

INDUSTRIAL HERITAGE STADY BASED ON URBAN MORPHOLOGY

- The Case of Shougang Industrial Field





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INTRODUCTION

Industrial heritage sites in cities are highly complex structures, they are fields that are still occupied by abandoned structures but already lost their original functions. Like an isolated island in the urban environment exists in the present urban environment but far away from the daily city life.

Even though industrial heritages had been once treated as negative elements in cities, their positive meanings have been noticed with the growing knowledge of them. Industrial Archaeology, which originated in the 1950's in the UK, regards industrial heritage research as a comprehensive discipline and started to face its multifaceted value. While the understanding of them has become more and more comprehensive with the development of research, the discussion on the protection of their value and the reuse of resources is a topic that has received more and more attention in recent years. This is also in line with the humanism prevailing culture and sustainable development concept that is popular in recent years.

Urban morphology is a discipline that focuses on the transformation process from the birth of object forms, through a multidisciplinary analysis of the effects and influencing factors in the process to understand the intrinsic meaning of form and helps to guide the future development in a continuous story. Urban morphology research could cover different levels from the whole city to the single construction elements, and observe the target field from many different directions of views. The application of it into

it into industrial heritage research can adapt to the complexity of an industrial heritage field, contribute to find its story along the time coordinates, and its situation in urban environment.

This paper explores the possibility of the application of urban morphology in industrial heritage studies. The first part is stating industrial heritage research and Urban morphology separately, and then taking Shougang Industrial Field in Beijing, China as an example by analyzing this abandoned industrial field from urban, plot and single element levels with morphological research method. While, the second part is firstly summarizing a general idea of current industrial heritage protection, and then trying to propose some guiding rules of the regeneration in Shougang Field based on the analysis result at the first part.

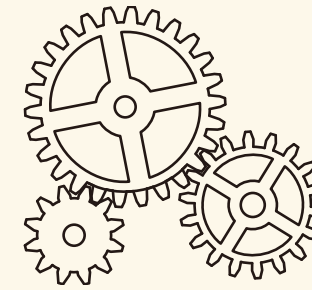
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PART 1
INDUSTRIAL HERITAGE RESEARCH

INDUSTRIAL HERITAGE RESEARCH

Industrial heritage refers to an area previously serviced industrial activities or related to industrial productions, it lost its original function caused by the functional redundancy during economic changes. An industrial heritage is a highly complex structure, it contributes an important part of our social, spatial, cultural, and technological past. *(Sonja Ifko, 2016)* Research on it aims to understand, assess and record these heritages. While, a deep understanding and proper value assess then is the first step and an important prerequisite.

The problems of industrial evidence at first be noticed by a few individuals, mostly amateur historians in the 19th century and early 20th century, and the term 'Industrial Archaeology'¹ had been introduced in English-speaking circles until 1950's within an article from Michael Rix², who is an amateur historian. *(Hilary Orange, 2008)* As one of the earliest subjects to have a sight on industrial heritage, archaeology has made early explorations in the field of industrial heritage research. Typical archaeological studies attempt to understand the human past through tangible, excavated evidence, while industrial archaeology is studying and conserving the existing remains were abandoned by producing functions on the ground.

Industrial archaeology is an integrated approach that examines all documentary evidence of material and non-materials produced by industrial processes, artifacts, stratigraphy and structures, human settlements, and

natural and urban landscapes *(Que Weimin, 2007)*, it has been a field based on multidisciplinary integration since its birth. An article on 'Industrial Archaeology' in 1960 managed by Dr E.R.R. Green which describes the content and outcomes of the meeting organized by CBA (The Council for British Archaeology) one year ago was given by a group of scholars from archaeology, Antiquaries, history, technology, historical monuments and an architectural editor. *(Marilyn Palmer, 2010)* It was an early attempt to break the isolate of industrial archaeology by borrowing views from other disciplines. David Gwyn and Welsh Slate mentioned in their book *Archaeology and History of an Industry* that in order to understand a heritage, it is necessary to have a mixed view from people from different field: "someone with an intimate knowledge not merely of one limited patch but of a whole nation, an archaeologist with hands-on experience, an engineer or at least someone with a good grasp of engineering, a historian with a deep understanding not only of the technicalities but of the all-important social and cultural dimension, and a writer with an analytical." *(Michael Lewis, 2015)*

History, culture, society, technic, aesthetic, ..., the scope of analysis is becoming larger and larger within the theoretical development. A trend in industrial heritage research is to pay more and more attention to the humanistic connotation hidden behind the objects. After experiencing the neglect of environment and history in the early stage of modernism, the sense of crisis in human living environment and cultural value became more and more serious in the 1970s, the return of traditional values to social environmental protection and historical protection became a common consciousness. The International Committee for Industrial Heritage was announced at the Third International Conference on Industrial Monuments held in Sweden in 1978. This is the first international organization dedicated to promoting the protection of industrial heritage. *(Wu Jingwen; Liu Cuiyun; Quyang, 2012)* In Collingwood's terms "inner side of the event" is seeking the original purpose and thought of the industrial heritage, which could led to the recording of industrial processes when the function of the site already gone or changed *(Hilary Orange, 2008)*, shows the concern on intangible cultural heritage. Loulanski T. argued that the conceptual focus on cultural heritage has to be shifted from monuments to people, from objects to functions, and from preservation per se to purposeful preservation and sustainable use and development. *(Mara*

Cerquetti, 2017)

Industrial heritage has a closer link with reality comparing with the other heritages, in the CBA meeting in 1959, “practical purposes” had been proposed as a factor in consideration of industrial heritage subjects³. In the 1990s in British, the combination of socio-economic research in industrial heritage study along with the monument-focused work considering questions of consumption and production including issues of exchange, power, identity and social relationships. (*Hilary Orange, 2008*) Almost in the same ages, a new generation of industrial archaeologists turned to focus on “the industrial transition and the changes that the process wrought on society, the landscape and above all the archaeological record,” beyond “the traditional emphasis on the detailed recording and analysis of manufacturing industry”. (*Marilyn Palmer, 2010*)

Urban morphology is a research method with multidisciplinary characteristics, it focuses on form of an object, is assistant by analysis from social, cultural, historical, economic.... Physical evidences left by the former industry are factors can be caught most intuitively, they are formed during their development and decline processes, are elements can comprehensively reflect values from different aspects and containers of the complex information. Treating them as a starting point to study about industrial heritage is a feasible choice whether from the archaeological or architectural point of view.

understand it. It recalls the collective memory of the ruins by tracing human activities in the industrial period and giving back their identities. Urban morphology treats influencing factors as important materials to explain form and has its advantage in organizing complex information, they can jointly sketch out the past story of an industrial heritage, are giving the soul to physical remains. Studying on these factors is a way that humans learn their past, which is a main content in archaeological study through the analysis of physical remains. An abandoned industrial zone can only be a valuable industrial heritage after the human activities, collective memories and spirit it bears have been recognized, and its cultural and social connotations and been understood. Urban morphological research method is an approach assists a comprehensive understand of industrial heritages. One significant way in morphology research is from detail to entirety, which treat a complex entity as is made up of several parts. (*Duan Jin, Qiu*

Guochao, 2008) Urban is a complex structure, it is not easy to analyze influencing factors deeply only from the target object. And studying the whole environment of its form language and effects from views of different scale levels of a city to divide the complex in relatively simple conditions probably has a positive effect on this issue. Under this thought, urban analysis can be treated as 3 levels: single element, plot and urban.

Plot is an artificial unit identified by common performance and conditions, it can be used to observe form and arrangement of buildings and space in the area on one hand, while, on the other, it contributes to analysis of effects who influence the shaping of forms - the temporary isolating with outside environment avoids interferences in research and treating issues in one plot along.⁴ This way reduces the complexity of urban morphological analysis, can be used to assist a deeply comprehensive analysis. It is not a rural strategy, Aldo Rossi talked about The Study Area in his book *The Architecture of the City* identified by form and social factors; M.R.G. Conzen divided towns into plots by a set of classification dependences, analyzed each plot individually about their physical performance and development process. As a classification of the complex urban environment, the collection of information from each plot makes up the condition of the city, and benefit from this step, characteristics and regular of single objects could be noticed easier, the analysis of the city as a whole is rather an orderly compilation of groups than a complex accumulation of information.

Single elements include buildings and space in and out of plots, they express their characters with its appearance and space organization directly. This is the micro level in urban research who more or less inherits the past as well as responses to current demands. It is accompanied with territorial message which can be shared from the analysis of the plot it belongs in most cases.

The view from urban scale includes the study about urban structure and urban environment attributes. The physical structure is a continue system contains smaller pieces with various of behavior, they are organized and connected by many reasons from social, culture, economy, etc., and finally crate the unique, transitional urban image. (*Colin Rowe, 1978*)

These three scales are distinguished and interrelated with each other, look at urban issues in the form and reasons from different perspectives and link them by their intrinsic associations.

The abandoned industrial field felled into sleep at the moment it stops working, but the surrounding urban space continues to follow the new age, it has become a cultural relic that is submerged in a city. It is in a different era with the surrounding environment, the time difference also causes spatial alienation even with adjacent urban land. This method can focus on the study of industrial heritage areas as archaeologists did, and provides the opportunity to put it back to the realistic urban context to define its present situation.

NOTES:

1. 'the prime task of the industrial archaeologist at the moment is an archaeological one and that is in fieldwork'. -Rix, M., *Industrial Archaeology (The Historical Association, 1967)* 18.
2. 'industrial archaeology serves as a useful reminder to the whole archaeological world that the terminus post quem of archaeological research is not 55 B.C. nor 410 A.D. The terminus post quem of archaeological research is today'. -Rix, M., *Industrial Archaeology (The Historical Association, 1967)* 19.
3. 'the subject should be considered for practical purposes as post medieval,... -Green, E.R.R., 'Industrial Archaeology', *Transactions of the Lancashire and Cheshire Antiquarian Society, LXIX (1959)*, 150.
4. "With respect to urban intervention today one should operate on a limited part of the city, ..." - Rossi

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**MORPHOLOGICAL ANALYSIS
IN THREE URBAN SCALES**

THE NOTION OF PLOTS

Plot mentions a continuity set of land in a city which have the similar physical experience and is in the similar situation, it is a middle scale level in between of single elements and entire city. A plot usually has a common plan type, a continue building pattern, with similar factors guides construction activities inside to embrace a group language in form.

Rossi cleared the diversity of urban as is made up of parts which cannot be reduced or generalized with a single way. He thought a part of a big city some time can be saw as a small city, and its size doesn’t really the matter in analysis. Study urban issues from those orderly fragments can avoid unwanted interference during researches about urban, so the analysis of those fragments can be more completely. He advocated to define “the study area” as an analysis unit in urban study, believes there is a homogenous relationship between society and form, the same life style and community organization would result similar territorial characteristics, so each study area has common form characters and social factors. These territorial characteristics can be reflected in mass and density, and finally be caught from plans and sections of the area. “The study area” has its internal unity, meanwhile, they are collected in urban fabric. *(Aldo Rossi, 1982)*

M.R.G. Conzen proposed the term morphology region with a relatively complete set of classification methods. He classified urban land from three aspects: plan type (streets system, plots and block plans, and buildings arrangement), building fabric (plan, façade and section), land and building utilization. One morphology region is formed during a period with same motivations and influence factors, it would express with a common form language different with its surroundings. The boundaries of regions are relatively stable, they consist a morphological frame together with street system to work as a protracted structure. As it shows in *Figure 1*, as long as a boundary emerge, it will be less likely to change, what then happened in most instances is subsequent division arousing new boundaries. (Yao Sheng, Tang Yi, 2009) So, boundary and size of a region may contain some messages from original intentions and development process as in Conzenians' thought. (J.W.R. Whitehand, 2001)

Scholars in Conzenian school are very focused on the transformation and renew process in a region, whose life cycle had been summarized as a circular process from filling-in, modify, distory, vacant, to a totally renew. (J.W.R. Whitehand, 2001) Space and building organization is both the basis of region division and an important phenomenon to express the region's characteristics, old characteristics would be replaced by new one, and the new one is also limited by its previous time, learns and inherits something from the past. The renew speed or the transition direction may not quite the same between different regions.

These two classifications of urban land are both searching for a suitable scale and dividing dependences to analyze complex cities. They abandoned the functionalism zoning method and treat the problem with a more comprehensive perspective by paying attention to the forming or transforming reasons and the development process itself. The size of a plot is not fixed but depend on the research target and definition factors. It could include a group of blocks or as tiny as a single element (morphotype¹ has the similar statement about the primary elements² strong and unique self-expression. Different from the single element and urban as explicit and intuitive scales naturally exist, the plot is actually a kind of perceivable unit be used to assist the research of a city, make it easier to observe morphological language and capture impact factors.

The study of a plot attaches importance to the physical research, it



Figure 1. Morphological region analysis of Ludlow.
[source from Conzen, 1988]

is not about detail performances like single elements, but the pattern (building arrangement, space organization, building mass, construction density...), group language, and volume indexes (construction density, floor area rate, function setting...). They are responds to the synthesis of demands, culture, geography and other factors. Rossi prefer to combine physical performance with social effects, "the activities of social groups are analyzed with respect to how they are continuously manifested in fixed territorial characteristics."³ While, although Conzenian school is based on morphogenetic and settlement geography to analyze the formation, inheritance and development of plots, they questioned the influences from society, economic, planning policy as well. Plot is a suitable size in these urban morphological research, its division method allows it to contain a relatively unified feature under one discipline.

Depend on the identity of The Study Area from morphology view by Rossi (an urban area with form and society homogeneity), society is an important factor which could or should multidisciplinary combination point during urban research. The relationship between society and plots can be partly caught from the relationship between people and environment. Kevin Lynch emphasized people's perception of realities, the summary of feelings could be used in testing realities,⁴ while Rossi focuses on the construction activities more.⁵ The existing environment provides people living or activity space, transfers spirit and cultural genes. They serve people, and educate them, finally become the collective memory of citizens. While on the opposite, people create and transform environment more or less by implanting their imagination comes from those existing experience, from their understanding of their own past and present. This evolutionary model is a coherent regional architectural development, a manifestation of local culture, has an undeniable value in cultural diversity. However, the interaction and integration with foreign formal languages in practice and the external factors such as top-down planning and design behavior are important factors that cannot be ignored.

While, during the development process of urban, especially a contemporary capitalist city, economic factors or let's say the market effects are non-negligible in plot forming, they are another kind of factors that is easily reflected in plot construction. Market decide the potential value and demands of land, and then influence its price, function, density, FAR, etc. Beautiful city skylines made up of skyscrapers in Pudong is a perfect example to explain how market works for a plot (*Figure 2*). At the very beginning, Pudong is an underdeveloped area with a few of industrial buildings only, the Shanghai CBD is just across the Huangpu river. So after the construction of the metro across the river, the value of this plot growth rapidly. Producers discovered its functional requirements, produced office buildings with growing volume to satisfied new demands. As the market keep developing and the demand and value keep growth, finally, the astonishing skyline replaced the undeveloped situation. This plot mainly responds to market demand which determined by its specific location and the opportunities created by economic development. Those skyscrapers instead of several scattered factories and the large farmland as it was before are actually a result of changes of plot positioning. (*Alain Bertaud, 2014*)



*Figure 2. Comparison of Pudong in 1990 and 2015.
[source from Wayne Grayson, 2015]*

THE STUDY ABOUT SINGLE ELEMENTS

Single elements here Include architectures and their surrounding environment. Like cells constituting the whole urban structure, they are a concrete expression of the complex urban condition.

