien to the immediate environment (Golany, 37), the traditional Chinese urban environment looked for harmony with nature and the establishment of a human-made environment and a natural environment.
**The root of Fengshui**

*Fengshui* had been an important urban design theory in China. It had great influence, not only on human life, but also on site selection and the site design of dwelling, city and villages. This was a system of geomancy to bring the placement of a grave, dwelling, neighborhood or city into harmony with natural forces. *Fengshui* means wind and water (Feng = wind; shui = water). This system is interpreted as “the Chinese art of placement”. Feng shui has contributed a great deal to village site selection and design.

Fengshui has its roots in an agrarian society, in which heaven, soil production, fertility cycles and all natural phenomena were the basis of human consciousness (Golany, 54). Fengshui combined a series of related elements such as folk beliefs, sciences, and religious beliefs. Those elements were integrated into the trinity of heaven, the earth as the balanced natural landscape, and humans. The earth and its natural elements formed a cosmic power that controlled the destiny of humans. Fengshui was to achieve the survival for humans and nature. Therefore, the future of humans depended on the earth’s equilibrium and also the cosmos. One can say that Fengshui was “an interpretation of the natural and ecological balance of earth and heaven, on which human existence is deeply dependent” (Golany, 54).

**The principles of Fengshui**

Basically, Fengshui was grounded on the integration of number symbols, the five elements (wood, fire, earth, metal, and water), and the forces of Yin and Yang. The Chinese throughout their history have been described the dynamics of every single human and natural phenomenon according to the mysterious forces of Fengshui. Before selecting any site for city, palace, or even dwelling, Fengshui was the first principle that was taken into consideration. The highest concern was the design layout, site selection, and the orientation of
the structures within the site and the surrounding physical elements. It was considered that the South was the source of blessings from the universe whereas North was the source of bad wind (Golany, 55).

It was believed that different sites and orientations of sites could bring different destiny for people living within them. Therefore, the fortune of humans depended on their relationship with natural forces. Through site selection, humans could change their destiny, and through site design, humans could receive blessings from the universe. Fengshui has been applied for both living and dead human. The former was very similar to contemporary environmental design principles, because it was rooted in the idea of preservation and enhancement of the natural environment (Golany, 56). A lot of principles have been used up to the modern era. For example, buildings and dwelling should be uphill and facing south in order to receive more sunlight and good wind, and also avoid flood. The land at the foot of the hill should be utilized for agriculture. The Fengshui experts analyzed the elements of the physical environment to select the site and place the built environment onto it. Usually, the principles which are still in use today have their roots in science rather than just folk or religious beliefs.

Nevertheless, Fengshui focused on the shapes of landscape and buildings, and incorporated many folk beliefs. The beliefs derived from the concept that because the built environment altered the physical environment, and thus affected the relationship between humans and nature, that it should be undertaken with knowledge of the possible consequences (Golany, 57)

The energy of the site was also very important in site selection. The active energy that flows through the earth is called Qi. According to Golany, this energy is noticeable on every
level and affects humans, agriculture and the climate directly. In humans, Qi is the energy that flows through the body; in agriculture, Qi is the force that causes fertile crops; in weather, Qi is carried by wind and water (feng and shui). This concept is also explored in modern science. Contemporary scientists recognized that the magnetic field of the earth can be traced to electric currents that emanate electromagnetic activities flowing from the earth into the atmosphere (Golany, 58). It is really hard to translate Qi into English since there is no equivalent word with the same meaning.

Wind was another important aspect of Fengshui. In site selection, according to Fengshui principles, the site should not be exposed to heavy wind. However, if there is no wind, the site is also undesirable because it is not good for human health.

According to Golany, the basic rules of Fengshui are the following:

- Buildings and towns should be placed on sloping or well-drained land;
- Buildings and towns should be protected by a mountain or belt of trees from the chilly north wind, which also bring bad energy (Qi);
- Cemeteries should face south, so that the dead face the living;
- All building entrances should face south, which is the direction of good Qi, warm winds, and sunshine;
- Building inside a horseshoe form of hills ensures the greatest flow of good Qi;
- A female or Yin site (gently rolling terrain) combined with an elevated spot (male or Yang) is most propitious. Flat land is not desirable. (The pragmatic reason: it is subject to flooding);
- Qi – good and bad – travels fastest along straight watercourses, so in order to moderate this, slow-running, curving streams or river a better building sites; and
- Strong winds scatter Qi, so a site with moderate wind is the best (Golany, 58).

The general rules for a house were the following:

- The living-room should be in the center of the house, the kitchen in the east or southeast, and the master bedroom at the head of the living-room (north of it);
- The house-lot should be rectangular, not square;
- Roads should lie to the east of the house, and building a house at a T-junction was considered to be bad luck;
- A tall building should not overshadow a low building; and
- Houses should not be situated over wells; a tree in front of the house or a stream running across the lot was considered to be not auspicious. (Golany, 59).

Many Chinese villages today were given form by Fengshui. The components of Fengshui can be seen at the scale of individual houses or villages or cities. From the above rules, one can see that Fengshui combined a number of criteria that dealt with the speculation, magic, and observation of environmental phenomena. Fengshui has helped in creating a lot of picturesque patterns in many Chinese villages and helped in making ecological decisions by the Chinese people. The principles of Fengshui for site selection and site design, as well as dwelling construction, are very detailed and deal with both the whole site and all its elements. Although Fengshui combined a series of folk beliefs, and religious beliefs, it is the science factor of Fengshui that made it long-lasting and makes it still helpful for contemporary urban and environmental design.

2.5. Conclusion

This chapter has explored the characteristics of Chinese rural villages. As the result of this thesis is a set of sustainable design principles for the urban villages of Anyang with regards to the traditional form and identity, it is important to understand the characteristic and structures of the rural villages. Sustainable design principles can not be successful without the careful consideration of local identities. The new design should consider the compactness of the villages, the dwelling typologies, and social structure of the rural villages with respect to Fengshui principles. The new design must reflect the sense of place of the traditional villages, while still developing them in a sustainable direction.
Chapter 3: Sustainable design principles for the built environment in urban context

3.1. Theories behind sustainable design for the built environment

The idea of sustainable design became strong in the early 1990s (Van der Ryn, 3), and has been becoming more and more significant along with the need to preserve natural resources and environments. Recently, there have been a lot of available reference standards for sustainable design. Design handbooks such as LEED Guidelines, The Toronto Green Standards 2006, or a number of similar standard systems in Europe give very detailed standards, case studies, charts, tables, etc, and have been very useful in guiding the construction activities and design of sustainable development. However, to get to this point, all of the above standard systems have their foundations and roots in the basis for sustainable development and theories of ecological design. These theories, which investigate the relationship between the built environment and ecology and the fundamental principles of environmental design, are the basis for later design guidelines and standards and provide the context for sustainable design. This section discusses these theories as developed by several notable urban designers and architects.

3.1.1. The basis for sustainable development

According to Sim van der Ryn and Peter Calthorpe in their book Sustainable Communities, sustainability refers that “the use of energy and materials in an urban area should be in balance with what the region can supply continuously through natural processes such as photo synthesis, biological decomposition, and the biochemical processes that support life.” (Van der Ryn and Calthorpe, ix) Sustainability therefore can help in reducing the energy budget for cities. New urban technologies can become less dependent on fossil fuels and rely
more on integration with biological processes. A sustainable community requires less of its inhabitants in time, wealth and maintenance, and demands less of its environment in land, water, soil, and fuel. Sustainable communities therefore should aim for a balance between local and regional integrity and trade on a global basis. (van der Ryn and Calthorpe, ix)

The idea of sustainability of van der Ryn and Calthorpe is the same as those of other sustainable designers. Judy Corbett and Michael Corbett, the designers of Village Homes, a sustainable subdivision, also mention that to design a sustainable community, some assumptions should be made. They are:

1. Every living thing survives by numerous and subtle relationships with all living things and with the inanimate environment; (Corbett, 53)
2. Ecosystems and parts of ecosystems composed of a wide variety of species tend to adapt better to environmental changes or human tampering than do those composed of fewer species; (Corbett, 54)
3. Part of the ecosystem is a complex system of energy transfers that depends, ultimately, on energy input; (Corbett, 55)
4. In the long run, every one of humanity’s physical needs must be satisfied either without the use of nonrenewable resources or through recovery and reuse of those resources; (Corbett, 55)
5. Although humans seem to be the most adaptable of living things, we still have certain inherent physical and psychological needs that must be met by the ecosystem, the human-made physical environment, and the social environment; (Corbett, 56)
6. Humans are for the most part genetically adapted to the environment that existed from about 200 to 20,000 years ago. This adaptation involves not just our physical makeup but also our modes of perception and behavior and relates to the social environment as well as the physical environment; (Corbett, 57)
7. The relationship between people and the environment goes both ways: humanity both shapes and is shaped by its environment; and (Corbett, 58)
8. Humans can adapt to a wide range of environmental conditions, but the result of adaptation to inhospitable conditions is temporary or chronic stress; (Corbett, 59)"

The above assumptions are the basis of sustainable design. They emphasize the strong relationship between each living thing and the surrounding environment, the need of renewable energy resources, and the mutual relationships between people and the natural environment: the human world shapes and is shaped by its natural environment.
William McDonough, an innovative architect emphasizing green design, also has created his own design framework for sustainable design. His design framework, “Cradle to Cradle”, is a revolutionary approach comparing itself to the Cradle to Grave Legacy. The Cradle to Cradle Design Framework rejects the assumption that human industry destroys the natural environment. Instead, it embraces abundance, human ingenuity, and positive aspirations. According to the Cradle to Cradle Design Framework, an industry can purify air, water and soil, and create positive effects on the natural environment, not damage ecosystems or social systems. A new strategy called eco-effectiveness proposes three basic principles: waste equals food, use current solar income, and respect diversity. Overall, this design framework is based on the idea of balances, which is similar to the theory of Sim Van der Ryn and Peter Calthorpe.

