

**Review Article**

# Study on the Reuse of Brownfield in Countries

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**Abstract:** With the development of China's sustainable development strategy, the problem of tan land is attracting more and more attention. Reusing of brown land is one of the important ways to promote the restoration of natural ecology and construct livable city. Many developed countries use advanced technology to make a positive transformation of brown land, and have achieved good results. Their management experience has a good reference to Chinese brownfields.

**Keywords:** Brownfield, Reuse, Different Countries

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## 1. Background

Brown Land (Brownfield) is opposed to the common green space (Greenfield). Brown land, as a global hot topic, the regeneration of brown land and political, economic, cultural and ecological aspects, are closely related to the city's renewal, and sustainable development strategy is crucial [1]. "Thirteen-Five planning" and the "Soil Pollution Control action Plan" are issued by the State Council state department last year, it indicated the importance of the restoration and reuse of brown land in China. At the same time, "the CPC Central Committee of the State Council on further strengthening the management of urban planning and construction", it has also made clear that the restoration of brown land as the city natural ecology to create a city livable environment one way. Many developed countries have carried on the positive guidance to the exploitation and utilization of tan land through legal policy support, fund support and insurance guarantee. Different governance policies provide more accurate, more distinctive and more predictable regeneration strategies for the regeneration of brown land.

## 2. The Concept and Characteristics of Brown Land

Brownfield first appeared in the British planning literature, the earliest formal definition was 1980 the United States

Environmental Protection Agency (USEPA, 1997) in the Superfund Act, "abandoned, idle or underutilized industrial or commercial land, in the process of re-development and utilization of such kinds of land, because it tends to exist objectively or potentially environmental pollution than other development processes more complex" [2]. This is a concept that is now widely accepted.

Brownfield is the international environmental science field to the city's high energy consumption, and high polluting enterprises after the relocation of the collectively. The image of the word pointed out that the land is valuable, but there are risks, so not "white" not "black" need to recuperate [3].

Brownfield includes not only industrial land, but also warehousing land, mining land, external transportation land, public service land, municipal infrastructure land and military land and so on. Brownfield re-development focuses on the harnessing of contaminated land and land reuse [4]. The main difference between brown land and other forms is that it has some degree of pollution or environmental problems, and the type of brown land is different from the formation reason [5]. To sum up, we can see that brownfield has the following characteristics: First, the land used to exploit, and second, it is now gradually declining, abandoned, or unmanned, and thirdly, there may be pollution; fourth, the brown land may be have barriers to re-develop and utilize [3].

### 3. Classification of Brownfield

In foreign countries, brownfield mainly refers to the sites and buildings left in the city because of the relocation of industrial and commercial districts or the cessation of operation. Therefore, the study abroad is about the city brownfield. Gao Xiaoli and other scholars in the collation of foreign literature on the basis of the discovery of the major foreign countries have four kinds of brown classification [6]:

(1) According to the different sources of pollution, brownfield can be divided into chemical brown pollution, physical brown pollution and bio-brown pollution, synthetic brown land pollution. Chemical brownfield pollution refers to chemical elements pollution, causing damage to humans and animals and plants, the pollution, due to the impact of chemical substances, will not immediately show endanger, and need to undergo a long time to emerge. Physical brown pollution is caused by harmful substances in the soil, such as medical waste, lead, mercury, and so on some heavy metals. Bio-brown contamination is caused by some harmful gaseous or solid substances produced by animals and plants in the process of decomposition. Synthetic palm pollution is a combination of the above two sources of contamination caused by.

(2) According to the purpose of the utilization of brown land, it can be divided into: industrial brown land, commercial palm land, residential brown land, public brown land. The industrial brown land is the palm land which is suitable for transforming the construction into industrial land; commercial brown land is suitable for the development of commercial premises in brown land; residential land mainly refers to the development of the residential area of the brown land; public palm is the brown land suitable for the development of public infrastructure land, which is convenient for people's livelihood.

(3) According to the different degree of contamination of the land, brown land can be classified into non-polluting brown land, mild pollution brown land, moderate pollution brown land and heavy pollution brown land.

(4) Brown land can be classified into the following categories according to the properties of land use: the extractive industries such as quarries, mines, opencast coal mines, etc. Manufacturing industrial-type brown land such as steel mills, the gas factory, the transportation facilities, such as industrial terminals, railway sites; storage facilities, such as warehouses; waste disposal facilities such as sewage treatment plants, landfill sites, waste accumulation fields, etc. other special types of brown land such as military bases, crematoria, etc [4].

(5) According to the different symptoms of the earth, brown land can be divided into suspected brown land and real brown land. Suspected brown land refers to the fact that although the existence of an expert assessment of the symptoms is still not judged to conform to the standard of palm lands; real brown land refers to an expert assessment and the existence of symptoms have been diagnosed with the criteria of the Brown land in accordance with the judgment [6].

