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**Adaptive Reuse of Industrial Buildings for Sustainability;  
Analysis of Sustainability and Social Values of Industrial Facades**

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**Adaptive Reuse of Industrial Buildings for Sustainability;  
Analysis of Sustainability and Social Values of Industrial Facades**

**by**

**Donghwan Kim**

**Thesis**

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## **Dedication**

This thesis is dedicated to my wife, Jae-hui Jeong, who provided endless nutritious meals, patience, and understanding to help me focus on this research. Furthermore, this thesis is dedicated to my beautiful daughter, Loah Kim, who always gives me endless energy with her smiles. Finally, it is dedicated to my parents continuously support my study financially and emotionally.

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## **Abstract**

# **Adaptive Reuse of Industrial Buildings for Sustainability; Analysis of Sustainability and Social Values of Industrial Facades**

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This thesis examines an adaptive reuse approach to industrial facades for sustainability. It is natural that buildings become redundant for many reasons, such as changes in economic and industrial practices, cost of maintenance, and people's perceptions. Most of these buildings are no longer suited for their original function and a new use has not been decided for them. Adaptive reuse enables the conversion of existing, obsolete buildings and sites into new, mixed-use developments that will play an essential role in enhancing local communities. Recently, many coal-fired power plants in the United States have been retired because of the environmental regulations and the increased availability of natural gas. Through adaptive reuse, coal-fired power plants and abandoned industrial sites can contribute to life enhancement as a new source of vibrancy for the community, especially through focusing on the adaptive reuse of industrial facades. This thesis explores the changed ratio of facades comparing old industrial facades to new proposed ones. Based on Bollack's diagrams of architectural transformation (Bollack 2013), I re-categorize the diagrams and add other types of adaptive reuse dealing with facades of industrial buildings.

Additionally, analyzing several specific adaptive reuse projects, this thesis describes what potential values are in those projects and why it is important to focus on abandoned industrial buildings for urban sustainability. This thesis conducts a literature review on sustainability of adaptive reuse based on economic, environmental, and social values. The findings of this research show design criteria for industrial facade preservation and illustrate the positive effects of adaptive reuse. Through analysis of the case studies, this thesis proposes that the sustainable adaptive reuse of industrial buildings has great potential in social benefits.

**Keywords:** *adaptive reuse, sustainable design, industrial building, historic preservation, facade*

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## Chapter 1: Introduction

Cities have been continually changing politically, ecologically, economically and culturally. Especially in downtown areas, which were planned to have more density and more high-rise buildings for offices and commercial spaces, urban sites have been changing rapidly, while their original functions have been abandoned or new uses are emerging for them. Currently in many cities, industrial buildings built in the nineteenth century are no exception. Especially, in the United States, many coal-fired power plants are being retired because of environmental regulations and the increasing use of natural gas. In Stewart Brand's book, 'How buildings learn; what happens after they're built', he mentions that all buildings are changing intentionally or unintentionally.

*Almost no buildings adapt well. They're designed not to adapt; also budgeted and financed not to, constructed not to, administered not to, maintained not to, regulated and taxed not to, even remodeled not to. But all buildings (except monuments) adapt anyway, however poorly, because the usages in and around them are changing constantly (Brand 1994), p.2.*

As these industrial buildings occupy strategic locations in urban areas with access to valuable waterfront, these building sites have the potential to provide new functions and public space for community neighborhoods. Examples of reused industrial sites comprise riverfront residences, shops, and offices, as well as museums, parks, and other community spaces. Tan et al. emphasize that adaptive reuse of industrial buildings is a sustainable way of providing an alternative for various parties in cities such as government, stakeholders, and neighborhoods (Tan, Shen, and Langston 2015).

Architects and planners need to consider sustainable design, building energy reduction (e.g. embodied energy, operational energy), and historic significance of industrial buildings. Instead of demolishing a brownfield, adaptive reuse can create beneficial spaces. Its methods give specific opportunities for the public to perceive the value of historic buildings and to be attracted to new-born spaces.

There are several strategies of adaptive reuse for old buildings. Illustration 1 shows four different sketches representing the adaptive reuse method for historic buildings. The first drawing shows a retrofitting type which deals with an old facade. It is one method to consider historic significance or improve energy performance of old buildings. The second drawing represents a common typology of demolition conducted in many architectural projects, meaning that many developers want to demolish old buildings by deciding their economic value. The third one is a method to convert the ground level into public use, which is a modern solution for considering historic significance of old buildings. Furthermore, it is possible to make more open public spaces for visitors and neighbors. Many architects and planners have been opening the ground level for public use because it is attractive to people and enables a city to be more walkable. The last drawing is the type of adaptive reuse involving an addition, which it might be a great solution to provide more floor areas in dense cities for promoting spatial components and also help to keep the old buildings from being demolished.

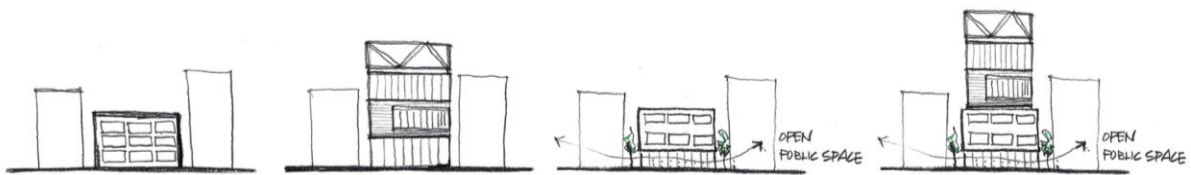


Illustration 1. Types of adaptive reuse from left to right; retrofit, demolition, conversion of the ground level, and addition. Drawn by the author.

### 1.1. Why industrial buildings matter

The questions of this research start with exploring a sustainable approach for providing appropriate uses for abandoned industrial buildings. I would like to focus on the reasons why we should keep the old industrial buildings and what potential values we could get from them without destroying them. The main research questions are below:

- *How do architects and planners deal with adaptive reuse of industrial facades for sustainability?*
- *Why is the adaptive reuse strategy important and what potential values are in adaptive reuse projects of abandoned industrial buildings?*

Many industrial buildings built in the mid-nineteenth century are now facing redundancy because of manufacturing industry declination. Douglas illustrates several options for reusing redundant industrial buildings (Douglas 2006). As the common characteristics of industrial buildings are large and single-story buildings, some industrial buildings are capable of being converted into sports facilities, industrial museums, or art galleries. With large open spaces and volumes, the spaces can provide room for exhibitions or open for public use. However, the adaptive reuse of industrial buildings also poses many challenges to face when converting into housing or offices. It is a matter of the size and condition for reusing those spaces (Douglas 2006).

This thesis focuses on retired coal-fired power plants and industrial sites. They have the potential to provide new functions or they could be demolished by stakeholders. However, expanding the life of buildings through adaptive reuse has positive effects that include lowering energy consumption, pollutions, and material costs, while creating new residential areas and contributing to sustainability. By giving a historic building a new

function and promoting greener practices, many buildings could benefit from new economic, social and environmental values. These benefits are not limited to the developer but are expanded to the community and the local government.

Expanding our views to not only industrial buildings but their occupied sites, it is possible to imagine that the old spaces can be converted into new places. According to Heidegger, the place in urban fabric can be interpreted as the space with time that social memory would be able to occur (Frampton 1996). Especially recently, people have been used to putting a high value on their own place which was related to their experiences. The ‘place’ might be an individual room or open public space in an urban city, which is relevant to enormous kinds of social relationship and natural environments.

Adaptive reuse may be considered as a tool to revitalize urban areas by positively stimulating the local economy through creating new public areas and jobs. Moreover, the action of historic preservation has the effect of promoting tourism by maintaining the old city blocks as something iconic (McCabe and Ellen 2016). These reasons enable private and public developers in the U.S. to choose adaptive reuse as a tool for urban revitalization and urban resilience.

According to research done by the U.S. Energy Information Administration (EIA)<sup>1</sup>, Figure 1 represents how the EIA expects renewable energy sources and natural gas to account for most of the capacity additions. The EIA predicts that coal-fired electricity generation will continue to decline gradually through 2050. This is a result of competition with natural gas prices (U.S. Energy Information Administration 2018). The coal power industry is facing major environmental regulations enforcing power plants to stop

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<sup>1</sup> The U.S. Energy Information Administration (EIA) is a part of the U.S. Department of Energy. Energy information is collected and analyzed for promoting policymaking, understanding energy for public, and it encourages an interaction with the economy and the environment.

generating electricity; 30% of the coal capacity was already retired in 2015, mostly from plants built between 1950 and 1970.

