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# The museum method of reusing Shanghai waterfront industrial heritage: continuation and reconstruction of urban memory

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## Abstract

In the context of transforming traditional labour-intensive industries into the service economy in China, the reuse of industrial heritage as museums has become a trend, for example, along Shanghai waterfronts, gradually fuelling the continuation of urban memory, reshaping urban cultural identity and promoting the development of the waterfront economy. Additionally, the connotation of a museum is continually being expanded from an institution to a method, and the major function is gradually shifting from collection to display. Previous studies on Shanghai waterfront industrial heritage have mostly referred to cultural factors, but these factors are still mainly included in macroscale large waterfront projects or microscale single practical project analyses. Mesoscale typology discussions between the two are rare. Therefore, this paper examines eleven industrial heritage sites that have been repurposed as museums along Shanghai waterfronts to analyse the urban memory elements of industrial heritage and summarise three classes of memory interpretation strategies: translating memory information, renovating memory carriers, and relating memory clues. Finally, the advantages and disadvantages of the study cases are discussed separately, and the following corresponding recommendations are made: 1) further enrich and balance memory interpretation strategies; 2) enhance the rationality, service, and tolerance of the “exhibition + ” mode; and 3) improve local laws and regulations related to the protection and utilisation of industrial heritage to provide references for similar reuse designs.

**Keywords** Waterfront industrial heritage, museum, reuse strategies, Shanghai, urban memory, memory interpretation

## 1 Introduction

*The architecture of those who preceded us must continue to be able to speak to us. Moreover, our new insertions must succeed in renewing emotions and in rejuvenating and keeping alive the dialogue with the*

*ancient. Architecture speaks—as you know—only if it can always ignite new collective and personal emotions at the service of collective happiness.*

*Marco Dezzi Bardeschi, Italy, 1934–2018*

China successively issued the Wuxi Statement—Pay Attention to the Protection of Industrial Heritage during the Period of Rapid Economic Development (also known as the Wuxi Statement 2006) and Saving Industrial Heritage—Proposal on the Protection of China's Industrial Architectural Heritage (also known as the Beijing Initiative 2010) based on the Nizhny Tagil Charter for Industrial Heritage (2003), proposing the five major values of industrial heritage: historical, artistic, scientific, economic, and social values. China holds that

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industrial heritage includes not only various production and residential buildings (structures) related to industry, facilities, and equipment but also towns, landscapes and intangible heritage, such as technological processes, data records, and enterprise archives. Later documents, such as the Hangzhou Consensus—Protection and Utilisation of Industrial Heritage (2012) and the Implementation Plan for Promoting the Protection and Utilisation of Industrial Heritage in Old Industrial Cities (2020), emphasise that industrial heritage is an important element of the emergence and development of modern industrial civilisation and that it is essential to actively explore multiple modes of conserving and adaptively reusing it, especially in terms of cultural facilities and creative cultural industries related to people's livelihoods, to preserve the historical context of the city.

Due to their unique geographical location, urban waterfronts became the primary site for many industrial facilities during the industrial era, especially in port cities. Therefore, the economic and cultural regeneration of urban industrial waterfronts has been extensively discussed internationally since the 1980s (Mann 1988; Sieber 1991; Hoyle and Pinder 1992; Craig-Smith and Fagence 1995; Norcliffe et al. 1996; Meyer 1999; Hagerman 2007; Xie 2015). These studies showed that when urban waterfronts are gradually freed from industrial and port functions, their regeneration gradually becomes a globalisation tool to improve urban competitiveness, create new urban public spaces, and enhance local vitality by providing attractive large-scale leisure spaces, business offices, and residential and other projects. In these contexts, culture-led approaches such as museums and thematic and heritage parks have become the new orthodoxy in industrial waterfront regeneration (Gunay and Dokmeci 2012).

Research on waterfront industrial heritage in China lags behind that in many developed countries, but this subject is gradually receiving more attention, especially in Shanghai (Li 2010; Zhang 2015; Zhou 2017; Duan 2020; Den Hartog 2021; Shen 2022; Zhu 2023). Shanghai is a typical port city that thrives on its port activity and is the birthplace of modern Chinese industry, with many industrial buildings along its Huangpu River and Suzhou Creek. However, in the 1990s, Shanghai underwent industrial restructuring under official policies such as “shifting from labour-intensive industries to the service economy”, and traditional industries gradually withdrew from the urban area, leaving behind a substantial level of industrial heritage, especially along the waterfronts. As of 2021, 229 industrial heritage sites were included in the protection list in Shanghai, of which 140 were in waterfront areas, accounting for 61% of the total (Cao and Zhu 2021, 84). Over the past 30 years, the reuse

practice of Shanghai industrial heritage can be divided into the following four stages: 1) early 1990s: spontaneous inappropriate commercial reuses, such as hotels and restaurants; 2) late 1990s: artistic workshops triggered by artists in Suzhou Creek; 3) early 21st century: government-led organised development of cultural and creative industries; and 4) recent decade: more diverse ways of reuse, such as offices, community service facilities, businesses, cultural leisure facilities, and urban open spaces (Lu et al. 2019). Thus, Shanghai industrial heritage has undergone a process of heritage decontextualisation and resignification from being inappropriately demolished on a large scale to having conservation and utilisation extensively promoted (Den Hartog and Martínez 2022). Diverse adaptive reuse approaches have emerged, especially culture-led methods (11% museums and 31% cultural creative clusters), which appear in 42% of all reuse cases in Shanghai (Cao and Zhu 2021, 336). It is worth noting the enormous development potential of reusing industrial heritage as museums. First, this approach is the best way to preserve the tangible and intangible elements of industrial heritage. In addition, there is increasing related policy support in Shanghai. For example, the 14th Five Year Plan for the Protection and Utilisation of Cultural Relics in Shanghai (2022) emphasises the need to improve the museum system by reusing industrial heritage, which is deemed beneficial to creating waterfront cultural landmarks (The 14th Five Year Plan for the Development of Huangpu River and Suzhou Creek in Shanghai 2021), shaping urban characteristics (Shanghai Urban Master Plan 2017–2035 2018), and effectively enhancing the city's public cultural service capabilities.

According to the Museum Regulations of China (2015), “A museum refers to a nonprofit organisation aimed at education, research, and appreciation, that collects, protects, and displays witnesses of human activities and natural environment to the public and is registered with the registration authority according to law”. However, from the perspective of cultural heritage conservation, the museum is not only an institution or a collection but also a method or even a kind of activity (Thomas 2010). The connotation of a museum is constantly changing, shifting from the collection and care of objects to a focus on people. Thus, displaying that connects humans and nature as well as humans and society has gradually become the core function of a museum. Correspondingly, museum layout and management models have become more flexible, emphasising publicity, inclusiveness, and sustainability. Therefore, in this paper, the museum method of reusing industrial heritage refers to transforming old industrial buildings into a cultural complex that is centred around the display of industrial heritage itself and the historical and cultural elements it carries and derives and that

is compatible with other diverse functions, such as other art exhibitions, participation, experience, and leisure (Huang 2023). Eleven waterfront industrial heritage sites that have been regenerated as museums in Shanghai are taken as cases to explore how to continue and reshape Shanghai's urban cultural memory and identity.