The direct expression of single elements' characters can be caught from their physical performances in their plans, elevations, and sections, and they are the reasons why it is never hard to distinguish Baroque with Gothic, or Italian with Chinese architectures only by observation. For example, courtyard houses can be found in many culture during different period, most of them consist with similar elements: a courtyard in the middle, with corridors, building or walls surrounding and enclosing. But when comparing courtyard houses from different culture and period (*Figure 3*), it is obviously that they look different. But what exactly is the difference? And what makes the differences?

Single element is a specific morphological expression of the comprehensive information it contains with its figurative form language: scale, ratio, space organization, detail decorations, material, or even color using. Its form is the expression of its context, demands, and spirit. In the study of single elements, the idea of typology is an important reference. It abstracts single elements into basic form language that can correspond to factors such as culture, region, and climate, which is called type, and analyzes changes and developments of the application of it.



Figure 3.courtyard house from different culture.
[source from Ilaria; Deusjz; Andy Serrano]

Quatremère de Quincy provided an important influence on typology study. He identified type as the common structure be extracted from “the reduction of a series of formal variants”. It should be “vague and generic”⁶, only transfer a nucleus but not describe an image or make some specific rules to guide, control and limit construction tangibly.

Aldo Rossi identified type as a predetermined abstracted structure which cannot be further reduced, the ideal architecture in mind infinity close to the essence. Its formation is not a man-conscious design, but more a natural growth depends on demands and aesthetic. So, it contains local information including natural conditions, national culture, social customs, etc., and passing this nucleus constantly along a continue development process.

Because of its high abstractness, in Rossi’s explanation, type is usually stable and hardly to be observed with changes. However, the stability of type doesn’t mean the performance of buildings don’t change. Rossi thought form consist with origin and development, which can also be explained as types and changes. In reality construction, the type of an single element - the “nucleus” – is usually fixed, while at the same time it experiences and records events. “...it reacts dialectically with technique, function, and style, as well as with both the collective character and the individual moment of the architectural artifact” (Aldo Rossi, 1966)

Similar with Rossi, Saverio Muratori agrees that type is not a result from analyzing, but some experience or knowledge was intuitively known in advance. It contains and transmits massages from moral, economic,

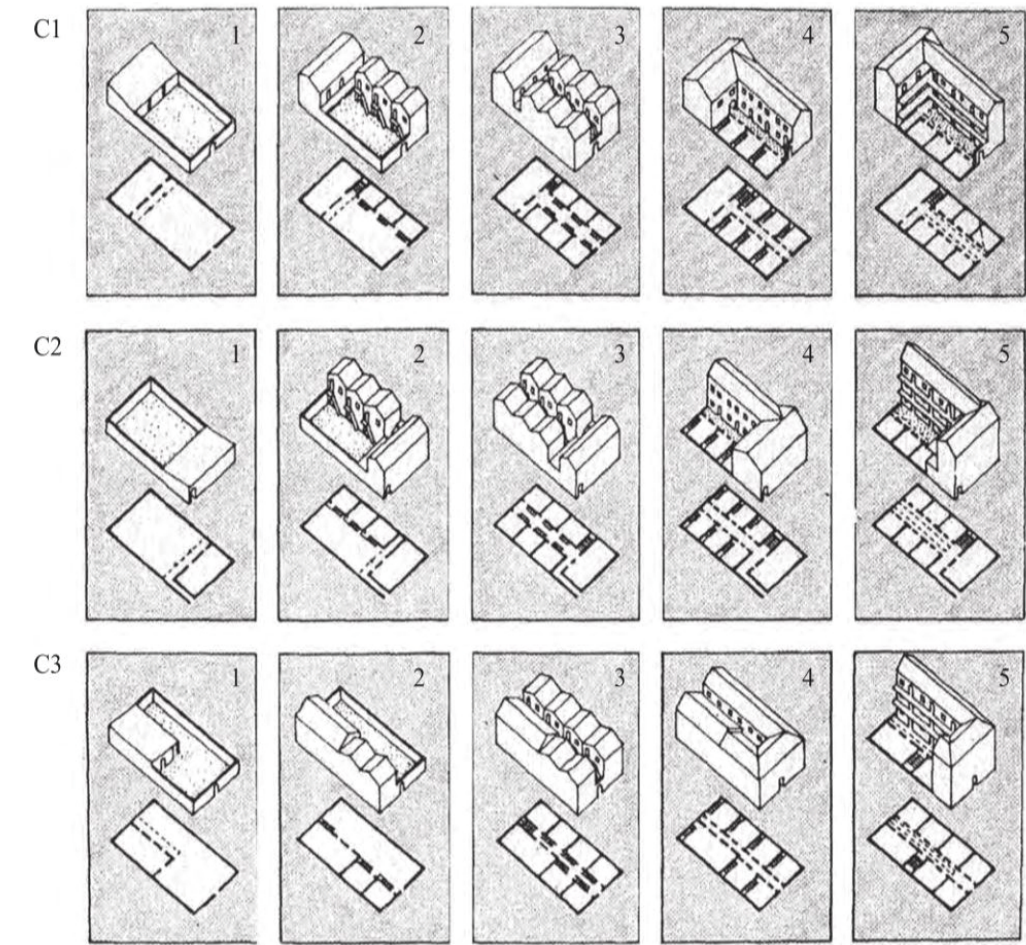


Figure 4. “process typology” Graphic.
[source from Attilio Petruccioli, 1998]

structural, technological and figurative aspects, reflects social reality and the ideal living environment. However, the different is Muratore not only cared about the meaning and using of types, but also noticed the regulation of their development process in a long period. He didn’t treat type as a static entity, but something slowly evolved along the continuous development direction of a certain civilization. His student Caniggia moved forward this idea and improved the term “process typology” to explain how type changes (Figure 4).(Jiang Zhengliang, 2015)

One of the common points in their research is that they all pay attention to both the inherit from previous experience and the response to the current conditions of single elements, treat the development of single elements as a continue process. While, another point is form doesn't emerge with no reason, they believe that it always has a strong relationship with social, geographical, economy, or technical effects, no matter during the original shaping or later transformations. To some extent, form is a reflecting of reality. Just like treating the form as a language that expresses its intrinsic properties, the vocabulary (formal tactics) and grammar (special organize method) of the language will change with the development process, but in the same language system, although it never It is not static, but the continuous inheritance relationship will last for a long time.

Single elements are end of urban spatial transformation activities, they are more sensitive of the changing aesthetic and functional requirements are able to respond in time. Their affecting factors are determined by conditions of the plot they belong in most cases. Like residential plots, which is a district with a sharing physical experiment, same determining factors and mainly used for living. The main motivation may come from the market, decision-making, fashion or other aspects acting on the plot, they can intuitive and efficient act on the target object, and this direct effect can sometimes affect the development of the city from the bottom up.

Beijing's famous 798 Art District is a typical case of a bottom-up change start from some points of the abandoned area driven by emerging function and economic values. It was an electronic equipment factory, after the abandon, the low rent and flexible architectural space with cultural connotation first attracted artist. They presence and the inject cultural industry which attracted people's attention and farther more improved commercial value, which led to the following development. Rossi regards this preservation in existing form of buildings but functionally the application of the current factor as a building's durability. It not only reflects the continuity of the building in time, but also considers and inherits the past and the surrounding environment. Change to make the current response.

URBAN ENVIRONMENT IS COMPLEX AND CONTINUE

The research in smaller scale provides a possibility that can ignore effects from the urban structure and its surrounding temporarily, to focus on the characteristics and conditions of itself. It confronts the complexity of the city and deconstruct it in order. However, urban is a complex constitute in reality situation contains various of different pieces. Researches on smaller scales focus on the independent information of their target, they are in favor of making a deeper understanding of the city. These researches can be collected in a view from a larger scale level by treating the surrounding urban environment as a continue entity.

Street system has not been analyzed as an important aspect in the researches upon, that's because it is a continue element both in time and space. It could be divided into parts in appearance design in terms to coordinate with plots and single elements nearby, but what more important is its structural significance - it plays an important role in urban construction as a protracted element shaping, dividing and connecting contents.

In plot studies, some strong self-expressing elements which cannot incorporate in any group are treated like independent units as smaller-scale plots. They are actually coincided with another term upon be proposed by Rossi - the Primary Element – in some cases when they bear the service duty in urban system, the net of them have a notable role in urban structure conform.

These two set of components are relatively stable continue systems constituted the skeleton of urban structure. A map who distinguish them with unstructured city content can be a way to observe the spatial form of a city.

Nolli maps (*Figure 5*), which had been drawn in the middle of 18th century, is a valuable attempt study about urban structure by treating urban ground space as a continues entity. It distinguishes private and public space with shadow and highlight: Private buildings include resident and shops are represented as units without clarifying each single, while public spaces include streets, squares, and public buildings are as detailed as be depicted by their ground floor with sculptures, fountains, walls, and pillars. (*Li Mengran, Feng Jiang, 2017*) In this way this map shows the continues public space on the ground of Roma clearly without limits from vertical enclosure. The proposal of Nolli map was raised for the urban space

system in 18th's Roma, in which there were public buildings totally open to citizens.

Another example who use figure-ground map (Figure 6) as an important tool to analyze urban structures is Colin Rowe. Perhaps because of the different dominant ideas of urban planning in different period, the focus of expression in Colin Rowe's and Nolli's maps have different focuses. Nolli maps are concerning more about spatial relationships at the ground of a city like a huge ground floor plan emphasizing the organization of public space. While, Colin Rowe's method is to draw from the top view to highlight the texture of buildings in a city. In his research, he shows buildings with black color and others with white to observe how buildings are arranged and how they form the urban texture. In his opinion, when buildings are enclosing, limiting and shaping space, they are helping to identifying it, and a space with limits and clear shape which can be perceived is easier to be understood by its users.

This method is easier to be combined with the study not only about urban space but also urban façade. The limited spaces, as the example of classic palaces and their courtyards in his book, the courtyard enclosed by surrounding architectures is like a room of the city, those surrounding architectures have two different roles, toward inside space, they are like walls of a room to construct space, and toward outside, they provide an urban façade, shaping urban space, decorating and identifying urban environment. (Figure 7) (Colin Rowe, 1978)

Variety of city image may exist in the same continuous urban structure, Kevin Lynch expresses a strong support in favor of the diversity and recommends to take advantage of them, suggest to consider from the macro level of the city to organize their diversity. He spoke highly of Florence: the cathedral and the campanile constitute a striking visual focus with symbolic meaning. In terms of overall structure, they collaborate with subordinate monuments in the city to build a controllable urban frame, regions with different emotions under this frame are completing the narrative structure of the city. This under control diversity presents an impressive urban landscape. In other words, an attractive city should be constituted of diverse environment which is unified in the entire narrative structure of the city. Comparing with this kind of variegated urban environment under unified control, a homogeneous city is lack of vitality and easy to confuse its users. (Kevin Lynch, 1960)

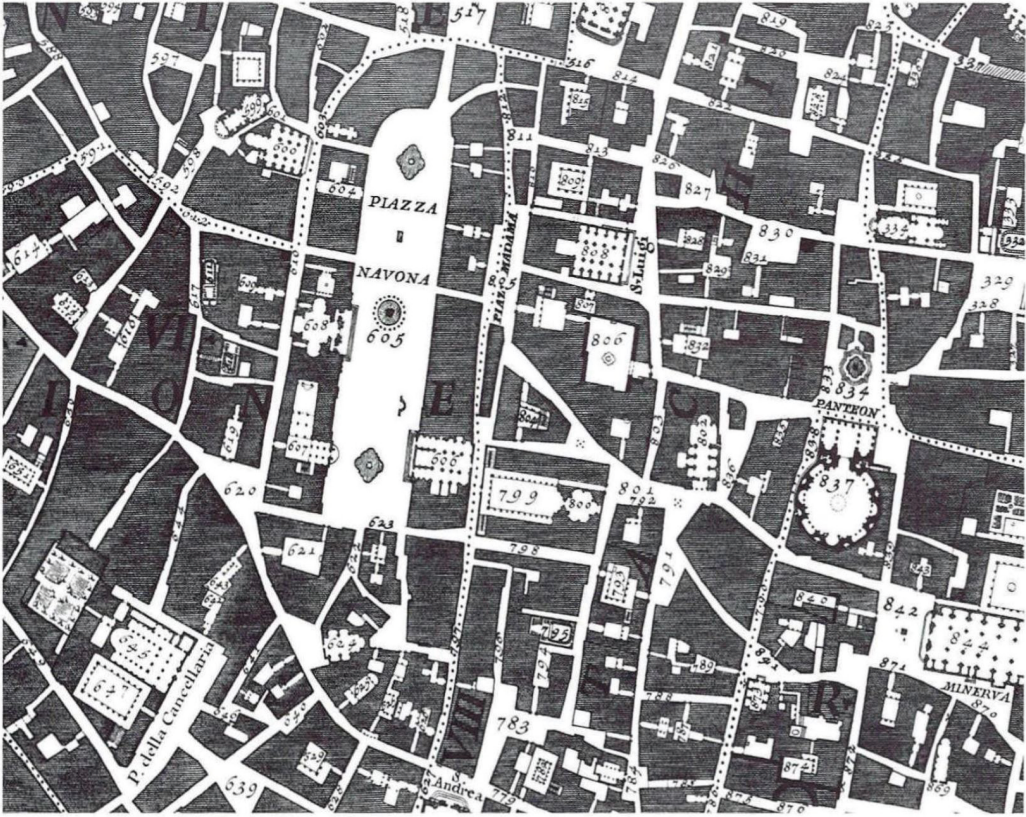
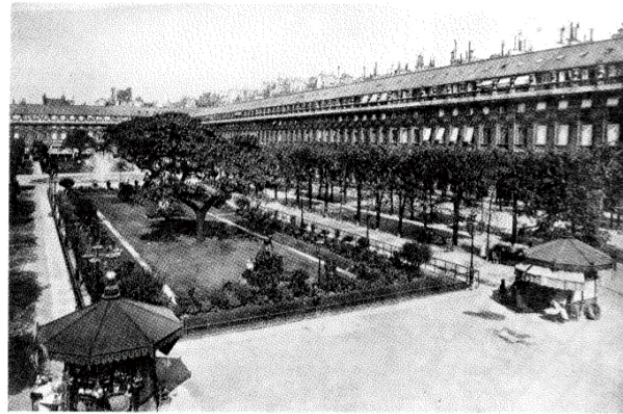


Figure 5.A part of Nolli maps
[source from Nolli maps, 1748]