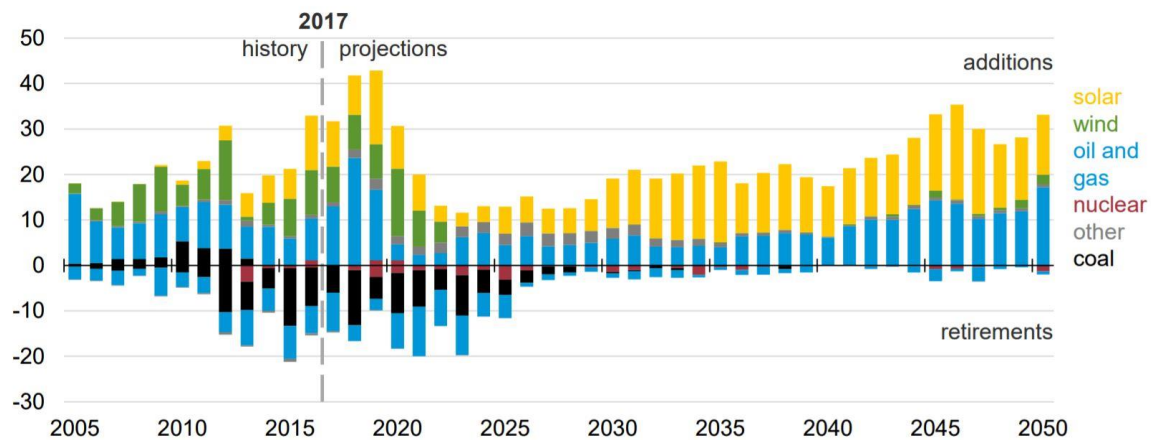


Figure 1. Annual electricity generating capacity additions and retirements. Source: U.S. Energy Information Administration.

Coal power capacity in the United States accounted for 39% of the country's electricity production in 2014, 33% in 2015, and 30.4% in 2016. The EPA (Environmental Protection Administration) has restricted coal plants from releasing mercury pollution, and smog in order to counteract global warming and to follow new standards (e.g. Mercury and Air Toxics Standards; MATS announced by EPA in December 21, 2011). Table 1 represents comparisons of number of electric power industry power plants by sector. In 2016, the remaining number of coal-fired power plants was 381 in the U.S., and the number will be decreasing gradually every year until 2020, based on the EIA report.

<i>Year</i>	<i>Coal</i>	<i>Petroleum</i>	<i>Natural Gas</i>	<i>Nuclear</i>	<i>Hydroelectric Conventional</i>	<i>Other Renewables</i>
2006	616	1,148	1,659	66	1,421	843
2007	606	1,163	1,659	66	1,424	929
2008	598	1,170	1,655	66	1,423	1,076
2009	593	1,168	1,652	66	1,427	1,219
2010	580	1,169	1,657	66	1,432	1,355
2011	589	1,146	1,646	66	1,434	1,582
2012	557	1,129	1,714	66	1,426	1,956
2013	518	1,101	1,725	63	1,435	2,299
2014	491	1,082	1,749	62	1,441	2,674
2015	427	1,082	1,779	62	1,440	3,043
2016	381	1,076	1,801	61	1,451	3,624

Table 1. Count of Electric Power Industry Power Plants, by Sector, by Predominant Energy Sources within Plant, 2006 through 2016. Source: U.S. Energy Information Administration, Form EIA-860, 'Annual Electric Generator Report.'

Figure 2 shows the location of coal power plants in the U.S. As mentioned above, coal-fired power plants in the U.S. will be retired due to several factors; their energy efficiency problem, EPA regulations, and the competition of low prices of natural gas. These locations will be abandoned or vacant for several other reasons, as well. Then, the power plants and their sites will be evaluated by criteria, such as economic, environmental, and social values.

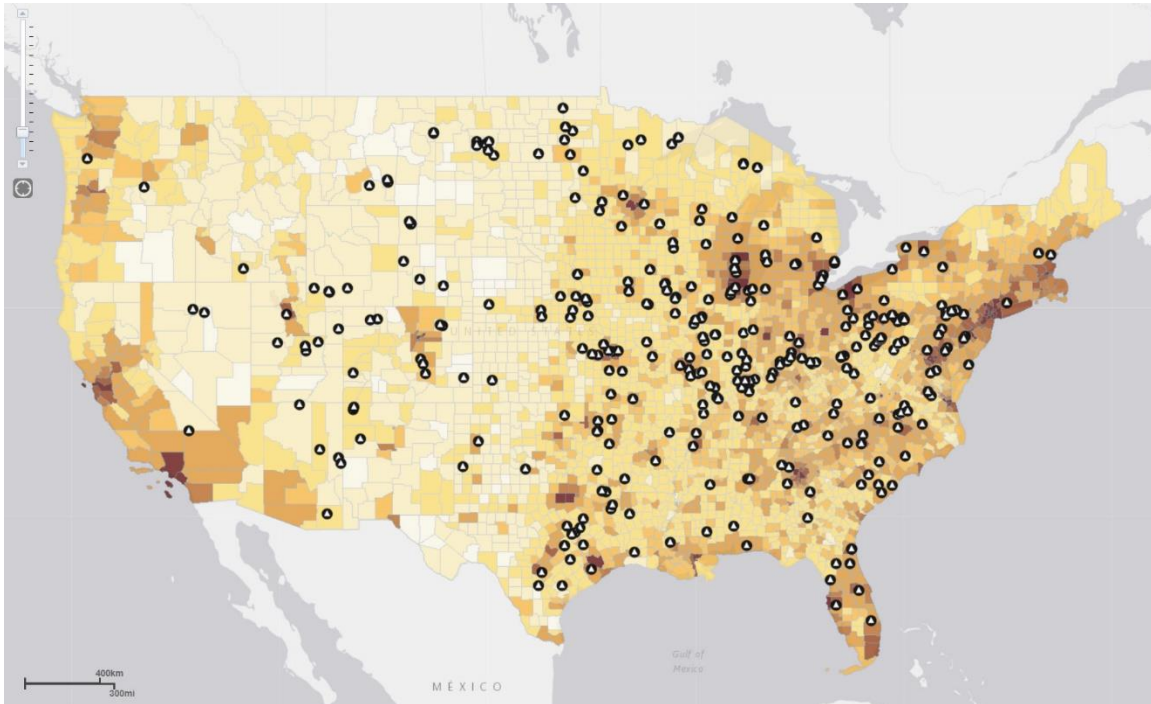


Figure 2. Coal power plant locations in the U.S., source from the U.S. Energy Information Administration (EIA).

Therefore, adaptive reuse of industrial buildings like coal power plants and abandoned industrial factories should be considered as potential brownfields for redevelopment. They have the potential to provide new private or public spaces in urban centers. With spatial advantages, the brownfields of industrial buildings become a key solution for urban sustainability. Ultimately, this thesis aims to examine the adaptive reuse potential of industrial buildings and demonstrate how to balance between preservation and sustainable development.



## Chapter 2: Literature Review

As the industry has declined, its strategic location of industrial buildings has potential opportunities to provide new spaces for its neighborhoods. Douglas emphasizes the sustainability of the adaptive reuse method compared to new construction characteristics in his book.

*Sustainability, “Reusing or upgrading old buildings is a more environmentally friendly than redevelopment. The latter involves demolition as well as new-build activities, both of which expend more energy and waste than adaptation (Douglas 2006).*

Through dividing a building’s components by using Brand’s ‘shearing layers of change’ diagram, it is possible to recognize that there are different rates of change of components. Brand illustrates its components by “six ‘S’s’”; site, structure, skin, services, space plan, and stuff (see Illustration 2). ‘Site’ indicates the geographical setting and has an eternal characteristic. The ‘structure’ is defined as the foundation and load-bearing elements, it has structural life ranges from 30 to 300 years. He explained that the ‘skin’, exterior surfaces, changes every 20 years or so. He named the working guts of a building as ‘services’, which comprise HVAC, plumbing, electrical wiring, elevators, and escalators. It has a seven to 15-year life span, thus many buildings are deconstructed because of outdated systems. Relevant to the interior layout, ‘space plan’ has different lifespans depending on the uses (commercial space – 3years, home – 30 years). Lastly, all the things which are daily changeable are ‘stuff’; furniture (Brand 1994).

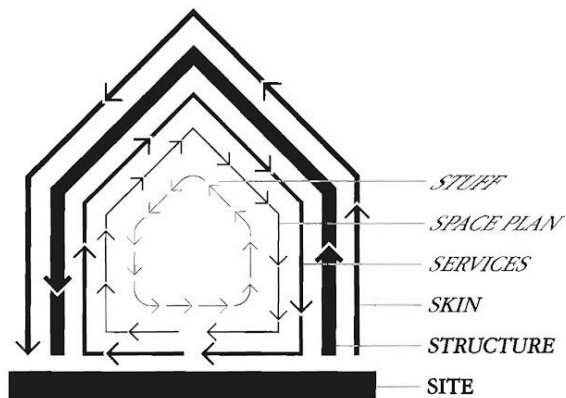


Illustration 2. "Shearing Layers of Change" by Stewart Brand (Brand 1994).