## 2 Study cases and urban memory theories

### 2.1 Study cases

Xu and Aoki (2021, 324–331), and Cao and Zhu (2021, 466–482) counted the number of industrial heritage sites reused as museums along Shanghai waterfronts at sixteen and thirteen, respectively. On this basis, combined with the author's daily observation, accounting for factors such as having been designed by professional architects, original buildings being the main reuse objects and not currently being demolished, and having relatively comprehensive relevant references, this paper ultimately chose eleven cases as the main research objects (Table 1). These buildings are located mainly along the banks of the Huangpu River; only one is located on the banks of Suzhou Creek (Fig. 1). In addition, different statutory protection identities (one national protection unit, one provincial protection unit, two county (city) protection units, one untitled immovable protection unit, two provincial excellent historical buildings, and another four with no statutory protection status), various industrial categories (one energy, three machinery, five storage, one building materials, and one manufacturing), and diverse developers (two government departments, four state-owned enterprises, one the original industrial enterprise and real estate company, and four commercial companies) are involved in these cases.

### 2.2 Urban memory theories

John Ruskin (1885) held that architecture positively influences the inheritance of cities' history and culture and the maintenance of cultural identity. Maurice Halbwachs (1925) developed the theory of "collective memory", which maintains that collective memories, comprising individual memories, survive in the long term only to the extent that they are indexed into architectural places and mapped into an urban and historical topography (Bilsel 2017). Many scholars have been influenced by Halbwachs. Pierre Nora (1999) found that the places left over from history have contributed greatly to the construction of cultural identity and proposed the concept of "Les Lieux de Mémoire", which refers to a place where collective memory is preserved and propagated becoming a representative place in the collective memory heritage due to people's will or the passage of time. This includes material sites of memory such as burial places, cathedrals, battlefields, and

prisons and nonmaterial sites of celebrations, spectacles, and rituals. Furthermore, Nora considered "Les Lieux de Mémoire" to be the initiation of collective memory studies. Aldo Rossi (1984) proposed that the city is a place of collective memory, and urban memory is a kind of collective memory. De Alba (2012) considered Mexico City as a case study, using Halbwachs's notion of collective memory as a theoretical framework and summarising the factors of urban memory: time and history, space, and groups. Based on the above research, Wang (2016, 7) divided elements of urban memory into three categories: subjective elements centred on the rememberer, objective elements centred on the carriers of memory, and temporal elements (Fig. 2). The objective elements are memory information, memory carriers, and memory clues (Wang et al. 2010).

## 3 Preserving and continuing urban memory: the museum method of reusing Shanghai waterfront industrial heritage

This paper regards the regeneration of waterfront industrial heritage, one of the important memory sites, as an important means to continue urban memory and regain a community's sense of identity and belonging. The urban memory elements of these study cases can be interpreted as follows. Memory information mainly comprises production skills, historical information, and daily lifestyle; memory carriers can be divided into environmental, architectural, production, and other elements; and memory clues include time clues, space clues, and particular cultural clues (Fig. 3). Accordingly, three classes of memory interpretation strategies can be summarised: translating memory information, renovating memory carriers, and relating memory clues (Table 2).

Most cases are simultaneously involved in the three classes of memory interpretation strategies, as shown in Fig. 8, but their main strategy varies with their key memory elements (Table 3). However, it is difficult to elaborate on each case in detail because of the limited space. Therefore, this paper takes four cases as representatives of the three memory interpretation strategies for a more detailed introduction, while the other seven cases appear sparingly as supplements in Sect. 4. They are the Sihang Warehouse (national protection unit), which emphasises translating memory information; the 80,000-ton Silos (provincial protection unit) and the Dome (County (City) protection unit), which focus on renovating memory carriers, and the Modern Art Museum (no protection status), which pays more attention to relating memory clues.

### 3.1 Translate memory information: Sihang warehouse

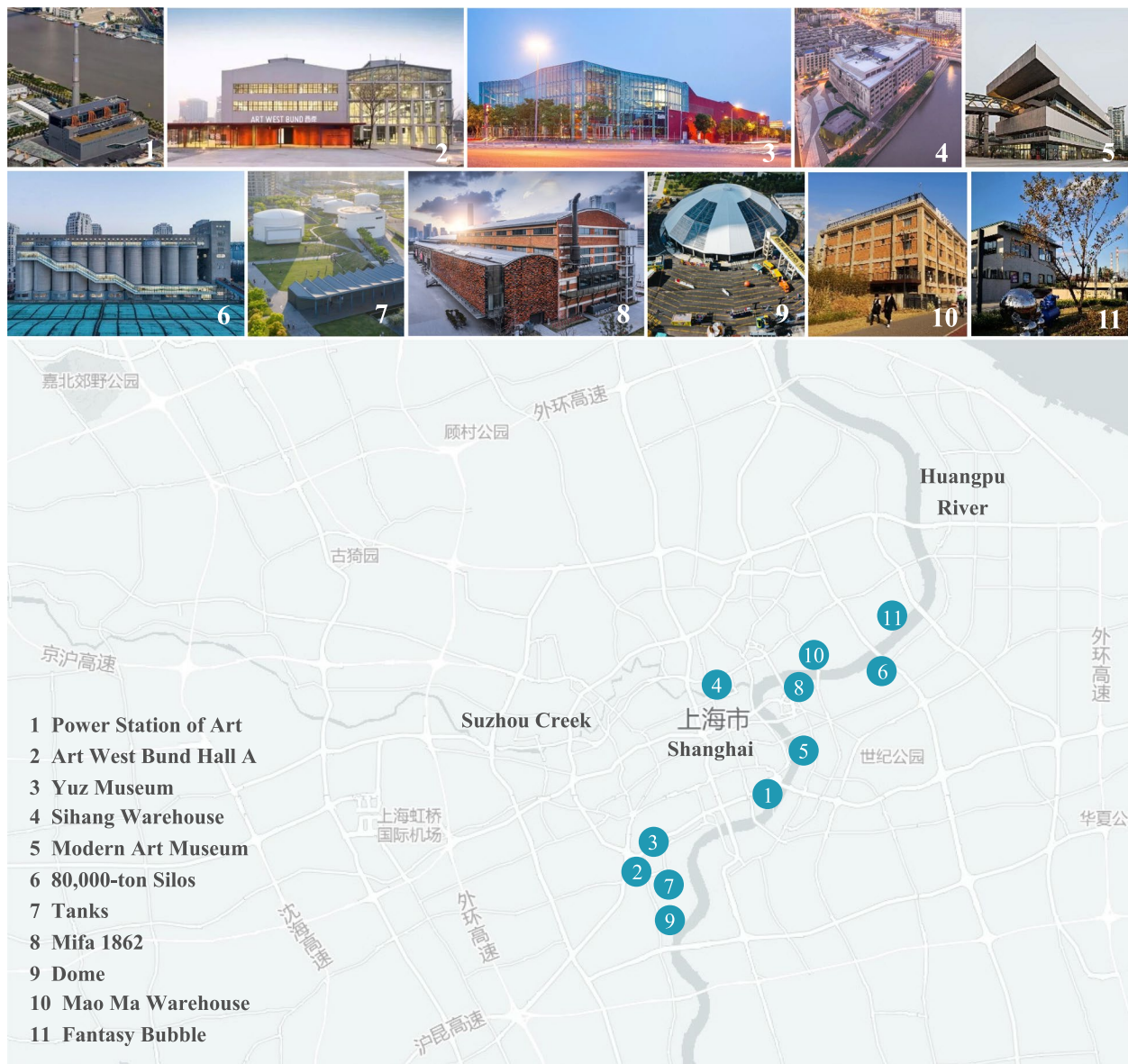
As a typical representative of modern storage buildings along Suzhou Creek, Sihang Warehouse was jointly built

