A study of museum courtyard space in eastern China

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ABSTRACT
The design of the contemporary courtyard is different from that of the traditional garden, but the practices based on the abstract relationships of the traditional garden represent a form of cultural continuity. The number of museum courtyard designs continues to rise in eastern China which has outstanding traditional gardens and a rich historical culture. This paper aims to put forward the design strategies of museum courtyards of different sizes in eastern China. First, the basic data of 60 cases are collected from a wide range of sources and analysed statistically. Secondly, the design concepts and spatial organisation are examined in combination with field research, and thirdly, interviews with several architects are considered. Finally, this paper concludes that the traditional folk houses, villages and especially gardens in eastern China exert a profound influence on the design of the contemporary museum courtyard. The design of the museum courtyard reflects the response to the traditional context in three dimensions: spatial layout, spatial scale, and spatial sequence. This paper describes the specific design strategies of the museum courtyard as they echo the traditional context across settings of three different sizes: less than 5,000 m², between 5,000–10,000 m², and greater than 10,000 m².

1 Introduction

1.1 Research background

The contemporary world in the network society has reflected the opposite trend of globalisation and identity (Castells 2010). The standard urban construction has split the traditional context, leading to the loss of urban memory and cultural identity. Increasingly more designs for courtyards emphasise cultural and spiritual needs, which is consistent with the development of museums. In addition to its established functions of collection, display, and leisure, a museum, as a carrier of regional culture, needs to meet psychological and spiritual needs and stimulate local cultural identity (Homadovski 2009; IMLS 2000). In eastern China, combining courtyard space with museums is an effective way to continue and showcase traditional culture.

The traditional Chinese garden has a unique style and represents an artistic accomplishment in courtyard and garden design at the world level (Tong 1963). Among Chinese courtyards, those of the eastern region (historically known as the Jiangnan area) are outstanding examples and embody the essence of the Chinese garden. Deeply influenced by ancient poetry and paintings, the traditional Chinese garden culminates in a visual and physical experience (Wang 2018). More importantly, the Chinese garden is the material space that reflects a particular conception of nature and philosophy of life. Many contemporary museum designs use courtyards to express cultural continuity. For example, the Suzhou Museum designed by the famous architect I. M. Pei reflects the relationship between the exterior design and the interior features through the practice of courtyard design, expressing respect for Suzhou’s culture heritage (Konecni 2015).

However, while there are many excellent contemporary designs in eastern China, a theoretical summary is lacking in the field. Therefore, this paper aims to study the museum courtyard space of China’s eastern region, analysing its design concepts and spatial characteristics, summarising the relationship between the museum courtyard design and the traditional context, thereby enriching theories of designing courtyard spaces and providing practical ideas for designing museums.

1.2 Research scope

The object of this paper is the museum courtyard space of the Jiangnan area which includes the city of Shanghai, Jiangsu province, Zhejiang province, and Anhui province (Figure 1). The museums in this area include art galleries, exhibition halls, memorial halls, and cultural centres built after 1990, when economic, political, and cultural development was well underway in a modernising China.
The eastern part of China is a flat region with abundant water and picturesque scenery, reflecting rich economic development and a profound cultural heritage. This urban texture consists of the courtyard unit in the midst of rivers and alleys. The traditional courtyard’s implicit aesthetics, with its flowing and layered spaces and rich philosophical conceptions, is the source of courtyard design for contemporary museums.

This paper collects 60 cases that have been completed in the past 30 years, including 25 that have been recognised for their award-winning national and international designs. The paper analyses the design ideas of these cases and finds that most of the design practices take the traditional gardens, folk houses or villages as the concept sources of design, and others such as traditional Chinese paintings and ruins are also sources of inspiration (Figure 2). As can be seen from Figure 3(a), the number of courtyard museums in eastern China grew rapidly around 2006 and continued to grow from then onwards. Figure 3(b) shows the proportion of courtyard museums in the total number of new museums constructed in the past eight years in eastern China. It is evident that from 2010 to 2014, the proportion of courtyard museums was on the rise. In 2010, the total number of museums was decreasing, but the number of courtyard museums was on the increase. There are two explanations for this: on the one hand, some museums were managed improperly; on the other hand, some of the museums were merged.

By comparison, it can be concluded that the proportion of museums with courtyards that reflect the regional context has gradually reduced from 2014. It is worth noting that an increase in the number of museums is an indication of the level of cultural construction in a region. However, museums with courtyards are an important feature and usually reflect the traditional culture and space and can distinguish eastern China from other regions. Therefore, the construction of museums should not only focus on their number, but should also pay attention to both regional and cultural characteristics. This is the only way that museums can continue to play the role of maintaining cultural essence.

2 Research methods

The research methods of this study are based upon a literature review, field research, and interviews with architects. First, the basic data and information are collected through books, periodicals, news media, and online sources, and such data involve construction
times, locations, areas, functions, and architects. SPSS (Statistical Package for the Social Science) is also used to process and analyse the data. Secondly, an emphasis is placed on the design concepts and spatial organisation that reflect a traditional context. Next, 21 field studies are conducted to record the usage and impressions of museum space, and to compare and summarise the key points of courtyard design. Lastly, several architects are also interviewed to help produce relevant conclusions.