In conclusion, one can see that although there are many theories of sustainable design, in nature, they have a common basis. The basis for sustainable design should be the ability of humans to integrate with the natural environment. People use natural resources but also increase and improve them, so that both people and nature can be healthy and well-being.

3.1.2. Five principles of ecological design

Based on the foundation of sustainable design and focusing more on the environmental aspects, ecological design can help in promoting the healthy and mutual relationship between the human and natural environments. This section discusses the five principles of ecological design by Sim van der Ryn, which can be considered as the very first foundation for later sustainable design principles and standards. Those principles, instead of setting up standards with numbers and charts, propose the theory behind the environmental design aspect of sustainability.
Ecological design, as defined by Sim van der Ryn in his book *Ecological Design*, is “any form of design that minimizes environmentally destructive impacts by integrating itself with living process” (van der Ryn, x). Ecological design connects green architecture, sustainable agriculture, ecological engineering and other fields (van der Ryn, x). By considering the conservation of natural resources, habitat, and minimizing energy use, ecological design can foster the development of a healthy community.

In his book, Sim van der Ryn proposed five principles that, according to him, are the fundamentals of ecological design. Those are: (1) solutions grow from place; (2) ecological accounting inform design; (3) design with nature; (4) everyone is a designer; and (5) make nature visible. These principles are starting points, which investigate the important factors in ecological design.

The first principle, “solutions grow from place”, emphasizes the significance of local factors in ecological design. Local factors are understood as local residents, local culture and knowledge, and local context. Knowing the details of local context is very important. Many of the most beautiful and appropriate homes have been built by non-architects because as they lived on the site, they learned about the peculiarities of their site. Therefore, they were able to develop the precise knowledge of place and construct their homes to respond to the particular context. (van der Ryn, 53)

Traditional cultures have strong relationships to the ecosystem. Van der Ryn mentioned that since local cultures are bound to a particular piece of land, actions have local consequences rather than global consequences (van der Ryn, 62). On the other hand, as urban design today is concerned more about sitemaking than placemaking, preserving the natural environment of a place can help in creating a sense of place. Not only does the natural
environment shape the built environment, it also shapes the daily activities of local resident. Therefore, protecting the natural environment and integrating the built environment with natural ecology also means conserving the sense of place and the connection of people to the place where they live.

Local knowledge is very valuable to ecological design because it provides specific information about everything that together creates the texture and identities of a place. Knowledge of climate, plants, trees, natural habitat, etc, is critical in design if one wants to preserve the natural environment and minimize the impacts of construction to the habitat. (van der Ryn, 64) This knowledge is earned through daily activities of residents and their experiences of local natural environment.

Local factors are significantly important in urban design because the design of the human habitat usually is limited to local resources and approaches. Although in the modern era, construction material hauling is much simpler than it was in the past, local resources are still dominant. In terms of design, buildings and neighborhoods tend to follow patterns that are best adapted to local conditions (van der Ryn, 69). Ecological design, therefore, begins with the particularities of place such as the climate, topography, soils, water, energy and materials, etc. A good design is one that can integrate the design with local conditions, and hence preserve ecological structure of a place (van der Ryn, 72). Ecological design, therefore, is different from place to place depending upon their particularities. That, nevertheless, does not mean that ecological design just has local values. Ecological design goals should be met in regional as well as the global level, with strong emphasis on the local context. (van der Ryn, 74)
The second principle “ecological accounting informs design” emphasizes the need to develop a way to recycle human wastes. Ecological design should be done with careful consideration of ecological costs, from resource depletion to pollution and habitat destruction. The ecological impacts of every built environment should be thoroughly understood in order to achieve ecological design. (van der Ryn, 54)

The third principle, “design with nature”, considers the way to reduce the ecological impacts of the built environment by working with the “living work”, considering that in nature, materials are continuously broken into their basic components and rebuilt into new living forms. (van der Ryn, 55) Also, in ecological systems, waste equals food. An example is that vegetation can transform water, carbon dioxide and sunlight into sugars, and these sugars are broken back down by other species. (van der Ryn, 107) For ecological design, a community should live in close association with nature and process its own wastes and cycle its nutrient.

The fourth principle “everyone is a designer” emphasizes the connection among different people within the community. A design should fulfill the needs a particular community of people with shared values and circumstances. (van der Ryn, 56)

The last principle, “make nature visible”, is based on the idea that ecological system should be visible so that people will feel more connected to it. Many people, especially the ones who live in cities, do not really have a connection to nature just because it is hidden from their everyday awareness. (van der Ryn, 161) Ecological design can transform that awareness of people by making nature visible, thereby calling for the participation and involvement of people in conserving the natural environment. “Ecological design brings us back to the wider living community, waking us again to the patterns of wind and rain, the sources of our food,
and the life-cycles of our materials. It illuminates the very flow that sustains us.” (van der Ryn, 162) Ecological design can create an environment nurturing both the human spirit and the more-than-human living world. (van der Ryn, 171)

3.2. Sustainable communities in an urban context

The first section of this chapter discussed the basis of sustainable design, which is the mutual relationship between humans and nature, the need to find renewable resources, the Cradle to Cradle Design Framework and so forth. The second part, going into more detail of the environmental aspects of sustainable design, focused on the principles of ecological design, which emphasize local factors (climate, people, knowledge, etc.) and the approaches to bring nature into human life. This part, going a little further, discusses what makes a community sustainable, which is a broader issue because it relates not only to environmental but also social issues of urban design.

This thesis focuses on sustainable design principles in an urban context. In the book Sustainable Communities, van der Ryn and Calthorpe proposed a system of sustainable principles in both urban and suburban context through both literature and case studies. According to Calthorpe, the city, on the one hand symbolizes the congestion, pollution, and waste that modern culture has created, and, on the other, a compact alternative to the constant invasion of open space represented by modern sprawl. The traditional pattern of the city, which had pedestrian streets, a public transit system, human scale city blocks, mixed use and a lot of public space, had a human dimension in terms of both environmental and social views. (van der Ryn and Calthorpe, 1)
Because of the human dimensions of the traditional form of the city, one must adjust them so that they can be more appropriate to the modern urban context. With new knowledge about sustainable design principles and standards, and new techniques for transportation, utilities and service, the major challenge for sustainable design in an urban context is to choose the relevant elements from tradition. It is possible to do that, especially in an urban context. Character of cities in the old tradition, such as dense cores, diversity in term of culture and economic activities, a pedestrian network, accessibility and the mix of local commerce, etc, are the important ones that still are appropriate for urban context. According to Calthorpe, strategies which can be used to achieve traditional city form in modern context encompass, but are not limited to, constructing new buildings on vacant lots, rehabilitating old buildings, adding new workplaces, retail areas or open spaces as needed. The most important thing that should be taken into consideration is to balance uses, climates and the needs of the building, community and the individual. (van der Ryn and Calthorpe, 2)

Calthorpe has presented a case study “Sacramento: Transforming the Urban Tissue” to illustrate his idea of a sustainable community in the urban context. The “urban village” plan in Sacramento emphasizes conservation and diversity. Conservation, in this case, means more than energy saving, but conserving the older qualities of the city which are a mix of housing, local commercial stores, and small offices. The plan develops low-rise housing along with rehabilitating existing housing and construction of new energy-efficient office buildings. The diversity issue is addressed by adding new housing for all income levels along with local restaurants and service retail. Workers therefore can live near their jobs, reducing the need for commuting. All new buildings use passive solar and climate-responsive design combined with the old ideas of mixed-use neighborhoods. New buildings are designed so that they could be
compatible with the old ones; therefore they can contribute to the urban context as a whole, and not simply be free standing objects. In that way, the scale and identity of a place could be maintained. (van der Ryn and Calthorpe, 7)

The plan of Sacramento reflected the old pattern of urban Sacramento with large detached dwellings, mid-block alleys, and commercial corners. Three scales are offered: 3.5 stories, 2 story townhouses, and a row of detached apartment buildings. Landscape spaces are designed so that they were various and able to provide for recreational privacy and cooling microclimate effects. To maximize the use of passive solar, the buildings are oriented to the south and are spaced to allow winter solar access to each unit. Features of passive solar are architectural details such as canvas shades, balcony overhangs, night insulation curtains, etc. (van der Ryn and Calthorpe, 7)

Not only focusing on environmental aspects, sustainable communities also emphasize community activities and street life by configuring community spaces and street blocks. Safety does not mean turning away from the street. In contrast, sustainable communities should attempt to reinforce street identity and activities. Design strategies and elements such as housing entrances, overlooking balconies, corner commercial stores and restaurants, and landscape street side sitting areas can contribute to the life and safety of the streets. The street spaces; thus, are more defined and become public spaces that reinforce community social life and relationships. (van der Ryn and Calthorpe, 8)

In terms of walkability, pedestrian life should be made possible again. Because walking can help in reducing energy, land demand, and pollution, pedestrian life should be made interesting and comfortable. Trees work well for pedestrians by providing shade in the summer and improving air quality by evapotranspiration. For walking to be interesting,
providing stores along street can attract more people and therefore bring activities closer together. (van der Ryn and Calthorpe, 11)

Furthermore, the structure of the block is as important as the street spaces. In the modern urban context, public space is not the only open space in city. Private open space and semiprivate zones are also as important. In the Sacramento plan, the interior streets are narrow and constantly interrupted by pedestrian bumps. Those streets are alley-like, thereby becoming more private and enjoyable places for residents and children to get together. They are also safer than larger streets. (van der Ryn and Calthorpe, 13)

In terms of energy efficiency, providing sunlight, good ventilation, adequate daylighting, sensitive landscape, etc, can not only conserve energy but also improve the quality of life and health of people. Design strategies should be compatible with the local climate. Doing so can also help in creating an identity for a place.