**Table 1** Eleven cases of Shanghai waterfront industrial heritage sites reused as museums

Order	Current name	Original name	Address <sup>a</sup>	Construction time	Industry	ministry	Protection class	Development time	Development subject	Transformation designer
1	Power Station of Art	Nanshi Power Plant	678 Miaojiang Road, Huangpu District	1995	Energy		Untitled immovable protection unit	2006	Government department	Original Design Studio/TJAD
2	Art West Bund Hall A	Stamping Shop of Shanghai Aircraft Factory	2555 Longteng Avenue, Xuhui District	Unknown	Machinery		Provincial excellent historical buildings	2014	State-owned enterprise	Atelier Deshaus
3	Yuz Museum	Repair Shop of Shanghai Aircraft Factory	35 Fenggu Road, Xuhui District	1958	Machinery		Provincial excellent historical buildings	2014	Commercial company	Sou Fujimoto
4	Sihang Warehouse	Joint Savings Bank Warehouse	21 Guangfu Road, Jing'an District	1935	Storage		National protection unit	2015	Government department	Arcplus Institute of Shanghai Architectural Design & Research (Co., Ltd.)
5	Modern Art Museum	Old Baidu Coal Bunker	4777 Binjiang Avenue, Pudong New Area	1984	Storage		None	2016	Commercial company	Atelier Deshaus
6	80,000-ton Silos	80,000-ton Silos on Minsheng Wharf	3 Minsheng Road, Pudong New Area	1995	Storage		Provincial protection unit	2017	State-owned enterprise	Atelier Deshaus
7	Tanks	Aviation Oil Tanks of Longhua Aircraft Factory	2380 Longteng Avenue, Xuhui District	Unknown	Storage		None	2017	State-owned enterprise	OPEN Architecture
8	Mifa 1862	Xiangsheng Shipyard Locomotive Shop	1777 Binjiang Avenue, Pudong New Area	1972	Machinery		County (City) protection unit	2017	Original industrial enterprise & real estate company	Kengo Kuma & Associates
9	The Dome	Shanghai Cement Plant Limestone Prehomogenisation Storage	2350 Longteng Avenue, Xuhui District	1920	Building materials		County (City) protection unit	2018	Commercial company	SHL (Schmidt Hammer Lassen Architects)
10	Mao Ma Warehouse	Mao Ma Warehouse of Shenxin Seventh Factory	32 Qinhuangdao Road, Yangpu District	1995	Storage		None	2019	State-owned enterprise	Tongji Architectural Design (Group) Co., Ltd
11	Fantasy Bubble	Auxiliary Area of Shanghai Soap Factory	1 Pingding Road, Yangpu District	1923	Manufacture		None	2020	Commercial company	Supercloud Studio

<sup>a</sup> The address is mainly referred to Baidu Map





**Fig. 1** Eleven cases of Shanghai waterfront industrial heritage sites reused as museums (Source: 1 from TJAD 2019; 4 from Tang and Zou 2018; 6 from Ma 2018; 7 from <https://www.gooood.cn/tank-shanghai-china-by-open-architecture.htm>. Accessed 2 September 2023; others from <https://image.baidu.com/>. Accessed 2 September 2023.)

in 1935 by four Chinese banks, demonstrating the development of Shanghai's national financial industry. In the second Battle of Songhu in 1937, the first large-scale battle of the Anti-Japanese War, as the final garrison of the Chinese Army (known as 800 soldiers) led by Xie Jinyuan, Sihang Warehouse was heavily damaged by Japanese artillery, especially its West Wall, on which many bullet holes remained. Until this century, the original West Wall was no longer traceable due to multiple changes, including repainting the exterior facades, adding sixth

and seventh floors to the roof, and constructing multiple-floor factories on the west side (Tang and Zou 2018, 18).

In 2014, in memory of the 70th anniversary of the Chinese Anti-Japanese War victory, the protection and repair project of Sihang Warehouse began based on the principle of "respecting history, comprehensively, completely and accurately reappearing the war scene at that time" (RETOURISN 2020). Therefore, the first to third floors on the west side were used as a memorial hall, with the rest used for creative offices. The two strategies

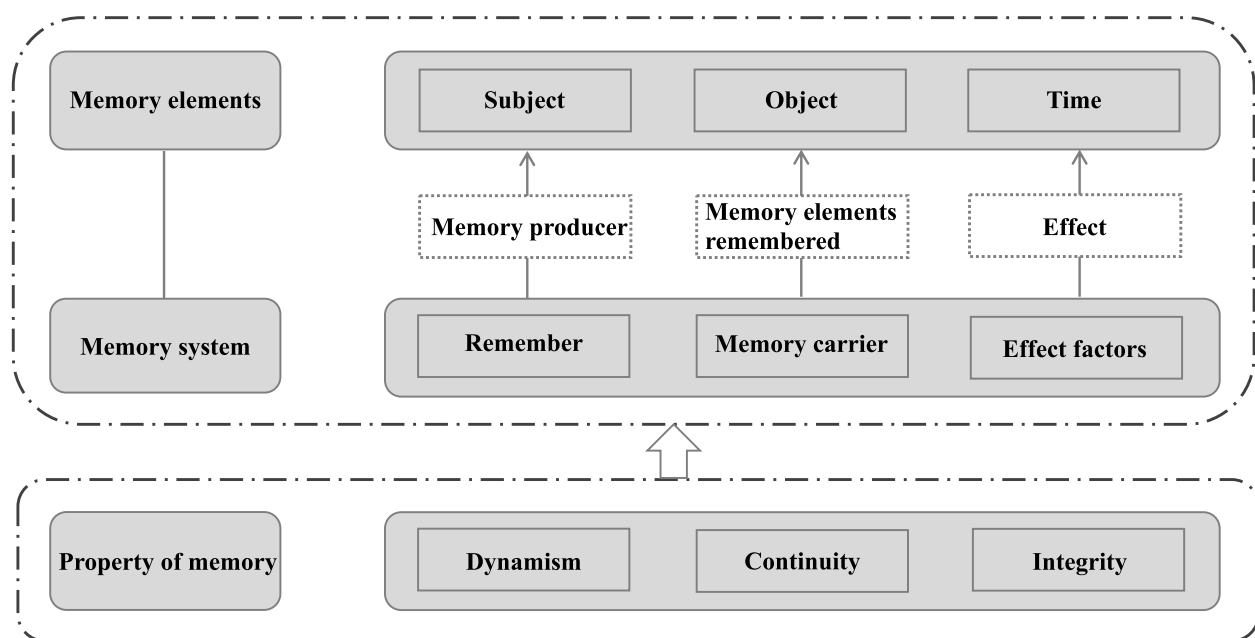


Fig. 2 Measurement elements of urban memory (Source: Wang 2016, 8)

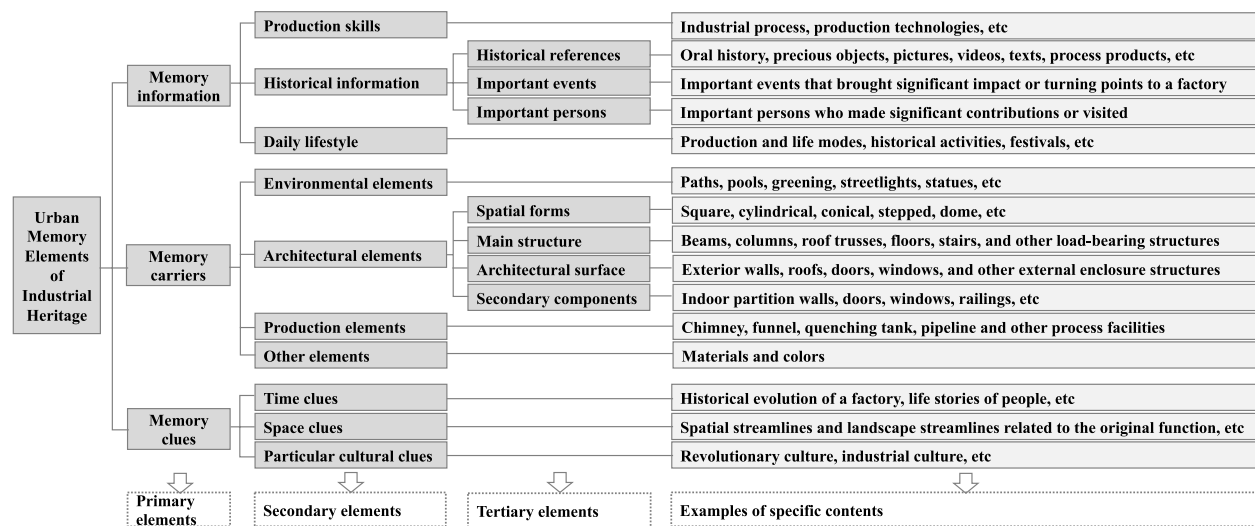


Fig. 3 Urban memory elements of industrial heritage (Source: the author)