3 Space analysis

In order to gain a more comprehensive understanding of the research topic, three architects were interviewed during the research. The topic of the interview was how courtyard spaces of museums could be designed to reflect the local traditional context.

The first architect was a chief designer for several museums in China and has rich practical and theoretical experience in the design of cultural architecture. He suggested that the concept of Critical Regionalism should be referred to in the design of museum courtyards. He also pointed out that during the architectural design process, it is necessary to critically think about the tradition of regional architectural culture. Hence, architects should actively integrate traditional courtyard design with modern factors and regional culture in the design of courtyard museums.

The second architect was also a university professor with rich theoretical experience and unique views on the theory of regional architectural design. He believes that the most important point when embedding traditional culture into the design of museum courtyards is to make the space situational. The design of visitors’ perception, including vision and touch, can arouse and resonate with people’s

Figure 3. (a) The relationship between quantity of Courtyard museums and time. (b) Comprehensive analysis of quantity of Courtyard museums.
emotions. In the design process, the visitor’s experience should take priority as it is through it that the traditional context can be felt.

The third architect was a landscape architect who mainly studies regional landscape architecture design. She believes that the realisation of the inheritance of the traditional context requires the inclusion of cultural factors into the courtyard design. She emphasised that there is a need to develop an in-depth understanding of the history of courtyard spaces. This is particularly important for traditional living spaces, such as streets and patios. This kind of approach will help transform the sub-transformation into meaningful cultural heritage, rather than just a simple imitation of traditional architectural patterns.

Inspired by the three interviews, this research is based on the study of traditional spaces, regional critical theory and spatial experience. Meanwhile, all three architects agree that a museum courtyard is an important regional feature that helps distinguish one region from another. Therefore, combined with the collected cases, the research will analyse the courtyard spaces of museums based on the following three dimensions: spatial layout, spatial scale, and spatial sequence.

### 3.1 Spatial layout

The layout of a museum is closely related to many factors, such as visitor streamlines and displayed content, and layout exerts a considerable influence on visitors’ feelings (Peponis and Hedin 1982; Wineman and Peponis 2010). In light of these factors, there are many possible modes for combining the courtyard space with the museum, thus forming a variety of spatial layouts. In the cases studied in this paper, the spatial layout of the museum courtyards can be divided into four categories according to their different compositions: centralised layout, decentralised layout, serial layout, and combined layout (Table 1).

First, in a centralised layout, the courtyard is surrounded by a single building or by a group of buildings, producing an “L” shape, a “U” shape, or a hollow square shape. The form of the museum’s building and its combination of exhibition spaces are important factors affecting courtyard space. In this centralised layout, the courtyard space reflects a certain sense of enclosure and a weak connection to its external surroundings. Additionally, the courtyard space is at the core and becomes a central point of design, echoing the surrounding urban texture. For example, the courtyard of the Suzhou Museum is reminiscent of the Humble Administrator’s Garden, a traditional Chinese garden in the North. The Fei Xiaotong Jiang Village Memorial Hall also has a central courtyard surrounded by buildings in a manner that expresses respect for the surrounding villages.

Secondly, the decentralised layout has evolved from the traditional garden layout of Jiangnan. The courtyard is surrounded by museum buildings, structures, and plants, with the buildings being scattered in the courtyard and connected by corridors. This decentralised layout is usually used in more affluent base areas. Spaces feel open and flowing, creating an experience much like that of visiting a traditional Jiangnan garden. For example, the extension of the China Silk Museum forms a dialogue with Hangzhou’s old buildings, evoking the city’s historical memory with classical gardens, curved walkways, windows, pavilions, plants, and other design elements. It shows the concept of harmonious coexistence with nature of traditional Chinese culture.

Thirdly, the serial layout is derived from the layout of Jiangnan’s traditional folk houses, organising spaces through a series of courtyards with a strong spatial sequence. In this serial layout, the courtyard and exhibition space are alternately arranged according to the museum’s streamline of visitors, and this order is expressed through the repetitive intervals of the courtyards. For instance, the multiple courtyards of the Jixi Museum not only preserve existing trees but also reproduce vernacular Huizhou architecture.

Fourthly, the combined layout combines the first three layouts, with a courtyard system not only visible in the overall layout but also in its different sections. Here, the spatial layer prevails and the spatial contrast is more vivid, which for visitors creates an impressive experience of space. For example, the combination of serial and centralised layouts in the Ningbo Fellowship Museum provides a rich spatial narration and evokes the collective memory of the Ningbo Fellowship and the united and diverse regional culture.

| Characteristics            | Centralized Layout           | Decentralized Layout          | Serial Layout                | Combined Layout               |
|-----------------------------|-------------------------------|-------------------------------|------------------------------|-------------------------------|
| Surrounded by buildings;    | Open and flowing; much like   | Strong spatial sequence; like | Combination of the other     |
| sense of enclosure          | traditional gardens           | traditional folk houses       | three abundant spatial layers |

Table 1. The four spatial layouts of museum Courtyards.
Based on SPSS analysis, this study concludes that museum courtyard layout has a significant relationship with gross floor area. The paper classifies 60 cases according to three kinds of gross floor areas. It can be seen from Figure 4 that museums are relatively evenly distributed in such areas, all of which are more than 15 cases. Figure 5 shows that the average area of museum courtyards classified by area are 2,946 m², 7,444 m² and 24,879 m², respectively. There are obvious differences between them. Therefore, the proposed strategies for courtyard museums according to three different sizes is reasonable and representative.