### 4. Reuse Type and Practice of Brownfields

#### 4.1. The Reuse of Brown Land--the Reserved Type

The reserved reuse means to preserve the construction, facilities and historical relics of a certain value in brown land, and to make suitable reconstruction and reuse of the status quo of the brown land. On the basis of its reservation, the use of landscape design and other performance methods to create a historic space for people to provide entertainment venues. This kind of reuse is now the most common way of transformation, such a reuse method not only retains the historical relics, but also promotes the overall environmental quality of the city, easing the tension of urban land use, and stimulating the vitality of the city. But this kind of reuse requires a lot of effort to plan the design.



Figure 1. The status quo of the transformation.

The Seattle Gas Plant Park (figure 1) is a case of successful reuse of industrial wasteland, which mainly utilizes modern new landscapes. The Seattle gas plant, which is located in the city's urban area, is in the top of north of the lake, where it was first built to extract petrol from coal and later from oil. During the operation of the factory, the discharge of a large number of pollutants on the local ecological environment caused great damage. When the factory ceased operation in 1956, the location of the environment has become quite deteriorated, the ecological environment is extremely poor, has been in the basic view of the extent of green plants. The Seattle government then bought the land to improve the city's environment and carried out a series of modifications to build the city's Central Park. In the process of repair, the use of advanced technology, through effective biological and chemical role, gradually eliminate the soil pollution. At the same time, a large number of sewage sludge was added to the soil, the grass and some other organic fertilizers were produced after the lawn was built, which increased the nutrition of the soil, thus achieving the aim of improving the environment. The design of the park with "minimal intervention, self-repair" as the core concept, the use of the existing resources in the site to carry out a reasonable deletion and transformation, fully combined

with the original industrial brown land and history, this site perfect combination of time and space, make its particularity more prominent.

The American High Line park (figure 2-4) is also a more typical example, for New York created a huge economic and social benefits, is the international redesign and construction of a model of brown land. It is a style aerial garden on the west side of Midtown Manhattan in New York. It was originally an air freight rail route to the Hudson Port, which was connected to the meat-processing zone and 34 street, and was in danger of being dismantled after it ceased operation in 1980. In the 1999, the American "Friends of the High Line" proposed to transform it into a public park. The park retains its original railroad track in design, plus a rich variety of vegetation, creating a unique aerial landscape.



*Figure 2. The way it used to be.*

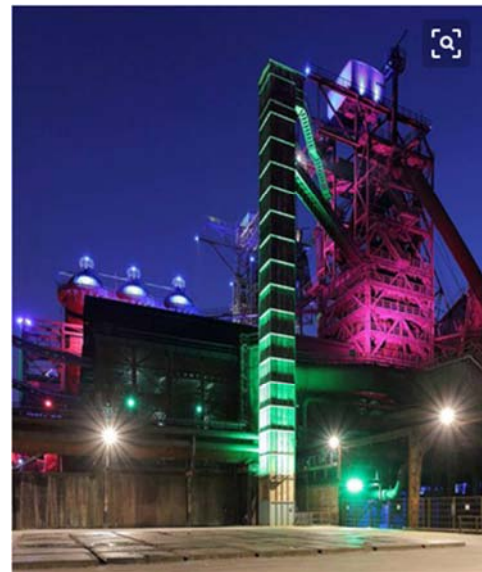


*Figure 3. One part of the High Line park now.*



*Figure 4. The way it is.*

The Duisburg Landscape Park (figure5-7) in Duisburg, Germany, was a large industrial base with a century-old collection of coal, coking and steel. Abandoned in 1985, it is now transformed into a large-scale industrial tourism theme park dominated by coal-iron industry background, emphasizing the value of post-industrial culture and the design model of post-industrial landscape Park. Designers Ratsio use ecological means to deal with this piece of broken area, the resources in the Brown land to make a good use of, given the new use function. Abandoned industrial machinery, industrial waste, coagulation plates, etc. are used as a good landscape construction materials, such as the waste tank converted into a diving club training pool, the wall has been transformed into a climber's paradise; the industrial waste of waste Land, such as Coke and Slag, is designed and used rationally to become a medium or ground material for plant growth, preserving the historical information of the plant to the maximum extent, while preserving the natural state and rough texture of the existing grassland in the site, On the basis of full respect for the natural ecological background to further improve the ecology. "Less is more" this unique design idea for the park has brought a great shock.