Based on the shearing layers of change, this thesis specifically focuses on the facade (skin) of old buildings. Most projects of adaptive reuse are dealing with their facade for energy retrofit or historic preservation of building heritage. The energy retrofit perspective is fitted into adaptive reuse projects and most industrial facilities are currently being considered to be changed into other uses such as housing (Valančius, Motuzienė, and Paulauskaitė 2015), or mixed-use development (Chalana 2016). Types and characteristics of adaptive reuse methods will be explored in chapter 4: Findings, comprehensively.

## 2.1. Definition of adaptive reuse

For this research, it is necessary to subdivide my thesis into sub-topics, such as a literature review of adaptive reuse, sustainability, historic preservation, and the value of historic facades. Through conducting literature reviews relevant to these terms, this thesis significantly will articulate social benefits of the adaptive reuse of industrial buildings. Furthermore, the findings would be related to economic, ecologic, cultural, artistic, and aesthetic values. From these findings, this thesis illustrates the methods of the adaptive reuse of industrial facades with sustainability and the positive effects on the social community in urban areas as a focus. Previous researchers explored and introduced the

adaptive reuse of heritage buildings for future generation (Appendino 2017; Phillips and Stein 2013; Ariffin et al. 2017; Avrami 2016; Ma, Liu, and Wang 2013; Adiwibowo, Widodo, and Santosa 2015).

For a comprehensive understanding of the definition of adaptive reuse, I explored several similar terms frequently used in architectural literature; adaptation, renovation, refurbishment, retrofitting, and rehabilitation (Wilkinson, James, and Reed 2009).

The term adaptive reuse has a definition of not only historic preservation but new life. Latham defines the adaptive reuse as “prolonging the period from cradle-to-grave for a building by retaining all or most of the structural system and other elements, such as cladding, glass, and interior partitions” (Latham 2000). The definition of adaptive reuse holds that as old buildings become unsuitable for their uses because of technology development, policies, and economic development, adaptive reuse is considered as a sustainable strategy for the reuse of sites or buildings.

Table 2 shows the definitions of related terms used in literature. Douglas describes that adaptation is any work to change a building’s capacity, function, or performance (Douglas 2006). At ICOMOS 2013 (International Council on Monuments and Sites), it explains that adaptation is an action for making existing use or a proposed use a place be suited in a place.

Addition also is used as a reusing solution in the built environment. An addition or an extension stands for adding stories or expanding the capacity of a building. An extension is an ability to increase the height/depth vertically or expand the plan area laterally (Douglas 2006). Byard assert in a book ‘The Architecture of Additions: Design and Regulation’ that an extension is a kind of addition set out to create new parts of an old business with relative independence while extending the understanding of the old building (Byard 1998).

<i>Terms</i>	<i>Description</i>	<i>Author/ Book</i>
adaptation	Any work to a building over and above maintenance to change its capacity, function or performance.	<i>Building Adaptation</i> (Douglas 2006)
	Adaptation meant changing a place to suit the existing use or a proposed use.	Icomos New Zealand, 2010 (ICOMOS 2013)
addition	Additions cannot be allowed except in so far as they do not detract from the interesting parts of the building, its traditional setting, the balance of its composition and its relationship with its surroundings.	The Venice charter 1964
conversion	Making a building more suitable for a similar use or for another type of occupancy, either mixed or single use.	Douglas 2006
	Work including a change in function or change in use, such as converting an office block and making it suitable for residential use.	Paul Watson, 2009 (Watson 2009)
	Conversions always affect the structure of a building. They extend the concept of refurbishment to interventions in the loadbearing members and/or the interior layout.	Giebelier 2009 (Giebelier, Krause, and Fisch 2009)
extension	Expanding the capacity or volume of a building, whether vertically by increasing the height/depth or laterally by expanding the plan area.	Douglas 2006
	Any extension is a new structure that is directly connected with the use of the existing building.	Giebelier 2009
refurbishment	Work that is related to a change in performance.	Paul Watson 2009
	The refurbishment of a building always means adapting it to meet current standards, too, whether because of change in users' demands or new technical regulations.	Giebelier 2009

Table 2. Similar terms with 'adaptive reuse' and their definitions in other articles or books.

<i>Terms</i>	<i>Description</i>	<i>Author/ Book</i>
rehabilitation	Modification of a resource to contemporary functional standards which may involve adaptation for new use.	ICOMOS Appleton Charter 1989
	Rehabilitation is defined as the act or process of making possible a compatible use for a property through repair, alteration, and additions while preserving those portions or features which convey its historical cultural or architectural values.	U.S. Secretary of the Interior 1995
remodeling	This is a North American term analogous to adaptation. It essentially means to make new or restore to former or other state or use.	Douglas 2006
renovation	Upgrading and repairing an old building to an acceptable condition, which may include works of conversion.	Douglas 2006
	Renovation does not add anything new to the building stock, nor does it replace old with new. Instead it maintains the value and the function of the existing building through competent “unkeep.”	Giebelier 2009
retrofitting	The redesign and reconstruction of an existing facility or subsystem to incorporate new technology, to meet new requirements or to otherwise provide performance not foreseen in the original design.	Iselin and Lemer 1993 (Iselin et al. 1993)
	Retrofitting is the replacement of building components with new components that were not available at the time of the original construction.	<i>Conservation as Preservation or as Heritage</i> (Ashworth 1997)

Table 2. Continued.

In 1905, there was an action of adaptive reuse by Peabody & Stearns to expand Boston Custom House which was originally designed by Ammi Young in 1849 (see figure 3). Bollack illustrates in the book, ‘Old Buildings New Forms: New Directions in Architectural Transformations’, the original Boston Custom building was treated as a base for the new taller building, which had a fundamental idea for visual continuity achieving harmony with classical architecture and the art of architectural composition (Bollack 2013). The strategy was to have new additional spaces and also keep the classical composition using symmetry, alignments, scale, and similar form.



Figure 3. Custom House tower, Boston, Massachusetts, photo courtesy of Detroit Publishing Co.

A similar word, conversion, represents functional change such as converting an office block and making it suitable for residential use (Watson 2009). Douglas also articulates that conversion is a method that considers a similar use for another type of occupancy (e.g. mixed or single use) and to make the function fit into a building appropriately.

Refurbishment and retrofitting are both frequently used with energy performance perspectives of an old building. Giebeler et al. explains that the refurbishment of a building definitely has an action for transforming it to meet current standards (Giebeler, Krause, and Fisch 2009). The term ‘renovation’ can be distinguished from adaptive reuse in that adaptive reuse can involve spatial additions to building stocks.

## **2.2. Historic preservation and facade**

*[P]reservation is no longer a retroactive activity but becomes a prospective activity. Rem Koolhaas ‘Preservation is Overtaking Us’ (Koolhaas 2004).*

An adaptive reuse strategy always takes into account the preservation of building heritage. From historic preservation perspectives, concern of historic preservation in the United States started during the nineteenth century, however, the efforts for preservation or conservation were almost entirely focused on historic landmarks which were considered to have cultural heritage. The first national legislation to promote protection of historic resources was the American Antiquities Act of 1906<sup>2</sup> (Green and Watson 2011).

Despite several efforts to preserve old resources, the destruction of Pennsylvania Station in New York in 1963 was a turning point for historic preservation. As it was torn down to make spaces profitable, it became the major impetus for the National Historic Preservation Act of 1966<sup>3</sup> (Laura Colini 2011). Lewis Mumford criticized the loss of this building for “an irresponsible act of public vandalism.” (Green and Watson 2011). This

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<sup>2</sup> The Antiquities Act of 1906, was signed into law by Theodore Roosevelt on June 8, 1906, in the United States of America. The purpose of this law is to protect “significant natural, cultural, or scientific features”.

<sup>3</sup> The National Historic Preservation Act (NHPA; Public Law) is legislation for preserving historical and archaeological sites in the United States of America. This preservation legislation was signed into law on October 15, 1966 by Lyndon Baines Johnson.

preservation legislation has been an essential role of promoting the ability of the federal government to keep designated historic buildings from deconstruction by delaying or managing preservation works appropriately.

Facade refers to the face of a building, which represents a major characteristic of any building. A building facade becomes an element of an urban space characteristic; the streetscape. Many adaptive reuse projects deal with their facade (building skin). As the facade represents the visual elements of a building, meaning facade preservation is responsible for preserving memories about building's background and function. Therefore, the adaptive reuse of the historic facade has the meaning of preserving historic significance and memory of an old neighborhood. Adiwibowo et al. explains that attractions of visiting historic places are influenced by public appreciation towards historical buildings (Adiwibowo, Widodo, and Santosa 2015). Preserving the historic facade encourages the old buildings to be attractive to tourism (Ariffin et al. 2017).

For a positive evaluation of an adaptive reuse project, it is necessary to understand the building's background and information. Furthermore, the emotional perception or attraction is also considered as a design element because historic buildings are evaluated by their aesthetic or visual elements such as color, material, and proportion (Coeterier 2002). Furthermore, architectural style, shape, size, age, texture, proportion and scale of the building are also considered at a design phase (Hossein Askari and Binti Dola 2009; Hossein Askari, Dola, and Soltani 2014).

