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# Machines and Space: Machine Aesthetics and the Renovation Design of Industrial Factory Buildings

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**Abstract**: This paper conducts a research investigation into the renovation design of old industrial factory buildings under the guidance of the theory of machine aesthetics. By elaborating on the characteristics and viewpoints of machine aesthetics—namely functionality, standardization, modularization, and the expression of technicality—it provides a core theoretical basis for the renovation of industrial architecture. It then organizes and examines its developmental history, stylistic features, and classic cases both domestically and abroad, and analyzes the positive significance of its application in aspects such as spatial reconfiguration, material presentation, and technological integration. Subsequently, from the perspective of preserving memory and texture, it proposes that applying machine aesthetics to the renovation design of existing industrial buildings can preserve their original historical memory, restore structural authenticity, and reuse industrial characteristics to endow them with new functions and aesthetic symbols, thereby embodying a design proposition that integrates historical context with modern life. Finally, the paper offers a prospect of future development trends in this direction.

**Key words**: Machine aesthetics; Industrial factory renovation; Spatial regeneration; Heritage preservation; Design strategies



## 1 Introduction

Since the Industrial Revolution, machines have not only changed production methods but have also completely altered human aesthetic concepts and spatial perceptions. The aesthetic trend of machine aesthetics, which praises technology itself and the geometric rationality, logic, and detail of mechanized systems, originated in the early twentieth century, and the field of architecture was no exception. If Le Corbusier's famous statement, "a house is a machine for

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living in," brought the thinking of machine aesthetics into public view, then this founder of modern architecture became the fundamental figure who integrated functionality and mechanical logic into architectural design.

Entering the post-industrial era, global industrial transformation and the reconstruction of urban spatial structures have given rise to a large number of industrial buildings—especially old industrial factory buildings—that have been detached from their production functions and have become "grey spaces" within cities. How to deal with industrial remains that possess a strong atmosphere of historical memory and embody the technology and craftsmanship of a certain historical period has become an important issue in the urban planning and design industry today. Blind demolition and reconstruction not only cause enormous waste of resources and destruction of historical culture, but also destroy the attributes of a city itself, resulting in the loss of its unique local cultural "grey space." Apart from such irreversible approaches, the most reasonable method lies in transforming functions based on the renovation of existing buildings, with the aim of revitalizing old industrial heritage.

Against this backdrop, the theory and principles of machine aesthetics possess strong vitality and guiding significance. Old industrial factory buildings are the most original existences of machine aesthetics, possessing characteristics such as large-span structures, clearly defined load-transmission logic, functional and explicitly expressed components, and spatial layouts serving production. Therefore, renovating them from the perspective of machine aesthetics is not an imposition of an external aesthetic style, but rather a process of awakening, continuing, and sublimating the internal genetic code of the factory buildings. Based on this line of thought, this paper explores the design considerations, theoretical discussion, and practical transformation paths of machine aesthetics in the renovation of old industrial factory buildings, as well as the representative cases under such a design approach, with the aim of explaining how such "old machines" can be transformed into "new spaces" for human use.

## 2 The Theoretical Framework of Machine Aesthetics and its Origins in Industrial Architecture

### 2.1 The Core Connotation and Historical Evolution of Machine Aesthetics

Machine aesthetics is not merely the admiration of the external form of machines or the imitation of mechanical styles, but rather the introduction of the logic, principles, and value concepts of mechanical manufacturing into design, thereby creating an aesthetic characterized by functionality, efficiency, and authenticity. Its ideological source can be traced back to Adolf Loos's criticism of "ornament". He believed that the more advanced the culture becomes, the more it must abandon ornamentation on useful objects, discard flashy and impractical elements, and pursue simplicity and authenticity. The Futurist school praised speed, power, and industrial civilization, which endowed machine aesthetics with a dynamic and passionate emotional expression. The person who established the status of machine aesthetics in the field of architecture was Le Corbusier, who proposed that "a house is a machine for living in," requiring architects to think like engineers, emphasizing new construction methods and mass production, advocating that function determines form and that form follows function—that is, the standardization of buildings as a whole and the mass production of components. The Bauhaus School further systematized and institutionalized this idea, applying it to various practical fields and integrating art with technology to a high degree. It regarded architectural principles as a design ideology to be taught to architecture students, thereby laying the foundation for modernist design. Today, development has surpassed the early fascination with machines themselves, applying the concepts contained in machine aesthetics to digital technology, parametric design, generative design, and other aspects, and has further evolved in the digital age into another type of machine aesthetics based on systematization, performance orientation, and technical expression.