*Figure 5. The night scene it is now.*



*Figure 6. The way it is now.*



*Figure 7. One of the corners of the park.*

The Weiss Park (figure 8) is located in the center of the city's northwest of Toronto, Canada. The region was originally Canada's Havilland airport and later became a Crawfordville Air Force Base until 1996. Later, the local government set up a special research center, starting from 2005, the use of advanced ecological, chemical and other technology to restore soil fertility, thereby providing plant growth base bed, and increase plant strength. At the same time, a number of pedestrian bridge systems that can guide tourists along the river banks through the grasslands, forest areas and internal wetlands have been built, and the original industrial buildings, military buildings and other facilities have been rebuilt, making them the campus facilities of the urban industrial creative culture. At the end of 2015, the park landscape and other related service facilities were completed. After more than 10 years of continuous transformation, so that the Weiss Air Force Base from a completely abandoned military base into a set of economic, social, environmental and unique national urban Ecological Park, but also to the local children to create a scientific exploration and social practice. With the opportunity of brown land transformation, the Toronto Government fully excavates and rationally protects the city industrial cultural heritage, traces, inherits and interprets the urban industrial culture, and promotes the all-round development of the related cultural industry and industry tourism.



*Figure 8. After the transformation.*

The Thames Park site (figure 9-12) is the port Operation area of London in the early 19th century. In the past, due to the development of the city economy, it has built a relatively

concentrated industrial printing and dyeing plant, chemical plant and military factory in this area. Later, with the development of the city, these factories were abandoned, so the industrial base became a waste land. The London government has taken a series of steps to revive and rejuvenate the brown land. According to different degrees of soil and groundwater pollution, the Government adopted different methods, such as physical, chemical and biological, to improve the groundwater and soil. The park in the process of transformation, the original industrial and cultural history and natural landscape, and successfully built a park with the surrounding ecological environment of a new type of ecological park. The establishment of Thames Park not only changed the appearance of this industrial brown land, but also led to the development of the whole region and brought new vigor to the development of the region.