of information narrative and space innovation are both reflected in the memorial hall, which mainly displays and restores the memory of the Anti-Japanese War through text explanations, physical exhibitions, miniature models, oil paintings, sculptures, three-dimensional scene settings, and sound effect simulations. Another strategy of space restoration was applied to the whole building. Only the seventh floor, which was added later, was removed, while the added sixth floor was retracted inwards to reduce its appearance on the facades. Furthermore, the

blocked central corridor and partial decorations of the other facades were restored. However, the greatest difficulty of space transformation was whether to preserve the West Wall's current status or restore it to its damaged status of 1937. After conducting many on-site investigations by infrared thermal imaging, photogrammetry, and other technologies, the designers identified the materials used for the original masonry (red bricks) and post-war sealing (grey bricks) of the West Wall (Tang and Zou 2018, 19), making it possible to partially restore the West

**Table 2** Memory interpretation strategies of Shanghai waterfront industrial heritage reused as museums

Urban memory elements of industrial heritage			Memory interpretation strategies		Definition	Application	Order of typical cases
Memory information	Production skills, Historical information (Historical references; Important events; Important persons), Daily lifestyle	Translate memory information		Information narrative	Space narrative	Space restoration	4, etc
		Renovate memory carriers	Reproduction	Space reproduction			
Memory carriers	Environmental elements, Architectural elements (Spatial form; Main structure; Architectural surface; Secondary components), Production elements, Other elements	Reproduction		Space reproduction	Space innovation	Space innovation	1, 11, etc
		Reproduction		External modelling reproduction			
Memory carriers	Environmental elements, Architectural elements (Spatial form; Main structure; Architectural surface; Secondary components), Production elements, Other elements	Internal space reproduction		Structure reproduction	Surface reproduction	Internal structure reproduction	4, 9, etc
		External structure reproduction		Internal structure reproduction			
Memory carriers	Environmental elements, Architectural elements (Spatial form; Main structure; Architectural surface; Secondary components), Production elements, Other elements	Internal structure reproduction		Facility reproduction	Other reproduction	Material reproduction	4, 10, etc
		Material reproduction		Colour reproduction			
Memory carriers	Environmental elements, Architectural elements (Spatial form; Main structure; Architectural surface; Secondary components), Production elements, Other elements	Various stations		Various stations	Various stations	Various stations	4, 8, 10, etc
		Various stations		Various stations			

**Table 2** (continued)

Urban memory elements of industrial heritage	Memory interpretation strategies			Definition	Application	Order of typical cases
	Collage	Space collage	External space reproduction	Add new building blocks	Closed and cramped single buildings or scattered group of buildings	3, 10, etc
			Internal space reproduction	Embed box spaces inside	Ample space or old structure with poor stability	5, 7, etc
		Structure collage		Add new structures based on the old structures	Stable old structure	1, 2, 5, etc
		Surface collage	Surface juxtaposition	Juxtapose the new and old surfaces	Damaged surface or surface with two or more overlapping forms	2, etc
			Surface overlaying	Adopt new and old double-layer surfaces	Damaged surface, poor thermal performance, or sun shading	8, etc
		Facility collage		Reorganise the abandoned facilities	Many small remaining facilities	8, 11, etc
		Other collages	Material collage	Collage similar or different materials and colours	Style restoration or comparison of new and old	3, etc
	Reconstruction	Space reconstruction	Colour collage Space division	Add partitions or floors horizontally and vertically	Specific themes Small exhibits or lack of exhibition space	11, etc 1, 7, etc
			Space combination	Remove horizontal or vertical divisions	Large exhibits or for lighting and transportation	1, etc
		Structure reconstruction		Add new separate structure	Old structure with poor stability, rebuilt or added to	2, 3, etc
		Surface reconstruction		Reshape the exterior facade or roof	Damaged surface with an original state that cannot be researched scientifically, or addition	5, etc
		Facility reconstruction		Transform existing industrial equipment or structures	Large remaining facilities	1, etc
		Landscapes reconstruction		Create new public landscapes	Various stations	5, 7, etc
		Other reconstructions	Material reconstruction	Use modern materials	Comparison of new and old, or addition	5, 9, etc



**Table 2** (continued)

Urban memory elements of industrial heritage		Memory interpretation strategies		Definition	Application	Order of typical cases
Memory clues	Time clues, Space clues, Specific cultural clues	Relate memory clues	Narrative lines	Colour reconstruction	Change the original colour	Highlighting exhibits; comparison of new and old, or expression of specific themes
					Extract time or space lines and interpret them	Remained temporal or spatial clues
			Cultural corridors	Connect industrial heritage groups through specific linear spaces such as greenways or rivers	Industrial heritage groups	2, 3, 9, etc
1 Power Station of Art						
2 Art West Bund Hall A						
3 Yuz Museum						
4 Sihang Warehouse						
5 Modern Art Museum						
6 80,000-ton Silos						
7 Tanks						
8 Mifa 1862						
9 Dome						
10 Mao Ma Warehouse						
11 Fantasy Bubble						