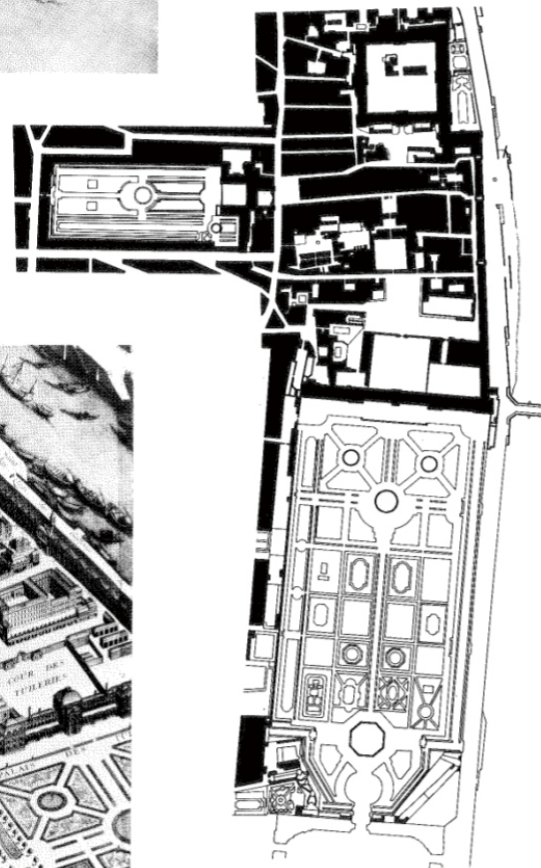


Figure 6. Figure ground maps
[source from www.sohu.com/a/146350981_659274]



Paris, courtyard of the Palais Royal

Paris, the Louvre, Tuileries, and Palais Royal, c.1780, figure-ground plan



Paris, the Louvre, Tuileries, and Palais Royal, from the Plan Turgot, 1739

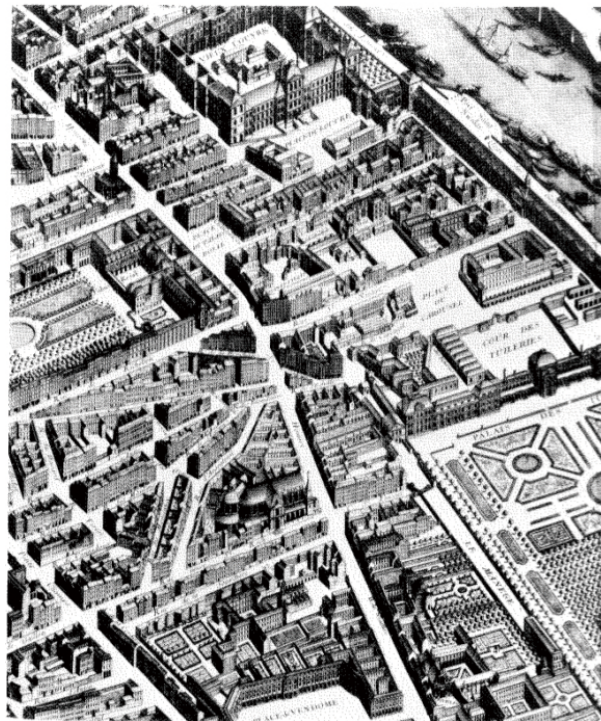


Figure 7. The palace as an urban facade towards outside and bound towards inside
[source from *The Image of City* by Colin Rowe]

What in between of urban fragments may be a formal approximation, a functional complement, or an intrinsic logic from socio, cultural and economy. They are conditions that affect the layout of the city, as well as clues to help understanding the city in the complexity and diversity condition. What are ruled at the continue stable system is the diversity of a city. After the division of plot as an analysis tool, urban can be seen as a series of fragments be unified. Scholars of the Conzen School use different colors to mark different areas in a city map after their study of plots, to observe and analyze information they contain from the city level. (*J.W.R. Whitehand, 2001*) On the one hand, this method can analyze the regulation of distribution from the macroscopic level and serve as a reference in urban design. On the other hand, it helps to coordinate the links between plots to achieve continuity and also diversity under the urban framework.

The physical performance are resulted by the joint action of multiple factors, it is the formal expression of the intrinsic properties and characteristics. The morphological discussion of the causes and influencing factors behind form is expressed in the aspects of land value, development trend, social organization and cultural connotation at the city level. Studying in those aspects can promote the thinking of the information behind the form and strengthen the understanding and response to the form. Like the above-mentioned relationship between single elements and human, a certain urban structure and the corresponding society are also keep interacting and push development and changes with each other. The difference is that urban structure is more inclusive, slower in changes and more influential than small-scale studies of monomers or regions. For example, the checkerboard layout of the Lifang system in the Tang Dynasty, regardless of functional distribution or spatial structure, is not only the embodiment of regional philosophical thinking in urban construction, but also the matching spatial form caused by social management needs. The grid structure of the original plan of Manhattan was the result of the Dutch plan to facilitate land transactions and can be considered a reflection of the economy.

SUMMARY

These three different research scales in urban morphological study can take care of characteristics under different detail level. Each level is bearing their own responsibilities when analyzing a city about its physical performance and intrinsic properties, each scale interacts and mutually achieve with each other at the same time.

The most significant duty of single elements is express their own attributes, but more than this, they also act as objects and enclosing elements in urban texture formation, which can be seen as a skeleton of a city channeled by the mixed effects from urban factors, it is the container, the macroscopic structure of the city who catalogues plots and elements inside.

In addition to being able to observe its own architectural space planning organization and development process, plot is more importantly, very suitable for analyzing the economic, social, and other factors that affect urban construction. This is largely due to its flexibility, as an artificial unit, it may have different sizes or classifications according to the analysis object, and this feature allows it serve to different research needs with stronger adaptability. Plot is a middle-ranking research object, which playing a markable role in bearing interdisciplinary effects, connecting macro and micro-scale researches. These effects downwards guide and control the formation and development of single elements, be expressed in their plans, sections, and elevations. While upwards, they are incorporated into the urban structure. Collecting information of adjacent plots in one map could be a good way to observe the relationship between them, in terms to discover a regulation in city construction and contribute to point out a reasonable direction of further development.

This research method is helping to collect information of an urban area comprehensively. It could be benefit to a continuous development on this area both from time and space dimensions through an in-depth understanding of its transformation process in history and special environment.

Notes:

1. M.R.G. Conzen pointed out the smaller places in the city that are made up of unique morphological elements as “morphotype” [9]
2. Rossi treat the study area and primary elements as two groups of elements constitute a city, the primary elements includes monuments and space for fixed activities, are pioneers of urban development, they are more permanent than other elements. [2]
3. Excerpted from *The Architecture of the City*
4. In his book *The Image of The City*, Kevin Lynch emphasized the legibility and identity of a city, they are embodied as the two-way process in building the image of the city: fragments of reality influencing people, people absorb and digest information they got from the environment, formed their own cognition or imagination of the city, there are individual differences exist in images.[7]
5. Rossi thought the existing environment influences people inside as a kind of cultural education, when people who with this knowledge produce or renew the environment, they inherit this culture and combine it with contemporary factors naturally.
6. Excerpted from “Saverio Muratori (1910–1973): *The city as the only model. A critical study, a century after Muratori’s birth*” from Jean Castex.

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**CASE STUDY:
Research of Shougang Area**

BACKGROUND

“Danwei Dayuan”

The Chinese word “Danwei Dayuan” includes two meanings, “Danwei” in Modern Chinese Dictionaries refers to agencies, groups, or departments that belong to an organization or group, ordinary “going to work in Danwei” in spoken language emphasizes its attributes as a workplace. The word “Dayuan” can be literal translate as “a big courtyard” in English, is a basic urban unit from Chinese tradition usually contains a social group. “Danwei Dayuan” then is a unit contains working duty and the corresponding social organization.

“Danwei Dayuan” emerged since 1949 after the founding of the People’s Republic of China, the goal of the Beijing planning in this stage was to break over the feudal hierarchy and rebuild it as a production city instead of a customer city. In this process, the construction of factories in Beijing City entered a phase that focused on the development of the secondary industry. (Michele Bonino; Filippo de Pieri, 2015) This initiative brought A large number of people from countryside into the city, resulted a rapid expansion which means the demand of residential and municipal facilities surged, as well as a more efficient social system to serve and organize the rapidly increased citizens. Meanwhile, partly because the new government

did not have the capability to solve these urgent problems at once, a land division plan had been proposed and gave land holders¹ considerable internal construction right and obligations to manage and serve employees. (Lian Xiaogang, 2015) These reasons result the urban structure is divided by units, in which the producing functions are close to residents.

Qiao Yongxue mentioned the small-yards-in-a-big model (Figure 1) of traditional Chinese urban construction in his paper, and believes the idea of the courtyard is reflected from a simplest courtyard to a settlement, from the Royal Palace to the entire old city. This model supports the social system in history and is integrated into the national culture, the “Danwei Dayuan”-based construction of city from this point of view can be seen as the new architectural demands applied within the influences from traditional spatial ideas. (Qiao Yongxue, 2004) Liang Sicheng had proposed a modern courtyard model (figure 2) as a construction unit based on this tradition in his Design Conception of Beijing Central Administrative Region in 1950. This model inherits the typical courtyard-house layout type (figure 3), has a highly enclosed boundary and clear axis, the nature of space changes to private from the main entrance to inside, but affected by the functionalism with a consideration of the district between buildings and the functional distribution. Even through the plan concept had never realized, this unit model influenced many early constructions of “Danwei Dayuan”.

A “Danwei Dayuan” is a closed, self-sufficient urban cell that contains work, residence, and other municipal facilities and service facilities. A “Danwei” often allocated housing as social welfare programs to employees in specific areas not far from the workplace. When work determines the location of residence, a two-way matching relationship between the workplace and the settlement is formed. the factory and the residential area were set up to shorten the commuting distance under the condition that the mobile traffic was underdeveloped in the city, which was in line with the production priority trend in that period. This kind of units performs like the rural clan-style state-owned institutions accommodated full set of city functions such as working, living, leisure, and municipal services, it is isolated from urban environments. The well-functioning group is like an independent village, which reduces the internal residents’ reliance on the unfavorable urban environment, and the complete living guarantee has greatly improved the unit’s production efficiency. The supply of water, electric and heating, the autonomy of medical, educational resources and even of commercial

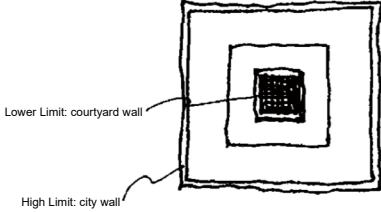


Figure 1.Small-yards-in-a-big model [source from Qian Yongxue, 2004]

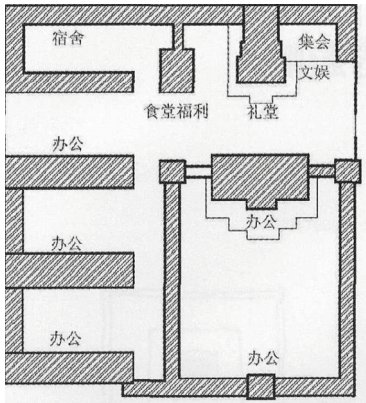


Figure 2: Danwei Dayuan Model from Liang Sicheng. [source from Qian Yongxue, 2004]

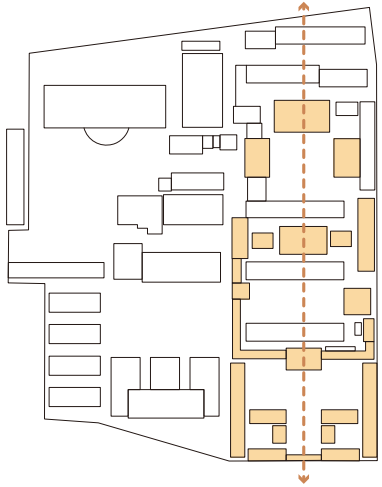
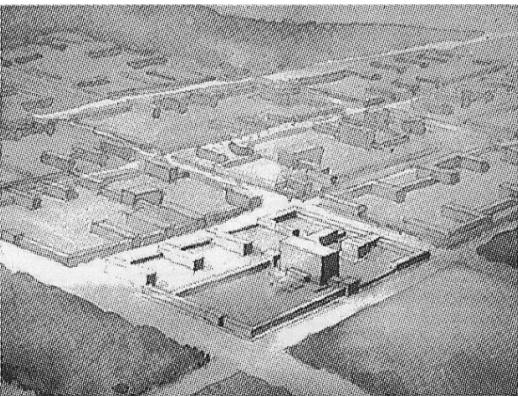


Figure 3: Zheng Wangfu spatial relationship. [Source from Lian Xiaogang, 2015]

The yard in China has both social and physical meanings. It is not only the carrier of social organization, but also an external closed, internal compound and opening space following an established order. It also plays an important role in the composition of urban space, from simple courtyards to large courtyard groups, from courtyards to the entire city, all of which are different manifestations of “yard”. These large and small courtyards are superimposed on each other and performed this model.

The Beijing “Danwei Dayuan”, which was produced by the combination of working units and yard model, has become a typical representative of the urban space form of the New China Unit Courtyard. It is also an important feature of Beijing’s urban space after the founding of the People’s Republic of China. Figuree 2 is the typology and urban planning suggestion propoesd by Liangsicheng in 1950.

The yellow part on the right is the Zheng Wangfu The main office space and the auditorium are located on the main axis in front of living space, which is set in the interior of the yard or relatively minor position on the side. The entire yard is like a scale-enlarged, simplified abstract courtyard house serves more people with multiple functions.

goods have led to a relatively superior and convenient life, and enhanced the cohesiveness of the unit from the aspect of physical service. (Michele Bonino; Filippo de Pieri, 2015)

The courtyard house served a closely linked group of people such as a family or a clan, this centripetal special type has its advantage in strengthen interpersonal relationships. “Danwei Dayuan” is a section of the urban administrative system has some certain political rights. It strengthens the connection of residents in the compound too from the aspect of urban administrative management. Most of the residents in the compound are immigrants, they work and live in Beijing but are isolated from the local residents in this independent introverted “danwei dayuan”. This unit promoted the exchange and integration between these foreign populations from different places has derived a vague-regional feature and led to a new collective so-called New-Pekingese. This new social classification had a cohesive force driven by superiority due to their relatively superior living conditions and high social status. (Zheng Yiran, 2013)

In one word, the “Danwei Dayuan” is a collection of space, function, social organization and collective spirit. In the prevailing period of the institutional “Danwei” model, this unit cannot be regarded simply as a production organization or a working department, but a strong social unit that incorporates a number of social functions and highly unified the residents’ different identities.

