

PAPER • OPEN ACCESS

The Research of Green Reuse on Old Industrial Building A Case Study of Changchun FAW

To cite this article: Weihong Guo *et al* 2020 *IOP Conf. Ser.: Earth Environ. Sci.* **567** 012030

View the [article online](#) for updates and enhancements.

A promotional banner for the PRiME 2020 conference. The background is a dark blue space-themed image with a globe. On the left, there are three circular logos: ECS (Electrochemical Society), The Electrochemical Society, and The Korean Electrochemical Society. The main text in the center reads 'Joint International Meeting PRiME 2020 October 4-9, 2020' in white and blue. Below this, a blue bar contains the text 'Attendees register at NO COST!'. On the right, there is a large 'PRiME' logo with 'PACIFIC RIM MEETING ON ELECTROCHEMICAL AND SOLID STATE SCIENCE' and '2020' below it. At the bottom right, a blue button says 'REGISTER NOW' with a right-pointing arrow.

ECS
The Electrochemical Society
The Korean Electrochemical Society

Joint International Meeting
PRiME 2020
October 4-9, 2020

Attendees register at NO COST!

PRiME
PACIFIC RIM MEETING
ON ELECTROCHEMICAL
AND SOLID STATE SCIENCE
2020

REGISTER NOW ►

The Research of Green Reuse on Old Industrial Building —— A Case Study of Changchun FAW

Weihong Guo¹, Bin Li^{1,2}, Yuqing Zhang^{1*}, Marc Aurel Schnabel²

¹ School of Architecture, South China University of Technology, Guangzhou 510006, China

² Wellington School of Architecture, Victoria University of Wellington, Wellington 6011, New Zealand

445453185@qq.com

Abstract. With the development of a large number of old industrial buildings, such as the relocation, transformation, demolition and other issues, how to reuse the building resources has become an urgent problem need to solve. This paper about architectural resources reuse, based on old industrial buildings in Changchun FAW, proposed using green technology to revive the vitality of old industrial buildings, at the same time, starting from the point of view of green energy-saving, proposed design principles, and recommendations about old industrial buildings green resources reuse in Changchun FAW.

1. Introduction and Background

1.1. Reuse of old industrial buildings

With the development of society and the change of the city structure, a large number of factories have been moved to the suburbs, therefore has produced a large number of reuse industrial buildings issues. Old industrial buildings reuse have many benefits for sustainable development, direct cost savings, indirect cost savings and additional aspects, not only in terms of energy and materials but also can shorten the construction period, reduce the pollution of the environment (Table 1).

Table 1. Benefits of building reuse

Sustainability	Energy savings
	Material savings
	Waste elimination
Direct cost savings	Labor expenditures
	Material expenses
	Disposal costs
Indirect cost savings	Construction period
	Construction liability
Additional	Noise reduction
	Related pollution

At the same time, the old industrial buildings often have their specific structure and appearance, with special artistic value, and carry the memory of people for these old industrial buildings. In the



historical value, social-emotional value, artistic value, economic value and other many aspects have a significant meaning.

1.2. Green reuse resources

The high-speed urbanization process has brought serious negative effects on energy and ecology, resource depletion and environmental degradation have become the common concerns of people. Respecting nature, protecting the environment has become the theme of social development, saving resources and reducing pollution is the necessary condition to realize green sustainable development.

Although a lot of old industrial buildings avoid demolition waste by putting new function to revive the old buildings, however, the major transformation of the practice is still in the artistic level of basic transformation stage, in the process of reuse old buildings paid little attention to the application of the concept of green skills. That can not provide a comfortable environment for people in low energy consumption. And in the construction process that is often accompanied by the serious waste of resources and environmental pollution, which go against the concept of green sustainable development.

The green reuse of old industrial buildings refers to the combination of the green building technology and the renovation design, in order to improve the environment of the existing buildings in a friendly way and realize the sustainable utilization of resources in the process of transformation. Green recycling measures include energy saving, water saving, material saving and land saving.

1.3. Changchun FAW

Changchun FAW is located in Changchun City, Jilin Province, start to build in 1953, completed in 1956 and put into production, produced China's first car in here. The completion of the FAW, creating a new history of China's automobile industry. After more than 60 years of development, FAW Group has become one of the most prominent automobile groups in China.

Today, with the continuous development of FAW, its industrial plant expansion, all over Chengdu, Tianjin, Shenzhen and other major cities. Changchun also continued to expand the local plant, but for the reuse of old industrial buildings has been abandoned, idle, etc., which caused a serious waste of the value of old industrial buildings.