Through exploring the relationship between the adaptive reuse of industrial facades and social benefits, this thesis fits into the literature of sustainable redevelopment and historic preservation for social community. The aim of this research therefore is to illustrate the reasons why we should keep the historic industrial buildings from being demolished, and to evaluate the selected projects based on my own criteria.



### **2.3. Adaptive reuse and sustainability**

The adaptive reuse strategy is closely linked to sustainability. Preservation and reuse of historic buildings reduces resource and material consumptions, and consumes less energy than demolishing buildings and new construction (Washington State Department of Archaeology and Historic Preservation 2011). When architects and planners deal with abandoned industrial buildings and sites, they consider balancing between historic preservation and sustainability. This research contends that a specific concept of urban resilience needs to be considered with a bouncing forward perspective, especially in the built environment. In historic preservation literature, researchers mainly deal with adaptive reuse as a method to increase historical significance (Appler and Rumbach 2016). A sustainable approach to abandoned industrial buildings and sites needs to be investigated by defining adaptive reuse and illustrating the relationship between adaptive reuse and sustainability.

In a broader sense, adaptive reuse plays a significant role in promoting sustainable development (Phillips and Stein 2013). As the adaptive reuse method uses an existing site and building, it helps reduce embodied energy compared to new construction. Richard Moe, who was a president of the U.S. National Trust for Historic Preservation, explains that the reuse of older buildings preserves embodied energy (Moe 2008).

As adaptive reuse methods deal with existing sites and buildings, especially if we use historic industrial sites in an urban area, it also helps to prevent urban sprawl. According to the U.S. Green Building Council (USGBC), in the United States only, buildings account for almost 40 percent of national CO<sub>2</sub> emissions (see Figure 4) (U.S. Energy Information Administration 2011). Moreover, buildings in the U.S. account for 39 percent of total energy use. The built environment has a vast impact on the natural

environment. From these concerns, the ‘green building’ concept is becoming increasingly desirable within the international construction market (U.S. Green Building Council 2016).

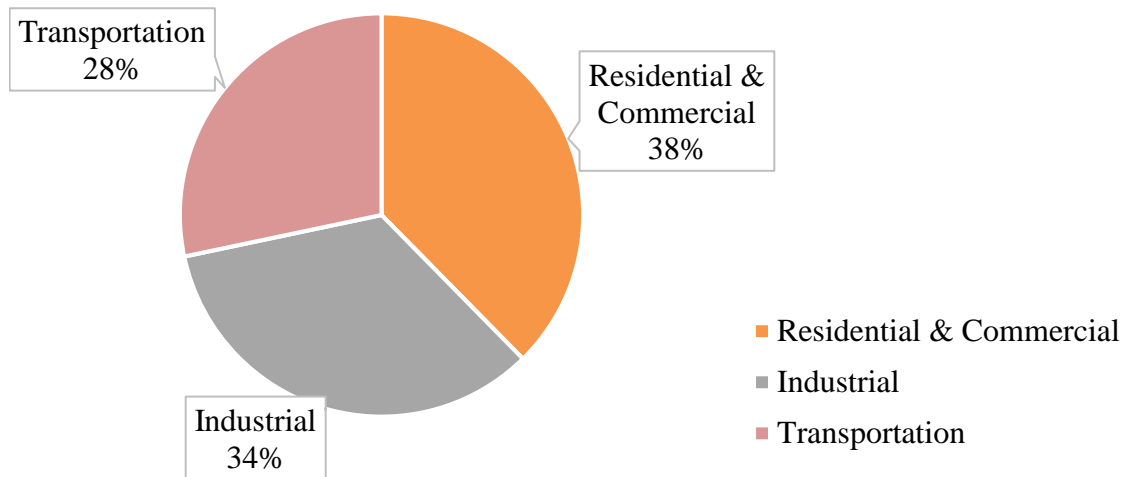


Figure 4. U.S. Greenhouse gas emissions by sector, 2009. Source: U.S. Energy Information Administration.

The concept of ‘sustainable development’ was addressed by the World Commission on Environment and Development (WCED) in its popular report, the Brundtland Report, ‘*Our Common Future*’, and is described as “development that meets the needs of the present without compromising the ability of future generations to meet their needs” (World Commission on Environment and Development (WCED 1987). Sustainable development involves two strategies; one involves a decision about what is to be sustained and the other contains distinct ideas about what is to be developed. Three major categories are identified; nature, life support, and community. The ideas of what is to be developed comprise people, economy, and society (National Research Council (U.S.). Policy Division, Board on Sustainable Development 1999).

For sustainable development, Scott Campbell conceptualizes the 3Es (e.g. Economic development, Environmental protection, and Equity). Figure 5 shows “the

planner's triangle" for sustainable development addressed by Campbell (Campbell 1996). The corners represent three priorities and the three axes between each point means conflicts which are always in between two factors. Campbell emphasizes the ideal sustainable development harmonizes the three factors, reaching the elusive center of the triangle (Campbell 1996).

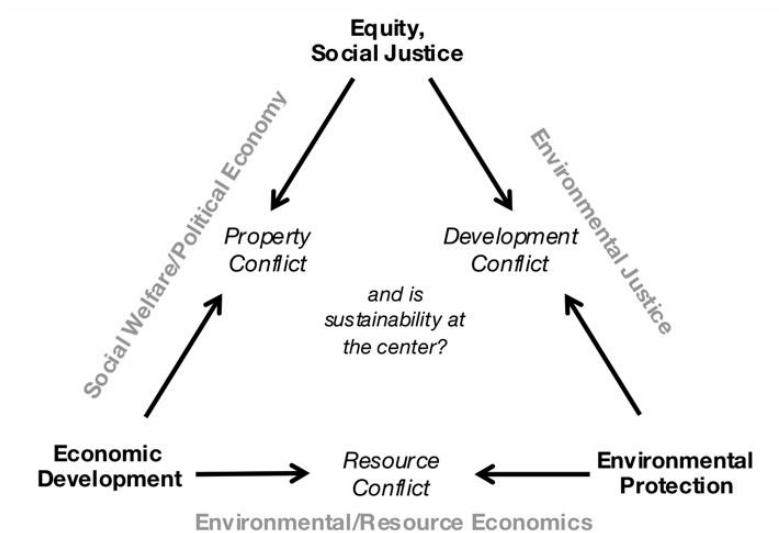


Figure 5. "The Planner's Triangle," for sustainable development by Campbell (Campbell 1996).

From Campbell's point of view, adaptive reuse strategy should be evaluated based on those elements. I selected fourteen different projects whose findings and evaluations are explicitly highlighted in Chapter 4.

With green building ideas and sustainable development strategies, adaptive reuse can be understood as a method for promoting energy performance of old buildings. Bullen and Love evaluate the effectiveness of adaptive reuse in Los Angeles based on sustainable urban regeneration criteria; retention of existing buildings, repopulating urban areas,

improving the social equity, reducing crime rate, reducing vehicle use, and reducing energy consumption. The residents recognized the adaptive reuse strategies as urban regeneration and sustainability (P. A. Bullen and Love 2009).

As mentioned above, a relationship between historic preservation and building performance is significantly influenced by a building's skin (facade). Because adaptive reuse mostly deals with original building facades to enhance their performance and to keep their social values, the method is considered to have strong potentials for sustainability. Through conducting refurbishment, retrofit practices involved in adaptive reuse methods for energy conservation, the retrofitting process can be recognized as one of the new ideas for making sustainable and green buildings in urban areas.

## **Chapter 3: Methodology and Methods**

In this chapter, I will describe the purpose of this study, methods of holistic research process, and the methodology employed. The purpose of the inquiry is to describe positive aspects of adaptive reuse of industrial buildings with a focus on facade preservation. To understand the adaptive reuse methods for historic buildings, this thesis explores the social, economic, historic and environmental values.

### **3.1. Methodology**

My epistemological perspective is constructivism, which means that I take the position that there is an interaction between human experiences and ideas. Significantly, this thesis starts from the idea that the built environment that we have developed and the natural environment are both influenced by human behaviors and experiences, which are socially constructed. This thesis is drawn from adaptive reuse projects by using a mixed research methodology; qualitative and quantitative. Illustration 3 shows the research design of my research process.