In conclusion, what makes a sustainable community in an urban context includes not only environmental design, and energy effective design strategies, but also the configuration and the structure of public space and street life to connect the social life of residents. There are many design strategies to achieve sustainable design, which are discussed in the next section. This part just want to discusses what factors can affect the sustainability of a community and how to coordinate them by design.

3.3. Contemporary sustainable design principles and standards for the built environment in an urban context

3.3.1. Overview
In an urban context, the built environment has a significant environmental impact on nature. By using appropriate design strategies, negative impacts can be reduced and positive ones can be increased. Urban design strategies can encompass a wide range of issues, including size, location, nature and type, density, quality and the disturbance of the built environment to the local ecology and landscape, as well as the local climate factor. (Pitts, 32) This section discusses some sustainable design strategies, which are popularly employed by urban designers and architects in North America and Europe. They include, but are not limited to LEED, Toronto Green Development Standards, the HOK Guidebook to Sustainable Design and the Building Future’s Design Principles. Issues that are discussed in this section are the ones that should be taken into consideration when attempting sustainable design. They are the factors that can be manipulated through urban design, such as: location, form, layout and orientation; water efficiency; energy conservation; air quality; material and resources; landscape and ecology; site design issues; and building typologies.

LEED, Toronto Green Development Standards, and HOK Sustainable Design guidelines are the sets of targets, principles, and practices to guide new development and encourage sustainable development. All these sets of standards are rooted in environmental design, and set principles to achieve it. These include promoting: better air quality; reduce greenhouse gas emissions and urban heat island effect; greater energy efficiency; improved water quality and water efficiency; less solid waste; protection of the urban forest and wildlife habitat; and reducing light pollution. (Toronto Green Development Standards)

### 3.3.2. Location, form, layout, orientation, and configuration

This section discusses the relationship between location, form, layout and orientation and sustainable design. The key determinant is whether the development occupies new land
separate from existing urban areas, adjacent to existing urban areas, or within existing urban areas. Ecological, topographical, and geological factors of the development site are important factors to be considered. The optimum size of development is also significant because a new urban area may need to be planned at a minimum size to provide sustainability for the local infrastructure (Pitts, 32). Also, in order to reduce the impact on the natural environment and habitat, development footprint should be minimized.

In terms of land use and accessibility, local commercial, retail, and workplace areas should be located so that there is easy access for local residents. The design of mixed-use development in which housing, retail, and commercial uses are planned to be close to each other is a good approach. In term of block structure, different activities should be combined at different levels within each block to enhance social interaction and also still offer access to green outdoor space. (Pitts, 71)

The shape and size of buildings and blocks also have a significant effect on the natural environment. To maximize passive solar heating and saving energy, the design of the site and building should take into consideration the local climate, the surrounding environment, the orientation of the building and assessment of the impact on sunlight, shade, air flow, and other factors. Orientation, spacing, distance, and scale are important factors to be considered. (Pitts, 71)

Block arrangements also have impacts on environmental design and sustainability. The orientation and style of blocks should not be too rigid. It would be better to optimize design to allow a southerly aspect (i.e., the longer dimension of a rectangular block follows an east-west direction). (Pitts, 71)
In LEED Guidelines for New Construction, regarding the location, and size of site, credits are given to new development within existing urban areas to protect greenfields and preserve the habitat and natural resources. Preference should be given to urban sites with pedestrian access to a variety of services. (SS Credit 2). Proximity to local services is considered by a half mile radius around the site.

Credit is also given to a project locating within walking distance to bus lines, commuter rail, or a subway station in order to reduce pollution and land development impacts from automobile use. (SS Credit 4.1) With the same intent, the use of alternative transportation with low emitting and fuel efficient vehicles is encouraged. (SS Credit 4.3).

3.3.3. Water efficiency

Water is an important natural resource. To use water efficiently, it is critical to reduce the use of water and especially potable water. In LEED NC v2.2, WE Credit 1.1, it is stated that water use for landscape irrigation should be reduced by at least 50% compared to the baseline. The intent is to limit or eliminate the use of potable water, or other natural surface or subsurface water resources, available. The reductions can be achieved by careful consideration to plant species factor, irrigation efficiency, or the use of captured water, recycled wastewater, or water treated specifically for non-potable use.

Stormwater control is a big issue in sustainable design. Stormwater needs to be controlled in term of both quantity and quality. LEED SS Credit 6.1 and 6.2 mentions the potential strategies and approaches to control stormwater quantity and quality, respectively. The intent of these credits is to limit the disruption of natural water hydrology by reducing impervious cover, increasing on-site infiltration, reducing or eliminating pollution from stormwater runoff, and eliminating contaminants. (SS Credit 6.1) Potential strategies include
designing the project site to maintain natural stormwater flows by promoting infiltration; specifying vegetated roofs, pervious paving, and other measures to minimize impervious surfaces; and the reuse of stormwater volumes generated for non-potable uses such as landscape irrigation, and toilet flushing. In more detail, the effective method to minimize water runoff volume and treatment is to reduce the amount of impervious area, using non-structural measures (vegetated swales, disconnection of impervious areas, and pervious pavement) and/or structural measures (rainwater cistern, treatment devices, etc.). Non-structural methods are more related to site design and can be done by providing a small building footprint, using pervious paving materials, harvesting stormwater for reuse, having a retention pond, green roofs, and so forth. The final purpose is to reduce imperviousness and promote infiltration thereby reducing pollutant loading. In terms of design, sustainable design strategies should be used, including but not limited to designing integrated natural and mechanical treatment systems such as constructed wetlands, vegetated filters, and open channels to treat stormwater runoff.

3.3.4. Energy conservation

The reduction of fuel-based energy and the increasing use of renewable energy resources are a critical issue for sustainable development. According to Pitts, the use of energy in buildings to create a comfortable indoor environment consumes about 50% of primary energy in developed countries. Sites and buildings can all be designed so that they are no longer considered as energy and resource consumers but contributors to the resource system by reducing their energy demands and acting as energy sources themselves. (Pitts, 40)
In order to utilize solar energy, solar access should be available. Sunlight and shade patterns cast by buildings should be considered because they will affect nearby buildings and landscapes. (Pitts, 75)

The scale of buildings and the spacing between them are also very important because over shading should be avoid during winter months. For parallel rows of dwellings, the spacing between rows has an important impact on shading and solar access. It is also critical to consider the slope of the site. Placing individual or low density buildings to the south side of a tall building increases solar access benefits. (Pitts, 75)

3.3.6. Air quality

In Planning and Design Strategies for Sustainability and Profits, Adrian Pitts has mentioned the effects of ventilation. They are very important around the exterior of buildings. In order to reduce the potential for air flow in winter periods, the overall building dimensions should be kept to a minimum to reduce the effect of wind pressures. The larger building dimension should avoid facing into the predominating wind direction. Long parallel rows of relatively smooth-faced buildings should be avoided. Tall buildings should step back with increasing height away from the wind. (Pitts, 76)

3.3.5. Material and resources

Building material choices are important in sustainable design because the extraction, processing and transportation steps required to process them have a great impact on the environment. Material related activities may pollute the air, and water, destroy natural habitats and reduce natural resources. The effective strategies for minimizing environmental impacts of material processing activities might include reusing existing buildings, substituting new
materials with salvaged material, and using local materials to support the local economy and reduce transportation.

In LEED NC v2.2, credits which can be used in sustainable site design are given to strategies such as reuse of material from existing building, using recycled content, and using regional materials. The requirements and standards are based on the ratio of the cost of reuse/recycled/regional material to total material cost. In MR Credit 5.1 “Regional Materials: Extracted, Processed & Manufactured Regionally”, the intent is to increase demand for building materials and products that are extracted and manufactured within the region, thereby supporting the use of indigenous resources and reducing the environmental impacts resulting from transportation. In MR Credit 6, Rapidly Renewable Materials, the intent is to reduce the use and depletion of raw materials and long-cycle renewable materials by replacing them with rapidly renewable materials (MR Credit 6, LEED NC v2.2). Rapidly renewable building materials and products are defined as materials made from plants that are typically harvested within a ten-year or even shorter cycle. They can be bamboo, wool, cotton insulation, agrifiber, linoleum, wheatboard, strawboard, and cork.

3.3.6. Landscape and ecology

Protection and enhancement of land and the ecological system of the site helps to promote a feeling of well-being and also creates a more pleasant place to live. Ecological systems themselves can also contribute to the absorption and recycling of certain waste.

Ecological planning should be carried out with a view to establishing the longer term viability of the area to preserve and enhance the local ecological features. Planting programs for urban trees and space for city farms might be considered where appropriate. (Pitts, 38)
The choice and use of appropriate landscaping techniques around buildings for climatic purpose and as an element of aesthetic design is very important. The measurement and quantification of the benefits to energy or the environment can be derived by considering the effects of shelter and windbreaks on air movement. (Pitts, 73)

Shelter, shading, and windbreaks can be created by topography, and the planting of shrubs and trees, and the construction of walls, fences, and other devices. The sun and prevailing wind direction should be carefully considered in order to optimize the effect. (Pitts, 73)

The spaces between buildings are very important. Wind-tunneling effects need to be avoided, and sufficient space should be allowed to prevent unwanted over shading. (Pitts, 73)

LEED for New Construction, SS Credit 5.1 mentions the potential strategies and technology to develop a site while protecting the habitat. The intent of this credit is to conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity. The requirements of this credit are to limit the site disturbance to a certain distance beyond the building perimeter, or to restore or protect a minimum of 50% of the site area, excluding the building footprint, with native or adapted vegetation. By definition, native/adapted plants are ones that are adapted to the local climate and are not considered invasive species or noxious weeds. Thus, these plants do not require active maintenance or chemical inputs such as fertilizers. They also provide habitat value and promote biodiversity through avoidance of monoculture plantings. The use of green roof can also be considered an approach to protect and restore the natural habitat. To achieve this, carefully surveying and designing of the buildings is necessary to minimize their footprints. Strategies might include, but are not limited to, tuck-under parking, and sharing facilities with neighbors.
Another credit, which is related to the landscape and open space, is SS Credit 5.2, Maximize Open Space. The intent of this credit is to provide a high ratio of open space to the development footprint to promote biodiversity. The requirements are to reduce the development footprint and provide vegetated open space within the site to exceed local zoning’s open space requirement by 25%. In case there is no local zoning requirement, provide vegetated open space equal to 20% of the project’s site area. The major potential strategies for this intent are similar to SS Credit 5.1, which are minimizing the development footprint and sharing facilities with neighbor to maximize open space on the site.