When the area is less than 5,000 m², two different layouts are usually adopted, centralised or combined, according to different conditions of land use. When the area is between 5,000 and 10,000 m², the courtyard tends to reduce the building’s sense of volume. In addition to the centralised layout, the serial layout is mainly used to increase the sense of architectural rhythm. When the area is greater than 10,000 m², the museum tends to have more diverse functions, more complex forms of organising space, and more sophisticated streamlines. The combined layout is mainly adopted to handle multiple functions and streamlines, all the while creating a rich spatial layer (Figure 6).

3.2 Spatial scale
Spatial scale is one of the important factors in the design of an exterior space (Ashihara 1975). In this
paper, the scale ratio of different spatial configurations is derived from the museum courtyards and compared with the traditional Jiangnan courtyards, thus allowing for a classification of museum courtyard space. The ratio of width to height for a courtyard ($D/H$) is used to reflect the scale of its space.

Table 2 shows cases of three specific traditional spaces that have been field researched, namely the Wangshi Garden, the Liu Garden and the Pang House in Nanjingtang historic district. Both the Wangshi Garden and the Liu Garden are well-known Chinese traditional gardens. The Pang House is a well-preserved Qing Dynasty dwelling with a representative spatial pattern. Based on the analysis of the traditional space, this paper advances three types of spatial scale based on the statistical analysis of museum courtyards and the analogy of traditional courtyard space: $D/H < 1$ (patios or alleys), $1 \leq D/H < 2.5$ (courtyards), and $2.5 \leq D/H$ (gardens), according to different scales.

When $D/H < 1$, the surrounding buildings tend to be squeezed into the courtyard, giving visitors a more cramped and compressed feeling of space. Like traditional patios or alleys, there is a certain sense of closure, and the courtyard has the orientation of opening up to the sky.

When $1 \leq D/H < 2.5$, the sensation of space is similar to the traditional Jiangnan courtyard. Here, space is somewhat limited but not closed. The ratio of about 1.3 is an appropriate proportion and provides visitors, who have a good view of the entire courtyard and the building, with a feeling of comfort (Ashihara 1984).

When $2.5 \leq D/H$, space is more open and dispersed, similar to that of Jiangnan gardens. Visitors are less aware of the overall perception of the courtyard and pay more attention to its detailed designs. Combined with the appropriate design of courtyard sightlines and streamlines, such a space can be conducive to achieving the effect, also found in the traditional gardens, of “bu yi jing yi”, with its varying sceneries and changing viewpoints.

### 3.3 Spatial sequence

The field research of this study indicates that despite walking through similar spatial layouts, visitors may feel completely different due to different designs of spatial sequence. Therefore, a rhythmic and distinctive spatial sequence becomes indispensable in the design of museum courtyard space. In the traditional Jiangnan courtyards, three methods are often used to produce a spatial sequence: *quzhe* (twists and turns), *shumi* (sparsity and intensity), and *duijing* (determining the sightlines between people and the scenery through the design of the spatial axis) (Tong 1963) (Table 2). During the literature review and field research, this study finds that in the courtyards of the contemporary museums, the spatial sequence is usually shaped by three methods: spatial expansion and constriction, spatial repetition, and sightline shaping (Table 3), all of which run parallel to the principles of traditional gardens.

Spatial expansion and constriction is the contrast between the opening and closing of a courtyard’s enclosure, increasing spatial variation and undulation, and avoiding monotony. For example, in the Memorial Hall of the Victims in the Nanjing Massacre, designed by academician He Jingtang, visitors can approach the
Table 2. Cases of traditional Courtyards and residential space.

(a) The Wangshi Garden (The Master-of-Nets Garden)

Introduction
The Wangshi Garden is located in the urban area of Suzhou. It was built in 1174 A.D. It is a typical private garden which combines homestead and courtyards. It covers an area of about 6700 m$^2$ and is characterised by its compactness.

Analysis
The design of courtyard is centred on water, and the D/H is about 3.8. The streamline starts from the southeast and passes through the house before entering the courtyard.

The layout is divided into three parts: the western inner courtyard, the middle central courtyard and the eastern residential area. Skilful combination of scenery and sightline is used to make the courtyard space more flowing and layered.

Meanwhile, quzhe and shumi are also used in the courtyard. The winding red area shows a high density of buildings, while the purple area shows a natural and loose scene, forming a sharp contrast.

(b) The Liu Garden (The Lingering Garden)

Introduction
The Liu Garden is located in Suzhou City. It is a large classical Chinese private garden with an area of 23,300 m$^2$. It is the representative of the Qing Dynasty courtyards and is known as one of the four famous gardens in China.