2. Current situation and problems

2.1. No resource reuse occurs

Although more and more of the old industrial buildings in the process of updating can get reasonable treatment to treat right. However, that mainly concentrated in Beijing, Shanghai and other economically developed areas, compared to many old industrial buildings in other areas, either no consciousness of reuse or poor economic returns, no modification of the factory or idle. Because of this phenomenon, it is urgent to solve the problem of resource waste. Old industrial buildings always tend to be tall, long span, open space, suitable for transformation and reuse for different functions.

Such as the reuse of Beijing Coking Plant, because of the site near the centre of the city, so that transformed to be an urban service centre. Shanghai 1933 rebuilt as the Creative Industry Park, brought new vitality of local economic development. SOHO in Manhattan reconstructed old industrial architecture for the artists' cluster to live and artistic works to be created. Shenyang Foundry Museum reused old industrial building to be a museum. Zhongshan Qijiang Park re-established original shipbuilding factory to be a city park in Zhongshan City, Guangdong province. From these, we can see that there are many ways and methods to reuse the old industrial buildings.

2.2. Resource reuse is not sufficient

China's old industrial buildings transformation project started in the late 1980s, such as the Beijing watch factory converted multi-storey buildings into ShuangAn shopping mall. Nevertheless, in the process of utilization of resources, people still in the demolition and reinvent way. Also due to the construction economic and technological conditions, architectural function factors in that time caused

poor thermal performance of building envelope as common, however, after the transformation of the old industrial buildings the problem still exists, it will not only affect the use of the buildings but also will bring a considerable energy waste. On this problem, the world-renowned architect Thomas Herzog's work to renovate Daikeshao warehouse in Germany to give people a good inspiration. This warehouse was built from 1936 to 1938, is a 1400 m² industrial warehouse with glass and steel structure. In 1997, SIEMENS decided to rebuild it as an efficient, open, energy-saving and ecologically office space, as a new workplace for companies with 60 people. The architect's design is concise and in line with the requirements of SIEMENS. He built skylight on the roof, under the eaves increased side window and transom, and below the height of 2.5m opened banded windows, so that meets the needs of natural ventilation and line of sight. The most special is, the architect used a transparent plastic film that can be natural degradation, enveloped above window frame indoor, leaving a specific distance from the air thermal insulation layer between the walls and the roof. The advantage of this is that the volume heating is reduced indoor, the thermal insulation layer is built, and the natural lighting and ventilation are added, thereby saving the energy consumption significantly. However, at present, the resource reuse of old industrial buildings in China is seldom considering the sustainable energy-saving design and renovation.

2.3. Problems of FAW reuse

FAW is located in Changchun City, Jilin Province, the factory buildings built in the 1950s, influenced by the Soviet Union, so the style of buildings are the same as Soviet building style, has a specific historical value, but now just part of old industrial factory buildings are still using, most of them are waste as garbage. It is urgent to solve the problem of resources waste, such as reuse by a car museum still has particular economic value, also can play to its historical value, social-emotional value and artistic value.

3. Solution and significance

3.1. Reuse and design methods

At first, the way to reuse about the function can reuse and regenerate old industry buildings like museums, art galleries and other public service space, can also be open for the city as a garden, community park, or creative industrial park, the artist's living space, of course, should according to the geographical conditions, cultural background, historical significance, the crowd demand conditions of the old industrial buildings to reuse; In the design method, often take the two ways to contrast or different coordination parts of old and new buildings. Contrast can be by built new or rebuilt old parts of old buildings to form different architectural style with old buildings, in order to foil each other's historical value and artistic value, also caused people's curiosity to the difference of new and old buildings, in order to achieve the maximizing reuse resources. The coordination design approach is often considered the overall plant architectural style and its surrounding environment, respect for the original plant area of the overall architectural style and to built a harmony and unity atmosphere.

Based on old industrial buildings reuse method of FAW, combined with the investigation of the current situation and the surrounding environment analysis (Figure 1), after comprehensive consideration here can reuse the old industrial building as the Automotive Museum to show the FAW culture, because service radius of exhibition architecture relative to other function buildings has its characteristics and advantages, can attract people around the country and the world, also considered the existing factory still in use. The surrounding shopping mall is close to the site, so proposed to use as an exhibition architecture in the future. Such as architect Frank Gehry's works of Bilbao Guggenheim Museum, that is, through an exhibition building revive the economic development of the whole city, attractive visitors be here, then built related services supporting and promoting the local economic development.

3.2. The way of green reuse

Because of the defects of reuse of old industrial building resources, it is considered that green sustainable development should be carried out in the future. Green reuse in the doors and windows, wall, roof, floors and other parts should be in accordance with the current regulatory requirements and the local climate and environment, also need to consider the structure, technology, materials and other influencing factors of the old industrial building when reusing them. For the requirements of urban development, land development analysis, the protection and renewal of old industrial buildings have to be considered.