In the process of development, more and more organized or unorganized constructions emerged in “Danwei Dayuan” as a reaction forward the increasing population. These additions affect the spatial layout of the original planned design which is generally considered to have a negative impact on the environment, although it has value in residence or service uses. After 1978, China’s economic reforms introduced the market economic system that ended the era of a fully planned economy. This change has changed the distribution supply system to a certain extent, gradually reduced the direct housing supply and municipal security from employers. It promoted the marketization of land and housing, and weakened the administrative and social functions of the “Danwei Dayuan”, accelerated the disintegration of this model. (Zhang Yan; Chai Yanwei; Zhou Qianjun, 2009)

Shougang District

Shougang Industrial Zone - include surrounding residential districts belonged to it - is representable “Danwei Dayuan” burned under this background. with a total area of approximately 7 square kilometers located in the central part of Shijingshan District and the westernmost part of Beijing Municipality (16 central districts of Beijing City), facing the Yongding River which acrosses the city.

However, the difference is that it is not built in the same way as the most others by the urban planning in 1950s, but was arose as early as at the end of the Qing Dynasty and developed from one of the earliest iron-making plants in the industrial enlightenment stage of China. Its superior traffic and geographical conditions close to the water source are important reasons be considered in the initial site selection. Another reason is from Wuxing(Five Elements)², the western direction corresponds to metal. It’s location at the western end of the Beijing horizontal axis is considered suitable for the development of the metallurgical industry. (Figure 4)

Shougang was established in 1919, when steel mills in large cities type was popular. The factory was designed under the ideological trend of learning from the western technology by the early capitalist. initially by an American company including the Iron Furnace NO. 1. But because of financial and political reasons the original constriction didn’t finished and the factory never been put into any production until more than 20 years later. It officially invested in steel production and formed the early scale during the Japanese occupation period, which laid the foundation for the development of the steel plant, but also damage especially with the

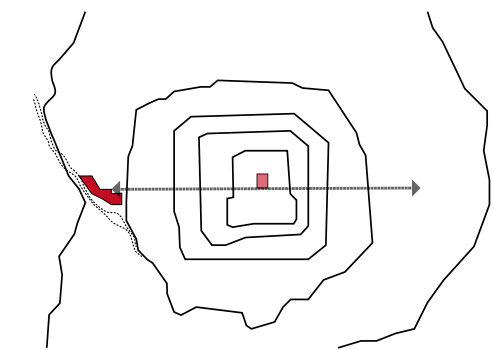


Figure 4. Location of Shougang in Beijing.

Japanese defeat and evacuation. It had been repaired and experienced development and expansion in the next decades after 1949, some relevant production abilities had been added, and the current pattern was initially formed in 1958 when the name of Shougang had been first used. Accompanying with the further construction on this field, a large number of residential areas provided by the factory were built around this field to accommodate the families of employees. These residential areas extended from the north and east of the factory to the Bajiao district and Moshikou village, covering the most of the Shijingshan District.

The presence of the large working field and residential areas helped to improve the local infrastructure level and urban assumptions, but also, steel production has had a major negative impact cannot be ignored on the surrounding urban environment. Furthermore, its demanding on transportation, facilities, raw materials, etc. caused more and more contradictions with the development of a modern city. Finally, on the eve of the 2008 Olympic Games, the factory was completely shut down and moved to the new industrial field in Caofeidian. The field had been Reopened as an industrial heritage park from 2013 but did last long, this valuable city land has more practical uses in the new urban planning. (Figure 5)

In the urban space structure of “Two Axis, Two Belt, Multi Centers” established in Beijing Urban Master Plan (2004-2020), Shougang Industrial Zone is in the key position of the western development belt and the east-west axis extension of Chang’an Street. In the 2016-2030 Beijing Master Plan, Shijingshan District is positioned to build a national-level industrial transformation and development demonstration zone, a low-carbon green comprehensive service area at west of the capital city, and an ecologically livable zone with a combination of landscape and culture.

The analysis below is according to the 3-scales morphological analysis method described in the previous part.



Figure 5. History of Shougang Industrial Field
[Sources from Shijingshanzatan, Qihuiran, Sunli]

1919-1937	
The original factory been built by learning from western technology by early capitalist. But didn't be put into production.	
1937-1945	
Occupied by Japanese, who bring equipment and start production	
1945-1958	
Recover from damage and further developed, the current pattern was initially formed in 1958.	
1958-2011	
Shougang period, further improvement the plant	
2011	
Discontinued, factory relocation	
2013	
Reopen as an industrial heritage park	
NOW	
Partially transforming into Winter Olympic venues	

a	e
b	f
c	g
d	

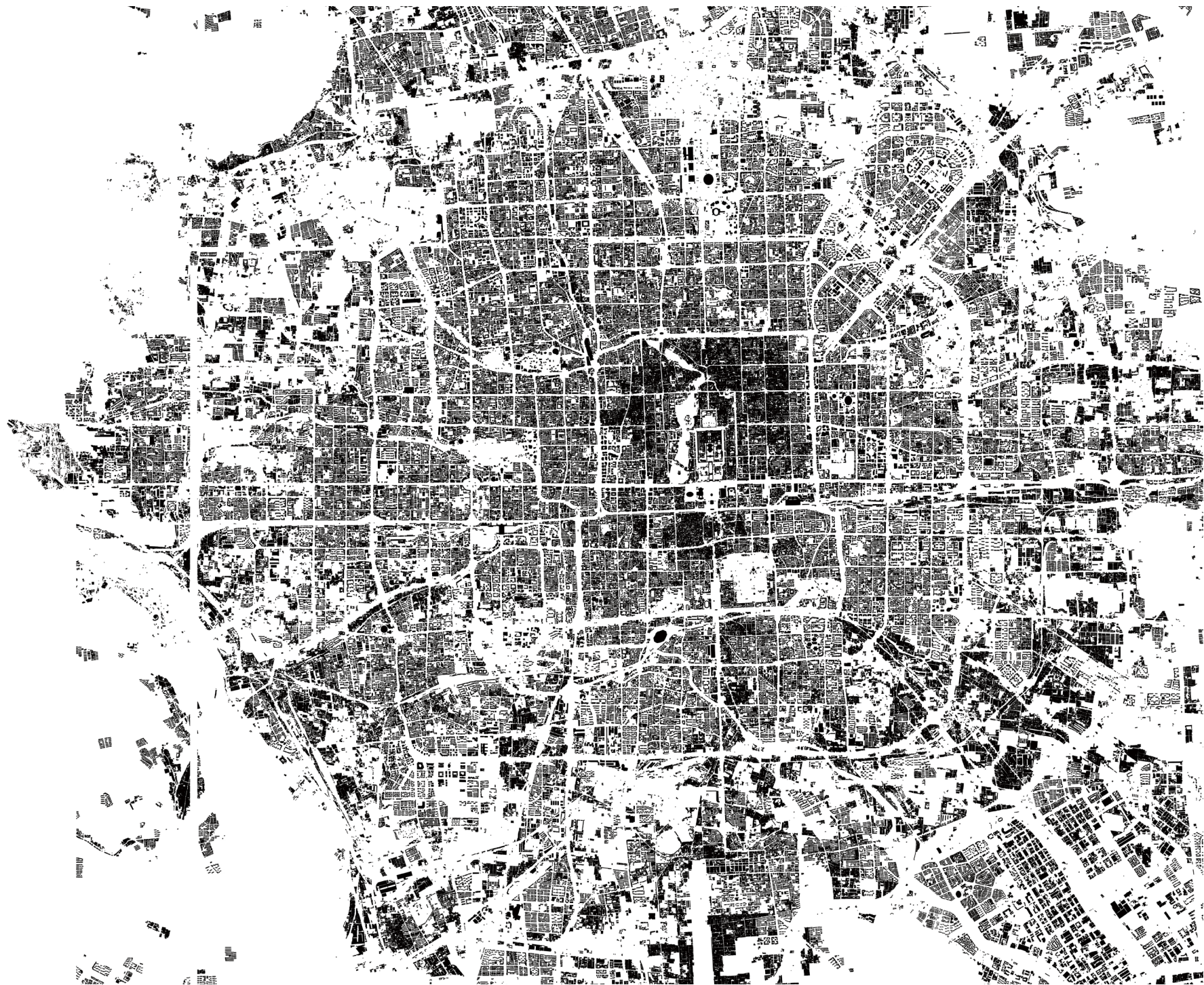


Figure 6. Figure-Ground Map of Beijing City

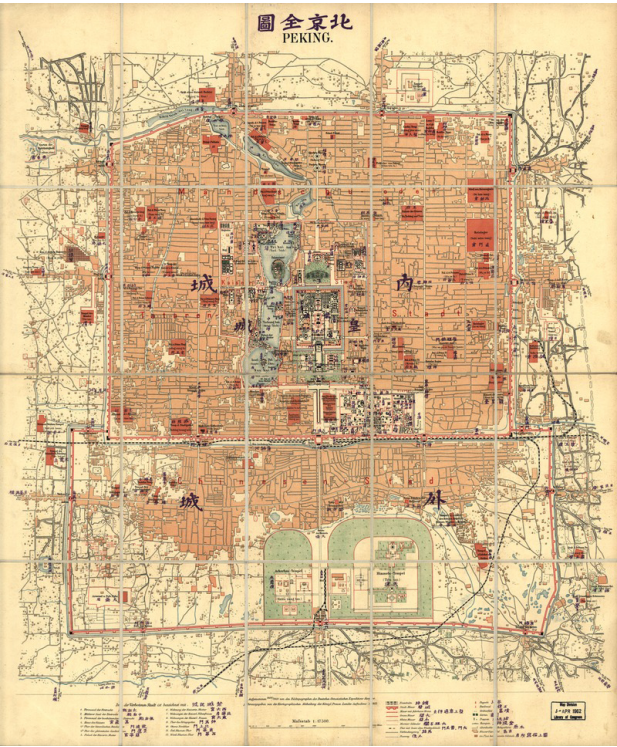


Figure 7. Inner city and outer city of ancient Beijing
[source from wiki]

MORPHOLOGICAL ANALYSIS OF SHOUGANG UNDER URBAN SCALE

Filling objects in Beijing City with black color could obtain a Figure-Ground map (Figure 6) is clearly distinguishing the densely populated blocks, urban street system and open space network, it shows the space structure characteristics of Beijing from a macro perspective.

One of the obvious features can be observed in this map is Beijing's famous loops - six circles from the inside out. To a certain extent, this form was originally evolved from the development of ancient Beijing's urban structure — The second ring is surrounding the old Beijing city. (Figure 7) Another feature is the grid type street network. Its development is similar with the boundary changing process proposed by Conzen School but the shape is more regularly splitting in the grid structure. This rule starts from the center old city and spreads out within urban expansion, till the fifth and sixth ring where shougang industrial field located, the control decreased. And due to the natural geographical conditions and the low density of urban developing land in the fringe belt, the layout of this field has both the control from the grid order and a relatively free plan.

In the old city, blocks filled with courtyard houses were inlaid in this network, in the stage of the popularization of “Danwei Dayuan” in the 1950s, this big size yard is the most popular new constructing fillings. Their clear physical boundaries such as walls or buildings along the street face the urban environment constitute a unique urban facade. (Figure 8) The commercialization of urban land promoted after the 1980s led to the opening of “Dayuan”, these enclosing structures were weakened but the division of blocks remained relatively stable.



Figure 8. Boundaries of “Danwei Dayuan”
[source from Qian Yongxue, 2004]

The Shougang industrial field is a relatively big unit comparing with many other similar units in Beijing, it occupied a huge rang of urban land. It had a strong boundary who was guiding the inside, insulated it from urban environment from external urban service, human activities, interrupted the continuity of urban space, formed an isolating, closing, stable, and controllable unit. Of course, this kind of urban organization is leading more and more urban problems in a modern city, and solutions that trying to solve this problem is constantly proposed: the new plan tried to open two main roads crossed in the field to the to join it with urban environment. (Figure 9)

Like many other “Danwei Dayuan” Shougang Industrial Field and the supporting residential blocks together occupy a huge piece of land formed Shougang district. It is the core performances a strong characteristic of heavy-industry texture with no doubt in the middle, its towering facilities attracted people’s attention even from far away. Towards the east there are residential blocks and public services settled following the grid type structure rule. The production, living, and service functions are all set in yard-style blocks, facing city with a closed façade. Towards the west direction, the giant industrial field and the Yongding River increased the difficulty of development towers west, now a city park now is under construction there. Shougang district expressed a significant image, and built a system contains the social organization served to productions. (Figure 10)

The relocation of Shougang industrial functions not only left the abandoned buildings and industrial field, but also people. According to statistics, some of the employees in the steel factory moved to the new location in Caofeidian, some gave up their job in Shougang, and another group, most including retired employs stayed and still live in this area. These residential areas originally provided by Shougang as employee’s welfares occupied by them and their families have complete municipal facilities, nowadays most of them remain intact except for a small part was developed into a new property through land replacement, and the resident composition is turning from the original purely families of Shougang employees to converged urban population.



Figure 9. the internal street system in the present
[Source from Study on the Overall Utilization Planning
of Industrial Land in Beijing Central City]

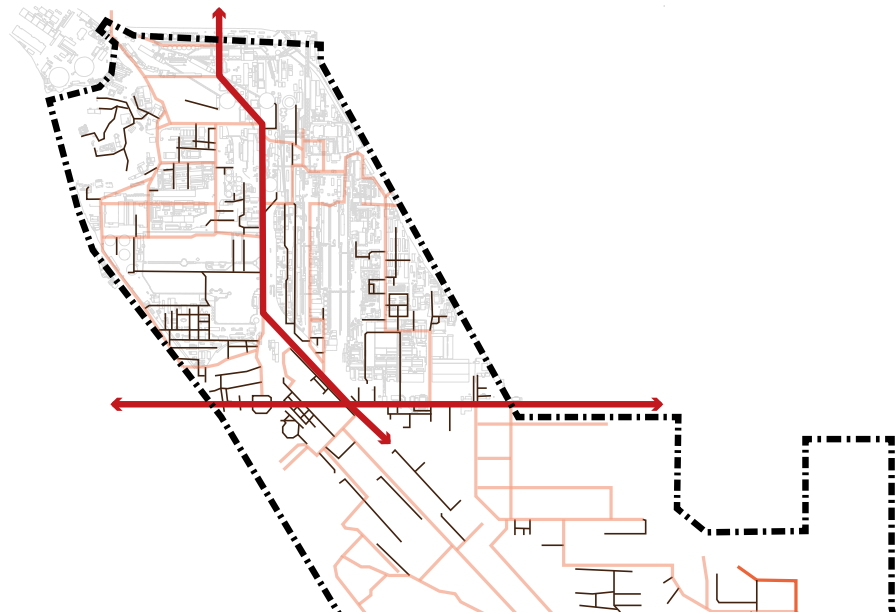


Figure 9. the internal street system in the future



Figure 9. Shougang Industrial Field in Urban Environment

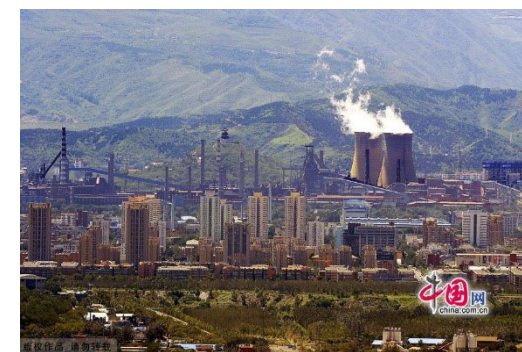


Figure 10. Image of Shougang
[Source from Jia Yunlong]

MORPHOLOGICAL ANALYSIS OF SHOUGANG UNDER PLOT SCALE

However, if the view turned to the inside of this field, the number of constructions and facilities in this huge area had gone through a long construction period which lead them to have different form styles, coexisting in the same area. On a shadow wall in front of the canteen near by the Coking Plant, a mural shows a total image of this field in a Chinese painting style represents the intention of Shougang's early planning and construction to some extent. (Figure 11) This image depicts modern industrial buildings, large-scale production equipment in the open air, as well as classical pavilions and decorated archways. These elements with different styles are unified under the perspective and composition of classical Chinese painting, the scenery including the plants and hills also adopt in this painting style. It probably can be seen as an evidence of the initial planning concept that attempted to combine modern, mechanical style with the territorial cultural context.