The urban heat island effect is also an important issue in sustainable site design. LEED SS Credit 7 intends to reduce the heat island effect in order to minimize the impacts on microclimate and human and wildlife habitat. For the non-roof part of development, it is required to provide any combination of the following strategies for at least 50% of the site hardscape. They include providing shade, paving materials with a Solar Reflectance Index of at least 29, and open grid pavement system; or placing at least 50% of parking spaces under cover. For buildings, the strategies include using roofing materials with a high Solar Reflectance Index for at least 75% of the roof surface; installing a vegetated roof for at least 50% of the roof area; or combining both strategies.

3.3.7. Building typologies

The objective for design at the building scale is to use effectively of resources throughout the lifetime of structure. It should impose a small burden on the environment as possible. In this regard, building forms, layout, and appearance should be considered. (Pitts, 82)
Similar to the Sustainable Site Design Principle, when designing sustainable buildings, issues to be taken into consideration include: sustainable sites, water efficiency, energy and atmosphere, materials and resources. All these issues are carefully considered in more details in building scale than in subdivision scale. The different issues can be that when working at building scale, one need to consider indoor environmental quality. Design processes and a checklist for sustainable building can be found in the *HOK Guidebook for Sustainable design*. Strategies and Standards can be found in the *LEED for New Construction*.

In general, looking at each site, the effective strategies can include minimizing the development footprint and using landscape to provide share and control the quality and quantity of water runoff.

At building level, to use solar energy effectively, the position of the sun should be taken advantage of. According to Corbett, the designer of the sustainable community Village Homes, in the summer, the sun is high in the sky and traverses an arc of 240 degrees from east to west. In winter, the sun is low and traverses an arc of only 120 degrees from east to west. By understanding the position of the sun, proper orientation allows a home to maximize heat gain in winter and minimize unwanted heat gain in summer. According to research, a house that is longer from east to west and shorter from north to south with most windows and a modest overhang on the south, can receive full sun in winter yet be fully shaded in summer. The shading comes from overhangs that are calculated to allow sunlight to come in during winter, when the sun is low, and to block sunlight in summer, when the sun is high. (Corbett, 34)

The use of a green roof at building level can help in achieving many sustainable goals. A vegetated roof can help in controlling the quantity of water runoff as it detains water, and
also the quality. A green roof promotes the diversity of habitat and cleans the air. It also has insulation functions and aesthetic benefits. Green roofs are now used in a variety of building types. Depending upon the scale and the use of buildings, green roof can be of an extensive, intensive, or semi-extensive type.

For water efficiency at building level, the use of water saving fixtures is encouraged. Recycled grey water and the use of non-potable water for irrigation… are both useful strategies to use water efficiently. Standards and potential technologies can be referred to LEED NC V2.2 and the HOK guidebook for sustainable design. Other issues (materials and resources, indoor environment quality, etc.) are mostly dealt with technical strategies, and therefore, will not be discussed in detail within the scope of this thesis.

3.3.8. Design issues

As discussed above, sustainable design can not be successful without consideration of vernacular architecture and identities. This is also the purpose of this thesis: to merge sustainable design with traditional urban design to promote development while still preserving traditional townscape. This section discusses the issues of character and local distinctiveness in sustainable design. The intent is to promote the characteristic of local, thereby enhancing the quality, character and amenity of areas.

The proposals for new development should take into consideration the contextual evaluation of the site and its surroundings. The scale, massing, and context of new development should be in harmony with the existing built environment. Architectural design should preserve or enhance local and historical characteristics with regard to the use of the buildings.
The scope of this thesis does not go deeply into a consideration of the sense of place. However, this is an important urban design issue because urban design today deals more with physical aspects of a place and focuses more on sitemaking than placemaking. While physical aspects of the built environment create so-called sitemaking, it is the daily activities of local residents, and local knowledge that create so-called placemaking. Placemaking can bring a sense of a place. This issue is within the scope of this thesis because the final purpose of this paper is to apply sustainable design principles to urban development, while still preserving the local characteristics and traditional forms and townscape of the rural villages. That can not be done without understanding the sense of place and what has contributed to making the rural villages of Anyang a place. It was also mentioned in the significance section of Chapter 1 that the future of urban design is the challenge to promote sustainable development while keeping the traditional townscape. Also, in the very first part of this chapter, the basis of ecological design, Sim van der Ryn has emphasized the significance of local factors in sustainable designing. Local factors include, but are not limited to local knowledge and experience, local climate, local culture, and so forth. Therefore, when designing a new sustainable community, it is important to understand not only sustainable design principles and strategies, but also the local factors of the place. Nevertheless, because each local area has its own placemaking characteristics, it is really hard to discuss it through within the scope of the thesis. This part, then, just points to the need to understand local factors and bring it into design, so that sustainability can be fully achieved.

3.3.9. Conclusion

This section has mentioned almost all the important issues in sustainable design for the built environment. However, within the context of this thesis, it is difficult to discuss them in
detail. The most important point in this section is that although there are many available sets of standards and principles of sustainable design, they are based on the foundation of sustainable design that has been discussed in the first section. Standards with numbers or percentage… like those in LEED were not discussed in detail because they may just be applicable to the US. In other urban areas in Europe or Asia, for instance, where the population density is much higher, those numbers are not necessarily appropriate. For examples, in China, the major vehicle means is still the motorbike. The percentage of automobile ownership is much less than that of US. China does not really have problems such as large parking lots and accessibility like in the US. Instead, China has issues with large scale development without regard to human scale and walkability. That is just one example to illustrate that the numeric standards can not be used in all cases. But the basic principles are of sustainable design can be applied anywhere, and so can the major steps in the sustainable design process, which are discussed in the next part of this chapter.

3.4. Key steps in the sustainable design process

The above sections of this chapter provide basis knowledge of sustainable development and sustainable design, while this last part of the chapter discusses the key steps in the sustainable design process. From the above sections, it is already know what issues are important and what strategies can be used to resolve those issues in sustainable design. In this section, how to use those strategies effectively in order to maximize the design is discussed. *The HOK Guidebook to Sustainable Design* is a useful book about sustainable design issues and processes. One should take into consideration, however, that the book deals mostly with
environmental design alone, and not with other issues. According to the guidebook, there are ten key steps in the sustainable design process. They are:

1. Project definition;
2. Team building;
3. Education and goal setting;
4. Site evaluation;
5. Baseline analysis;
6. Design concept;
7. Design optimization;
8. Documents and specifications;
9. Bidding and construction;
10. Postoccupancy. (Mendler, 17)

Among those steps, steps 3-7 are very helpful for the content of this research because they deal with the physical design of the built environment and are performed mostly by planners working with landscape architects and engineers. The other steps are mostly performed by project manager and engineers. Steps 3 to 7 are very detailed and can be applied to any case. In each step, tasks are listed and assigned to each individual who is in charge. A checklist is also provided so that design team can easily follow the steps and not miss anything. This section focuses on the steps and tasks that are managed by planners/urban designers, and/or landscape architects. Following the guidebook step by step can help in the design process.

**Step 3: Education and goal setting**

“Engage team in discussion of sustainable issues and opportunities, including cost and schedule impacts. Then hold a sustainable goal session with all team members to set broad goals and measurable outcomes, such as a LEED target. Review design criteria and standards and challenge those that work against integrated sustainable solutions.

**Step 4: Site evaluation**

“Analyze the site to identify constraints and sustainable opportunities. Evaluate the microclimate and macroclimate to determine solar and wind availability and orientation, potential thermal sinks, and rainfall. Inventory plant and animal species and their habitats. Identify transportation networks, and cultural and/or historical resources that should be preserved.”
“Truly understand sun, wind, and water patterns. Identify resources that can contribute to energy efficiency and capture “free” energy. Study the ecology, hydrology, and geology of the site. Analyze regional impacts on water quality and wildlife habitat. The goal is to design a building that sits lightly on the land, that engages the natural energy flows of the site, and that coexists gracefully with the other living systems of the site.” (Mendler, 67)

**Step 5: Baseline analysis**

“Develop baseline energy and water analysis; establish budgets and compare with benchmarks and project sustainable design goals. Explore potential for renewable energy, financial incentives, and/or utility rebates for energy efficiency, water, and renewable.” (Mendler, 67)

**Step 6: Design concept**

“Use an integrated and collaborative design process to embed sustainable strategies within a design concept that is responsive to the project site and the regional ecosystem.” (Mendler, 83)

**Step 7: Design optimization**

“Explore, test, and evaluate a broad range of solutions to discern those with greatest potential. Engage the entire design team in a multidisciplinary approach to seek synergies in the development and refinement of building and site systems.” (Mendler, 107)
Chapter 4: Case Studies

The above chapters have discussed the basis of sustainable design and some of the important contemporary principles and standards. This chapter explores the sustainable design practices in US, UK, and China. Within each case study, the design principles and results are discussed and what might be appropriate for the case of the urban villages of Anyang is investigated. The three case studies explored are the Village Home in California, US; the Telford Millennium Community in Telford, UK; and the Huangbaiyu Sustainable Village in Liaoning, China. The case studies are chosen based on the relevance they have to the urban villages of Anyang.