**Table 3** Typical cases of memory interpretation strategies

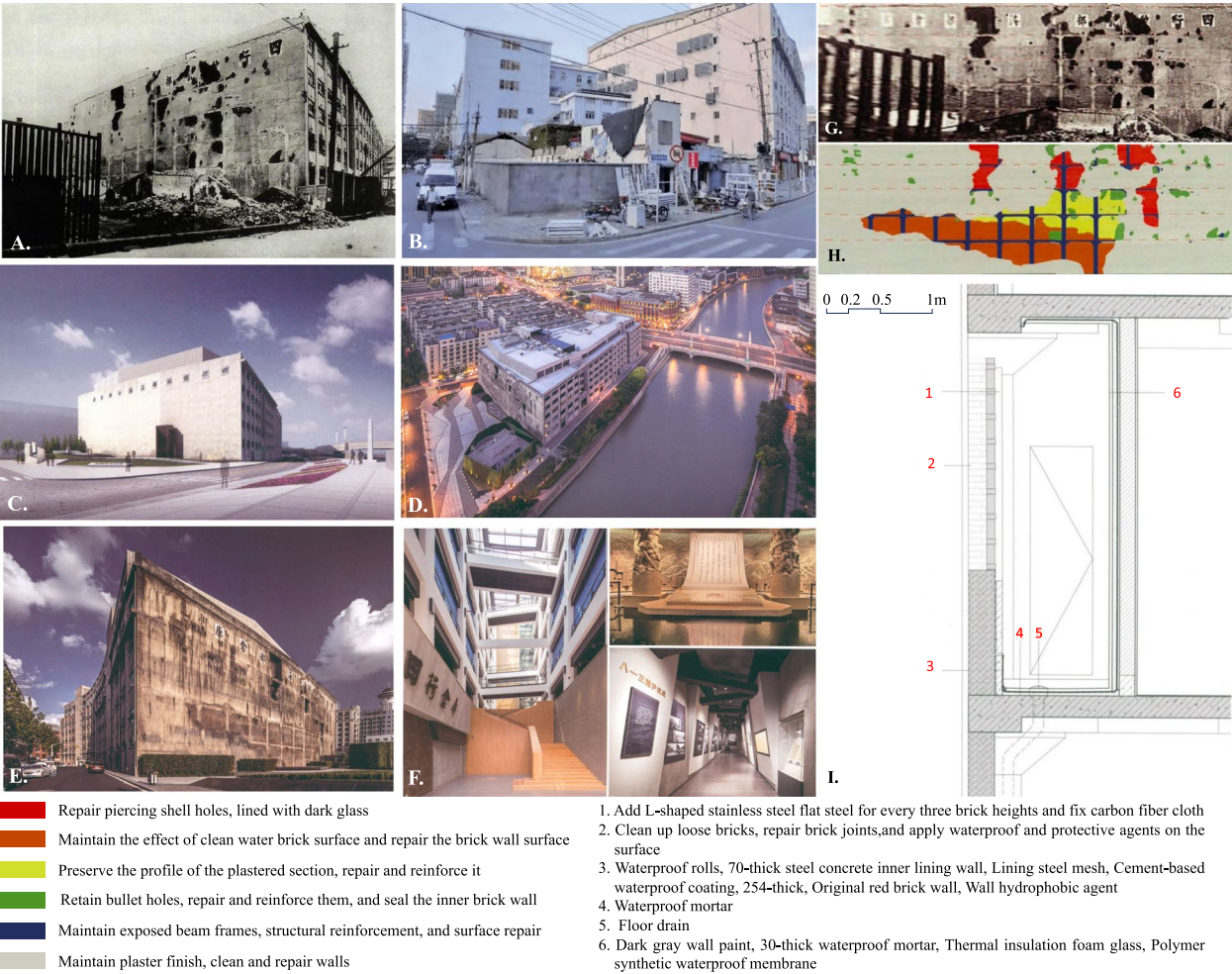
Memory interpretation strategies	Typical cases
Translate memory information	<b>Sihang Warehouse</b>
Renovate memory carriers	<b>80,000-ton Silos; The Dome;</b> Power of Art; Art West Bund Hall A; Yuz Museum; Mifa 1862; Mao Ma Warehouse; Tanks
Relate memory clues	<b>Modern Art Museum; Fantasy Bubble</b>

Wall to its appearance in 1937 (Fig. 4). After the related movie “The Eight Hundred” was broadcast, Sihang Warehouse became an internationally known battle memorial site, attracting many mourners.

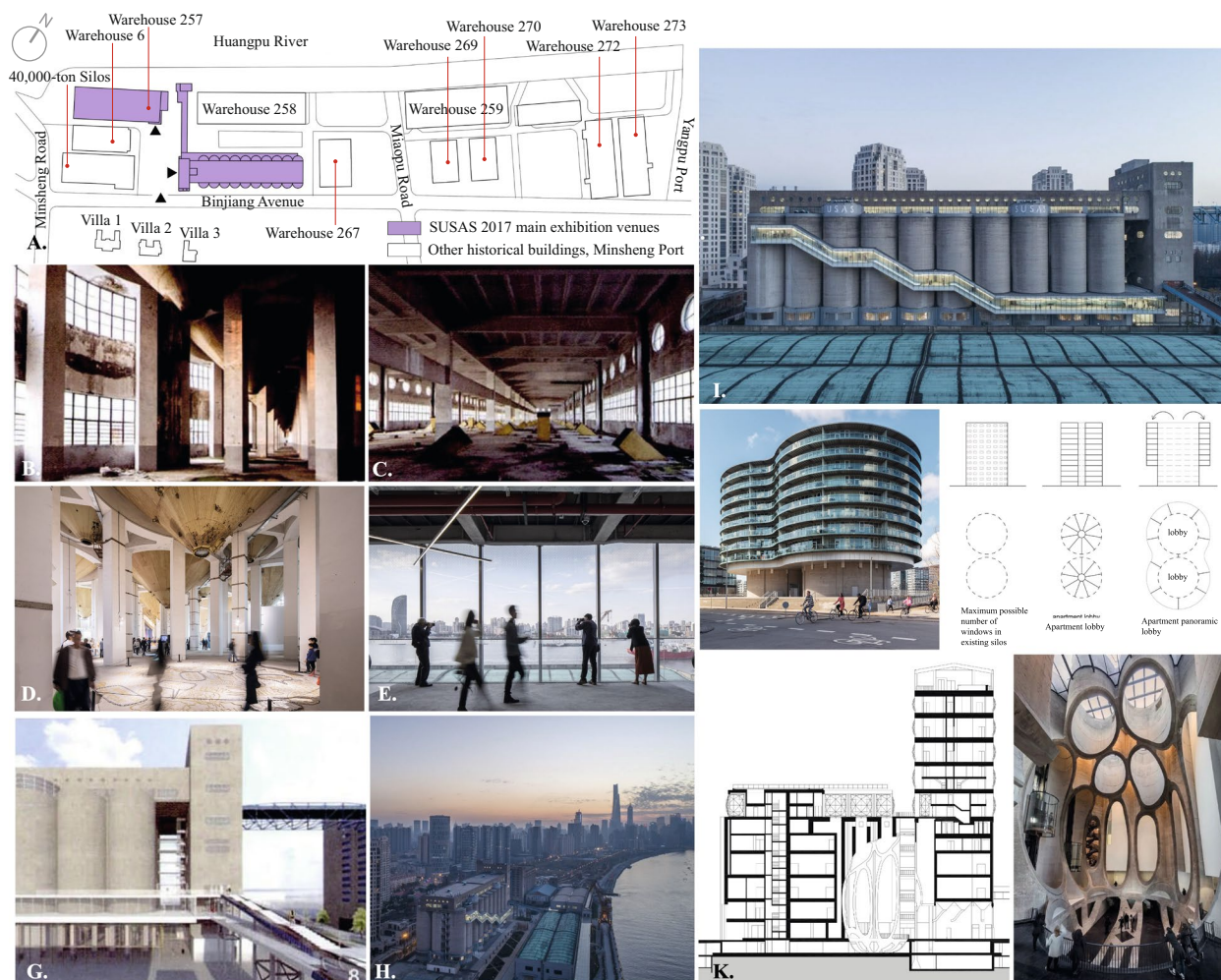
3.2 Renovate memory carriers: 80,000-ton Silos & The Dome

3.2.1 80,000-ton Silos

In Shanghai Minsheng Port, the 80,000-ton Silos were built and put into use from 1995 to 2005 and were once the largest granary in Asia (Duan 2020) at 140 m long and 48 m high, comprising 30 reinforced concrete cylinders with a diameter of approximately 14 m, an auxiliary building on the silos and a work building. Although it is



**Fig. 4** Sihang Warehouse and its West Wall before and after the restoration. **A** The West Wall after the war. **B** The West Wall in 2014. **C** Alternative design plan of the West Wall. **D** A bird’s-eye view of the restored Sihang Warehouse. **E** The restored West Wall. **F** The central corridor and exhibition hall. **G** Restoration photo of the West Wall. **H** Specific restoration methods for different types of damage. **I** Detailed drawing of the West Wall’s holes. (Source: B from Qiang 2021; others from Tang and Zou 2018)



**Fig. 5** 80,000-ton Silos before and after the restoration and two similar cases. **A** SUSAS 2017 main exhibition venue distribution map. **B** First floor of the silos before renovation. **C** Building built on silos before renovation. **D** First floor of the silos as the main exhibition venue. **E** View of the Huangpu River from the interior of the aerial corridor. **G** Long-term renovation plan of the 80,000-ton Silos. **H** The Silos are located in the East Bund of the Huangpu River. **I** North elevation of the silos after the first phase of renovation. **J** Transforming the silos into apartments: Frøsilø in Copenhagen, Denmark. **K** Transforming the silos into a museum: Zeitz MOCAA in Cape Town, South Africa. (Source: J and K from <https://www.google.com/imghp?hl=zh-CN>. Accessed 23 September 2023; others from Ma 2018.)

less than 30 years old, it is still an important industrial architectural heritage site with high protection value because its special form and function may not appear again in the future.