Focusing on the northern part of Shougang industrial field (Figure 12) and starting from its layout it can be observed that this field can be further divided into some lower level units. The strongest dependence is its interior street system, (Figure 13) it is the skeleton divided this huge area into smaller pieces, in a way influenced by the inherited urban construction idea. The original Shougang field organized these lower-level plots divided by streets is also a kind of strategy to organize this field and makes the internal activities absolutely convenient and easy to be managed. Another contribution of this organization approach is that it is classifying the morphological elements and simplifying the analysis of the whole area: even through the Shougang industrial field has contained a range of different construction styles, each plot normally has a relatively uniformed building pattern and architectural feature, self-consistent function, and



Figure 11. Mural on a shadow wall in Shougang
[The photo was taken in Shougang by the Author]

clear boundarie, since then this complex field can be treated as a series of collections with unified languages.

The plots in the north half can be mainly classified into to two categories, a serious of linear steel production facilities occupied the central situation, and plots containing secondary units distribute on both sides of it. (Figure 14)

The production Line is a serious of core facilities highlights the industrial characteristics of Shougang. It is starting from the silo area near by the north entrance, occupies a large contiguous land in the middle of the field from north to south. This area carries the core production activities - Iron and steel smelting - in Shougang, includes silos, smelting facilities are centered with four blast furnaces, and a coking plant is connected at the southern end.

This group of facilities are announcing their characteristic by their appearance, and constructing a rhythmic image with mechanical aesthetics. The producing facilities such as the furnace tower are point-like elements that are connected by linear transport corridors. They are having a relatively taller, bigger and more complex appearance that can easily become a visual focus. In addition to the production points that be connected, there are smaller vertical structures such as transfer station, production facility, operating rooms, and steel bracket, they are supporting the suspended pipelines and corridors at intervals. And even from outside these towering elements can easily to be noticed as are the most prominent features of Shougang from a city view.

The main direction of facilities in this plot is from north to south except for the corridors connecting the blast furnace to the silo area are from northwest to southeast, the consistent direction shows a sense of order. This artificial forest constituted by the horizontal transportation system, vertical production and discharge facilities is generally towering, is dense and intricate. This order is the experiencing the logic – industrial production process – forming the industrial assembly linear landscape. This part is the most typical plot displays the steel industrial aesthetic signifies Shougang field. The industrial atmosphere of rough machinery can be really felt between the thick steel pipes, staggered supporters and various complex facilities, and the flare of productions can be imaged in front of the clod steel bush. (Figure 15)

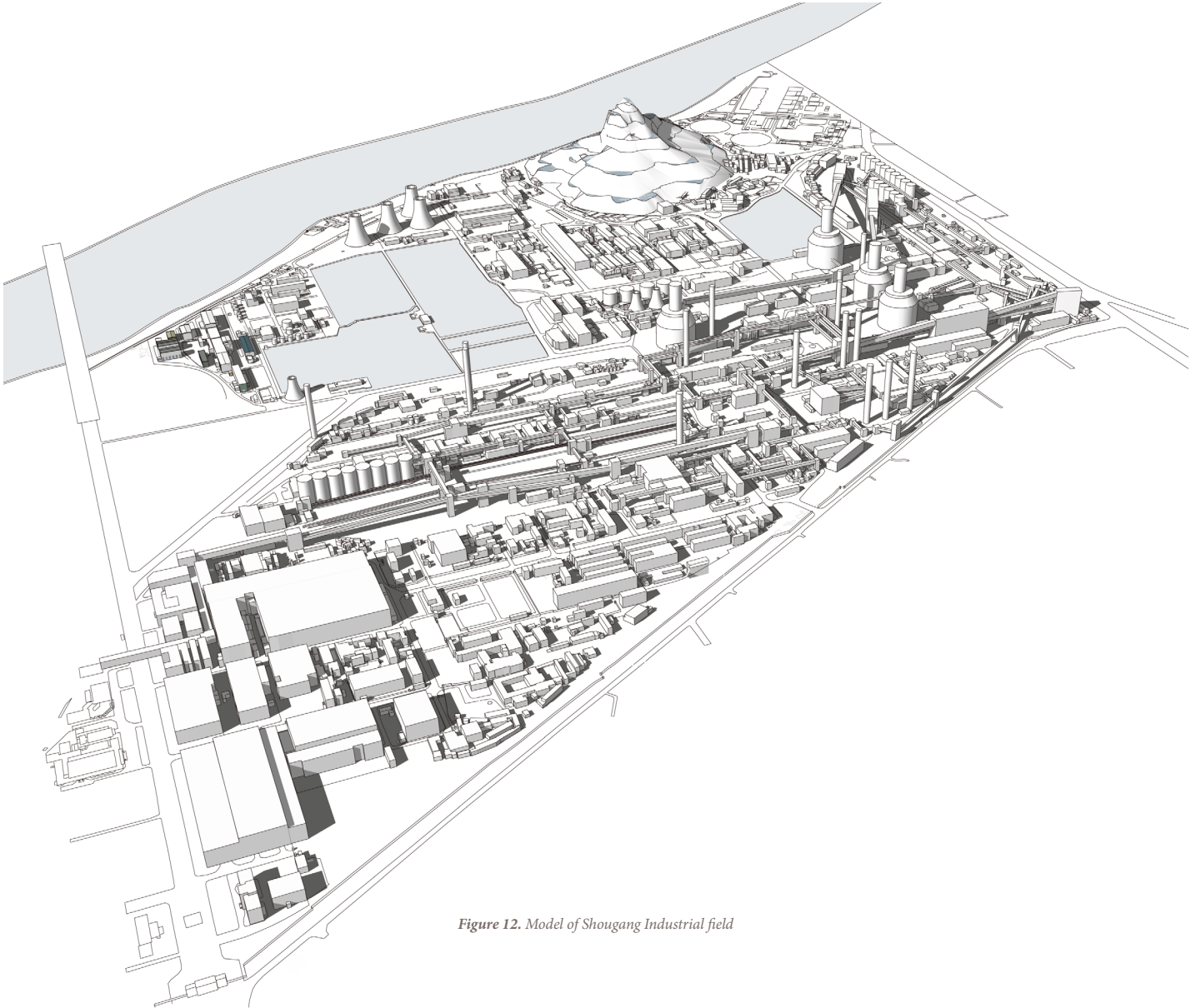


Figure 12. Model of Shougang Industrial field



Figure 13. Streets in Shougang Industrial Field

a	b	a,b - main streets inside Shougang Industrial Field
c	d	c,d - branch
e	f	e,f - roads inside plots

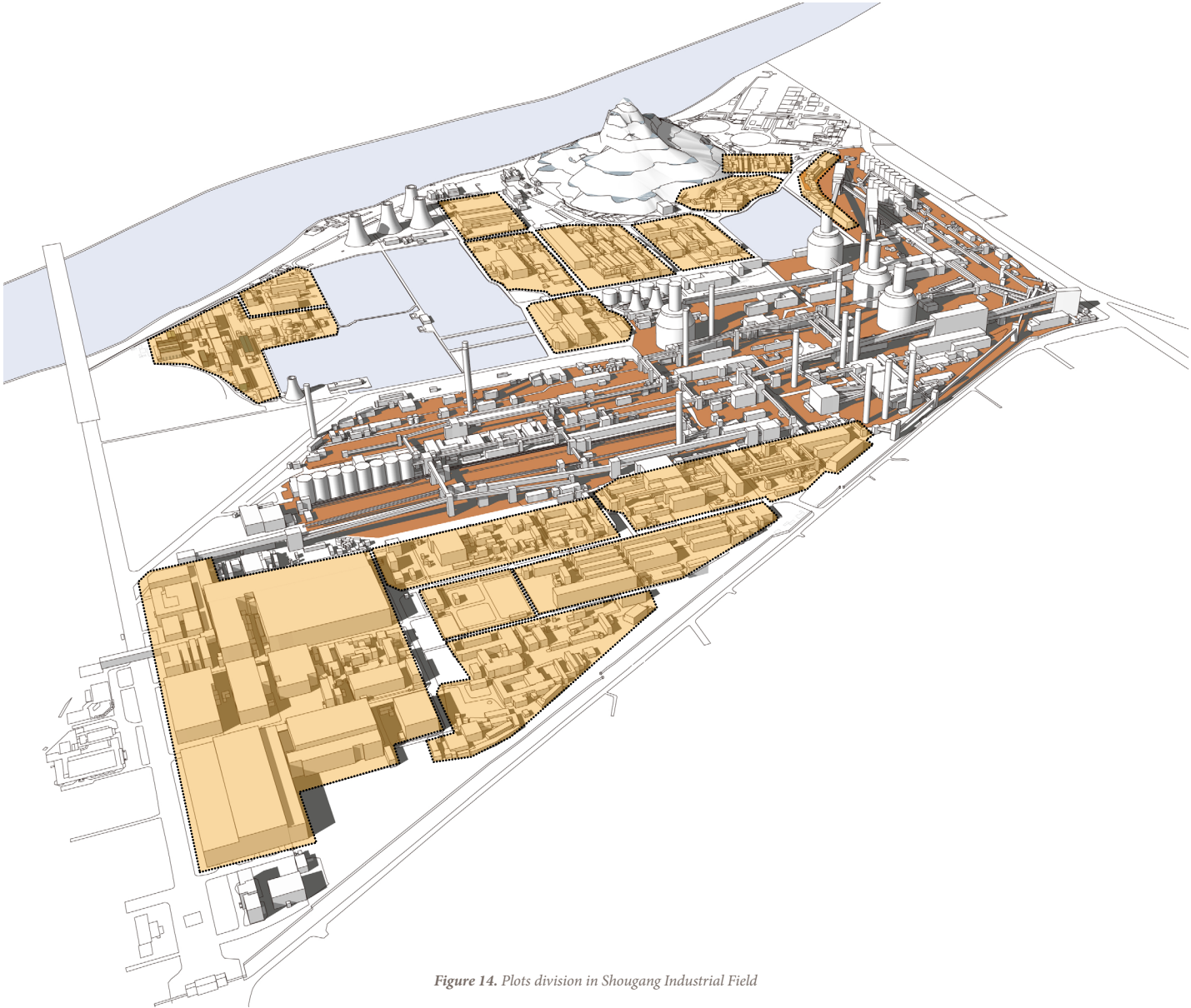


Figure 14. Plots division in Shougang Industrial Field



Figure 15. Images of the main production line
[The first two photos at top are from bj.news.163.com]

a	b	a, b - over view images c-g - detail images
c	d	
e	f g	

This plot is the core of the field from its location, function and form. They have been built since the beginning of Shougang, and have experienced more than a century of development, is the most faithful record of the history of Shougang's ups and downs. But unlike the general architectural structure, their extreme functional and mechanical properties lead to the unification of structure form. The influence of large time span on form is almost negligible in these facilities. In the industrial period, these huge structures exhausted loud roar and a splash of fire, the sweaty bodies of the steel workers were busying back and forth. In the memory of Shougang's retired workers, it survived in the tragic experience that labors had been forced to work were struggled on the survival line during the Japanese occupation period, and experienced a radical period that people had the honest hope of constructing homeland by industrial development under the social atmosphere of vigorous and collective spirit lead by collectivism. Its history now has become a part of collective spirit and memory of the relevant group of people even after the relocation of the factory.

Since Shougang also carries some auxiliary service duty and some other product manufacturing functions downstream of steel smelting, these functions had been set as secondary units and been contained by different plots, which are more quantity and wider distribution in the field. Each of these plots occupies a piece of land and constructed it relatively independently, bearing production, administration, and even life services functions, and their smaller size helps to make sure construction language in one plot has a relatively continue and stable expression.

This kind of plot can mainly be divided into two categories depend on their space organization: large cubic producing buildings assembled simply side-by-side, and the courtyard-type organization.

The first category is characterized by a huge volume, who carries the demand of the large-scale space usually serve production activities more than human. The space organization is very simple, more attention is paid to intuitiveness and accessibility than spatial richness. So, they usually expressed as neatly held cubes arranged in a linear or matrix. Buildings in them are exposing their functions, structures and materials without any disguise, and from some of them the influence from the Soviet Union can be caught in their red brick façade and some details. *(Figure 16)*

And the second category is more human-friendly comparing with the

previous one, they bear management and service functions and every other duties contain people as the audience. Their space organization is similar with Liang Sicheng's model, inheriting the traditional centripetal spatial model, using buildings and walls as enclosed components, only the scale is enlarged. Although these plots often do not strictly follow the initial model due to functional and site constraints, they help create a familiar social relationship and event atmosphere in a modern organization. Buildings in these plots are more diverse, most of them are based on modernism, adding Soviet or native architectural language to the exterior and facade. *(Figure 17)*

These plots are separated from each other in the field, and are collected in the closed area to form a strong union in the urban environment. It is the inheritance of the traditional Chinese urban construction thought, which seems still popular in present Chinese urban construction.

These two pattern types can also collaborate to construct a plot, the Oxygen Plant located at the south of Qunming Lake is an example, it used to be the place to supply blast furnace oxygen started from 1970's. In the corner of the lake there is the open-air operating area, at the west there are some industrial buildings side by side, and at the south across a road there is a group of linear industrial buildings. Industrial buildings are facing to the open-air operating area, which is like the courtyard in this group. The line of buildings is an enclosing element to the yard behind it, and at the west and south the yard is surrounded by some other industrial buildings and few services. Despite this, the yard had a cycle of wall to shape its inside space, where there is a long and thin industrial at the bottom and another smaller one in front of it. There is no separate boundary around this plot, but is defined by the lake and the boundary of the whole field. The character of space turns open to privet since the operation area, who together with the other yard behind are two elements polymerized buildings in this plot. *(Figure 18-22)*

Secondary units in Shougang can not only group production functions and architectural styles, but also divide workers and provide more specific management, service, belonging and collective identification. For these workers, Shougang is an external powerful label while the secondary units are internal labels that different an employee with others. This division is a result of complex functions, but their apparently boundaries within a tight

group and the introverted space are also the lineage of social organization under the small-yards-in-big model.