4.1. Village Homes, California, US

Village Homes is a sustainable community designed by Judy and Michael Corbett. Located in Davis, California, Village Homes is a sixty-acre, 242-unit mixed-use residential “garden village” which incorporates innovative ecological and social features. Ecological design principles can be easily recognized when looking at the layout of the village. All homes face the south to maximize the use of the sun for heating. Homes are provided to people from a variety of income levels. The houses use both passive and active solar space heating and have rooftop solar water heaters. The streets are long cul-de-sac, alley-like, much narrower than normal standards. The houses open onto common areas, which are linked by bicycle paths that form a grid throughout neighborhood. Agricultural land is incorporated in the village. Water runoff is taken care of by a natural drainage system which is a system of creeks and ponds. (Corbett, 23)
The design of Village Homes has not only created a sustainable environment but also enhanced the social life of the community. Design strategies like narrowing the streets can save money and resources, and also make the streets safer by slowing traffic, using less land, making more land available for open spaces and other purposes, lessen water runoff by reducing impervious surface, and increase the sense of community. (Corbett, 27)

The design of Village Homes is really successful in creating a sense of community. According to Corbett, “the sense of community seems to be what residents like best about Village Homes.” (Corbett, 29) Many features of this community are unique, thus creating a sense of community. There is no through street. Instead, paths are the quickest way to travel through the neighborhood, and they encourage more energy-efficient modes of transportation: walking or biking, and promote community orientation by creating a place for neighbors to meet and interact. (Corbett, 29) The narrow streets also allow a greater sense of community because as residents are moving along the street, they perceive the space as belonging to them rather than being a strange piece of land. (Corbett, 30) Although critics are concerned that the community is physically isolated from the rest of the city, in fact, Village Homes is well connected with adjacent areas by bike paths, which is also a success of Village Homes in the sense that it promotes the use of vehicles other than the automobile. (Corbett, 31)

**Energy Conservation and Use of Solar Energy**

The design of Village Homes effectively conserves energy and uses solar energy. As the climate in Davis is Mediterranean, the solar approach in individual houses ranges from active mechanical systems to simple passive systems. (Corbett, 33) In each house, walls and roof are well insulated and windows are double-paned. Exterior walls and the roof use light-color paints and materials in order to keep the house cooler. The houses use high-mass
materials to store heat from the sun as the adobe can absorb and store heat and coolness. Water, concrete, stone, brick, and tile also are able to store heat and coolness; therefore they are utilized in a variety of ways in the built environment of Village Homes.

To maximize the use of passive solar energy, all the lots in Village Homes are oriented north-south. Overhangs are carefully calculated, so that they can well shade the houses in summer. The combination of properly oriented houses, high-mass materials, good ventilation, and overhangs has reduced the cost for utilities by 50% (Corbett, 35) Solar energy is also used for water heating. Almost every roof in Village Homes has a solar water heater which fulfills water heating for seven months of the year. During the rest of the year, solar energy provides 40% to 50% of water heating. (Corbett, 35)

Landscaping is also used to facilitate solar access in Village Homes. The trees that were selected for street planting provide shade in the summer and allow sunlight to pass in the winter.

**A Design Closer to Nature**

As mentioned above, what residents like best about Village Homes, is the sense of community. Fences, stucco walls, and shrubs have been placed along the street to form private courtyards between the street and houses. The long, narrow cul-de-sac streets are alley-like, bringing people closer to nature. The typical width of a street in Village Homes ranges from 20 to 26 feet, which is much narrower than normal standards, but very successful in slowing down traffic and creating a sense of community. Also, it helps in reducing the area of impervious surface and providing more land for other activities. Rather than being oriented toward the street, the houses in Village Homes look out on common areas with vegetated
landscape, which creates a sense of green space. The use of drought-tolerant plants is encouraged to conserve water. (Corbett, 37)

Open spaces in Village Homes include:

- Streets,
- A central green,
- Vineyards,
- Orchards,
- Common areas,
- Playgrounds,
- Drainage swales,
- Community gardens,
- Private courtyard, and
- Bicycle and pedestrian path (Francis, 36)

**Neighborhood agriculture**

Agriculture is another component of Village Homes, with seventeen acres allocated for agriculture. Usually, a cluster of eight homes shares a common area to plant personal vegetable gardens. (Corbett, 40)

**Natural drainage**

The use of natural drainage in Village Homes is one of the most successful sustainable strategies and quite unique. It brings Village Homes closer to nature. Whereas in conventional subdivisions, lots are graded to slope toward the street so that rainwater can run into it and then into underground storm drains to be carried away, in Village Homes, natural drainage is used. The lots are graded away from the street so that when rainwater runs off the roofs and lawns, it does not run into the street. Instead, it runs into the attractive, creek-like shallow swales that run through the common areas behind the houses. These swales carry the water to larger channels that run through the greenbelts. They are artificially created by grading, but are designed so that they look like natural streambeds with rocks, bushes, and trees along the
two sides. Water runoff from the streets goes directly into these larger channels. To slow the flow of water, small dams are constructed. According to Corbett, this surface drainage system allows all the water that falls to be absorbed into the ground and at least 90% of water runoff is held on site. Allowing the soil to absorb rainwater has reduced by a significant amount of the watering of the plants. In addition, this natural drainage benefits the community in term of aesthetic value; it also saves money for developers. (Corbett, 45)

**Evaluation**

Corbett mentioned that Village Homes failed to implement the sewage system that would have recycled treated sewage water to orchards and woodlots and gray water from showers and sinks to yards and shrubs. However, Village Homes is very successful in energy conservation and creating a sense of community. The design and the landscaping of Village Homes not only create an attractive townscape, but also foster a close-knit neighborhood. It proves that it is possible to live in harmony with the environment in an ordinary, comfortable and enjoyable way.

The designers of the urban village in Anyang can learn from Village Homes effective ways to conserve energy and enhance the sense of community. The latter is very important because the sense of community is what needs to be created in the urban village of Anyang. The anticipated result is new sustainable development while keeping the traditional townscape. Village Homes is very successful in creating a sense of place and making people feel like the neighborhood really belongs to them. The residents in the urban village of Anyang also need to feel that the townscape surround them is familiar and belongs to them. Aside from sustainable goals, the design of the urban village of Anyang needs to focus on a sense of place. That can be done by realizing what traditional urban design elements are
suitable for new development and enhancing them. This is discussed in Chapter 5 in detail, but the case of Village Homes is very helpful for the urban villages of Anyang in term of energy conservation design and creating a sense of community.

*Figure 5: Master Plan of Village Homes*

*(Source: Village Homes, a Community by Design)*

*Figure 6: Some images of Village Homes*


Bird-eye view                               Natural Drainage System
4.2. Telford Millennium Community (TMC), Telford, UK

Telford Millennium Community (TMC) is a new suburban community on a 34 hectare (approximately 84 acres) brownfield site in Telford, UK. The project forms part of English Partnership’s Millennium Communities Program, which promotes best practice for design and procurement, and brings together new ways of planning, designing, and constructing homes to enable a more sustainable way of living. It aims to demonstrate that energy efficient, environmentally responsible development is achievable regardless of geographic location.

TMC is currently being constructed. The master plan was designed by Lifschutz Davison Sandilands Urban Design, and has been granted many awards. According to Urban Design Future, the design of TMC has explored new urban forms to deal with issues of remediation, ecology, sustainable drainage, solar orientation and new forms of housing. The efforts result in a plan that combines traditional and contemporary elements. (Moor, 178)

The sustainable strategies in TMC include:

- All households to be designed to meet internal specification of Housing Corporation Scheme Development Standard requirements
  - Eco-Homes Excellent;
  - 50% reduction in embodied energy;
  - All materials to be Green Guide A rated;
  - 20% reduction in metered energy use;
  - 10% improvement in day lighting and acoustics;
  - Reduced construction waste to 25m3 per dwelling;
  - Improve upon national injury rates; and
  - Sustainable Urban Drainage Systems (SUDS), on site renewable and local sourcing of materials.

(Source: http://enquire.hertscc.gov.uk/buildingfutures/design/telford.cfm)

**TMC new standard**

The design of TMC has emphasized creating an exceptional new neighborhood. Extremely high environmental standards were established during the very beginning of the
TMC aims to use the best possible techniques to deliver a high quality development that is friendly to the environment. These techniques set new standards for housing developments in a number of ways, including:

**Energy efficiency**: All houses in TMC are designed to be energy efficient and aimed to cut the amount of pollution by 20%. The homes are made more energy efficient by capturing the maximum possible amount of sunlight, using low energy heating systems and high levels of insulation.

**Landscape and environment**: Only a section of the TMC site is being built upon. The remaining green space is left to provide local amenities and a wildlife area. Amongst the new homes, there are large amounts of green space, including wildlife corridors, play areas and hundreds of trees.

**Ecology**: To protect important animals and habitats, TMC relocates them within the site to ensure that they are not affected by construction activities and continue to flourish. Wildlife corridors are designed so that animals can move from one area to another safely, promoting biodiversity and protecting the wildlife habitat. Therefore, local wildlife is protected and there is lots of green space where plants and animals can flourish.

**Waste management**: The use of local underground recycling bins and doorstep recycling collection helps TMC residents to recycle more of their waste.

**Transport**: TMC helps provide a realistic alternative to the car, including improved bus services, new footpaths and new cycle paths.