In 2017, the ground floor and the top storehouse of the 80,000-ton Silos were selected as the temporary main exhibition hall of the Shanghai Urban Space Art Season (SUSAS). It was necessary to follow certain protection principles because of the facility's statutory protection status (Ma 2018): except for the first floor, the four facades, external walls, external windows, cone funnels, the occlusive relationship between the building on the silos and the lower cylinders, the work building and some outdoor stair components were to be retained to the

greatest extent possible. The difficulty of the renovation was how to solve the problems of streamlining the exhibition and fire evacuation. In the beginning, the architect hoped to set up more escalators between the silos to obtain a better pedestrian experience. However, the necessity of this idea was questioned, and there was not enough time for the escalators to be finished. Therefore, only the atrium and a group of escalators from the first to third floors were added in the gap between the silos and the work building (Liu 2018). The traffic from the remaining three floors to the top floor was routed mainly through a cantilevered escalator corridor on the north facade, establishing the landscape connection between the originally closed silos and the Huangpu River (Fig. 5).



In addition, four of the 30 silos were equipped with vertical evacuation stairs and fire elevators for emergency use.

### 3.2.2 The Dome

The Dome was built in 1995 and was originally the limestone prehomogenisation workshop of the Shanghai Cement Factory, founded in 1920, which was not only the first wet cement factory in China but also the largest in Asia. With the development of the Huangpu Waterfront, the Cement Factory closed and relocated in 2009, while the Dome was retained as the most representative industrial building of the factory because of its unique dome structure. It covers an area of approximately 6,000 m<sup>2</sup>, with a height of 29 m and a large steel reticulated shell on the roof spanning approximately 90 m (Shi 2021).

From 2014 to 2021, Shanghai Dream Center Company, with the assistance of West Bund Company, started the Dome reuse project and endowed it with a new development orientation: transformation from “an industrial production raw material mixer” to “a multicultural mixer” (Qian 2021). Its giant scale was preserved, and its core spirit—“emptiness” and “centralisation”—was strengthened by adopting the “centralised+homogeneous” spatial layout logic; thus, any entrance can be used as the main entrance to the interior of the Dome. The assumption of multiple rather than single functions, similar to the Carnival, the Third Future Lab Art and Design Innovation Future Education Expo, and the NBA Finals, truly realises the time-sharing use of the building.

One of the most important problems was addressing the contradiction between the enormous, closed appearance of the structure and the waterfront location. Two schemes for the appearance of the dome were made: one transparent version and one half-closed version. The former version was built in 2021, retaining the core of the original metal roof and replacing the rest with glass. However, the third version, which currently survives, was developed based on the transparent version by adding the alternate closed roof between the transparent phases (Fig. 6).

### 3.3 Relate memory clues: Modern Art Museum

Located at Old Baidu Port, the Modern Art Museum was originally a coal bunker built in 1984. From 2009 to 2015, the bunker was successively transformed into an observation platform and a temporary exhibition hall and was even almost completely demolished to build a new gallery (Mo 2018, 95). Although it ultimately survived, the bunker's original non-load-bearing walls and roofs were removed, leaving only the reinforced concrete column network and the eight coal hoppers that it supported.

Confronted with the bunker with only the skeletons, the designer finally extracted two elements of the horizontal corridor bridge and the “V” shape from the coal

transportation channel and coal hoppers as the dominant design clues (Fig. 7). In terms of appearance, the art museum and the waterfront winding corridor on the north side were both outlined with smooth aluminium plates, forming a horizontal line and continuity of the interface along the river (Mo 2018, 96). The exterior of the art museum adopted slightly staggered horizontal layers and slender vertical suspension rods woven in a V-shaped pattern, the waterfront winding corridor was transformed by adding a two-story walkway on the reinforced concrete bent foundation of the original coal transportation channel, and a series of glass boxes used as shops or small exhibition halls were embedded below the walkway. Furthermore, the museum adopted a new steel suspension structure system to maximise the protection of the original structure and highlight linear design elements. The old frame columns on the top floor supported a group of giant trusses that were used to hang down through all the floors for more exhibition areas and were also connected with the coal bunker structure, enhancing the integrity of the structure and the connectivity of the space (Liu 2021). The waterfront high walkway underwent a similar treatment.

## 4 Discussion

### 4.1 Advantages

#### 4.1.1 The diverse interpretation of heritage memory elements

As summarised above, the three classes of memory interpretation strategies for the study cases are chosen according to the industrial heritage site's most important memory element, which provokes further discussion about the different choices as follows.

- 1) Translate memory information: restoration vs. preservation

For Sihang Warehouse, the key memory element is memory information, that is, the history of the Anti-Japanese War in Shanghai. Thus, its buildings and exhibits are displayed in keeping with this theme rather than industrial memory. For example, most people consider the restored damaged West Wall to be educational, while others believe it to be an imitation. Both views are reasonable. However, there are many remnants of industrial storage buildings in Shanghai, but only Sihang Warehouse bears heavy urban and national trauma. Therefore, there is no doubt that it was reasonable and meaningful to restore the West Wall based on historical photos and on-site traces (rather than assumptions). The wall has become the largest exhibit



**Fig. 6** The Dome before and after the renovation. **A, B, C** Historical photos. **D, E** Indoor photos in different functional scenarios. **F** Building renovation plans in different functional scenarios. **G** First version of the roof. **H** Second version of the roof. **I** Third version of the roof. (Source: E from <https://new.qq.com/rain/a/20211113A08HD000>. Accessed 7 March 2023; I from [https://www.thepaper.cn/newsDetail\\_forward\\_14682772](https://www.thepaper.cn/newsDetail_forward_14682772). Accessed 10 June 2023; others from Shi 2021.)

in this museum. Unfortunately, there is no sign to remind people that the West Wall is only a restoration as opposed to being in its original historical state.

## 2) Renovate memory carriers: intervention vs. transformation

In contrast, the 80,000-ton Silos and the Dome's core memory elements are memory carriers, especially the buildings themselves and their affiliated industrial facilities. Therefore, their approach to memory interpretation is mainly to retain the form, structure, and facilities of industrial sites. However, they reflect two completely different design attitudes: cautious intervention and bold transformation, especially in terms of appearance.

For the 80,000-ton Silos, some people believed that the architect was too cautious because there were almost no changes inside the silos except for the external stairs. However, it now seems that the architect's decision was undoubtedly wise and correct. Similar cases abroad have involved changing the facade beyond recognition or hollowing out the internal structural components (Fig. 5 J & K), which is obviously not applicable to the 80,000-ton Silos from the perspective of structural safety or heritage protection (Song 2022). On the other hand, due to the pandemic and many other factors, the silos have remained closed, and the fate of the building remains unknown.