Analysis
The central courtyard of the Liu Garden consists of water and mountains, and the D/H of the courtyard is greater than 2.5. The streamline is mainly organised by the corridors. The corridors in the eastern area are full of twists and turns. The west and north side of the climbing corridors are undulating and continuous.

(Continued)
### Table 2. (Continued).

| Diagrams | Plan District | Sightline |
|----------|---------------|-----------|
|          |               |           |

**Analysis**

The layout is divided into three parts, the western mountain courtyard, the middle central courtyard, and the eastern buildings area. Streamline pauses at the main buildings and pavilions to increase the sightline shaping. Some techniques such as *dujing* have been used.

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#### Shumi

**Diagrams**

![Shumi Diagrams](image)

**Analysis**

The two sides of the central courtyard form a *shumi* contrast. The red area is a building-based interface that has a compact feeling. The purple area is a natural interface formed by rockeries, trees and is a loose interface.

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#### Spatial Expansion and Constriction

**Diagrams**

![Spatial Expansion and Constriction Diagrams](image)

**Analysis**

The entrance of the Liu Garden is a winding corridor with a small patio, which gives people a feeling of oppression, thus prompting people to move forward continuously. When reaching the open central courtyard, visitors can experience a rhythmic fluctuation.

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### (c) Nanjingtang Historic District and Pang House

**Introduction**

The Nanjingtang in Changshu is a historic district with well-preserved architectural features and spatial patterns. Among them, Pang House is a well-preserved Qing Dynasty dwelling with a representative spatial pattern.

**Diagrams**

![Nanjingtang Historic District Diagrams](image)

**Analysis**

In the Nanjingtang district, the D/H of traditional alleys is less than 1. In this well-preserved district, people can still feel the pleasant scale and winding feeling of traditional alleys and lanes.

**Diagrams**

![Section Plan of Courtyard in Pang House](image)  ![Site Plan of Pang House](image)

**Analysis**

The D/H of the second courtyard is 1.9. It is an effective way to organise space in traditional architecture and create introverted space. In traditional dwellings, courtyards have many functions, such as ventilation, catchment, and lighting.
altar at the end of the streamline and feel the suppressed atmosphere of this space. Afterwards, visitors can enter the final courtyard with a wide field of vision and experience peace. The spatial expansion and constriction of the courtyard space reinforces a sense of spatial sequence and forms a sense of place for the museum’s exhibited content.

Spatial repetition means that the courtyard space appears repeatedly during the visitor’s tour, emphasising the progressive relationships and rhythmic sensations of space. More specifically, repetition has two functions, one using different courtyards to create a sense of repetition, and the other using the same courtyard to repeat its sense of space in the museum’s streamline. For example, in the Jixi Museum, a same courtyard can be repeatedly observed or visited from different angles in the streamline, with the effect of changing spatial perspectives, allowing visitors on their stroll to experience scenery inspired by the ancient town of Jiangnan.

Sightline shaping is a visual dimension of the courtyard design. Its organisation of scenery and framing of vision is based on the route of the visitors’ tour. There are two forms of sightline shaping, one is dynamic and presents different courtyard scenes during a visit. Here, the visitor’s sightline continually changes during the tour, with space undulating like the plot of a novel (Ashihara 1975). The other form is static; that is, after visitors reach a certain point, the courtyard’s landscape is revealed.

### 4 The strategies on Courtyards of museums

In this study, different spatial layouts and traits are found to be associated with different gross floor areas. This is because museums with different areas have to deal with different problems such as surroundings, traffic streamlines and functions.

Design strategies for museum courtyard space are proposed based on three classifications of areas: less than 5,000 m$^2$, between 5,000 and 10,000 m$^2$, and greater than 10,000 m$^2$. Table 4 shows three representative cases of the three different areas, while Table 5 shows all the 60 museum courtyard cases and the 21 cases highlighted in bold are the field research cases.

#### 4.1 Area less than 5,000 m$^2$

If the gross floor area of a museum is less than 5,000 m$^2$, centralised layouts and combined layouts are frequently adopted to respond to the multi-courtyard urban texture of Jiangnan area. However, if museums are located among villages, decentralised layouts are adopted to match the surrounding open environment. This is because villages in eastern China are mostly located in plain areas, where buildings are sparsely distributed and different from the densely populated cities. Village spaces form a loose texture, which can be echoed by the decentralised layout of the museum courtyard. The scale of courtyard space in a centralised layout is usually $1 \leq D/H < 2.5$, so it appears comfortable and suitable according to human scale, emphasising the integrity of space, while in a decentralised layout, the scale of courtyard is $2.5 \leq D/H$, giving visitors an open feeling of villages. In spatial sequence, sightline shaping is commonly utilised combined with streamlines to strengthen the sense of spatial sequence. Due to the limited quantity and area of exhibition space, fixed and unfixed streamlines are combined. Both the designed fixed path and the unfixed free approach of self-guidance can forge the overall impression of exhibition

| Methods                      | Diagrams              | Characteristics                        |
|------------------------------|-----------------------|----------------------------------------|
| Spatial expansion and constriction | ![Diagram1](attachment.png) | Contrast between opening and closing; increase spatial variation |
| Spatial repetition           | ![Diagram2](attachment.png) | Emphasise rhythmic sensations of space |
| Sightline shaping            | ![Diagram3](attachment.png) | Organise sightline based on the route; dynamic form and static form |