**Quality construction**: TMC uses high quality, modern construction techniques to provide homes with fewer defects and that help to reduce household energy use. The layout of the homes is flexible, allowing them to be altered to meet the changing needs of the owners.
**Visual quality:** All homes in the development are extremely high quality in terms of visual standards. They have been designed following extensive local consultation and there are a range of houses and apartments available that provide a variety of choices for resident. The design of houses also allows the layout to be easily adjusted to meet the changing needs of the owners in the future. Every home, including apartments, features some outside spaces, either a garden balcony or roof terrace, which is not very common in new developments. The visual appearance of TMC is designed to an extremely high standard. All homes have elegant, simple contemporary design, but remain in harmony with their surroundings.

*(Source: [http://www.tmc-eastketley.info/site_draftmasterplan.htm](http://www.tmc-eastketley.info/site_draftmasterplan.htm))*

**Evaluation**

The TMC is now under construction, and therefore, the success or failure of the project can not be evaluated. However, it is easy to predict the successful result of the TMC project. All the sustainable goals are stated very clearly with effective strategies. TMC offers a variety of housing types, but it still creates a high visual quality of neighborhood. What is successful about the TMC project is its new urban form. As mentioned above, the design of TMC explores new urban forms to deal with issues of sustainable design such as ecology, sustainable drainage, solar orientation and new forms of housing. These efforts result in an urban form that combines traditional and contemporary elements. TMC preserves the traditional urban form of England, but tries to incorporate within it the sustainable design principles to create a new design. Sustainable design principles such as continuous landscape, compact and centered housing, maximizing green spaces, etc, are well-presented in the design. Looking at TMC and its surrounding neighborhood, one can see that they have the same form, but TMC, of course, has sustainable design elements in it. That is the success of
TMC master plan and what can be learned and applied to the case of the urban villages of China. In all the available documents of TMC, none of them mentions the sense of community. However, it will be one of the outcomes when the design becomes reality.

The designers of the urban villages of Anyang can learn a lot from the TMC master plan, in the sense that TMC has incorporated new sustainable design principles and applied it to the traditional townscape and achieved an attractive master plan design. The context of TMC is very relevant to that of urban villages of Anyang in that they are both new development, they are both trying to apply the sustainable design to the community while preserving the old, traditional townscape. MC can be evaluated as successful as it has received many awards and investments from developers. Although TMC and the urban villages of Anyang are different in terms of geographic location and social context, the case of TMC proves that traditional townscapes can be preserved and have new, sustainable development at the same time.
Figure 7: Final Master Plan of Telford Millennium Community
(Source: http://www.tmc-eastketley.info/site_draftmasterplan.htm/)

Figure 8: Excerpted Detailed Plan of Telford Millennium Community
(Source: http://www.lds-uk.com/)

NEAP = Neighbourhood equipped area of play  LEAP = Locally equipped area of play
Figure 9: A few views inside Telford Millennium Community

(Source: http://www.lds-uk.com/)
4.3. Huangbaiyu Sustainable Village, China

Huangbaiyu Sustainable Village is one of the first sustainable communities that apply the cradle to cradle design principles as a model for the revitalization of China’s rural communities. It is located in Huangbaiyu, near Benxi City in North East China’s Liaoning Province.

Huangbaiyu is an agricultural area covering 135 hectares (330 acres) surrounded by steep hills and mountains. The village accommodates about 1,400 people. Located in China’s North Temperate Zone, winters are harsh. Most of the homes rely on corn husks or coal for heating.

Designed by architect William McDonough and using the Cradle to Cradle Design Framework, the Huangbaiyu Sustainable Village is powered by the sun and built of materials maintained in a closed-loop system of technical and biological nutrition. It aims to create a community of people productively engaged in restorative commerce. Its goal is to provide a higher quality of life for the villagers. (Sustainable Industries) The Plan features cradle to cradle design innovations in several aspects such as village infrastructure, energy systems, information technology, mobility/transportation, water, wastewater and solid waste management, as well as the creation of cradle to cradle commercial enterprises. (Ecoworks Foundation) The first stage of the sustainable village includes 42 households, equipped with rooftop solar panels, radiant heat floors and pipes for methane heating. (People Daily Online)

**Design principles**

Huangbaiyu Sustainable Village has applied the following cradle to cradle design principles and techniques:
Materials: Materials used in construction of Huangbaiyu Sustainable Village are locally sourced, rapidly renewable materials that can be safely returned to the ecosystem as “biological nutrients” or made of man-made materials designed to be safely reused for the construction of new buildings in the future as “technical nutrients” in the circular economy. This is the basis principle of the Cradle to Cradle design principle. McDonough’s book with Michael Braungart, *Cradle to Cradle: Remaking the Way We Make Things*, has mentioned how to redesign products with either biological nutrients to be tossed into the compost or technical nutrients that can be endlessly recycled. McDonough always affirms that good design is integral to creating a waste-not, want-not, non-toxic world. (Sustainable Industries)

Energy: Alternative energy including solar, wind and locally sourced, rapidly renewable materials – including animal, human and agricultural wastes – are major energy sources of the village buildings. Solar panels are installed for each building, which can be seen in Figure 13.

Agricultural Protection/Habitat Enhancement: The development land is centralized and consolidated to optimize the use of the valuable productive land, and maximize open space while preserving and enhancing wildlife habitat and biodiversity.

Community Planning: Quality of life is improved through increased community, convenience and comfort.

Master Plan: The master plan of Huangbaiyu Sustainable Village reflects the traditions and lifestyles of the area. It includes the use of renewable energy, a community water system, closed loop material and waste flows, and habitat and agricultural enhancement.

Housing: A demonstration of model home is designed to help guide the future construction of the village using cradle to cradle design principles.

There are two housing prototypes in Huangbaiyu Sustainable Village:
Housing Unit A - Biological Nutrient Construction System Prototype: This prototype uses local "biological nutrients", such as earthen bricks and straw bales.

Housing Unit B - Technical Nutrient Construction System Prototype: This prototype uses selected "technical nutrients" such as BASF's Styropor(r) expandable polystyrene (EPS) resins.

The model home features both biological and technical nutrients, including walls and roof structures built with a combination of Vermeer compressed earth block and straw bale technologies and BASF Styropor expanded polystyrene. (China-US Center for Sustainable Development)

Other technologies used in China’s sustainable development include: BASF — a prototype Styropor energy efficient roof and insulation material; BP — a 1000 watt grid connected solar PV energy system; Nextek Power Systems — an integrated DC/AC power system; and Vermeer Manufacturing. (Eco-works Foundation)

Evaluation

According to the Eco-works Foundation website, Huangbaiyu Sustainable Village is the first sustainable village in the efforts to revitalize China’s rural communities using cradle to cradle design. However, according to the Sustainable Industries website, the first phase is not successful. “Meanwhile, the new village’s neat rows of 42 eco-dwellings — outfitted with rooftop solar panels, radiant heat floors and pipes for methane heating and cooking fuel from a nearby biomass gasification plant — currently sit empty. No villagers have yet agreed to cash in their old homesteads in order to purchase the comfort of a McDonough-designed bungalow.” (Sustainable Industries)
In term of sustainable design, the author believes that Huangbaiyu is on the right track and has achieved a certain level of success. All the houses are designed according to sustainable design principles. However, a part of the failure of Huangbaiyu lies within the design. Of course there are other reasons related to social, economic conditions, but the design of Huangbaiyu somehow does not create a sense of a rural village. Looking at the master plan, one can see that, in terms of housing, there are just a few types. The village does not provide a variety of housing types for residents. The design looks monotonous with all the houses looking the same and all the streets in north-south or east-west orientation. In comparison to the Village Homes, all the houses are also facing south to maximize the use of solar energy. But the design still can make the village look attractive because of the elegant narrow cul-de-sacs and the distribution of green spaces, playgrounds and orchards within the community. In the Telford Millennium Community, the design is also very successful since it creates an attractive landscape and a variety of housing types. In Huangbaiyu, the design does not really remind one of traditional rural villages. Residents, who are the farmers of Huangbaiyu, will not feel like the place belongs to them. This is an experience to be aware of for the designers of the urban villages of Anyang.

Although Huangbaiyu Sustainable Village and the sustainable urban villages of Anyang are different in terms of context; i.e., Huangbaiyu is a rural village and in the case of Anyang, the villages are urban villages; the case of Huangbaiyu still can offer many lessons for the future design of the urban villages of Anyang. Designed by an American architecture firm, Huangbaiyu Sustainable Village has applied many contemporary sustainable design strategies and techniques. The designers have also made an effort to incorporate the new sustainable design framework, cradle to cradle, with local materials and characteristics.
Techniques and strategies such as using compressed earth bricks for house construction, and using solar panels for individual houses...are suitable for the case of the urban villages of Anyang. However, this is not very successful in creating a sense of community; in this case, it creates a sense of a rural village. In the future, when designing for the sustainable urban villages of Anyang, that is an important lesson to be applied.

*Figure 10: Master Plan of Huangbaiyu Village*

(Source: http://www.chinauscenter.org/VillageSlideshow/photoessay.asp)
Figure 11: Excerpted plan of Huangbaiyu Village  Figure 12: Existing Housing  
Source: China-US Center for Sustainable Development  http://www.chinauscenter.org

Figure 13: Sustainable Housing Typology in Huangbaiyu with a Solar panel on the Rooftop.  
Source: China-US Center for Sustainable Development  http://www.chinauscenter.org
Chapter 5: Sustainable design principles for the urban villages of Anyang

Chapter 2 has researched the traditional form of the rural villages of Anyang with issues relating to orientation, layout, housing typologies, etc., while Chapter 3 has researched contemporary sustainable design principles and standards, which give a full understanding of the intent, requirements and strategies to achieve sustainable goals related to important issues such as landscape and ecology, orientation and form, energy conservation, and water efficiency. Chapter 4 has gone a little further with three case studies in US, UK and China to provide information on current sustainable design practices in different areas of the world. The third case study, Huangbaiyu Sustainable Village, gives an understanding of sustainable design practice in China. It is the first sustainable village in an effort to revitalize the rural villages of China that is designed according to the cradle to cradle design framework of William McDonough. In this chapter, based on the research of the previous chapter, sustainable design principles for the urban villages of Anyang are explored and proposals are made.