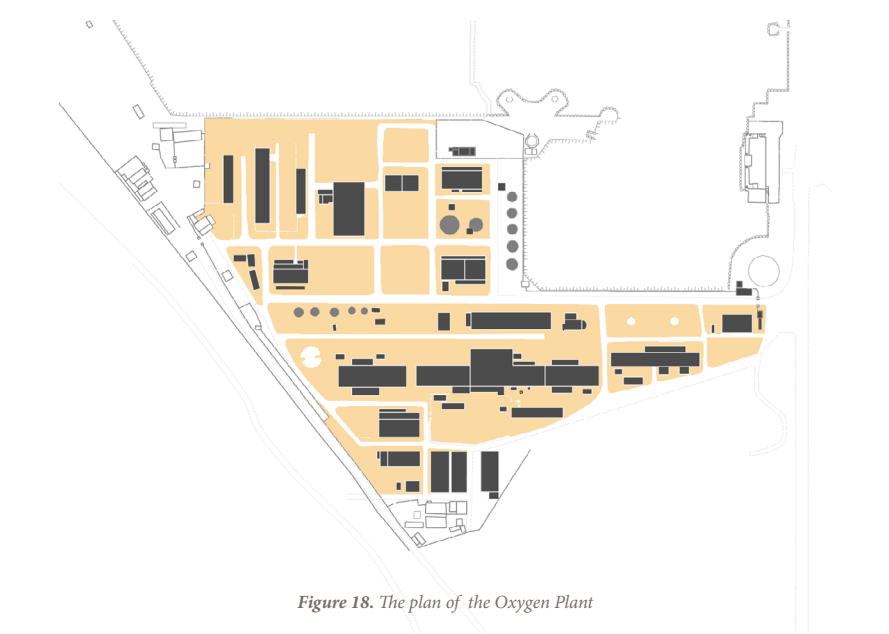
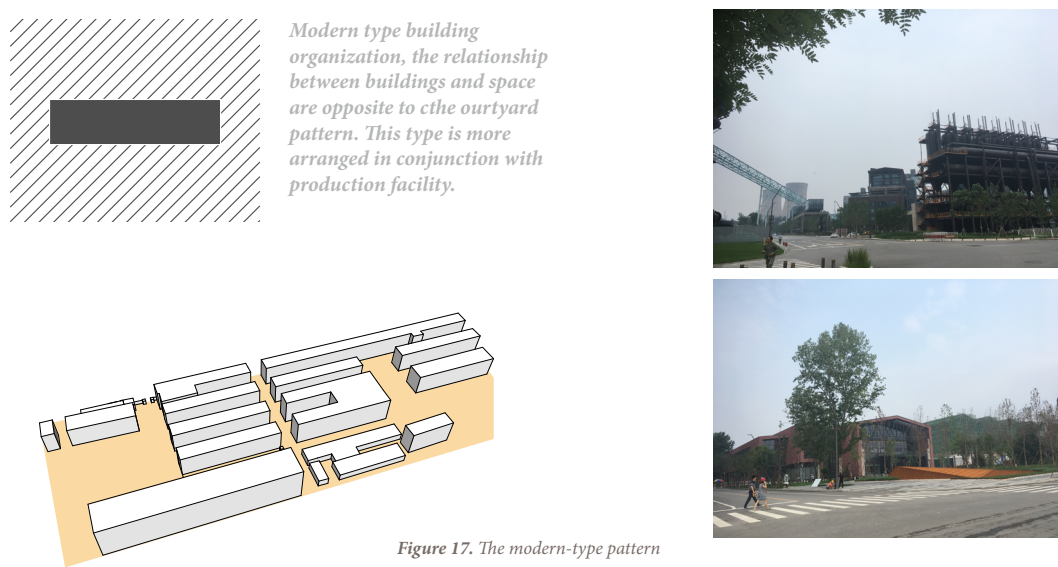
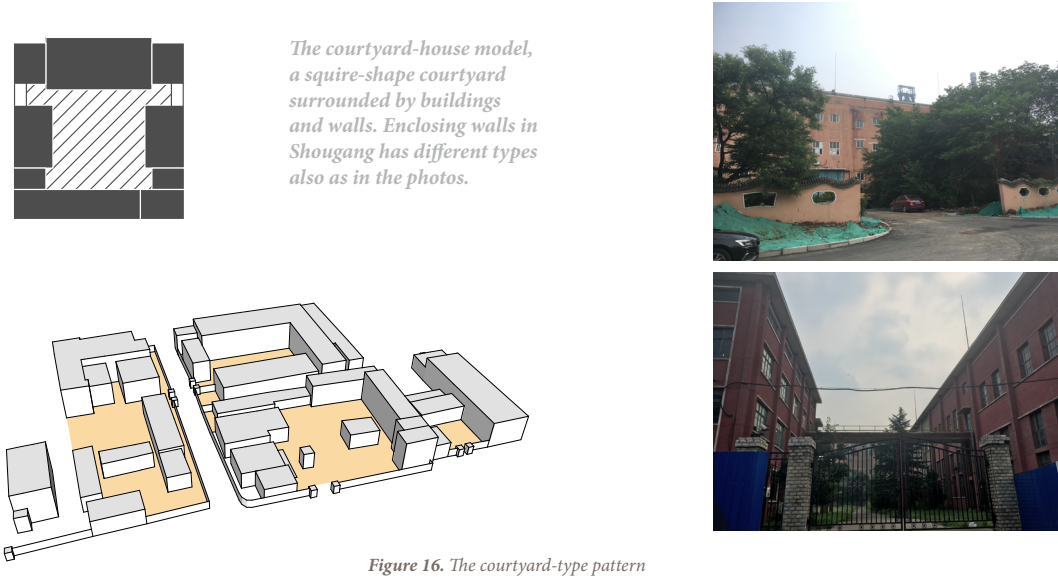
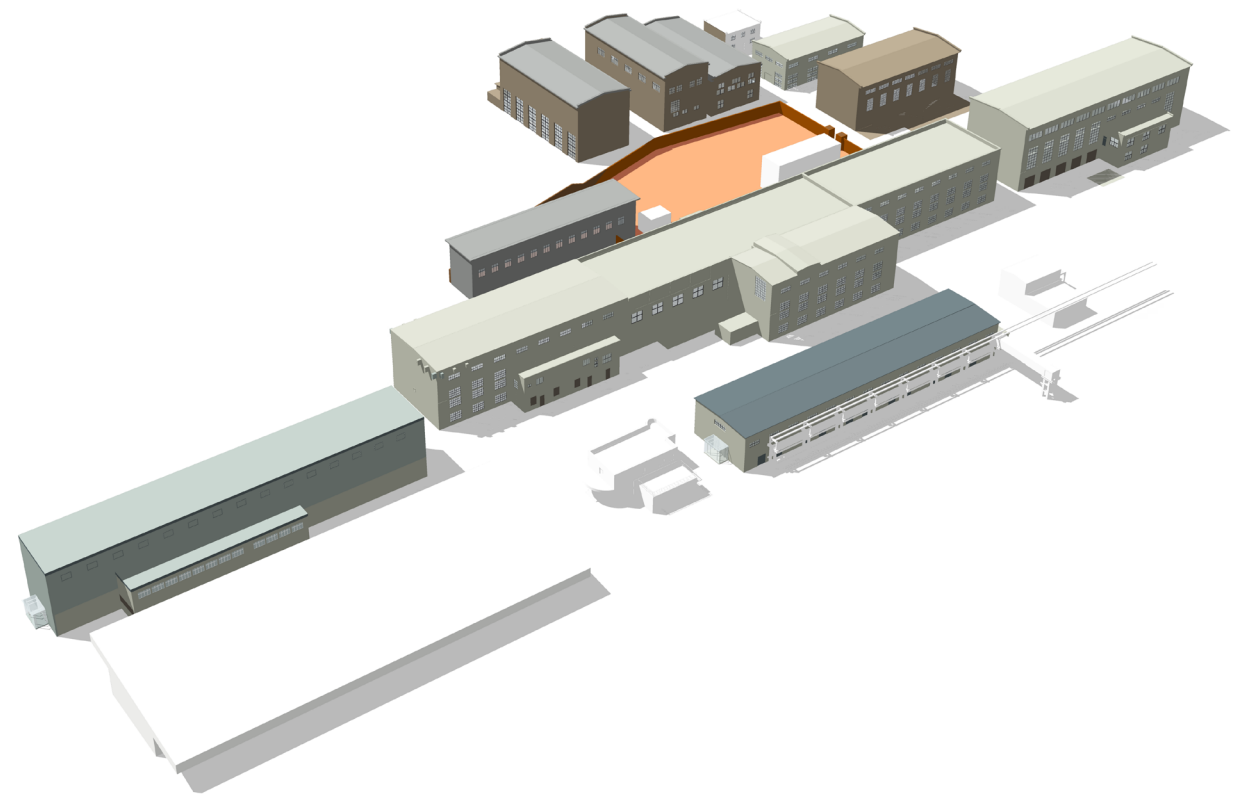
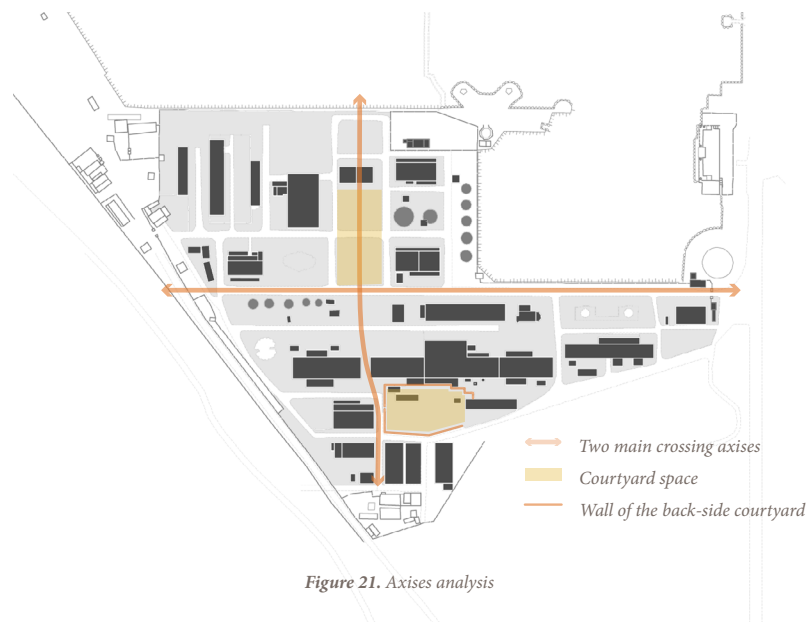
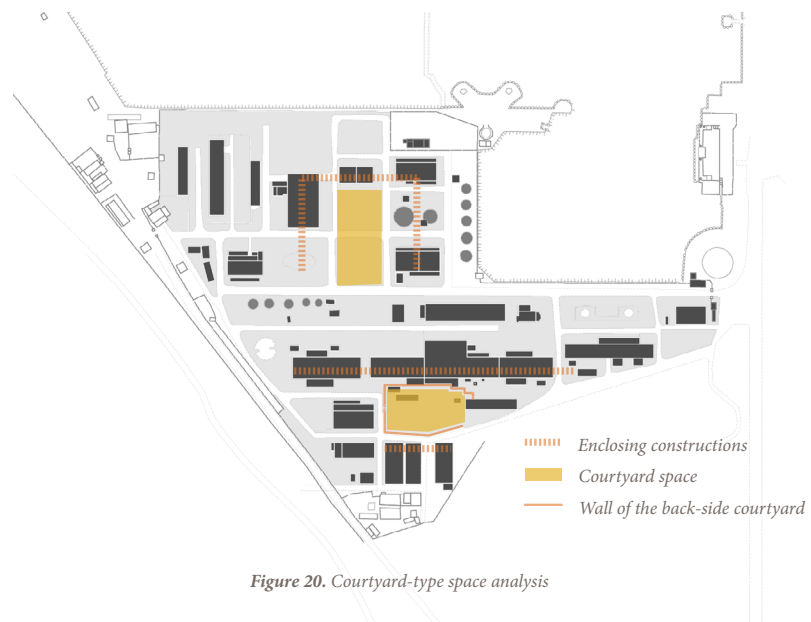


Figure 18. The plan of the Oxygen Plant



Figure 19. Images of the Oxygen Plant



SINGLE ELEMENTS SUMMARIZING

Function is generally considered to be one of the contents reflected by the architectural form. According to theories from Muratori and Rossi about “type”, form is also a reaction within effects from social, cultural or other aspects. Morphological research of abandoned industrial elements concerns about their transportation experience and effects from history, society, culture and other aspects. While, the Shougang field — an industrial cultural heritage, is normally agreed having its material cultural values and intangible cultural values. The link between activities or the collective memory it carried and its form should possibly to be found out by summarizing and abstracting these buildings and spaces of their language.

A special type of constructions is the production facilities such as blast furnaces and chimneys scattered in the various plots of the field. They are not strictly buildings, but they are the iconic component inseparable from Shougang. After the suspension of production, they are the most intuitive elements declares Shougang's past as a steel factory. Although they have different shapes, they all have a strong sense of industry or mechanics, like exhibits with a rumbling past and time imprint in the post-industrial era.

The division of Shougang area into a series of secondary plots simplified not only analysis in plot scale but also in single buildings. The architectural languages in this land mainly have 3 sources: the Modernism(*Figure 23*), western influence from Soviet(*Figure 24,25*) and local traditional language(*Figure 26*).

The functionalist lead to a very simple box type mainly used in the large span industrial buildings or some office building constructed after the 1970s. They mostly have flat roof, brick walls with painted façade or simple tiling, and regular windows opening based on layers. This type of buildings are function-forward, without any extra decoration, showing little of emotion or character. This type has simple appearance, cost few and the construction speed is relatively faster. It is an economical choice when the economy was entering a rapid development period from a lower level. Besides with complete functionalism architectures, this high-efficiency and low-cost strategy is actually the dominant idea and basic type of buildings in Shougang area, and the other languages and emotional details are more like additions are combined upon it.

Benefit from the close relationship with the Soviet Union between 1950s

to 1960s, a large number of buildings with obvious Soviet architectural features, including factory buildings, offices and houses, were produced. The Soviet-style buildings in Shougang field were mainly industrial buildings and a few of office buildings, as well as some staff service places. Their notable features are their appearance who influenced by the Western classical geometric composition method, the red brick façade, triangular gables and sloping roofs. These buildings are mostly durable due to their stable structure and thick brick walls.

The last type resource is the antique architectural language existing in this area or be inherited as a cultural factor during construction. The beam-column structure, the outstretched eaves with flexible curve and slightly raised corner, and their decoration and material. The existing is a part of textural context, and the inheriting is a kind of expression of the culture context.