Table 3. The three methods of shaping the spatial sequence of museum Courtyards.

| Methods                      | Diagrams              | Characteristics                        |
|------------------------------|-----------------------|----------------------------------------|
| Spatial expansion and constriction | ![Diagram1](attachment.png) | Contrast between opening and closing; increase spatial variation |
| Spatial repetition           | ![Diagram2](attachment.png) | Emphasise rhythmic sensations of space |
| Sightline shaping            | ![Diagram3](attachment.png) | Organise sightline based on the route; dynamic form and static form |

Table 3.
Dynamic sightline shaping and static sightline shaping are used flexibly. Moreover, changes of streamlines in the cross-section of museums are used to show different levels of courtyard space, enriching the experiences and effects for visitors.

### 4.2 Area between 5,000 and 10,000 m²

If the gross floor area of a museum is between 5,000 and 10,000 m², the increased volume makes spatial layouts more flexible. In addition to centralised layout, serial layout is also adopted. The unit repeatability of the exhibition space is utilised to separate the courtyard in order to enhance rhythmic structure of the museum. The arrangement of courtyard space often determines the axis relation of the museum. The scale of the courtyard in serial and centralised layout is usually $1 \leq D/H < 2.5$. However, urban scale and the influence on urban space is also considered in addition to considering the human scale, so a specific courtyard scale is related to the structure of surroundings of a museum. Spatial sequence mainly utilises spatial repetition and sightline shaping. According to the relaxation and pause of space perception, courtyard space is integrated in the exhibition space to relieve fatigue for visitors. Sightline shaping is structured differently from the direct display in smaller area museums, therefore sightline can be interrupted or hidden, thus guiding change for a richer spatial sequence.

### 4.3 Area greater than 10,000 m²

When the gross floor area of the museum is more than 10,000 m², combined layout is mostly utilised. As the volume of the building is massive, it is a skilful way to use courtyard space in the museum layout to merge it with urban texture. In the plan, different courtyard spaces are adopted to deconstruct the museum architecture. In the section plan, part of the building can be hidden underground through the courtyard. For example, the West Lake Museum hides most of the building volume below ground through the courtyard, which is integrated

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**Table 4. Analysis of three representative cases.**

| Analysis | Diagrams |
|----------|----------|
| **Fei Xiaotong Jiang Village Memorial Hall**  |
| Spatial Layout: Decentralised; building connected by corridors  |
| Spatial Scale: To echo the village surroundings; contrastive scale  |
| Spatial Sequence: enrich the experience by sightline shaping  |
|---|---|
| **Liangzhu Culture Museum**  |
| Spatial Layout: Serial  |
| Spatial Scale: Similar to traditional courtyards and patios  |
| Spatial Sequence: emphasise the rhythmic sensations by spatial repetition  |
|---|---|
| **Taizhou Exhibition Centre for “Scientific Outlook on Development”**  |
| Spatial Layout: Combined; a courtyard system  |
| Spatial Scale: Transitional; connecting urban scale  |
| Spatial Sequence: Emphasised in a comprehensive approach  |

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(Wineman and Peponis 2010).
Table 5. Detailed information on 60 research cases.

| Museum Name                                      | Time | Area (m²) | Location   | Layout  | D/H of Courtyards |
|-------------------------------------------------|------|-----------|------------|---------|------------------|
| 1 Haining Museum                                | 1990 | 5,000     | Haining; City | Combined | D/H < 1          |
| 2 Southern Song Dynasty Guan Kiln Museum         | 1990 | 3,758     | Hangzhou; City | Decentralised | 2.5 ≤ D/H      |
| 3 National Tea Museum of China                   | 1990 | 8,000     | Hangzhou; Village | Decentralised | 2.5 ≤ D/H      |
| 4 Changshu Tablet Museum                         | 1991 | <5,000    | Changshu; City | Decentralised | 1 ≤ D/H < 2.5   |
| 5 Lin Sanzhi Art Museum                          | 1992 | 750       | Maanshan; Nature | Centralised | 1 ≤ D/H < 2.5   |
| 6 Shaoxing Museum                                | 1993 | 10,000    | Shaoxing; City | Combined | D/H < 1          |
| 7 Songhu Anti-Japanese War Memorial Hall        | 1999 | 3,249     | Shanghai; City | Centralised | D/H < 1 (Back); 2.5 ≤ D/H (Front) |
| 8 Anji Bamboo Museum                             | 2000 | 3,200     | Anji; Village | Centralised; (Relatively Loose) | 2.5 ≤ D/H      |
| 9 Hangzhou Museum                                | 2001 | 6,660     | Hangzhou; City | Centralised | 1 ≤ D/H < 2.5   |
| 10 Tiantai Museum                                | 2003 | 5,900     | Tiantai; Village | Centralised | D/H < 1        |
| 11 West Lake Museum                              | 2005 | 8,000     | Hangzhou; City | Centralised | 1 ≤ D/H < 2.5   |
| 12 Art Museum of Han Culture                     | 2005 | 4,050     | Xuzhou; City | Centralised | 1 ≤ D/H < 2.5   |
| 13 Ningbo Art Museum                             | 2005 | 23,000    | Ningbo; City | Combined | Multiple         |
| 14 Shanghai Qingpu District New City Construction Exhibition Centre | 2006 | 10,155    | Shanghai; City | Combined | Multiple         |
| 15 Jinyun Museum                                 | 2006 | 3,780     | Jinyun; City | Combined | D/H < 1         |
| 16 Suzhou Museum                                 | 2006 | 19,000    | Suzhou; City | Combined | Multiple         |
| 17 Xuzhou Han Stone Portrait Art Museum (new)    | 2006 | 8,000     | Xuzhou; City | Centralised | D/H < 1         |
| 18 Ningbo Xikou Stone Museum                     | 2006 | <5,000    | Ningbo; Village | Serial | 1 ≤ D/H < 2.5   |
| 19 Dehe Root Carving Art Museum                  | 2006 | 4,000     | Ningbo; City | Centralised | 1 ≤ D/H < 2.5   |
| 20 Li Keran Art Museum                           | 2007 | 2,583     | Xuzhou; City | Centralised | 1 ≤ D/H < 2.5   |
| 21 Suzhou Science and Cultural Arts Centre       | 2007 | 150,000   | Suzhou; City | Combined | Multiple         |