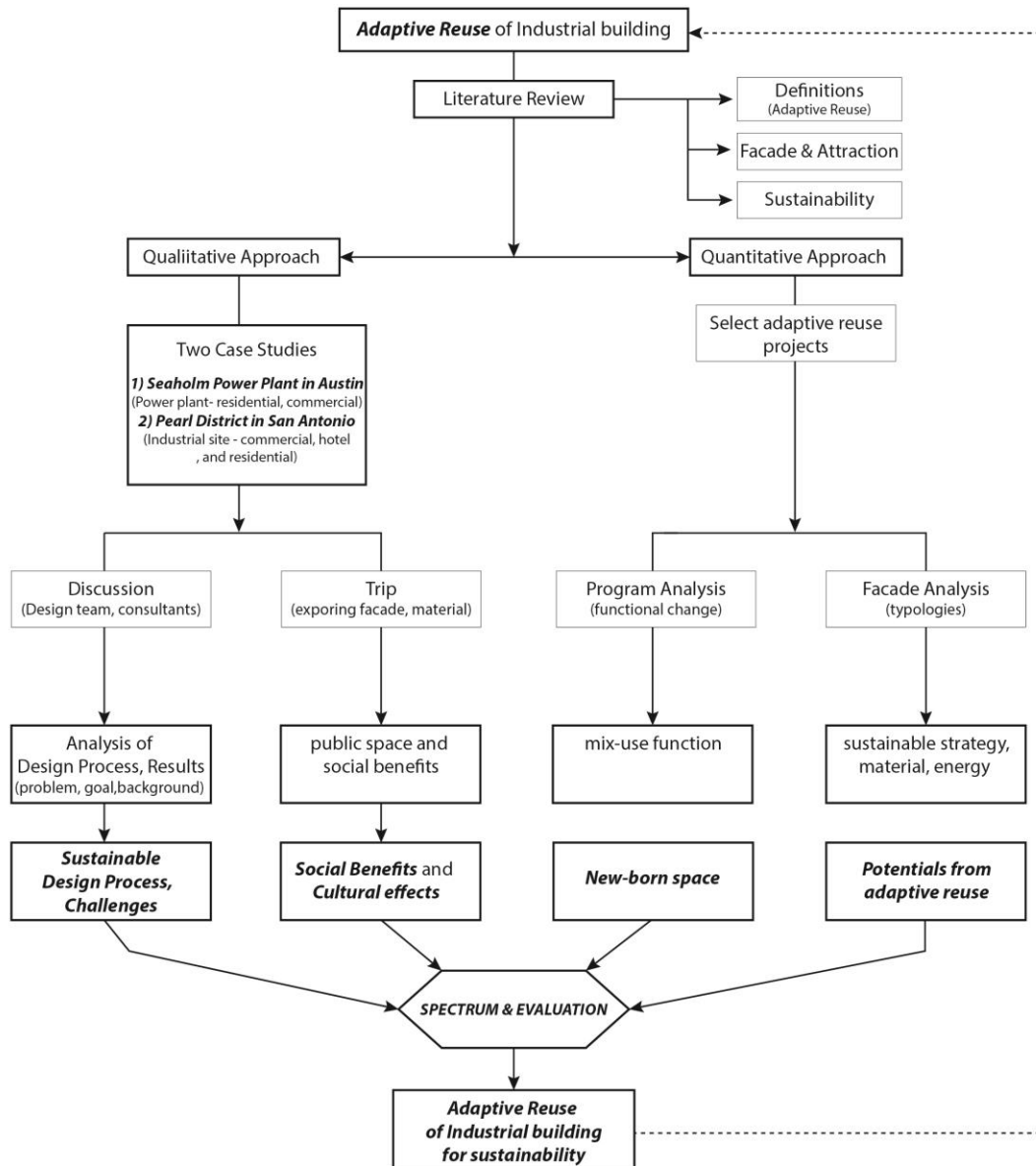


Illustration 3. Research Design

### **3.2. Methods**

For this research, I selected four specific methods/tactics to analyze adaptive reuse projects; literature review, discussions with architectural designers, adaptive reuse pattern analysis, and two case studies of industrial buildings.

Initially, I conducted a literature review to search the definition of ‘adaptive reuse’ in the built environment. There are some similar terms with adaptive reuse, for example, addition, alteration, conservation, conversion, preservation, rehabilitation, renovation, and restoration (Wong 2017). This thesis explores the term, ‘adaptive reuse’, by comparing similar words and searching how the term ‘adaptive reuse’ is in use (see the Chapter 2: Literature Review). The literature review is categorized by three elements; 1) definition of adaptive reuse, 2) historic preservation and facade, 3) sustainability.

Adaptive reuse methods are highly related to historic preservation. Through a literature review, I analyzed the benefits of historic preservation. Additionally, I explored the perspectives of preservationists, including designers and scholars, from when they conducted their projects. By analyzing historic preservation projects in the relevant literature, I focused on the relationships between the building’s preserved and the roles in social environments. Furthermore, I will address not only the physical aspects of historic significance, but also social values and the emotional impacts on neighborhoods.

Adaptive reuse pertains to a major change of an existing building’s function when its former function has become obsolete. This thesis examines the social, cultural, ecological, and economic values of the adaptive reuse method in detail. My goal is to research the benefits that will be useful for both practitioners and the predicted occupants through adaptive reuse methods. Through the literature review, I will demonstrate ‘adaptive reuse for sustainability’ and describe the social factors in adaptive reuse projects.

For this research, I selected fourteen different projects relevant to adaptive reuse of buildings. Table 3 shows the information of the fourteen projects which were built from the 18th to the 19th century. They have different sizes, materials, proposed functions, and climate zones. These projects are evaluated by types of adaptive reuse based on revised diagrams. I will comprehensively discuss these in Chapter 4: Findings.

<i>no</i>	<i>project</i>	<i>architect</i>	<i>first built</i>	<i>new</i>	<i>city</i>	<i>country</i>
1	Seaholm Power Plant redevelopment	STG	1950s	2015	Austin	USA
2	Pearl Brewery Redevelopment	LAKE FLATO	1883	2009	San Antonio	USA
3	Hearst Tower	Foster and Partners	1928	2006	New York	USA
4	Westminster Arcade	NCA	1828	2013	Providence	USA
5	Rotermann's old and new flour storage	HGA	1904	2009	Tallinn	Estonia
6	Neues Museum	David Chipperfield	1855	2009	Berlin	Germany
7	Antwerp Port House	Zaha Hadid Architects	1990s	2016	Antwerp	Belgium
8	School of Design, The Melbourne University	NADAAA		2014	Melbourne	Australia
9	Apple Store, Upper East, NY	Bohlin Cywinski Jackson	1922	2015	New York	USA
10	Caixa Forum Madrid	Herzog & de Meuron	1899	2007	Madrid	Spain
11	Zeitz MOCAA	Heatherwick Studio	1921	2017	Cape Town	South Africa
12	Tate Modern	Herzog & de Meuron	1947	2000, 2016	London	UK
13	Bunny Lane House	Adam Kalkin	1890s	2001	Bernardsville	USA
14	Higgins Hall, Pratt Institute	Steven Holl	1869	2005	Brooklyn	USA

Table 3. Adaptive reuse projects.

I discussed with architectural designers who were involved in successfully transforming the power plant in Austin. The discussions with practitioners who were actually involved in the design process proved helpful for understanding not only the



results of the planned adaptive reuse but also its challenges, intentions, and goals during the design phase. This provided the possibility to emphasize the positive effects of adaptive reuse, helping this thesis to illustrate sustainable design strategies for industrial facades in practice.

The Seaholm power plant redevelopment and the Pearl Brewery redevelopment that I selected for this study have a memory of industrial sites and new-born values for people in those cities. Analyzing the selected projects' characteristics with the criteria in the literature, I researched the benefits of several projects and addressed the social values of adaptive reuse of industrial buildings and sites.

Conducting case studies of the two adaptive reuse projects, especially industrial buildings, is an adequate approach for this research because of its primary characteristics: 1) a focus on cases in their contexts, 2) the capacity to explain causal links, 3) the role of theory development, 4) using multiple sources of evidence, 5) generalizability to theory (Wang and Groat 2013). In the book related to case study research, Yin describes a case study as the following definition: "A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (Yin 2014). Case studies are illustrated by archival research and formal analysis. Architectural drawings such as plan, section, and elevation are explored to make a spectrum of adaptive reuse projects. Analyzing historic districts with an old industrial building and focusing on its facade element, this thesis deals with social impacts of the facade on the public.

Furthermore, this thesis articulates the social impacts of adaptive reuse of historic industrial facades for neighborhoods. Through examining the adaptive reuse of industrial facades with sustainable objectives, this research categorizes examples for design strategies

that set a precedent for the treatment of the facade. This analysis will be a guideline for other coal-fired power plants and abandoned industrial sites in other cities.

To be specific, this thesis explores sustainable strategies and industrial facade preservation. Analyzing the buildings in other cities by selected criteria, this thesis demonstrates aspects of historic significance and sustainability.

Finally, I expect that these findings will be applied to other retired power plants and abandoned industrial buildings with sustainable strategies. These anticipated findings demonstrate the sustainable adaptive reuse of industrial facades and emphasize the significance of historic facades and their preservation for the social communities.