In contrast, the Dome obtained new, highly transparent surfaces that display the special dome structure to the greatest possible extent and simultaneously reduce





**Fig. 7** Modern Art Museum before and after the renovation. **A** Historical photos. **B** Exterior view of the museum. **C** The waterfront elevated walkway. **D** First floor of the museum. **E** The combination of the old and new structures. **F, G, H** The steel suspension structure system. (Source: B/C/D by Fangfang Tian, from <https://www.gooood.cn/modern-art-museum-and-its-ancillary-facilities-by-atelier-deshaus-tongji-architectural-design-group-co-ltd.htm>. Accessed 10 June 2023; others from Liu 2021.)

the volume of the giant buildings, weaken the boundaries between indoor and outdoor, better integrate into the waterfront, and rebuild a friendly urban interface. However, some questions arose. Does the identity of a county (city) unit allow such a large change in its appearance? The final choice demonstrates the official answer; however, the author believes that while the protection class of the Dome is relatively low, allowing some creative ideas, the overall transparent roof remains questionable. Highly transparent roofs and facades are not always suitable for specific application scenarios. Furthermore, it also makes the space overheated in summer and colder in winter, increasing the building's energy consumption and costs of maintenance. The third version responds to this question to a certain extent.

### 3) Relate memory clues: renovation vs. demolition

For the Modern Art Museum, the most important memory element is memory clues. Unlike the above three cases, the Modern Art Museum was not subject to statutory protection. Moreover, it retained only the main structure, so it faced more severe retention problems. The bunker was reused as a temporary exhibition hall in the 2015 SUSAS exhibition, which showed the owners the possibility and power of the art museum method. Finally, the owners decided to directly transform the bunker into a museum instead of pursuing the original idea of demolishing it and building a new gallery. In this context, the greatest challenge for the renovation lay in how to continue and re-create architectural



and cultural symbols rather than restore the original physical space. In other words, it was necessary for the designer to reconstruct the building's appearance and external public space by mining memory information and developing memory clues (the coal transportation channel and coal hoppers), thereby achieving a connection between new and old memories. Actually, the Modern Art Museum has been a success, and its survival may inspire or save many other ordinary industrial buildings faced with demolition.

#### **4.1.2 Heritage catalyst effects and cultural brand effects under policy support**

The introduction mentions that official policies strongly support combining cultural creative industries and the protection and utilisation of industrial heritage. Therefore, many architectural cases in this paper were marketed in online media to quickly improve their popularity and attractiveness, stimulating the potential development of surrounding areas. It is common to combine buildings with large-scale cultural events, such as the use of Sihang Warehouse in the film "The Eight Hundred", the Dome for holding various cultural and sports events, and the 80,000-ton Silos (2017) and the Modern Art Museum (2015) for the SUSAS exhibition. In addition to creating waterfront industrial heritage landmark buildings, Shanghai has tried to make full use of industrial heritage groups to create cultural brands, such as building the Yangpu Waterfront Industrial Heritage Belt and the West Bund Culture Corridor. The latter comprises Art West Bund Hall A, the Dome, Tanks, and other industrial heritage sites.

#### **4.1.3 Integration with the waterfront public landscape**

The geographical location of the waterfront is not only a challenge for the regeneration of waterfront industrial heritage but also an enormous advantage. In most cases, transparent surfaces have been adopted to achieve the penetration and integration of architecture and waterfront landscapes; however, in some cases, such as the Modern Art Museum, the shaping of public landscapes was regarded as an important component of architectural design. When the author visited the museum at dusk in 2021, it had closed. Nevertheless, the outdoor waterfront high walkway was open to the public, where many people were walking in a leisurely manner and enjoying the beautiful river scenery at night. For another example, the multistory factory buildings added on the west side of Sihang Warehouse were demolished and opened as Jinyuan Memorial Square, which builds a tight connection between the riverbank and the warehouse and makes it possible for visitors to sit, lie, jog, and walk their dogs by the river after visiting (Qiang 2021).

#### **4.1.4 Application of new technologies**

With the development of the times, emerging investigation technologies and repair technologies can help better continue and reproduce the value and memory elements of industrial heritage. For example, the restoration of the West Wall of Sihang Warehouse benefited from not only the use of modern survey technologies, such as infrared thermal imaging technology, photogrammetry technology, and drawing positioning technology, to accurately explore and position the historical bullet holes in the wall but also the innovative exploration of various protection technologies, such as reinforcement, anti-seepage measures, waterproofing, and drainage, to maintain the structural stability of the building after the historical bullet holes were restored. Another example is the use of suspension structure technology in the Modern Art Museum, as mentioned above.

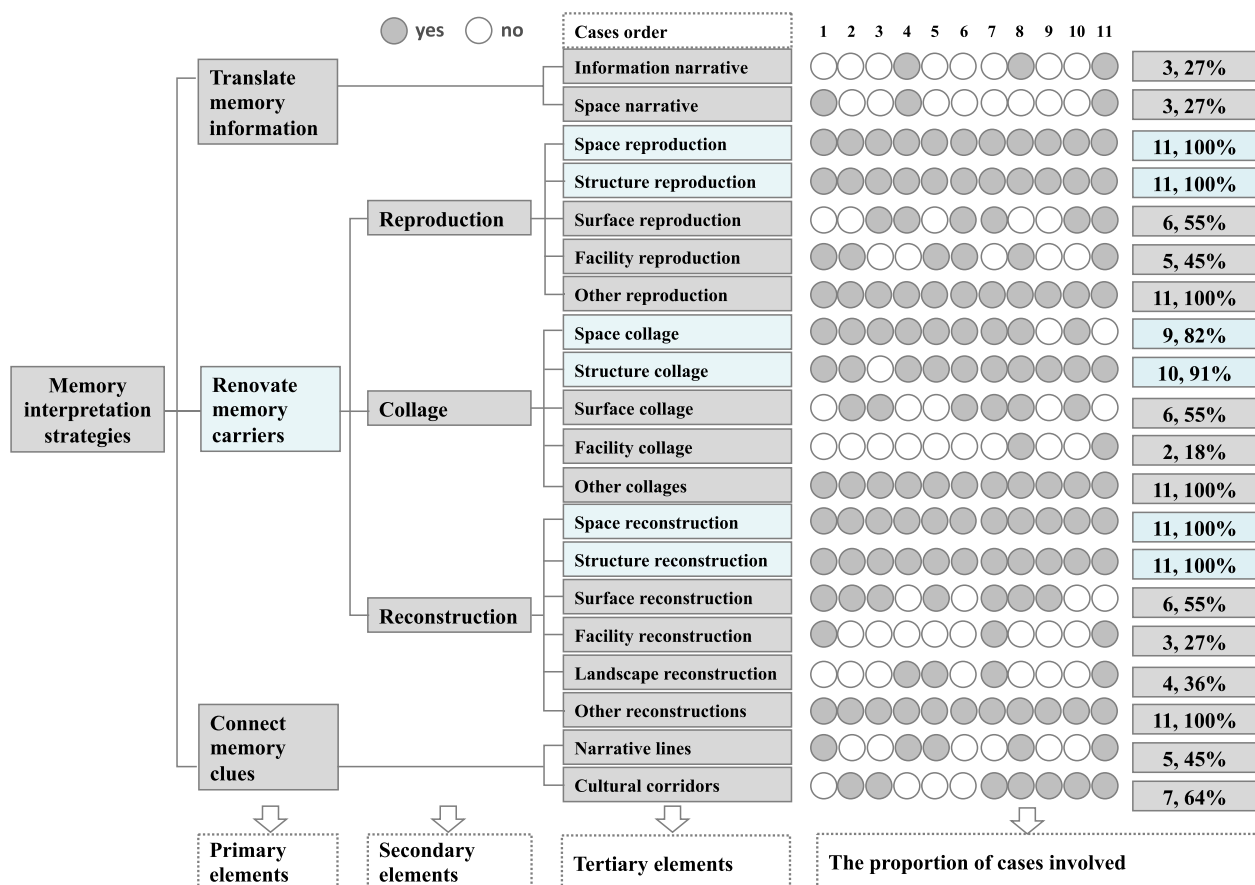
### **4.2 Disadvantages**

#### **4.2.1 Unbalanced interpretation of heritage memory elements**

Analysis of the application of memory interpretation strategies (Fig. 8) shows that the museum method of reusing Shanghai waterfront industrial heritage focuses on the creation of memory carriers, especially space renovation and structure renovation, which cover all cases, and ignores the mining and translation of intangible cultural information, such as memory information and memory clues, which are involved in approximately one-third of the cases. Regarding memory carrier elements, compared to architectural and production elements, the associated environmental elements are easy to ignore in reuse because of few remnants, relatively high replacement frequency, and great difficulty in historical research. Thus, few cases involve landscape environment restoration. Even though some cases have reshaped public landscape space, there is still a phenomenon of long-term closure and nonopening to the outside world, such as the roof platform of the Sihang Warehouse and the external escalator corridor enclosed with the 80,000-ton Silos. In addition, the joint development of waterfront industrial heritage has been uneven. The overall development of the West Bund of the Huangpu River is significantly better than the scattered renovation cases on the East Bund due to the group-driven effect of the Yangpu Waterfront Industrial Heritage Belt and the West Bund Culture Corridor.