Fig.1. current situation and the surrounding environment analysis about FAW

For green reuse of FAW, that taking into account the old structure of technology and has an absolute historical value. Here proposed to the detection of durability, stability and safety of all parts of the building structure at first when in the process of green reuse. For the security risks present should use corresponding reinforcement measures or partial replacement method. At the same time, use the related software simulation and analysis on the overall thermal performance, according to the function, the effect of space owner wants to do corresponding design, consider the location about the window and door, and other parts to rebuild under overall planning and design. Furthermore, the implementation process should coordinate the doors and windows, walls, floors, roofs, etc. with a corresponding design.

Because of the Changchun City is located in the cold area, so for old industrial building, green reuse should be strictly controlled. That should replace the original single glass doors and windows to the double layer or three-layer glass doors and windows. For the wall, based on the historical value is the dominant factor of the building so that it can be building thermal insulation structure indoor. Using the Trombe wall structure (Fig. 2) in the outer wall surface, will not affect the overall building style, also suitable for energy-saving utilization in the seasons of the year.

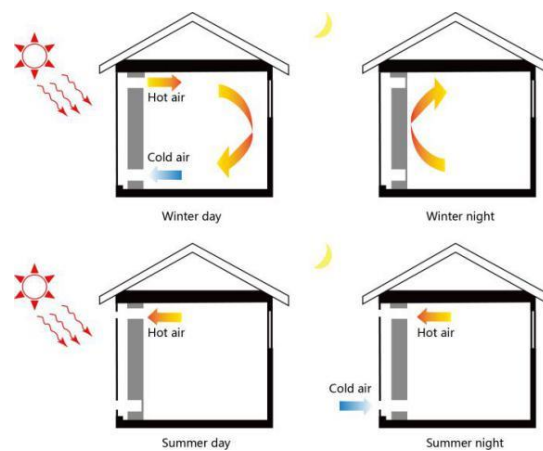


Fig.2. Working principle of Trombe wall

The ground is mainly related to moisture-proof, waterproof, and other structural treatment that should use energy-saving measures in accordance with the cold weather. The roof should pay attention to waterproof, heat insulation problems. And the problem of lighting and ventilation should be considered for the greening of the outdoor environment, the planting location and combination of the vegetation.

In the green energy-saving measures, that should pay attention to comprehensive use skills about energy saving, water saving, material saving, and land saving (Table 2).

Table 2. Green reuse measures

Energy saving	Solar energy utilization
	Passive energy saving
Water saving	Permeable rigid pavement
	Rainwater recycling
Material saving	Reuse components
	Use recyclable materials
Land saving	Bottom overhead
	Vertical greening
	Roof greening

Energy-saving can be achieved by the utilization of solar energy and energy-saving passive design. Water-saving can be taken as rainwater collecting and irrigation system, water recycling system. Material saving first to use the original building structure, material, for excess material can be performed as pieces of apparatus for people to enjoy. At the same time, we should pay attention to the use of recycled materials. Land saving can achieve by taking vertical greening, roof greening, solar roof etc.

4. Conclusion

In the rapid development of the urban renewal process, in the face of demolition and pushed again transformation to traditional mode has brought serious resources waste and environmental pollution, people gradually clear to recognize the importance of reuse of old industrial buildings, renovation and utilization have gradually been society widely recognized.

More and more scholars and architects began an in-depth study of the transformation of old industrial buildings reuse research. However, most of the transformation also belong to the fundamental transformation stage, although the old industrial buildings were preserved and reused in other function. Nevertheless, the transformation in the process of attention to energy saving and environmental protection is not enough, and often occur material waste, pollution emission, unideal condition use, and other problems. In the future transformation of the reuse process, how to integrate into the concept of green building, make full use of the limited material for reducing waste and

pollution, is worth deep thinking and research, green transformation mode will be a new development direction to the renovation of old industrial buildings.

This paper were related theory and case study of old industrial buildings for green transformation, attempts to summarize a mode to use green building concept into the transformation process, and puts forward the development mode and method of Changchun FAW's future green recycling. We hope this paper to be able to achieve a good effect and attract more attention and research by scholars and architects.

Acknowledgments

This research was supported by the National Key R&D Program of China(Grant No. 2017YFC0702505); General Program of National Natural Science Foundation of China (No. 51678239); Science and Technology Program of Guangzhou, China (No. 201804020017).