## **Chapter 4: Findings**

Many researchers and relevant organizations have been focusing significantly on sustainable cities. Sustainable cities can be achieved by growing denser, preserving smaller buildings in order to create diverse neighborhoods. Powe et al. support the idea that the preservation and reuse of old buildings play an essential role in creating sustainable cities while integrating old and new buildings (Powe et al. 2016). Rather than pursuing unplanned developments, architects and planners should consider planning for the life-enhancement and revitalization of existing urban communities. Adaptive reuse methods create difficulties for architects and planners as they make decision (P. A. Bullen and Love 2011). On the other hand, the adaptive reuse of industrial facades for sustainable purposes has diverse values and potentials for revitalization (Tam, Fung, and Sing 2016). This thesis includes the social benefits of adaptively reusing industrial facades to encourage many developers and architectural practitioners to reuse industrial buildings instead of demolishing them. This thesis will be relevant to the literature of sustainable architecture and urban design for abandoned industrial buildings and sites. Adaptive reuse methods also have many limitations to encourage urban revitalization and resilience; however, these have many opportunities such as reduction of energy consumption, material preservation, and production of new community spaces for existing neighborhoods (Washington State Department of Archaeology and Historic Preservation 2011).

### **4.1. Challenges, intentions, goals of adaptive reuse**

From a discussion with architectural designers who were involved in an actual project of adaptive reuse of an old industrial building, I was able to explore challenges, intentions, and goals which were inherent in the project. From this discussion, it was clear that at the early design phase, architectural designers and planners have various challenges

between historic preservation and development of the entire property, considering the fact that the entire property is a brownfield and requires permission from the government for the next process.

To be recognized as a successful example of adaptive reuse of an industrial building, the project needs to respect or preserve the significance of a building as well as provide a valuable new-layer for the future (P. A. Bullen and Love 2011). As architects and planners should consider both goals, such a project would have different challenges compared to new construction projects. Without significant considerations, desired goals or standards of new buildings may not be achieved even after adaptive reuse of heritage buildings; inappropriately proposed functions, uneconomical change, and unfamiliar transformation (P. Bullen and Love 2011b, 2011a).

Methods of dealing with historic industrial building are especially not easy to process. With strategic location, various kinds of parameters emerge, which play a significant role involving stakeholders such as the owner, developers, historic organizations, and the National Registry of Historic Places. Bullen and Love investigated and collected the data about positive and negative factors from interviews and surveys (P. A. Bullen and Love 2011).

They gathered the data and created categories of factors affecting the design process of adaptive reuse projects. Figure 6 represents the proportions of respondents identifying each factor during a decision process and a feasibility study phase. When the architects or planners were involved in an adaptive reuse project, environmental sustainability was identified as the most important factor during the design phase by 87 percent of the respondents. Moreover, they considered social impacts such as value to the local community (47 %), social sustainability (51%), heritage significance (83%), and cultural significance (68%). The economic sustainability was considered by 70 percent. Therefore,

the triple bottom line; environmental, economic, and social, is the main consideration for successful adaptive reuse of heritage buildings.

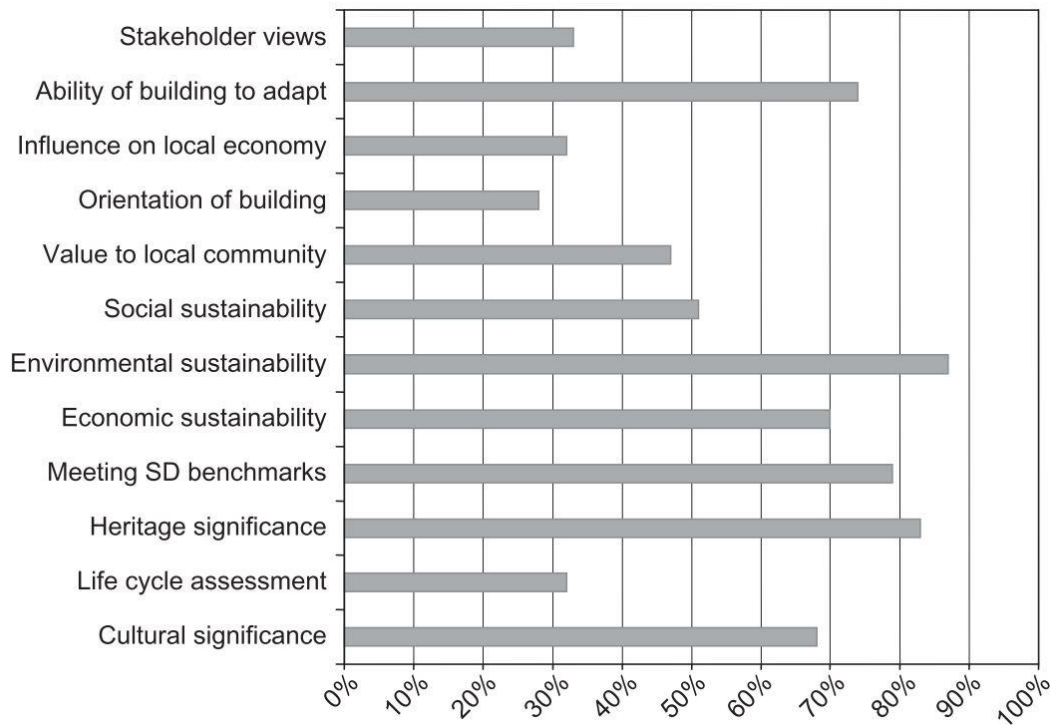


Figure 6. Factors that affect the adaptive reuse decision process, source: Bullen and Love, *'adaptive reuse of heritage buildings'*, 2011 (P. A. Bullen and Love 2011).

However, there are some barriers which are identified. As mentioned above, various stakeholders are involved in adaptive reuse projects. Moreover, heritage organizations have specific guidelines for historic preservation. Bullen and Love identified the heritage council guidelines as the most challenging factor which could be identified as a barrier by approximately 90 percent (see Figure 7). Figure 7 represents barriers implement adaptive reuse; concerns about materials, community value, heritage guidelines, visual impact, planning approval, and public awareness.

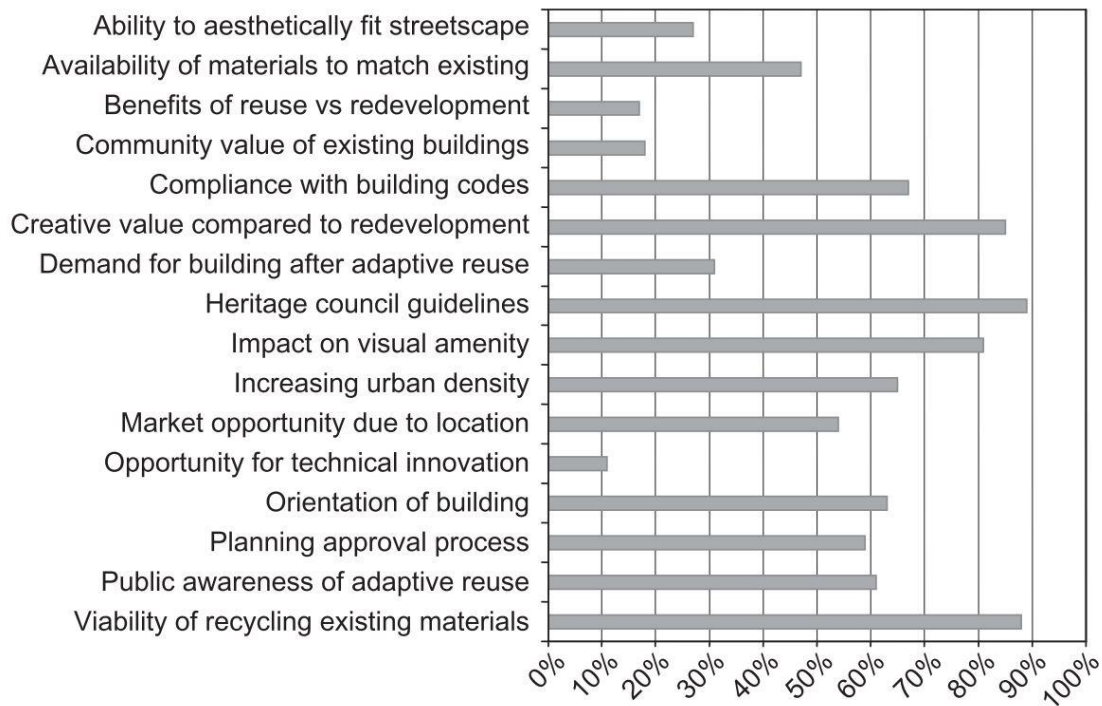


Figure 7. Barriers to implementing adaptive reuse, source: Bullen and Love, '*adaptive reuse of heritage buildings*', 2011 (P. A. Bullen and Love 2011).

From the discussion with architectural practitioners, many professionals recognize adaptive reuse methods as a huge factor to achieve sustainability. According to Bullen and Love's research, approximately 73% of respondents replied that the reduction of demolition is a factor in making a project sustainable. In architectural fields, the adaptive reuse of old buildings can also be a creative method for economic, environmental, and social impacts for their existing communities; historic resource, economic viability, extension of building life cycles (Giebelier, Krause, and Fisch 2009), reducing greenfield uses, increasing the value to the local community (McCabe and Ellen 2016), and reducing resource consumption (P. A. Bullen and Love 2011; Zagorskas et al. 2013).