In the city near the West Lake. Visitors can feel the spatial transformation in the process of looking back at different elevations. The D/H of the sunken courtyard gives visitors a sense of an archaeological process.

In the new district of Shanghai city. Continuous changes in the scale of the courtyards give visitors a constantly changing sense of space. For example, the D/H of courtyards may change from 2.5 to 2 to 1.5, making the transition from public space to private space.

Next to the famous Humble Administration Garden. It echoes traditional garden with courtyards and axis. It uses sightline shaping such as duijing and jiejing to make visitors feel the artistic conception of traditional gardens.

Located to the north of Jinji Lake. Spatial sequence consists of multi-storey nesting of buildings and courtyards. The courtyard on top of the middle building is designed based on the traditional Suzhou garden.

(Continued)
| Museum Name | Time  | Area (m²) | Location | Layout    | D/H of Courtyards |
|-------------|-------|-----------|----------|-----------|-------------------|
| 22 Nanjing Yuhua Stone Museum | 2007 | 1,600     | Nanjing  | Centralised | 1 ≤ D/H < 2.5     |
| 23 The Memorial Hall of the Victims in Nanjing Massacre by Japanese Invaders | 2007 | 20,000    | Nanjing  | Serial     | Multiple          |
| 24 Suzhou Garden Museum (new) | 2007 | 3,390     | Suzhou; City | Decentralised | Multiple          |
| 25 Liangzhu Culture Museum | 2008 | 9,500     | Hangzhou Village | Serial | 1 ≤ D/H < 2.5     |
| 26 Ningbo Museum | 2008 | 30,000    | Ningbo; Combined | Multiple |                  |
| 27 Ningbo Huamao Art Museum | 2008 | 4,915     | Ningbo; Combined | Multiple |                  |
| 28 Ningbo Fellowship Museum | 2009 | 24,107    | Ningbo; Combined | Multiple |                  |
| 29 Jiangning Weaving Museum | 2009 | <10,000   | Nanjing | Decentralised | 2.5 ≤ D/H        |
| 30 Wushan Museum | 2010 | 6,082     | Hangzhou City | Serial | 1 ≤ D/H < 2.5     |
| 31 Xuzhou Art Museum | 2010 | 23,114    | Xuzhou; Combined | Multiple |                  |
| 32 Fei Xiaotong Jiang Village Memorial Hall | 2010 | 2,234     | Wujishan; Village | Decentralised | 2.5 ≤ D/H (Central) |
| 33 Expo 2010 Ningbo Tengtou Pavilion | 2010 | 1,200     | Shanghai; City | Combined | 1 ≤ D/H < 2.5     |
| 34 Zhu Jiajiao Museum of Humanities and Art | 2010 | 1,818     | Shanghai; City | Serial | 1 ≤ D/H < 2.5     |
| 35 Shanghai Spiral Gallery | 2011 | 250       | Shanghai; City | Centralised | D/H < 1          |
| 36 Huishan Clay Museum | 2011 | 10,321    | Wuxi; City | Centralised | 1 ≤ D/H < 2.5     |
| 37 Taizhou Exhibition Centre for "Scientific Outlook on Development" | 2011 | 17,970    | Taizhou City | Combined | Multiple          |
| 38 Baohua Chinese Painting Research Institute | 2012 | 7,180     | Hangzhou | Decentralised | 2.5 ≤ D/H        |
| 39 Shanghai Natural History Museum | 2012 | 45,086    | Shanghai City | Centralised | 1 ≤ D/H < 2.5     |
| 40 Jixi Museum | 2013 | 10,003    | Jixi | Serial | 1 ≤ D/H < 2.5     |

In the natural area. Centralised layout with inner courtyard. The D/H of courtyard implies local folk houses.