#### **4.2.2 Unsatisfactory operation and management**

A quarter of the investigated cases were unused or had been used for other functions (Art West Bund Hall A and Fantasy Bubble were changed to shelter hospitals during the epidemic) for many reasons. On the one hand, approximately half of the reuse projects were developed by



**Fig. 8** Application of memory interpretation strategies (Source: the author). 1 Power Station of Art. 2 Art West Bund Hall A. 3 Yuz Museum. 4 Sihang Warehouse. 5 Modern Art Museum. 6 80,000-ton Silos. 7 Tanks. 8 Mifa 1862. 9 Dome. 10 Mao Ma Warehouse. 11 Fantasy Bubble

social enterprises or commercial companies that focused on maximising the economic value of industrial heritage rather than historical and cultural elements. If a project fails to achieve profitability in the long term, it is likely to be discarded or resold. To further explore this point, in some cases, project planning failed to balance the interests of operators, developers, and heritage owners, resulting in conflicts between planning and practice. The unreasonable ancillary business form is also a reason for unsatisfactory reuse; for example, the occasional commercial activities held at Jinyuan Square in Sihang Warehouse were criticised for diminishing the solemn atmosphere.

#### 4.2.3 Lack of local special conservation laws and regulations

Although the practice of conserving and reusing Shanghai's industrial heritage is ongoing, there are no specific documents providing evaluation criteria and conservation principles for industrial heritage. Shanghai's industrial heritage is included mainly in the Immovable Cultural Relics Protection Units or Shanghai Excellent Historical Buildings; thus, it is necessary to abide by the

corresponding Principles for the Conservation of Heritage Sites in China and Regulations of the Protection of Historic Areas and Outstanding Historical Buildings in Shanghai. However, these universal principles may contradict actual practice because they are not sufficiently deep and detailed. The parallel nature of multiple conservation systems may also lead to the intersection and ambiguity of management. Moreover, the difficulty of being admitted to the statutory list may cause many ordinary industrial buildings to be demolished or improperly transformed because of their lack of heritage status.

## 5 Conclusion and recommendations

In summary, Shanghai's leading role in China's industrial culture and economic society has contributed to the regeneration of its waterfront industrial heritage to a certain extent. Cultural leadership has become a new fashion, and the museum method is bound to affect more cities because of its positive influences on preserving the heritage values of waterfront industrial buildings, continuing the cultural context of the city, shaping urban cultural

landmarks, and improving the city's public service ability. However, the museum method is not equivalent to freezing these industrial buildings as hard-to-use "antiques". The key is determining and categorising the core memory elements of industrial heritage and its development potential and choosing appropriate memory interpretation strategies, including translating memory information, transforming memory carriers, and relating memory clues. In addition, whether restoration or preservation, intervention or transformation, renovation or demolition, there is no single correct answer but rather a reasonable solution after many options are weighed. Furthermore, the practice of reusing Shanghai waterfront industrial heritage as museums has benefitted explorations into the diverse interpretation of heritage memory elements, the effects of heritage catalysts and cultural brands, the integration of the waterfront landscape, and the utilisation of new technologies. Some shortcomings remain; thus, some recommendations can be made.

### 5.1 Enrich and balance memory interpretation strategies

First, more attention should be given to mining nonmaterial information elements, such as memory information and memory clues. The subject (remembers) is the prerequisite for the existence and continuation of memory, especially among those familiar with industrial heritage, whether they are the leaders and staff of the factory or the surrounding residents and tourists who visited the inside and outside of an industrial heritage site and established feelings and memory connections with it. The manner in which such connection occurs is more behavioural and event-based than written when the industrial building is more like a container to be experienced with five senses. It is necessary to evoke the senses by excavating, reproducing, or translating public historical events that can be related to the original production processes, significant events related to the development of industrial parks, or even important events or festivals. Second, despite the prevalent unique space experience created by industrial buildings and facilities that may tend to be homogeneous and lack surprise, people's demand for public landscape space will always be relevant. Therefore, public landscape space should be considered an important part of reusing industrial heritage, and the opening of roof terraces, air corridors, and other spaces should be strengthened. In addition, the connection between the two sides of the Huangpu River should be strengthened, and the rapidly developed West Bund can drive the development of the East Bund.

### 5.2 Enhance the rationality, service, and tolerance of the "Exhibition + " mode

Although the museum approach is a reuse mode based on public benefits, its operation and management still

involve multiple interests. In the planning stage, we should not only start from the perspective of architectural space but also comprehensively consider property rights, management, capital, and other aspects to enhance the rationality and practicality of protection planning. The government should act as a guide to properly encourage the social market to participate in the regeneration of industrial heritage through preferential policies such as subsidies, loans, or joint investment as well as a supervisor to balance the relationships among protection and utilisation, commerciality and publicity and to ensure that other functions that meet the current needs are appropriately increased on the premise of preserving the historical memory. In addition, the cases transformed into shelter hospitals during the epidemic inspired us to enhance the service of the museum complex to the surrounding communities, such as the appropriate implementation of community activity centres, community stadiums, community medical stations, and similar functions, to enhance the resilience of the museum. Moreover, the tolerance of functions should be appropriately improved; that is, if there are many uncertainties in future development, the renovation should be able to adapt to the needs of multiple scenarios. The irreversible transformation of heritage should be minimised as much as possible.

### 5.3 Improve local laws and regulations on the protection and utilisation of industrial heritage

In March 2023, China issued the Regulations for the Administration of National Industrial Heritage, officially starting to identify national industrial heritage. Drawing on the experience and practices of world cultural heritage evaluation standards, the standards and indicators for identifying and evaluating national industrial heritage were refined and improved. The regulations also put forward the principle of "protection priority, rational utilisation, dynamic inheritance, and sustainable development". In the same month, Shanghai announced the list of the first set of twenty industrial heritage sites in the city and proposed automatically identifying units evaluated as national industrial heritage sites as Shanghai industrial heritage, meaning that the country and Shanghai opened an independent identification channel for industrial heritage. However, whether and how to distinguish the recognition conditions of national and provincial industrial heritage remains a problem, and the Shanghai government has not yet issued relevant documents, which must be further explored. In addition to improving the evaluation system, local protection principles, particularly the value or memory element interpretation system, should be further established based on national recognition conditions and protection principles.

This paper has some limitations. Some of the buildings were closed throughout the study period for many reasons, and some cases are still being transformed; thus, relevant publications, media reports, and public comments were studied as auxiliary materials. The author expects to continue this research bringing more details for further analysis on cases that were not accessible, or lacking first-hand information.

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#### Authors' contributions

Lan Luo was responsible for the research design, cases selection, investigation and analysis, and draft writing. Professor Cao was responsible for research design and draft editing. All authors read and approved the final manuscript.

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