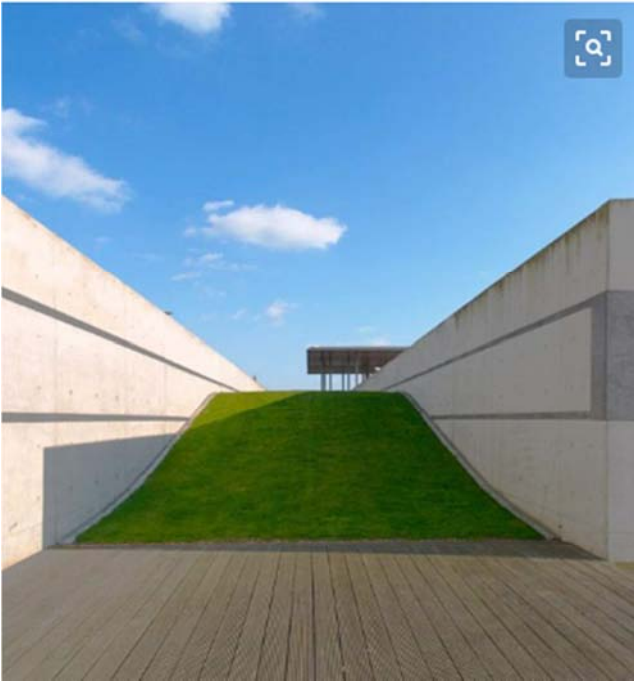
*Figure 9. The whole design drawing.*



*Figure 10. After the transformation of port operation area.*

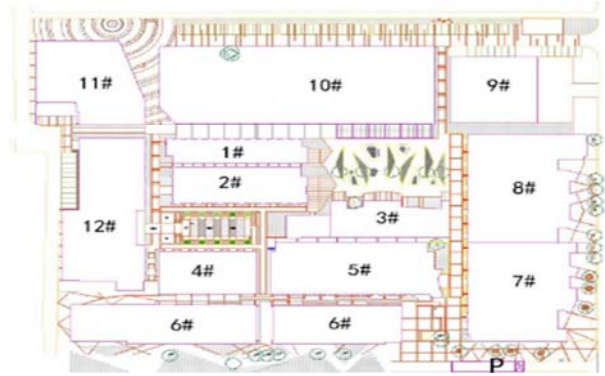


*Figure 11. What it looks today.*



*Figure 12. The reuse of port operation area.*

The reconstruction and utilization of Shaanxi old steel mills (figure 13-16) in China is a typical example of the reuse of brown land. Shaanxi Old Steel Plant 1958 set up in northeast of China, 1964 moved to Xi ' an, 1965 and relocated to the Dalian Steel Plant, a workshop reorganization, and put into production, and then gradually developed into a large-scale special steel enterprises. After 30 years of glory, in 1998, the transition was discontinued, and 2002 was acquired by Xi ' an science and technology industry group. The transformation of Steel wire Workshop, in the preservation of the old industrial plant based on the integration of art, fashion and other elements, made after the Beijing 798, Shanghai Red Square, northwest of the first creative theme of the city's theme industrial park. Old steel Plant design Creative Industrial Park covers an area of 50 mu, the total construction area of about 40,000 square meters, the unit area of 100 m<sup>2</sup>-2000 m<sup>2</sup>, the layer up to 3.9m-15, green coverage of 30% above, 354 parking spaces. Park to design creative industry chain as the core, the Ecological office area, exhibition Exchange area, performing arts and visual arts area and leisure industry as a supplement, promote the integrity of the industrial chain, enhance the overall positioning and level of the park, to promote the horizontal exchange between the enterprises, to achieve common development, mutual aid win. Old steel Plant Design creative Industry Park is a creative display Exchange center, loft Creative Ecological Office, creative block, cultural and art Exchange center, and other space forms of polymerization, the formation of contemporary art, architectural space, cultural industry, historical context and urban living environment integration of the compound organic space.



*Figure 13. The whole design drawing.*



*Figure 14. What it used to look like.*



*Figure 15. After the transformation of old steel mills.*



*Figure 16. One scene of the transformation of old steel mills.*

#### 4.2. Re-utilization of Brown Land--Reconstruction

Reconstruction reuse means the demolition of waste, buildings and other facilities in brown land directly, in the case of no risk assessment of the site, and then directly to the site of the redesign and planning use, to form a new area. This kind of reuse is very common, which can be quickly reshaped in a short period of time, but it is not the most suitable, the most ecological, the most sustainable way to reuse brown land, and it is not conducive to the development of the city.

### 5. The Value of the Reuse of Brown Land

The redevelopment and utilization of brown land has become the inevitable choice of sustainable development of cities and countries [8]. In the long run, the management and development of brown land has many benefits such as easing environmental pressure, promoting economic growth, improving urban transportation and service facilities, and revitalizing the Old City. Since in the mid 1990 of the 20th century, the Economic Cooperation Organization has noted the value of palm land, pointing out that brown land development has a total output factor of up to 3.8 and can bring huge ecological, historical, cultural, social-economic and environmental education values to the broad masses of stakeholders [9].

#### 5.1. Ecological Value

First, the brown land is used to mitigate the risks associated with the brown land itself and the surrounding area. Brown land is the inevitable result of industrialization and urbanization, which often brings about the bad effects of land idle, environmental pollution and urban space fragmentation [10]. Impact on the social-economic and environmental impacts of the area where Brown is located. It is possible to reduce the risk of brown land and improve the capacity of urban ecological environment by converting brown land into green space after the treatment of reducing pollution. Secondly, it can reduce the consumption of green space by converting brown land into construction land or other land. The redevelopment of brown land can not only protect the ecologically superior areas that have not been developed, but also improve the condition of the damaged areas of ecology. In a word, the reuse of brown land is of great significance to itself and its surroundings, and it can effectively curb the deterioration of ecological environment and bring about irreplaceable ecological benefits by repairing, eliminating or reducing the negative effect to reduce the risk of brown land including ecological and environmental risks.

#### 5.2. Historical and Cultural Values

Brown land is the product of industrial society, in a sense, is the development of the human era memory, recording the history of the city's development. Some brown land, after reasonable preservation and transformation, can completely become a local characteristic culture, promote the

connotation of local humanistic spirit, reproduce the historical context of the city, and effectively extend the historical and cultural tradition of the city. For example, the German Customs Union No. 12th coking plant, which has been included in the World Heritage List, has become a symbol of the German industrial Age [11].

#### 5.3. Social-Economic Value

The reuse of brown land is a kind of transformation and utilization of resources, which can save the cost of landscape transformation, beautify local environment, effectively promote the increment of urban land, and provide a good foundation for urban follow-up development [11]. In addition, a large number of foreign studies have shown that the management and development of Brown land has a significant impact on attracting investment, increasing tax revenue and financial revenue, and promoting economic development. In 2008, the United States Alliance of Mayors released a report showing that the real tax revenues from brown land management and development amounted to \$408 million trillion, far exceeding the 223 million and 100 million dollars of the previous two years [6].

#### 5.4. The Value of Environmental Education

The rapid development of society has allowed people to forget the importance of protecting the environment for a long time. Brown land is the "scar" on earth, its existence and governance reminds of the importance of sustainable development. If the rational planning and design, ecological restoration, and reuse to give new functions and uses, will have a huge environmental education significance for future generations.

### 6. Conclusion

Nowadays, the industrial development of our country is rapid, the modern industry also pays more attention to the coordinated development of the ecological environment, so the reconstruction and reuse of abandoned buildings or facilities is a serious realistic problem faced by many cities, and the reformation of brown land is paid more and more attention by the Government. In the process of reuse of brown land, foreign advanced technology can be used as a reference, which is beneficial to the local government to transform the cost effectively.

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