In the city. The courtyards are placed in the streamline to organise the spatial sequence. It uses different D/H to express courtyards with different themes, and uses spatial expansion and constriction to strengthen spatial sequence. The whole museum provides a rich spatial narration and brings spiritual shock to visitors.  

Located in the new district of the city. Courtyards are placed on different floors. Visitors can experience the feeling of the traditional Chinese gardens and recall the lanes, patios of old Ningbo through different D/H of courtyards.

In the city. It organises space by various proportion of courtyards, strengthens spatial sequence by means of spatial expansion and constriction, and arouses the memory of residential buildings and courtyards.

In the city. It enhances the spatial sequence by means of traditional courtyard methods such as shumi and quzhe.

Located next to the ancient town. The courtyard layout draws from the texture of residential building of the town. Through the control of sightline, visitors can feel the ancient trees, ancient town and the surrounding environment.

Near the village. It uses courtyards with different D/H to reinterpret folk houses in Anhui. The courtyard space is comfortable and pleasant, and it uses spatial repetition and sightline control to emphasise the change of spatial sequence.

(Continued)
| Museum Name                                      | Time | Area (m²) | Location          | Layout            | D/H of Courtyards |
|------------------------------------------------|------|-----------|-------------------|-------------------|-------------------|
| Shanghai Songze Ruins Museum                    | 2013 | 3,680     | Shanghai; City     | Combined          | D/H < 1           |
| Jiading Museum                                  | 2013 | 9,608     | Shanghai          | Centralised       | 2.5 ≤ D/H         |
| Nantong New Museum                              | 2014 | 13,500    | Nantong; City     | Decentralised     | 2.5 ≤ D/H         |
| Liang Xi Memorial Hall                          | 2014 | 3,900     | Huzhou; Nature    | Serial            | Multiple          |
| Ningbo Keli Museum                              | 2014 | 4,500     | Ningbo; City      | Combined          | D/H < 1           |
| Fan Zeng Art Gallery                            | 2014 | 7,028     | Nantong           | Combined          | Multiple          |
| Xia Houwen Art Museum                            | 2014 | 3,264     | Longquan; City    | Combined          | D/H < 1           |
| Imperial Examination Museum Of China            | 2014 | 200,000   | Nanjing; City     | Centralised       | 2.5 ≤ D/H         |
| Mu Xin Art Museum                               | 2015 | 6,700     | Jiaxing           | Serial            | Multiple          |
| Art Gallery of Anhui Academy of Art             | 2016 | 8,833     | Hefei; City       | Serial            | 1 ≤ D/H < 2.5     |
| Suzhou Museum of Imperial Kiln Brick            | 2016 | 15,087    | Suzhou; City      | Decentralised     | 2.5 ≤ D/H         |
| Chinese Silk Museum (new-built)                  | 2016 | 22,999    | Hangzhou          | Decentralised     | 2.5 ≤ D/H         |
| Suzhou Museum of Intangible Cultural Heritage   | 2016 | 14,000    | Suzhou            | Multiple          |                  |
| Jingjiang Folk Museum                            | 2016 | 30,000    | Jingjiang; City   | Decentralised     | 2.5 ≤ D/H         |
| Xuzhou City Wall Museum                          | 2016 | 950       | Xuzhou; City      | Centralised       | 1 ≤ D/H < 2.5     |
| Gongwang Art Museum                              | 2016 | 37,816    | Hangzhou; Village | Decentralised     | 2.5 ≤ D/H         |
| Ten Li Dowry Museum                              | 2017 | 11,800    | Ningbo; County    | Serial            | Multiple          |
| New World Expo Museum                            | 2017 | 46,550    | Shanghai; City    | Centralised       | 1 ≤ D/H < 2.5     |
| Design Museum of China                           | 2018 | 16,800    | Hangzhou; City    | Centralised       | D/H < 1           |
| Main Exhibition Hall of 2018 Jiangsu Horticultural Exposition | 2018 | 12,680    | Yangzhou          | Combined          | Multiple          |

Part of the floor area sources in the table: Sun (2017). “Research on the Design of the Courtyards Space in Museums in Yangtze River Delta” Master diss., South China University of Technology.
with the surrounding mountains and lakes and shows the humility in Chinese traditional culture.

As for the space scale, large-scale space considers not only the surrounding urban texture, but it also considers its own impact on the surroundings. For example, in Taizhou Exhibition Centre of Scientific Outlook on Development, the courtyard is designed to form a transition space by connecting the two different urban scales at the south and north, to improve original defects and continue the urban texture. In the combined layout, the scale of the courtyard has many possibilities. For instance, the courtyard of Ningbo Fellowship Museum presents a different spatial artistic conception through different scales of space. The scale of the entrance courtyard is $2.5 \leq D/H$; the plan design is close to the square, giving visitors a feeling of openness, similar to the landscape that was used for classical gardens in eastern China. While the D/H of “Water Street” courtyard is about 1.5, the plan is slightly long, giving people a sense of being in Jiangnan streets, encouraging people to move forward.