### 2.2 Industrial Factory Buildings: The Original Carriers of Machine Aesthetics

Large old industrial factory buildings are the most physical expressions of machine aesthetics, whose original design purpose was solely to serve production and use, which is the most thorough embodiment of functionalism. Structurally, they mostly adopt exposed steel frames or concrete bent-frame structures, and the transmission paths of forces can be clearly seen, reflecting the persuasive essence and logic of "structure as decoration." Spatially, they follow functional development and, without excessive division, form tall, transparent, and column-free spaces to facilitate production line operations. Materially, there are no unnecessary additions or creations; materials express themselves directly in the factory, and red brick, concrete, steel, and glass are used in their original form. In addition, in order to construct factory roof trusses, crane beams, purlins, and other components more quickly, prefabricated standardized materials were generally used as both the structural framework and the interior and exterior finishing materials. This further reinforces the fact that old factories, as gigantic "machines", share the same aesthetic characteristics, because their aesthetic value stems from their own essence of efficiency, practicality, and authenticity. In the renovation process, the guiding ideology of machine aesthetics is to apply a theoretical system that shares the same origin, allowing both space and function to be transformed with modern significance.

## 3 Renovation Design Strategies for Industrial Factory Buildings under the Guidance of Machine Aesthetics

### 3.1 Spatial Reconstruction: From "Production Machine" to "Living Container"

Renovation is a process of functional replacement and spatial reconstruction. The spatial reorganization guided by the thinking of machine aesthetics is a further excavation of the original spatial potential and its efficient utilization. The inherent characteristics of large-scale old industrial factory buildings are spaciousness and height. Under the context of machine aesthetics, part of the main factory building can be preserved and used as a public activity center, such as an art exhibition hall, performance hall, library, and so forth, allowing the sense of monumental scale and the resulting perception of a "mega-structure space" to bring people a sense of awe. In fact, this is also a direct continuation of past machine aesthetic practices. The representation of horizontality and verticality—revealed through fluidity and permeability—borrows from the "mobility" of machines by inserting new elements such as corridors, staircases, and platforms into the space, thereby creating various visual intersections and path choices in the expansive space in both horizontal and vertical directions. This produces a meandering yet continuous spatial experience, allowing a person to feel as if they are shuttling through all corners of the space. From a visual perspective, the Musée d'Orsay, which was transformed from a train station, demonstrates this characteristic: the intersecting visual pathways inside the building operate like a large machine. Treating “insertion” as a method, new functional modules are implanted following the approach of a “room within a room” or “modular units”—inserting modern functional modules into the original large space to form a contrast between foreground and background. On the one hand, this satisfies the current need for subdivided spaces; on the other hand, it preserves the integrity of the original large space. This realizes the machine logic of modular design.

### 3.2 Expression of Materials and Structure: Authenticity as Aesthetics

Machine aesthetics advocates genuine materials and honest construction, and this is even more applicable to industrial factory buildings. In renovation practice, emphasis is placed on “picturesque preservation”, where necessary reinforcement and repairs are undertaken, and then presented as a focal element, fully utilizing the historical marks imprinted on rusted steel beams and the mottled surfaces of concrete columns, turning these traces of time into a unique aesthetic language. By juxtaposing old and new materials—retaining the existing ones while boldly introducing contemporary materials such as weathering steel, glass, anodized aluminum, and cast-in-place concrete—different material perceptions such as rough/smooth, heavy/light, old/new produce a strong sense of temporal contrast. In the collision between ruggedness and delicacy, hardness and softness, the era’s visual impression is manifested, clearly marking the traces of the intervention of renovation methods. Attention is also given to detailed handling; new reinforcement components and connection joints are often exposed using riveting and bolts, revealing a meticulous construction relationship akin to that of precise machinery. As a result, these buildings fully present the unity of modern technology and historical authenticity, the harmonious integration of the artificial and the natural, and the tight connection among the past, present, and future.