## 4.2. Types of adaptive reuse

In Bollack's book, *'Old buildings new forms; New directions in architectural transformations'*, she conceptualizes adaptive reuse typologies. Depending on the changed patterns, she categorizes them into five different forms: 'insertions', 'parasites', 'wraps', 'juxtapositions', 'weavings'.

I modified the five diagrams into eight different types (see Illustration 4) based on Bollack's conceptual diagrams and analyzed adaptive reuse projects through use of these diagrams. I divided the 'parasites' type into three parts depending on how the old space interacts with the new space. To be specific, a 'Parasites' type invades the existing space, while 'parasites-stacks' and 'parasites-juxtapositions' types do not interrupt the old structures. I have kept Bollack's analysis: 'insertions' and 'weavings', but I added 'peeling' and 'transplanting' diagrams after visiting the sites of the Seaholm power plant and the Pearl Brewery Redevelopment project. I will comprehensively discuss these two in Chapter 5: Case studies.

Illustration 4 shows the relationship between an old building and a newly proposed addition. The black line represents its structure such as wall, floor, or envelope. The grey color space with green borderline shows a new function through adaptive reuse methods.

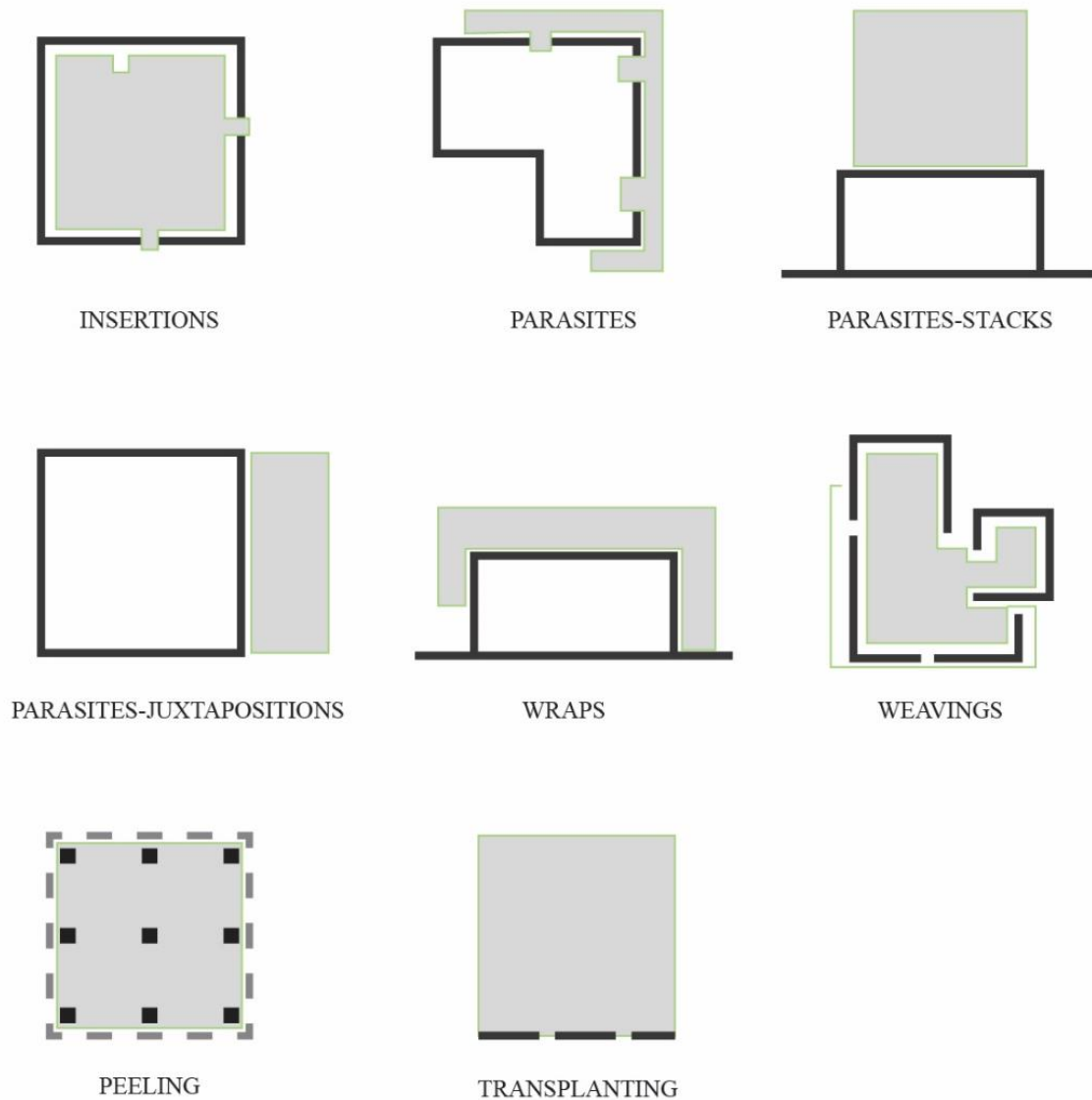


Illustration 4. Types of adaptive reuse, formal analysis, created by the author, based on Bollack, F.A (Bollack 2013).

The type '*insertions*' is a method of using existing old structure to protect original buildings while inserting new spaces into the older volume (Bollack 2013). Bollack describes the insertion method as maintaining the old building facade as a skin to preserve memories and emotion. The actual insertion defines the new space. Recently, many European cities have applied this strategy for inserting new space into old buildings which



were built in the late eighteenth and early nineteenth centuries. This is responding to the dense urban context. For example, Westminster Arcade (see Figure 8) applied the ‘*insertions*’ type, keeping the outer historic facade and inserting new functional spaces (micro unit apartments and retails). The existing skin is preserved with its old materials, forms, and proportions. With new functions inside and a preserved outside shell of memories, it is emotionally attractive for the public to see and perceive such old structures and forms, as this helps preserve the existing atmosphere of the historic districts.



Figure 8. Westminster Arcade facade, Providence, Rhode Island, U.S., photo courtesy of Northeast Collaborative Architects (left) the author (right) (Appendix A).

I categorized ‘*parasites*’ into three typologies; parasites, stacks, and juxtaposition. Bollock emphasizes that the ‘*parasites*’ type should have a positive and beneficial relationship with the host (old structure) and the parasite (new) (Bollack 2013). The types of parasites, stacks, and juxtaposition are distinguished by the form of addition.

Currently, the type ‘*parasites*’ comprises the original building and new additions, which are clearly legible (Bollack 2013). The original building keeps its form and material that can be recognized as its historic memory, while the new part is added on to the old structure, representing new forms and aesthetic. The new building after adaptation becomes

meaningful symbolically, historically, and adds interest through spatial layering (Bollack 2013).

*The ‘parasites-stacks’* type represents vertical adaptive reuse method; extension or addition. One characteristic of this type is that it clearly distinguishes the existing condition of the old facade and the new spatial addition with materiality, design, and form. This idea can be a direct solution for adding more spaces on existing sites, as pressures to increase floor space are increasing in many urban centers, with historic buildings occupying prime locations. The representative project related to this type is Hearst Tower in Manhattan, New York (see Figure 9).



Figure 9. Hearst Tower, New York. Photo courtesy of the author.

*The ‘parasites-juxtaposition’* type is categorized by horizontal addition adjacent to the old building. The addition is positioned next to the original building and does not interrupt the older structure. It looks like any other *‘parasites’* types, in Bollack’s notion, which are obviously legible; “no blurring of boundaries, no transfer of architectural elements” (Bollack 2013). The new and old facade are separated visually by distinct styles,

different materials, colors, and textures. Each form and volume are both valuable in their context.

A representative building with juxtaposed interventions is Higgins hall. Figure 10 shows an elevation view and plan drawing of the building which is currently used as an academic building for School of Architecture in Pratt Institute. This building was redesigned by Steven Holl architects after the fire destroyed the Central Wing of the building. The addition at the center of this building can be distinguished by different materials such as channel-glass. The added spaces are used as a functional inner connection, providing rooms for architectural studios and galleries for an exhibition.



Figure 10. Higgins hall, Pratt Institute School of Architecture, Brooklyn, New York, USA. Elevation view (left) and plan drawing (right). Photo courtesy of David Sundberg

According to Bollack's notion, a concept of '*wraps*' is encapsulating an older structure for protecting the original materials and forms (Bollack 2013). This strategy keeps the original volumes, but the old facade cannot be seen from the outer view. A building known as Kalkin's Bunny Lane House located in Bernardsville, New Jersey, shows the typical '*wraps*' concept. The architect, Adam Kalkin, explained the design concept as an

“airplane hangar”. New modern style envelope warps and encases the original cottage (see Figure 11).



Figure 11. Bunny Lane House, Bernardsville, New Jersey, 2001, Adam Kalkin Architect. Photo courtesy of Peter Aaron.