For spatial sequence, spatial constriction and expansion, spatial repetition and sightline shaping are comprehensively used. Courtyard space also solves complex function set and multiple streamlines of the museum. Meanwhile, spatial sequence design focuses more on representing the narrative fluctuation in museum visits, consisting of the beginning, transition, climax, and ending. Furthermore, the expression of courtyard materials and details are emphasised according to the traditional context.

### 5 Conclusions

The study of museum courtyard space in eastern China is a new research topic under exploration. Within this context, this study is conducted on the basis of existing practice and produces three conclusions.

First, the design of contemporary museum courtyards, as based on the abstract spatial relationships of traditional gardens as well as streets and villages, can echo eastern China’s traditional context. Most of all, an appreciation of a traditional garden’s implicit beauty, with its flowing spaces, philosophical and artistic conceptions, can have a profound influence on the design of modern museum courtyards.

Secondly, the design of the museum courtyard space reinforces cultural continuity in three dimensions: spatial layout, spatial scale, and spatial sequence. For spatial layout, the organisational forms of courtyards include the centralised layout, the decentralised layout, the serial layout, and the combined layout. Regarding spatial scale, different ratios of width to height (D/H) of courtyards stimulate people’s memory of traditional streets, patios, courtyards, and gardens. For spatial sequence, spatial expansion and constriction, spatial repetition, and sightline shaping are used to enhance visitors’ spatial experience in museums.

Thirdly, to be more specific, museum courtyard space responds to regional cultural traditions depending on the different design strategies of different gross floor areas. If the area of a museum is less than 5,000 m², centralised or decentralised layouts are often adopted to respond to the urban and rural texture. The scale of the courtyard space is usually $1 \leq D/H < 2.5$ in a centralised layout and $2.5 \leq D/H$ in a decentralised layout, with a focus on creating a comfortable human scale. Also, sightline shaping is used to create a sense of spatial sequence.

If the area is between 5,000 and 10,000 m², serial and centralised layouts become primary. The spatial scale is usually $1 \leq D/H < 2.5$ and the scale of urban space is taken more into consideration. Spatial repetition and sightline shaping are used to emphasis spatial sequence.

If the area is greater than 10,000 m², a combined layout prevails. There are many possibilities for spatial scale (D/H), which may help maintain urban texture. Spatial sequences emphasise narrative fluctuations. In addition, spatial expansion and constriction, spatial repetition, and sightline shaping are used comprehensively in the museums under consideration, and design details are emphasised to respond to the traditional context.

### 6 Discussion

This article not only analyses the courtyard space characteristics, but also deeply studies the design process and methods of the cases and provides the following reference for future design practices.

First, it is evident from layout maps that the layout of a museum’s courtyard space changes with its area. In a smaller museum, a centralised single courtyard can effectively organise space and ensure the simplicity, purity and integrity of the museum. As the area of a museum increases, its functions and streamlines become more diversified and complex, and its environmental impact on the surrounding area gradually increases. Therefore, a multi-yard combination is adopted to ensure that museum courtyards have a positive influence on the environment. On the one hand, a multi-yard combination can meet the needs of complex functional streamlines; on the other hand, the use of courtyards of different scales can decompose building volume and achieve a transitional effect on the environment.

Secondly, the three courtyard spatial design strategies, distinguished by museum area, can be further divided into two categories in terms of their mode of expression: simile or metaphor. In this context, “simile” refers to the use of the elements and vocabulary of traditional courtyards in modern courtyard space, reproducing the appearance of traditional
garden architecture and giving visitors an intuitive impression of tradition. Metaphor, in contrast, is the modern interpretation of the spatial relationships and structure of the traditional courtyard. It is not limited to the expression of form, but conveys an abstract similarity. Visitors experience only “local” and “ancient” feelings during their visiting experience. In different environments, these two modes have distinct advantages. Alternatively, a few architects have attempted to break away from the connection between contemporary and traditional courtyards and create new contemporary cultural identities.

Thirdly, investigation of the process of designing museum courtyard space reveals that some cases are designed from the perspective of urban design, whereas others start with a traditional artistic conception of a specific courtyard scene. However, the process of designing museum courtyard space does not simply occur from the inside to the outside or from the outside to the inside; because it is the carrier of cultural expression, it has both a dominant context (such as the texture of urban space, architecture, street) and an implicit context (such as the historical and cultural background, living habits), with corresponding properties. The design must both echo the urban context and continue the regional culture. When the design process starts from internal space, the spirit of the courtyard space is the starting point of the design. Next, the courtyard space must be coordinated with the functions, space, and streamlines of the whole museum and integrated with the city context. When the design starts from the external environment, the courtyard space needs to follow the city context at three levels: region, block, and building. The design process thus moves from the whole to the local. The courtyard space helps to organize the museum plan, including its functions and streamlines, and the final layout is rooted in the shape and expression of the courtyard space. Therefore, in the final expression, the design of courtyard space is an integrated whole because of the repeated process of coordinating with the external environment and internal space.

Disclosure statement

No potential conflict of interest was reported by the authors.

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