References

- [1] Bin Li, Weihong Guo, Marc Aurel Schnabel, Tane Moleta. (2020). Feng-Shui and Computational Fluid Dynamics (CFD): Analyzing Natural Ventilation and Human Comfort. Proceedings of the 25th International Conference of Computer-Aided Architectural Design Research in Asia (CAADRIA 2020), pp.731-740.
- [2] Bin Li, Weihong Guo, Marc Aurel Schnabel, Yuqing Zhang. (2020). Virtual Simulation of New Residential Buildings in Lingnan using Vernacular Wisdom. Proceedings of eCAADe 2020.
- [3] Chancellor, W., Abbott, M., & Carson, C. (2015). Factors Promoting Innovation and Efficiency in the Construction Industry: A Comparative Study of New Zealand and Australia. *Construction Economics and Building*, 15 (2), pp.63-80.
- [4] Davies, R. B., Butler, R., Ting, F., and Steiner, V. (2014). Revealing the Rainforest - Discovering the Dynamic Interchange between Landscape and Culture. *X-Section Journal*, 4: Exchange. 34-44.
- [5] Emmett, S. (2013). Waste to Worth: Adaptive Re-use of Recycled Waste in Existing Structures. Master Thesis Explanatory Document. An Unpublished Explanatory Document Submitted in Partial Fulfillment of the Requirements of the Degree for Master of Architecture (Professional), at Unitec Institute of Technology.
- [6] Harfield, T., Kenley, R., Panko, M., and Davies, K. (2008). Up-skilling the New Zealand Construction Industry: A Critique of the Learning Options. In Haigh, R., and Amaratunga, D. (Eds). Proceedings of CIB W89: International Conference in Building Education and Research BEAR2008 'Building resilience' conference. Salford, UK: University of Salford. CD Rom : 434-445.
- [7] Hughes, L. (2014). Breathing Life back into the Mundane: the Adaptive Reuse of Dunedin's Industrial Heritage. An Unpublished Explanatory Document Submitted in Partial Fulfillment of the Requirements of the Degree for Master of Architecture (Professional), at Unitec Institute of Technology.
- [8] J.Eco-Journal, J. (2000). China's Ecological Environment and Its Regional Differences in the Sensitivity of Study, China (9-12).
- [9] Kiroff, L.& Tan, X. (2015). Adaptive Reuse of Industrial Buildings in a New Precinct in Auckland's CBD. *Global Science and Technology Forum* (Ed.), Proceedings of the 1st International Conference on Urban Planning and Property Development, Singapore (44-54).
- [10] Laefer, Debra, F;Manke, Jonathan, P.,J. (2008). Building Reuse Assessment for Sustainable Urban Reconstruction. *Journal of Construction Engineering and Management*, China (217-227).
- [11] Luo, Chao, J. (2015). Study of Regeneration Mode in Disperse Old Industry Area. *Industrial Construction*, China(47-49).
- [12] Turner, D. (2015). Whole Building Recycling as a Waste Reduction Practice. In M. Panko & L. Kestle (Eds.). *Building Today - Saving Tomorrow: Sustainability in Construction and*

- Deconstruction Conference Proceedings. (pp.18-26).
- [13] Weihong Guo, Bin Li, Yuqing Zhang, Wenwen Li. (2019). Indoor Thermal Comfort in Villages during Winter in the Southern Region of Hot Summer and Warm Winter Zone of China. Proceedings of Healthy Buildings 2019 Asia.
 - [14] Weihong Guo, Bin Li, Jianqi Dou, Ziqi Zhang. (2020). Research on Wind Environment of Healthy Settlement Based on Epidemic Prevention —— Taking Lingnan Yuedao Settlement as an Example. South Architecture.
 - [15] Weihong Guo, Bin Li, Yuqing Zhang, Guowei Liu. (2020). Research on Revitalization of Nanping Village on Gaidong Cultural Route. Landscape Architecture, 27(03):118-122.
 - [16] WU, S. Y., XU, L. & XIAO, L. (2020). Performance Study of a Novel Multi-functional Trombe Wall with Air Purification, Photovoltaic, Heating and Ventilation. Energy Conversion and Management, 203.
 - [17] YU, S. Q. & IOP (2017). Exploration on Factors of Old Industrial Building Renovation and Design Practice. 2nd International Conference on Materials Science, Energy Technology and Environmental Engineering.
 - [18] Zou, P., Hardy, R. and Yang, R. (2015). Barriers to Building and Construction Waste Reduction, Reuse and Recycling: a Case Study of the Australian Capital Region. In M. Panko and L. Kestle (Eds.). Building Today - Saving Tomorrow: Sustainability in Construction and Deconstruction Conference Proceedings. (pp.27-35).