Shougang is a result of a collision of local culture, global ideology, and modern industrial functions. This attribute is reflected in the construction of plots and single elements. It is worth to mention the integration between the three types. For example, the localization of Soviet-style architecture has merged this foreign type with the local language in the treatment of the roof, the connection between the roof and the gable wall follows a Chinese classical roof type by rising the gable wall exceeding the roof. (*Figure 27*) This type of building is probably the widest use in the early construction of the compound. They reflect the formal inheritance of local traditional customs, and also represent the political tendencies of the certain historical period, additionally together with the industrial architectural features embodied in the volume and the façade. they are the iconic reflections of Shougang's past story. (*Figure 28*)

The abandoned industrial field of Shougang is changing since its shutdown, now the warehouse becomes office buildings, clean coal workshop turns to a group of Winter Olympics venues, a couple of buildings in the Oxygen Plant have once been used for exhibitions. These changes on the one hand are the exploration of the reuse of objects, improving the space environment by implanting new features. On the other hand, these regenerated fragments have a positive effect on the field, enhance the land development value in this area, and start the way to connect Shougang with the real city life activities.

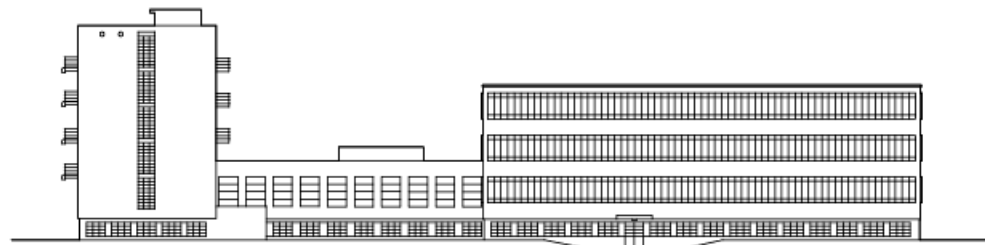


Figure 23. Modern-type facade_Bauhaus
[Source from ceco.net]



Figure 24. Classical facade
[Source from wxwenku.com]

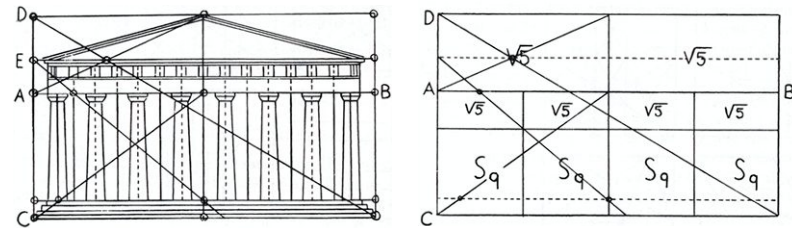


Figure 25. Geometric Control in Classical Architecture
[Source from sites.google.com]



Figure 26. Typical facade of Chinese traditional buildings_硬山顶
[Source from anxinpiao.com]

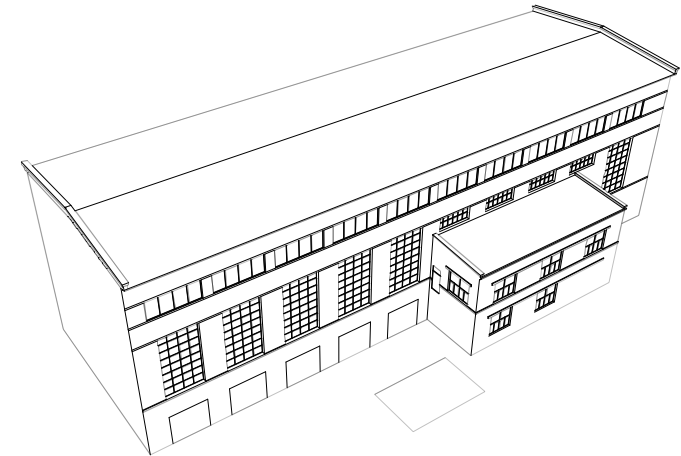


Figure 27. The model of a typical building in Shougang



Figure 25. Images of buildings in Shougang

SUMMARY

There are three series of formal elements integrated in Shougang Industrial Field, local language, modern industrial style, and foreign influence. They are reflected in each scale levels and result a significant image. It has distinctive industrial characteristics, and contains a variety of kinds of human activities at the same time, internal divided groups make the diversity in the field organized. In the industrial period, due to the unique social role of “Danwei Dayuan”, the industrial field is an important core of social organization and population activities in this district. But now it is huge and inaccessible, like an isolated island in the urban environment and a giant industrial souvenir that can only be seen from a distance.

Notes:

- 1. The landowner in the public ownership context can only be a unit but not cannot be an individual.
- 2. "The Wu Xing (Chinese: 五行 ; pinyin: w ŭ x í ng), also known as the Five Elements, Five Phases, the Five Agents, the Five Movements, Five Processes, the Five Steps/Stages and the Five Planets of significant gravity: Mars- 火 , Mercury- 水 , Jupiter- 木 , Venus- 金 , Saturn- 土 [1] is the short form of "W ŭ zh ǒ ng lì ú x í ng zh ī q ì " (五種流行之氣) or "the five types of chi dominating at different times".[2] It is a fivefold conceptual scheme that many traditional Chinese fields used to explain a wide array of phenomena, from cosmic cycles to the interaction between internal organs, and from the succession of political regimes to the properties of medicinal drugs. The "Five Phases" are Wood (木 m ù), Fire (火 hu ǒ), Earth (土 t ŭ), Metal (金 j ī n), and Water (水 shu ĭ). This order of presentation is known as the "mutual generation" (相生 xi ā ngsh ē ng) sequence. In the order of "mutual overcoming" (相剋 / 相克 xi ā ngk è), they are Wood, Earth, Water, Fire, and Metal."

- from Wikipedia

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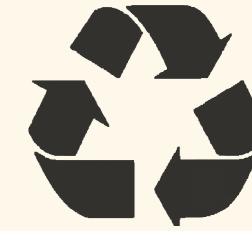
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PART 2
INDUSTRIAL HERITAGE REGENERATION

THE ADAPTIVE REUSE OF INDUSTRIAL HERITAGE

Industrial heritages are industrial remains with historical, technical, social, architectural or scientific value, (*Liu Boying, Feng Zhongping; 2009*) it is a kind of cultural heritage exists with physical urban monuments. As a historical witness of the development of human civilization, they are increasingly protected and valued by people. Nowadays the protection of cultural heritage is still primarily based on the 1964 Venice Charter (*Mirjana Roter Blagojevic; Anica Tufegdzcic, 2016*) who emphasized protecting “not only the single architectural work but also the urban or rural setting in which is found the evidence of a particular civilization, of a significant development or of an historical event”, and the cultural value¹ of monuments². The UNESCO Convention (1972) proposed that they are “having outstanding universal value from the point of view of history, art or science”. The European Charter of architectural heritage (1975) declares that “they have a cultural, economic and social irreplaceable value which promotes the harmonious balance of the society and has an important educational value.” And the Cracovia charter (2000) started to take care of collective memories. Convention for the Safeguarding of Intangible Cultural Heritage (2003) further expanded the scope of protected content with the term of intangible Cultural Heritage points to the practices, representations, expressions, knowledge, skills – as well as the instruments, objects, artefacts and cultural spaces associated therewith – that communities,

groups and, in some cases, individuals recognize as part of their cultural heritage. As argued by Loulanski, when defining cultural heritage, the conceptual focus has to be shifted 1) from monuments to people, 2) from objects to functions, and thus 3) from preservation per se to purposeful preservation and sustainable use and development. (*Mara Cerquetti, 2017*)

Industrial heritage faced a decline in production function during the post-industrial period, and the original order is losing. In the first part, studies about industrial heritage from urban morphology view attempts to sort out the complex information it contains and discover its values, properties, opportunities and challenges. And the next step-protection or regeneration - aims to preserve its values can be implemented based on the reorganization of these conditions and to re-establish contacts between present using, cultural value, and the physical space in a continuous story.

THE PRESERVATION OF INDUSTRIAL HERITAGE.

Cultural heritages record the past of human beings, protecting their diversity is an important way helps people understand themselves. During the research and analysis at the early stage, industrial heritages are understood by a small number of scholars. It is undoubtedly that understanding is the first step of protection, however, when talking about protection, recording and reserving them in an academic way in libraries is not enough, and keeping their vitality in human civilization is another option more proactive. One viable way is to describe, emphasize and express in propagable ways, to process the information into cultural products that can be observed, experienced, and understood by ordinary people, or in a simply word, to interpret those values. The American scholar Freeman Tilden pointed out that interpretation is an inspiring activity based on information, which combines the expressions of various artistic methods to stimulate and arouse people's reaction. (*Zhang Yuqi, 2015*) It enables the content of the heritage to be seen and understood by the public, thus promoting the inherited of cultural, maintaining its vitality and ensuring the continuity of development.

There are two principles in interpretation: authenticity and integrity. Authenticity has been defined by Mirjana Roter Blagojevic and Anica Tufegdzcic as an essential qualitative factor in relation to the credibility of available sources of information and measure of the degree to which attributes of heritage truthfully and exactly testify to its importance,

emphasizing original features' retention in the process of preserving and repairing. It includes the preservation of historical remnants superposed industrial period and other times such as architectural form, material texture, functional uses, construction techniques, management systems, spiritual emotions and etc. The authenticity requires that preservation and restoration should be based on authentic and reliable documents or other information resource, against the forgery imitate of historical styles, and the old and new should be identifiable. (*Zhang Yuqi, 2015*) If the authenticity of an industrial heritage has been lost during the interpretation, then the value of it will be greatly weakened.

Integrity refers to both the complete reflection of the industrial period in the interpretation of the function and structure of the old industrial site, and the historical integrity from the historical perspective, that includes Different qualities left over from the industrial era and previous history, In the consideration of the protection of the industrial heritage. With the deepening of the value of industrial heritage research, the value of different aspects is recognized, which also leads to the integrity of more and more content: structure and technology, society, space, aesthetics, context... The pursuit of integrity under the ever-widening research boundaries seems cause a paradox, but its purpose is to present the heritage as completely as possible and to avoid damage to its structure or value during reuse.

THE TRANSFORMATION OF INDUSTRIAL HERITAGE

The transformation of industrial heritages mainly refers to exploring the possibility of reusing architectural monuments. It is looking into the operation of recycling existing urban resources, improving the urban environment by giving it a new vitality. Different from interpretation, the strategy of transformation pays more attention on using values of a heritage and tends to promote protection by increasing its visibility in citizen's life.

Unique cultural language requires new answers, knowledges, judgments and understanding, (*Sonja Ifko, 2016*) but it's never easy to get enough attention from the public only through understanding and respect, returning these values back to public to push them to be noticed, understood, and accepted. The recycling of these abandoned urban resources is relieving the negative influence mentioned by Anderson (*Sunniva Sutestad; Saruhan Mosler, 2016*). Zeynep GÜNAY thought the protection method of turning an industrial heritage into a "product" with market value was a management of

historical environment and cultural heritages, that the post-industrial field are rearranged and organized to promote consumption. This approach links the protection to economic development so that "the values of heritages start to be related to the economic value it sustains or generates". (*Zeynep GÜNAY, 2014*)

Architectural monuments are containers left after the original functions disappeared, this container can contain other functions except the industrial productions had been eliminated in post-industrial time. In order to adapt to new functions, the transformation of monuments is inevitable. The transformation mainly refers to the commodity and industrialization besides interpretation in the reappears of industrial heritages, playing its economic potential and realizing the transformation of industrial heritage from cultural documents to cultural products and cultural industries.

The retrofit of the industrial field has a challenge to preserve its formal characteristics, special experience, and spatial industrial atmosphere with still satisfying a different function with previous industrial production. The original industrial field generally had been built in a large scale to suit with production and transportation demands, which makes it has more flexibilities, this leads to more broad possibilities during transformation.

ADAPTIVE REUSE

Sonja Ifko quoted from the World Commission on Environment and Development in the report Our Common Future (1987) the definition of sustainable development "is the basis of conservation of resources, reuse of materials and built structures, as well as the areas that lost their original function." He pointed out that the really activate of abandoned sites can be achieved by focusing on the living conditions and needs of local residents from a social and economic perspective, thereby promote to highlight the value of industrial heritages. It is hoped that this will connect the future to the past by not only satisfying the development needs, but also avoiding the Tabula Rasa development and destroy the cultural heritage value. (*Sonja Ifko, 2016*) Mirjana Roter Blagojevi and Anita Tufegdzcic considered cultural heritage as a non-renewable resource and should be regenerated and adapted to modern needs by providing them with sufficient purpose and ongoing maintenance. And the "sustainable renewal is the proper management of use and change in and around historic places and spaces, so as to respect and enhance their value to society." In general,

the conservation of historic environments requires maintaining a balance between preserving the past for its intrinsic value and accommodating new demands (Ashworth, 2000)

Adaptive reuse was first officially presented in the Barra Charter adopted by ICOMOS in 1979. This concept refers to the adjustment of a site to accommodate new functions. It is a sustainable thinking that takes into account the complex content of the heritage, seeking a transformation strategy to satisfying the present or even future demands without break cultural heritage values.

Although “industrial heritage conservation advocates cultural, historical and economic significance of obsolete spaces and transforms them into viable places”, (Mihye Choa & Sunghee Shinb, 2015) which in fact promotes the regeneration of abandoned sites, there are contradictions cannot be ignored between the preservation and transformation options on an industrial heritage in a current urban environment. Preservation is a basic requirement but is advocating less change, while, transformation is encouraging changes lead to development possibilities, they are facing two opposite directions, the past and the future.

Montella believes that cultural heritage can also produce productive value, (Mara Cerquetti, 2017) especially when the experiential economy becomes more and more popular, cultural connotations can become a value-added condition in heritage reuse if the combination between cultural value and new function of heritage could be caught. Cultural value can play a positive role in the protection of heritage, it enhances the sensory enjoyment of users as a unique cultural experience. In the current experience economy, it can enhance the economic value of space and promote protection practice. Meanwhile, a suitable transformation can not only bring the heritage back to city life, but also promote its values be noticed, felt, and understood by population. Therefore, the key point to reconcile the contradiction during adaptive reuse activities is to find a balance between preservation and transformation.

Fahmi and Sutton proposed in their article in 2010 that “industrial heritage conservation requires more than maintaining balance between preservation and adaptive re-use. It requires cultural valorization of obsolete spaces as heritage sites. In other words, it entails creating and legitimizing a new set of cultural meanings.” (Fahmi; Sutton, 2010). It is a higher requirement

encourages sustainable development from cultural aspect, suggests the present expression of an old language, or even considering about its possibility in the future. Realizing the continuation and regeneration of heritage value.