### 3.3 Technological Integration: Intelligent Systems as New “Machines”

In modern industrial factory renovation, the expression of machine aesthetics increasingly relies on the deep integration of intelligent technologies, which not only significantly improves building performance but also reshapes spatial experience. Green technologies are efficiently integrated into the existing buildings, such as enhancing natural daylighting through clerestory windows, utilizing original ridge vents to achieve natural ventilation, and introducing solar photovoltaic systems and geothermal heat pump systems. Their visualized monitoring and efficient operation themselves become a manifestation of technological beauty. Meanwhile, intelligent control systems—including automatic regulation of lighting, temperature and humidity, and energy consumption—allow the building to function like a precision instrument capable of responding in real time to environmental and usage demands, achieving energy-saving and efficient operation. Furthermore, with the help of AR and VR digital interactive technologies, digital layers of historical transformations or equipment operation information can be superimposed onto the physical space, injecting dynamic and participatory mechanical narratives into static industrial remains. This not only continues the industrial spirit but also constructs a futuristic spatial experience. Thus, technology is no longer hidden behind functions but becomes the core medium for expressing machine aesthetics in contemporary practice.

## 4 Case Studies

The Power Station of Art (PSA) in Shanghai and the Tate Modern in London can be regarded as exemplary cases that embody machine aesthetics within industrial factory buildings. The former was upgraded from the old Nanshi Power Plant, largely retaining its original industrial appearance. Its most notable feature lies in transforming the 165-meter-high chimney into an "urban thermometer", making it a new landmark landscape; the vast column-free exhibition hall inside the large factory building is a unique expression of "mega-structure" aesthetics; the originally exposed steel structures and coal-fired boiler foundations continue to be utilized as part of the architectural space, while newly added weathering steel and glass circulation cores form a dialogue with the surrounding old red brick and concrete, thus realizing the transformation from an industrial-era "energy machine" into today's "cultural machine". The latter, based on the original riverbank power station, underwent complete preservation and renovation. Its best design feature is the retention of the transparent turbine hall as a space for large-scale installation exhibitions, which also demonstrates the project's ultimate pursuit of industrial efficiency and scale. In addition, the newly added glass volume is light, while the thick brick mass is heavy, forming a strong contrast between void and solid; staircases and ramps, like smoothly operating delicate mechanical parts, are embedded within the existing structure. Coupled with the design of the plaza in front of the building, this massive platform draws pedestrians into the site, thereby generating the effect of a "cultural machine". Both projects reset the value of space in new ways and uproot the temporal traces of the past, hence representing what can be called machine aesthetics.

## 5 Conclusion and Outlook

Machine aesthetics provides industrial factory renovation with profound theoretical insight and practical approaches. It no longer regards traditional industrial factory buildings as burdens to be destroyed and crushed, but transforms them into valuable existences. By utilizing the original construction logic, excavating spatial potential, and authentically reflecting material textures, and by integrating contemporary intelligent technologies, old "production machines" are transformed into new "living containers" of today. Looking into the future, machine aesthetics will continue to develop in the field of industrial factory renovation along several trends: first, integrating with green and intelligent systems, emphasizing the full life-cycle properties of buildings, focusing on contributions to the environment under high-tech systems, and possessing energy efficiency, productivity, and self-adjustment capabilities; second, strengthening regional narrative expression, combining global technological logic with localized industrial history and craftsmanship memories, so as to avoid cold universality; third, achieving functional diversification, continuing to develop various models such as mixed-use communities, innovation parks, and educational complexes on the basis of cultural and artistic creativity. Whether during the construction process or thereafter, industrial factory renovation is a process of re-creation. This is not merely about the preservation and restoration of architecture, but requires further polishing of historical context and the interconnected display of the sense of the times. Therefore, machine aesthetics-based industrial renovation has important significance: first, it continues the historical memory of the city; second, it becomes a vivid picture of sustainable development; third, in the dialogue between the old and the new, it continuously defines new aesthetics and revitalizes the machines of the past. Old times gain eternal memory in the evolving historical process, engraving past stories into the charm of historical culture, so that each moment of being in such a place feels like personally returning to yesterday's stories.

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