The first section of this chapter, “The relationship between Chinese traditional design principles and contemporary principle”, explores the common elements as well as the different ones, between traditional design principles in China and contemporary principles that have been used in US and Europe. The traditional design principles of the Chinese have achieved a certain level of success, and therefore, it is important to evaluate them and keep the elements and principles that are suitable for contemporary new development. In the second section of this chapter, “Proposed sustainable design principles for the urban villages
of Anyang”, a set of principles is proposed. This section is more detailed with principles and strategies, whereas the first is more theoretical and based mostly on qualitative analysis.

5.1. The relationship between Chinese traditional design principles and contemporary principles.

As discussed in Chapter 2, the rural villages of Anyang have had a long history. Located in the North Plain Region of China, the rural villages are compact, centered with almost no green space inside the villages. The layout and the organization of the rural villages have advantages as well as disadvantages. In general, the characteristics of the rural villages in terms of form, layout, and organization are as follows:

- The villages are very compact and organized with no open space;
- The main, longer road of the village runs in an east-west direction;
- Streets are narrow;
- Commercial establishments are located along both sides of a street. Shops are opened daily. The fair is held periodically;
- Housing located following north-south direction; and
- Courtyard housing is the most common housing typology. Some houses have small gardens.

The above characteristics are the major ones of the rural villages that are summarized from Chapter 2. The design principles of the rural villages mostly follow Fengshui principles. In this section, if traditional urban design principles have some common elements with contemporary principles, and what traditional elements and principles can be kept in future designs are discussed. The purpose is not only to create sustainable design but also to
incorporate local knowledge and experience into new development, so that the new design can fulfill the needs of the residents and can be successful in creating a sense of community.

Although Fengshui has been used in very early times, it is still considered as a significant method and theory in dwelling designing, as well as site selection and site design in China. There are many similar views between Fengshui and contemporary urban design theory. Modern urban and architectural design, when looking at the natural environmental factor, can profit from the theory of Fengshui.

The principles of dwelling design of Fengshui are related to some of the modern design principle. According to Design: to Dwell on the Earth, the proper role of the architect is to find for every structure a unique form that expresses the essence of the building’s function while sustaining every activity that take place within it. Also, the process of dwelling is a correspondence between nature and culture. Making and caring for a place comprises the aesthetic experience of dwelling (Spirn, 92). This is similar to the theory of Fengshui, which seeks the harmony of the human-made environment and the natural environment. The modern view emphasizes the uniqueness of design while retaining the building function and its integration with nature. Fengshui emphasizes more on the natural environment, since according to its principles, humans should follow natural forces. Going against natural forces will lead to negative consequences.

According to Van der Ryn in Eco-Villages: Toward Sustainable Architecture, although at present there are many different approaches to ecological practice, the principles that shape the design and building process are common. Those principles are: place, process, materials and resource conservation, and geometry, with the following details:
**Place:** Landscape should be an active foreground to the building and its activities. Each place is a place of great beauty and power – a quality to respect but not to be intimidated by. The best information about place comes from people who know it well – old time residents – and one’s own well developed intuitions, which usually are heard only when we get really quiet and listen to the land and one’s self.

**Process:** Creating an ecologically sound building means using a design process that reflects and incorporates the social ecology of the client community.

**Materials and Resource Conservation:** Using recycled and indigenous on-site materials.

**Geometry:** The geometry should offer the site the best solar configuration. For example, the geometry should follow the optimal solar configuration for the harsh, sunny climate: the long east-west axis, offering maximum solar exposure on the south, and the north wall. (Sim Van der Ryn, 95)

The four principles that Van der Ryn offers show the possibilities for sustainable architecture and community design, implying a balance between the material needs of human habitation and the ability of the natural community to support human culture over the long term. Among the principles, principle of place has a lot in common with Fengshui, as it emphasizes the role of the natural landscape as the foreground for the built environment. Place is also created with the culture and daily activities of people living in it. Fengshui, although dealing with the relationship of humans and nature, has its roots not only in Western science but also in folk beliefs and religious beliefs. It is the belief that created the cultural aspect of Fengshui and makes a site a place.
The principles of site selection and site design of Fengshui also have some elements in common with more recent points of view. Urban design now focuses on environmental factors more than ever. According to Anne Whiston Spirn, the city has been compared to a poem, a sculpture, and a machine, but “the city is more than a text, and more than an artistic or technological artifact. It is a place where natural forces pulse and millions of people live – thinking, feeling, dreaming, doing”. (Spirn, 90) Therefore, an aesthetic of urban design must be rooted in the normal processes of nature and of living. “This aesthetics encompasses both nature and culture; it embodies function, sensory perception, and symbolic meaning; it embraces both the making of things and places and the sensing, using, and contemplating of them ... This is not a timeless aesthetic, but one that recognizes both the flow of passing time and the singularity of the moment in time; and one that demands both continuity and revolution”(Spirn, 90).

Also, according to Spirn, the flow of time, change, and rhythm are very important to a city. The perception of time and change is essential to developing a sense of who we are, where we have come from, and where we are going, as individuals, societies, and species. Design that fosters and intensifies the experience of temporal and spatial scales facilitates both a reflection upon personal change and identity and a sense of unity with a large whole (Spirn, 91). This can be considered the “Western view” of the city. In the Eastern view in general, and in Fengshui particular, the similarity to the perception of time and change is the concept of the unity of heaven, human, and earth. Fengshui concepts view humans just as a connection between heaven and earth; and the harmony among heaven, humans, and earth is significant to all activities or human-made objects. In this relationship, humans should always know their position and, therefore, take suitable actions for the earth and natural environment.
Spirn also mentions that when one neglects natural processes in city design, one not only risks the intensification of natural hazards and the degradation of natural resources, but also forfeits a sense of connection to a larger whole beyond oneself (Spirn, 92). The similar Fengshui concept stresses that the humans should respect nature, and that any action that violates the natural environment will lead to bad consequences. This Fengshui principle is based on religious and folk beliefs more than science. However, the idea of protecting natural environment is good, and therefore, it is still applied even now.

It is nature and culture together that make a place particular. Natural processes give rise to the initial form of the land and comprise the base rhythm to which the cultural process responds. Every urban landscape is a symphony of complex harmonies, which evolve continually in time in response to natural processes and changing human purposes (Spirn, 92). It is possible to create urban landscapes that express a connection to the natural and cultural history of the place, and still are adaptable to meet changing needs (Spirn, 95). Therefore, the built environment should respect the natural landscape and process. The harmony between the human-made environment and the natural environment can make a place sustainable. One should not learn the religious belief aspect in Fengshui, but should learn the respect to nature of it.

It is believed that the Fengshui system presents a comprehensive view of environmental forces. It provides the whole system of rules for design and construction of the built environment that is integrated with the natural environment. Fengshui also correlates influence Chinese site selection methods and spatial design for the built environment. Since Chinese culture is involved a lot with the universe, cosmology, the harmony of heaven, humans, and the earths; Fengshui has had a very strong impact on Chinese urban design,
“which had no parallel in other ancient civilizations” (Golany, 60). Even now, it still has a strong influence on urban and site planning as well as dwelling design. Because Fengshui has its roots not only in folk beliefs and religious beliefs but also in science factor, some of its principles are really based on the analysis of geometry, topography, wind and water direction, etc; making it still useful today.

In conclusion, one can see that the traditional form of the rural villages and the traditional design principles behind it have many useful elements that can be incorporated with contemporary sustainable urban design principles. In the next section, a set of sustainable design principles is proposed based on both traditional urban form and on the contemporary principles and strategies.

5.2. Proposed sustainable design principles for the built environment of the urban villages of Anyang.

This section of Chapter 5 discusses the sustainable design principles that can be applied to the urban villages in Anyang and other new developments that have similar context. The issues discussed are the same as in Chapter 3, including: form, layout, orientation and configuration; water efficiency; energy conservation; air quality; material and resources; landscape and ecology; building typologies; and design issues. Because of the lack of information and data from the City of Anyang, within the scope of this thesis, it is not be able to go into detail and set up very detailed guidelines for the urban villages of Anyang. However, the principles with regard to local conditions and context can be very helpful, and, in the future they can be used as a foundation for any system of sustainable guidelines and
standards developed for the North Plain Region of China. In addition, the application design in the next chapter can help in visualizing the principles.

When recommending sustainable design principles for the urban villages of Anyang, taken into consideration are that the traditional principles mostly deal with location, form, layout, orientation, and ventilation. Contemporary issues such as water efficiency, air quality, material and resources are mostly derived from the literature review of the current sustainable design systems.

**Form, layout, orientation and configuration**

Both the traditional and contemporary design principles have emphasized the north-south orientation for new development. Blocks can be oriented with the longer side running in an east-west direction and the shorter side running north-south so that buildings can face the south. The orientation of the traditional rural village can totally be used in the new urban villages.

In term of density, the urban villages should focus on low-rise development with high density and compact form. However, the traditional form is not a good idea because there is almost no green space in between the buildings. Therefore, more open spaces should be added into the new design. The design should be organized and compact with a minimum development footprint to save land for open space.

In terms of land use, mixed-use is encouraged by contemporary sustainable principles. In traditional rural villages, commercial land uses are located along the two sides of a the street and are open all day. There are also periodic fairs. In the urban villages, as the context is different, other uses such as offices, institutional space, day-care centers, etc, can be incorporated with commercial use along the streets to provide enough services within walking
distance for residents and promote a livable neighborhood. Land should also be reserved for periodic fairs, but the rest of the time, it should be used for other functions such as children’s playgrounds or so forth.