CASE STUDIES

Rhondda Heritage Park was an abandoned coal mine in Wales and now it is an example preserving and interpreting its old values. The local people chose to remain its industrial characteristics as the territorial identification, and was looking forward to the industrial tourism leaded by it could push local economic development. This project kept the landscape, facilities and buildings from industrial era on the ground, and even the underground mining tunnel had been turned into an tour project - people can experience the working environment under the guidance of tour guides who probably was a worker in the coal mine. (Figure 1) In addition to this, there are exhibitions and explanations helps people to understand its industrial history. (Figure 2) (Michel Rautenberg, 2012)

This project completely preserved the production process, scenes, and social organizations associated with the industrial heritage and transformed abstract cultural heritage into figurative cultural experience activities. Undoubtedly, it protected the industrial heritage completely and truly seems a perfect way remain and spread the value of it. However, from the economy point of view, it is hard to make a profit and the government has kept subsidize it. (Richard C. Prentice, Stephen F. Witt, Claire Hamer, 2018)



Figure 1: Landscape of Rhondda Heritage Park
[Source from Adrian Warren]



Figure 2: Image of Rhondda Heritage Park
[Source from radiomuseum.org]

Lingotto in Torino is an example pays more attention to the value of the existing constructions and urban land. The building used to be a huge industrial complex (about 250.000 sq.m.), built by FIAT car manufacturing at the beginning of the last century. After the factory's manufacturing function left, it was transformed into a complex that carried functions such as hotels, shopping malls, concert halls, cinemas, etc. (Figure 3)

In the practice of transformation, it is more practical to maximize practical functions instead of highlighting its cultural value. It is true that its history can be felt from some fragments in this building such as the test track on the roof left by the automobile manufacturer and the spiral ramp connects it with ground. (Figure 4) And in some space split between old and new functions may sometimes cause confusions. (Figure 5) But these are just reflections of the facts and do not particularly emphasize its past. Those who are familiar with it can evoke their memories from these fragments and conflicts, while, strangers are more likely to experience the space and services it provides. (Annalisa Colombino; Alberto Vanolo, 2016)

This case expresses another kind of coordination relationship between transformation and interpretation, and balances functions, urban space, social and cultural connotations as considerations of the transformation plan. In the previous case, the cultural heritage value is the core element and the final target is the preservation. Different with it, this project uses physical remains as the container and resource of urban renew, in which could coordinate elements related to its past and the present. It promotes the evolution of urban functional allocation and space setting.

Although the two cases beyond focused on different side in their treatment of industrial heritages, both of them made their choice about preserving or transporting. These decisions are made in relation to the status of industrial heritage in the local urban environment and the role it is given.

Zeche Zollverein is closed its life as a mine at the end of 1980's and lost its status as an economic center. (Figure 7) In 1989, the local government initiated repairing and recycling works, while restored the old constructions and sorting out this abandoned industrial area. Meanwhile, they tried to introduce new industries that could be integrated with this heritage. One important strategy was the Internationale Bauausstellung Emscher Park, who opened the way for this area to transform into cultural industry. Since then, as a result, the cultural industry became an important means of



Figure 3: Lingotto in the past and present
[Source from atlasobscura.com]



Figure 4: The Spiral ramp and roof of Lingotto
[Source from Annalisa Colombino and Alberto; Vanoloatlasobscura.com]



Figure 5: Inside of 8 Garally in Lingotto
[Source from Annalisa Colombino and Alberto; Centro Commerciale 8 Gallery]

breaking the spiritual constraints that hinder the modernization of this field, and has enabled the reuse of large quantities of industrial heritage that have emerged as a result of the decline of coal and steel companies.

The Internationale Bauausstellung Emscher Park suggested to transform the mine NO. 12 into a Cultural Industry Center, in where there is the famous Red Dot Design Museum, together with the studios, exhibitions and conference areas designed by architects Heinrich Böll and Hans Krabel, become a design center in Nordrhein-Westfalen. (Figure 8) This operation not only created an interior space that combines the original mine facilities with the newly built exhibition space, but also improved the external environment of the building. in the immediate vicinity of the building, there are also new walkway and parking.

Later, in order to cooperate with the operation of the “Industrial Heritage Road” plan of Ruhr Industrial Zone, Zollverein had a new master plan used the status quo as a starting point to build a future cultural design park. In this plan, firstly, the original railways, flyovers, and mines in the mining area were retained and opened to visitors. The public walkway contained the railroad track was connected with main buildings. Second, the plan was to inject new features into the area included the Ruhr Museum, a visitor center, a design school as well as two business parks. At last, planned a walking pass around the building complex where visitors can walk, jog or roller skating along the trail. And a number of connected trails would be built to connect the area with the northern part of Essen. (Figure 9) (Li Jiajie, 2015)

The regeneration of the industrial heritage of Zollverein has gone through a long process in which itself has been constantly adapted to the new context. In the end, it realized the regeneration and avoided the destruction of its cultural value, maintained its historical continuity and life vitality during the development in a new era.



Figure 5: Panoramic view of Zeche Zollverein in the present
[Source from zeche.org]

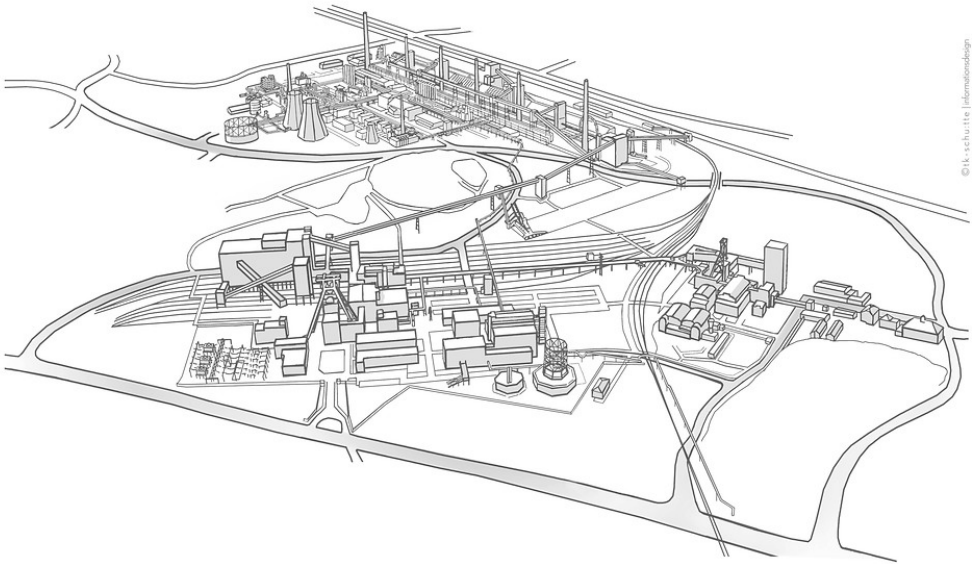
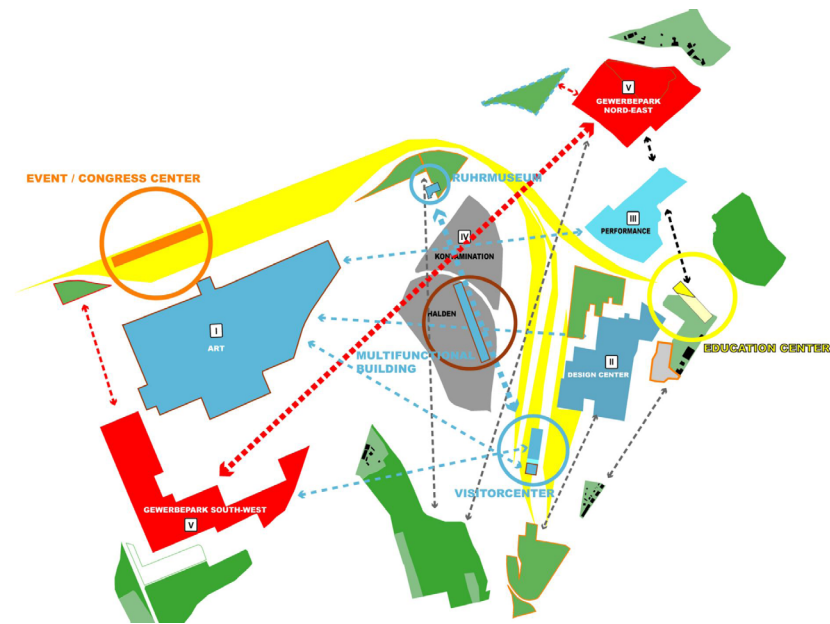


Figure 7: Panoramic view of Zeche Zollverein
[Source from kuladig.de]



Figure 8: Red Dot Design Museum
[Source from fosterandpartners.com]



SUMMARY

Industrial heritage encompasses physical remains and cultural values. The contradiction between the protection and transformation of industrial heritage can be seen as a contradiction between the protection of cultural heritage and the regeneration of physical urban resource. While, the adaptive reuse attempts to balance requirements from both aspects, avoids interrupting the continuity of the industrial heritage's development along ages, and also avoids its isolation from the surrounding urban environment as a result of adhering to the past only. Therefore, a successful adaptive reuse plan of an industrial heritage should comprehensively consider its various of properties from culture, society, economy and other aspects, combine its own characteristics with urban environment and discover its potential under the new context.



Figure 9: Masterplan from OMA
[Source from /oma.eu]

Notes:

1. “Monumental works bearing a spiritual message of the past, represent, in the present life, the alive witness of their centuries-old traditions. Humanity, which every day takes note of human values , evaluates them as common heritage, recognizing itself responsible for their preservation for future generations and for the safeguard of their authenticity”. — Venice Charter
2. they are not only “to great work of art”, but also “to more modest works of the past which have acquired cultural value with the passing of time”. — Venice Charter

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<http://chenhao.studio/>鲁尔区之北杜伊斯堡后工业景观公园north-duisburg-landscape-park/

THE MEANING OF MORPHOLOGY ANALYSIS RESULTS

Urban morphology is a comprehensive study around the form of an object, it has an outstanding performance in understanding the development and transformation process of the object's form and motivations at the back. Applying it in industrial heritage research, as mentioned in the first part, helps to fully understand the historical, cultural, social and economic connotations of an object, and more importantly, to discover how they influence the object's formation and evolution, and their visual results. This is truly from an architectural perspective to study industrial heritages, which treat the physical monument as the entrance of research and the element finally will bear responses. After analysis, adaptive reuse is a feasible idea to guide the protection and retrofit plan aims to redevelop the historical field without damage its existing values, emphasizes the consideration of inheritance and development as two main points, it requires a comprehensive consideration from economy, culture, and society under the present urban context. While, the urban morphological research is providing a premise of this work.

In the whole process, the most valuable work is finding the link between an influencing factor and form elements. It could be the reference of and transformation and retrofit practices, to make sure the continuity in development.

The positive significance and protection value of industrial heritage in

cities are facts that have been generally agreed, under different urban scales they can experience different meanings and values. The separate consideration is an inductive way for dealing with a large amount of complex information, which helps to simplify the research object and provides corresponding references at different stages of the regeneration design.

In the 3-scale analysis in the first part, the analysis under urban scale provides dependences of transformation strategies aims to integrate industrial heritage with the present context in terms of urban structure system, urban image and function distribution, which has positive contribution of its regeneration by increasing its connection with the realistic city. After that, researches on plots level is focusing on building pattern, function and architectural styles, and single elements is focusing on more detail building language. they are deeply digging into the formation process and influencing factors of the heritage, announcing resources and values of it. These two scales are bearing preservation and transformation options, expressing the result directly to steppers.

However, in fact, these three levels cannot be simply split like that, they are closely related to each other. The method classifying and editing industrial heritage information through scales has its remarkable meaning in promoting the continuity from both time and physical urban space in the practice of industrial heritage reuse. And the continuity of these two aspects in the industrial heritage adaptive reuse domain is called heritage conservation and urban space regeneration.

The morphological research is meaningful to the adaptive reuse of an industrial heritage along the process. In Shougang example, it at first can provides dependences of strategy formulation, and later it is the reference and guidance of specific transformation design.

The analysis from urban level can be regarded as an analysis of the skeleton of the area involves the Shougang Industrial Field. This analysis helps to understand the territorial context in order to clarify its position in the skeleton and the future feasible development direction. The Figure-Ground map shows the characteristics of the urban space system and the surrounding space organization, it establishes an intuitive two-dimensional model that reflects the situation of Shougang - between the urban fringe belt and the eastward regular urban space. More than this, it also exposes

the problem caused by this oversized insulated urban unit — the Shougang Industrial Field — it interrupts the city, caused many urban problems especially in the post-industrial period such as increasing urban traffic burden and wasting urban development land. From the urban development view, they are undoubtedly negative factors, but from the perspective of protection, the huge size and insulated internal space is a kind of relic of the factory, which is a record of the characteristics of the industrial period.

Thus, the contradiction is revealed between inheritance and development, inheritance requires the original boundary, and development requires more effective urban space. One way to reconcile this contradiction is to change the boundary of the Shougang plant area as a symbol and remove its functionality, its internal constructions and space should be kept to guarantee the continuation of its heritage attributes, but change its closure, integrating especially its traffic network into the urban.

The Shougang field can be seen as a plot in the city and a collection of many smaller plots. They are constituting the complex but traceable internal environment, were mediums help to understand this whole field. The collecting way they are organized is leading to a complex field can bear various of functions might be distributed in different plots. This way has a flexibility and avoids to change its structure. According to the theory of industrial heritage adaptive reuse, diversification of functions helps to enhance regional vitality and promote regeneration.

Shougang field presents a special industrial landscape in the city image, taking it as the core can observe a circular function distribution structure. Another aspect in morphological researches is on the social, economy and cultural conditions that influence the process of its development. Through the understanding of the “Danwei Dayuan” model, it can be seen that this core-linking structure is a reflection of the social organization in the industrial construction period. It represents the social state and civic activities in a historical period. The industrial area is surrounded by residential districts. This urban organization model was serving the industrial production and represents the image of the city during the industrial period. However, urban development has changed the land use and increased its real estate development value. Defining the land parcel as a city service area providing public event spaces, opening spaces, and focusing on serving the surrounding residential area, not only is maintaining its status as the core of the regional organization, but

also gives it the opportunity to integrate into the real environment of the current city. Moreover, Service functions such as public buildings, open spaces have more flexible requirements on space forms, which helps keep Shougang's original style and promote heritage protection.

The dominant basic architectural types have laid the foundation for the façade within the field and character of using spaces. The ongoing development projects in the field are quietly changing the area, making a new position for Shougang's city status. In particular, the presence of the Winter Olympic Stadium is a very promising opportunity to reorganize and regenerate this area. The improvement of surrounding facilities to match with it is also an important topic for its further transformation.

Basing on upon, there are 4 strategies can be proposed means to guide the adaptive reuse of Shougang Industrial Field:

- 1. Turning the boundary into a historical symbol and open the inner space to the city;*
- 2. Emphasizing it as the core of Shijingshan district by keeping its simblc industrial landscape and adjusting modern urban service functions in this field;*
- 3. Integrating internal traffic into the urban street system, and retaining secondary-unit divisions for various of specific developments depend on their own characteristics;*
- 4. Taking an advantage of cultural values and enhance the using experience withing transformation, encouraging protection and transformation promote each other to achieve value added.*

And based on these strategies, Shougang Industrial Field then can be treated separately with a set of secondary plots. And the retrofit on each of them following the masterplan and should also keep its own space and architectural language in some way.