In terms of street organization, as one can see in the photographs of Anyang, there are almost no sidewalk along both major and internal roads of the existing rural villages. There are either streets with no sidewalk or alleys where both people and vehicles are traveling within the same space. That, however, can not be kept as the traditional elements of the rural villages. To increase comfort and safety, sidewalks are proposed in the new design. Nevertheless, characteristics of the rural villages like narrow streets and small alleys can be incorporated in the urban villages as they slow down traffic and enhance the sense of community. Width of streets can vary from 26 feet (9m) for major streets, 21 and 15 feet (7 and 5m) for internal roads, and 10 feet (3m) for alleys.

In term of block configuration, the structure of the rural village is monotonous because of the dense housing and lack of open space. In the new design for the urban villages, both private and public open spaces are included to have many types of open space.

**Water efficiency**

In terms of water efficiency, the intent is to reduce the use of potable water and to control water runoff effectively. Potential design strategies for the urban villages at neighborhood level can include constructing retention ponds, and creating a natural drainage system. Ponds and a natural drainage system can both benefit not only environmental but also aesthetic value of the urban villages and help them resemble the landscape of the rural villages. For sidewalks and other paved areas in public or private spaces, the use of open grid, pervious surfaces is encouraged.
Potential design strategies at building level can include using saving-water fixtures and constructing cisterns to contain rainwater. At building level, encouraging the construction of green roofs is also an effective strategy. Intensive green roofs can be used for buildings with large floor area, and extensive green roof can be used for residential housing or small office buildings. As the urban villages of Anyang focus on low-rise development with human scale buildings, the use of extensive green roofs is more suitable.

**Energy conservation**

At neighborhood level, energy conserving strategies can include the proper orientation of buildings within the neighborhood and the use of sustainable energy systems such as those used in the case of Huangbaiyu. At building level, energy conserving strategies can include passive solar energy, energy saving from architectural details such as balcony, overhang, etc.; and the use of solar panel. As in the case of Village Homes, the solar panels on the rooftop of each house can provide enough hot water for most of the year and reduce by at least 50% of the cost for utilities. The construction of a green roof is also helpful in terms of energy conservation because it prevents the hot air from coming into the building in summer and keeps it warm in winter.

**Air Quality**

At neighborhood level, in terms of design, strategies to improve air quality include the proper orientation of the neighborhood (for example, the rows of buildings that are parallel to each other are not recommended because it is not good for ventilation; and the larger building dimension should avoid facing into the predominating wind direction.. etc). The design strategies also encompass the design of a landscape system to improve air quality through evapotranspiration of plants.
Air quality also needs to be considered during the construction process.

**Material and Resources**

The use of locally sourced, rapidly renewable materials is recommended for the urban villages of Anyang. According to Solar City (http://www.solarcities.org/), recent research has been exploring the use of compressed earth bricks for exterior walls in the rural villages of China. The traditional material for exterior walls is regular earth brick. However, compressed earth bricks provide greater strength than earth blocks and do not require wet mixing and drying. They also do not require firing, and do not require a factory. Therefore, the use of compressed earth bricks can eliminate a large amount of pollution by reducing the energy required to fire the brick and the pollution caused from hauling the bricks from factory to construction site. Compressed earth bricks can be manufactured on site with a mix of earth from housing sites or from aquaculture excavation sites with a small percentage of cement (two to ten percent). The cement controls the compressive strength of the bricks. Compressed earth brick is considered a sustainable material as it is locally available and after it is used, it can be a “biological nutrient”, as in the Cradle to Cradle Design Framework. Bamboo, a rapidly renewable material which is popular in China, can also be used for building fences or as a construction material. Other materials are also chosen based on the renewable characteristics and sources. However, as the urban villages are within the urban context, one ought to take into consideration that construction materials should be mass-produced using high-end technologies.
Landscape and ecology

At neighborhood level, the design strategies to preserve and enhance landscape and ecology can include, but are not limited to, the maximization of land for landscape, the use of high Solar Reflectance Index material to prevent the urban heat island effect, and the use of native plants. To promote biodiversity, green spaces should connect to each other. At building level, the use of green roofs also contributes to this goal.

Building typologies

There are many sustainable strategies for buildings. In terms of sustainable technologies, the strategies can include, but are not limited to, the use of water saving fixtures, the use of sustainable materials, the use of renewable energy, etc. Because this thesis is working at an urban design scale, important sustainable strategies include building orientation, building type, and site design. The houses in the urban villages of Anyang can use the sustainable technologies that are mentioned in Chapter 3. For building types, courtyard housing still seem to be the best choice for the urban villages of Anyang because of its
abilities in saving energy and creating a comfortable indoor environment for residents. However, the area of courtyard housing is quite large, therefore other parts of the villages can develop uncompleted courtyard housing types. Low-rise apartments also can be designed similar to the configuration of the courtyard housing typology.

**Design Issues**

This same section in Chapter 3 discussed the importance of local factors to design practice. Local factors are understood as local knowledge, local identities and daily activities of local residents. Design elements that promote the creation of a sense of community are encouraged. The new urban villages of Anyang should be able to create a feeling that the community belongs to each resident, and that the new development does not change their daily activities. The typical images of the rural villages of Anyang with tile roofs, narrow roads between two rows of big trees, and the roof of the pagoda hidden behind the leaves, the village entrances, the periodic fair, or the community gardens are what created the identities for Anyang. It is important to bring such images into the new design to create a sense of community for the residents.

**Conclusion**

Because of the limited data, this thesis could not go further in providing more detailed standards for the urban villages of Anyang. Therefore, it is accepted that, in technical aspects, the above principles are not enough and still need the work of people from other disciplines such as environmental engineers or construction engineers. However, in its urban design aspects, the principles have provided enough information to realize a good design. In the next chapter, one urban village is designed according to the recommended principles in order for the reader to visualize the principles and strategies.
Chapter 6: Application design

6.1. Goals

The proposed master plan of the Anyang Eastern New Town by the School of Planning encompassed eight urban villages. They are developed on the sites of existing rural villages. However, the rural villages will be replaced by new developments. The design concept of the whole master plan is sustainable/innovative urbanism which employed sustainable design principles with regards to traditional urban form and design principles.

The village, which is selected for application design, is the one close to both the river and the green corridor along the railroad. This village is selected randomly.

Figure 15: Proposed Master Plan for the Anyang Eastern New Town by the School of Planning, University of Cincinnati
(Source: School of Planning, University of Cincinnati)
The proposed design must achieve the general goals of the New Eastern District of Anyang. They include:

- To promote the development of attractive residential neighborhoods and green architecture.
- To build a new, modern rural community with vernacular characteristics.
- To make sure it is well-served by public facilities and infrastructure.
- To create a substantial amount of green space.
- To establish a system of open space and ecological corridors and provide for open space and park facilities at walking distance from residential areas.
- To promote mixed-use development and convenient commercial uses within walking distance.
To maintain, where possible, the connection between the old and the new by integrating new development and existing rural fabrics.

In the case of the urban villages, the goals should include the application of sustainable design principles as proposed above.

6.2. Design Application

The chosen urban village is located next to the riverfront green space and the north-south green corridor. Using the concept of sustainable/innovative urban design, the author proposes a grid layout for the whole urban village. The streets run along north-south and east-west directions. The street blocks have the longer side running in a north-south direction, so that almost all the houses can face south.

The design creates a compact form which is similar to the rural villages. However, to solve the problems caused by a compact living environment, such as ventilation and lack of open space, the design proposed a system of green spaces. These green space corridors connect to the green space corridors of the New Town and connect to each other. This connection can be seen in Figure 18. These green spaces are designed so that they are within five minutes walking distance of all the houses, thus promoting pedestrian activities and walkability. The main street is mixed-use with commercial uses (Figure 19). There is an elementary school and an open space for the periodic fair, which is used as a playground the rest of the time.

The design proposes various types of housing. Completed courtyard housing and uncompleted courtyard housing, which are the traditional housing types in rural villages, are the two major housing types in the new design. The design also proposes new housing types and affordable courtyard apartment buildings in order to provide housing for people with
various income levels. Garden houses with gardens in the back of the houses are proposed to promote urban agriculture and satisfy some of the population who come from the rural villages. Another new type of housing, which is located along the main street, has the opportunity to be expanded in the future. This housing type, with its depth much longer than its width, has open space in the back. This open space can be developed as the members of the family increase.
Figure 17: Urban Design Plan
Figure 18: Connection of green spaces

Figure 19: Commercial street
Chapter 7: Conclusion

Malcolm Moor has mentioned in his book *Urban Design Future* that we are now moving toward the future of urban design. In this generation, urban design will seek solutions to resolve the issues between the increasing demands for environmentally responsible development and traditional townscape. The future of urban design will be sustainable design with energy efficiency and adherence to local vernacular identities. (Moor, 187) New sustainable design principles require new morphologies and typologies for sites and buildings. The challenge for urban designers now is to balance between sustainable design and traditional and vernacular urban design and architecture to create a new townscape.

China today also is emphasizing the importance of sustainable design and green technologies. They have been incorporating with US to research on sustainable issues and strategies. As mentioned in the Huangbaiyu Case study, the Huangbaiyu Sustainable Village is the first one to be designed following the cradle to cradle design framework. The sustainable design program has just been started in China, and soon has become a critical program. As the urban development in China is getting stronger and faster than ever, a large amount of rural villages have been transformed into an “urban” look with large blocks, multistory apartment buildings... and a great number of farmers are becoming urban residents every day. It becomes obvious to realize the importance of the integration between sustainable design and local vernacular. Local factors and identities need to be preserved and enhanced while developing. This thesis proposes a set of guiding principles that might have Anyang and other new developments with similar conditions in their way to sustainable development.
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