The ‘*weavings*’ strategy is similar with “patchworks”, weaving the addition and the original building. Like other adaptive reuse strategies, architects should decide whether or not leave the old structures intact or to eliminate it in the design phase. Weaving is common in reconstruction of ruins from the post-World War II or from natural disasters. The old elements or original facades are reused, and new additions resemble the old materials, facade composition, or proportion. It is not a method to conserve or restore the old building entirely, the new and the old parts are distinct.

The ‘*peeling*’ type literally means a method to eliminate an external wall, and then adaptively reuse the old columns, interior materials, and the original slabs. It is not a common type of adaptive reuse compared to other strategies. However, this strategy can produce public spaces with simply deleting the facade. Figure 12 shows the peeling type example. This concept will be illustrated in detail, describing the Pearl Brewery redevelopment project in Chapter 5: Primary Case Studies.



Figure 12. Peeling type in Pearl Brewery Redevelopment. Café (left), open public space (right), San Antonio, Texas. Photo courtesy of the author.

Lastly, the '*transplanting*' concept is to put the old parts into the new building like transplanting. Through saving the old materials and compositions of the facade, its elements can be kept and reused as the facade of a new proposed building. Then, the old parts can be recognized as an ornament, or artistic element with aesthetic, historic values. I explored this type of interventions within the School of Design building in the Melbourne University. This case will also be addressed and evaluated comprehensively in the next chapter.

### **4.3. Analysis of adaptive reuse projects**

This thesis addressed several types of adaptive reuse in detail. I selected fourteen adaptive reuse precedents which were applied in different approaches for harmonizing the new addition and the original building. For functional analysis of these selected projects, this thesis explores the function by comparing the old uses to the new proposed uses. Table 18 shows the comparisons of the original uses and the new programs of each building.

Abandoned industrial buildings, or obsolescent residential, commercial, academic buildings, or art museums, for various reasons (e.g. low energy efficiency, current energy standards, economic value loss, trend change, needs change, or environmental pressure), have been transformed and applied in new proposed uses. The new use should be compatible (ICOMOS 2013), which means that adaptive reuse methods take historic significance and long-term economic viability into consideration (Yung and Chan 2012). The adaptive reuse strategy is not only preserving historic elements but adding a contemporary layer which is valuable for the future and a long-term goal (Department of Environment and Heritage 2004).

#### ***4.3.1. Seaholm Power Plant Redevelopment***

Seaholm Power Plant is a historic power plant located in downtown Austin, Texas. The original structure and building of the power plant is listed on the National Register of Historic Places (NRHP)<sup>4</sup> and is a Recorded Texas Historic Landmark. In 1989, the plant stopped producing energy and finally stopped operating in 1996.

From 2004, the abandoned power plant was considered as a redevelopment site, and the Austin city council received proposals from several companies and consultants.

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<sup>4</sup> The National Register of Historic Places (NRHP) provides official list of districts, sites, buildings, structures, and objects which are have the worthy of preservation with their historic significance (Wikipedia 2018a).



The redevelopment plan started in mid-2013 with mix-used functions (e.g. condominium apartment, commercial use, and office), and finally completed in 2015. The basic information regarding the Seaholm Power Plant redevelopment is below (see Table 4). More detailed analysis of this adaptive reuse project will be discussed in Chapter 5: Primary Case Studies, which are related to social, cultural, environmental values.

Seaholm Power Plant Redevelopment	
Location:	Austin, Texas, USA
Area:	119,790 ft <sup>2</sup>
Original built:	1951
Original Use:	Coal-fired power plant
Adaptive reuse:	2015
Architect:	STG Design
Gross Floor Area:	810,000 ft <sup>2</sup>
New Use:	Condominium Apartment, Commercial (market, retail), Office
Top Height:	30 stories (Residential tower)



photo courtesy of the author

Table 4. Building Summary, Seaholm Power Plant Redevelopment.

#### ***4.3.2. Pearl Brewery Redevelopment***

The Pearl Brewery in San Antonio was one of the Texas' largest breweries in beer production before the prohibition of production, importation, transportation, and sale of alcoholic beverage (Wikipedia 2018c). The Pearl Brewery was owned by several companies until 2001. In 2000, 'Pabst Brewing Company' had a plan to close all breweries and end their beer production because of economic problems. This finally resulted in ceasing operations and abandoning their remaining facilities in 2001.

Pearl Brewery Redevelopment	
Location:	San Antonio, Texas, USA
Original built:	1883
Original Use:	Brewery Company (Industrial building)
Adaptive reuse:	2009
Architect:	Lake   Flato
Area:	93,000m <sup>2</sup>
New Use:	Mix-used development, Residential apartment, Commercial (market, retail), Office, Education Hotel, Performance center
Top Height:	10-story (Residential apartment)



photo courtesy of the author

Table 5. Building Summary, the Pearl Brewery Redevelopment.

Table 5 shows the building summary of the Pearl Brewery Redevelopment. The brewery's building started to be considered as a strategic location for redevelopment because it was near the downtown area and near several highways in San Antonio. Furthermore, it was close to the San Antonio River Walk<sup>5</sup> which is a major tourist attraction. These attributes could be a motif for successful development with preserving the brewery facilities. The historic brewery facilities are converted into a mix-used development with an adaptive reuse strategy preserving the old brick materials/facade and providing new active commercial uses. The private owned industrial site was rehabilitated and restored as a tourist attraction.

<sup>5</sup> The San Antonio River Walk is an attractive place to tourists and neighborhoods with a successful pedestrian street along the banks of the San Antonio River. It is a city park, and it was planned from 1921 for flooding control. In 1938, "San Antonio River Beautification Project" started with 2.5-mile-long River Walk.



#### 4.3.3. Hearst Tower

New York City's first 'green' high-rise, LEED Gold skyscraper, Hearst Tower, was completed in 2006 by the architect Norman Foster with an adaptive reuse strategy. The original six-story building was the office for headquarter of Hearst Magazine, which was designed by the architect Joseph Urban in 1928 ("Hearst Tower (Manhattan)" 2017).

The old building which had a historic cast stone facade was designated as a historic landmark by New York City Landmarks Preservation Commission. With the strategy of historic preservation, the building got an approval for the new addition from the Landmarks Commission. The historic building was planned to play as a base for the new tower. After 80 years, the new office tower addition was completed above the historic building ('parasite-stacks' type) (see Figure 13 and Table 19). The new addition provides 46 stories of office space with a symbolic external diagrid structures. A harmonic balance between the old and the new form is attractive to the public. The Hearst Tower creates a strong visual impact on the Manhattan street with contemporary intervention (Goldberger 2015). Paul Goldberger, an American architectural critic and educator, describes the Hearst Tower in his book 'Building with history'. The description about the tower is the following;

*"Foster builds with history as a way of looking forward, not backwards, reconceiving the old not as an artifact but as an essential part of contemporary life. The goal is to bring the old into a harmonic balance with the new, and to provoke a dialogue that gives each of them a different and richer architectural identity than they could ever have had on their own—an identity that embraces a wide temporal arc. The presence and visibility of this arc makes each of these works of architecture and civic space a living and changing thing, not an object frozen outside of time. In every project examined here, while the new would not have been brought into existence without the old, the old would have an entirely different existence—and a vastly diminished meaning—without a contemporary intervention beside it to provide the architecture of the past with constant challenge, protection and resonance." Paul Goldberger, 'Building with History', 2015 (Goldberger 2015)*

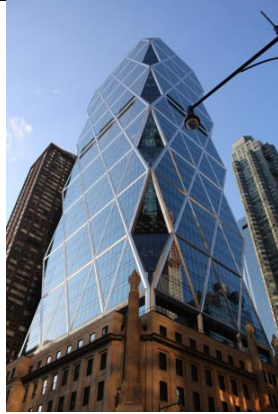
Hearst Tower		
Location:	Manhattan, New York City, U.S.	
Original built:	1928	
Original Use:	(Architect: Joseph Urban) office (6-story, 40,000 ft <sup>2</sup> )	
Adaptive reuse:	2006	
Architect:	Foster + Partners	
Gross Floor Area:	861,100 ft <sup>2</sup> (2,150%)	
New Use:	Office, Commercial, Gallery	
Top Height:	182m (597 ft), 46-story	

photo courtesy of the author

Table 6. Building Summary, Hearst Tower.

Through extraordinary additions above the original building, the tower provides more office spaces, a four-story atrium which is used as exhibition and restaurant space (see Figure 13), and an energetic space with old structures and materials. Furthermore, it has positive impacts on the street level with its preserved facade and new striking tower.

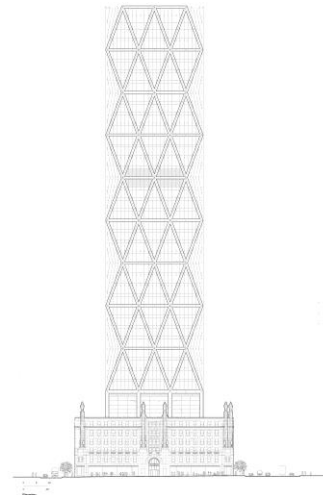


Figure 13. 3rd floor (left), photo courtesy of Chuck Choi and elevation drawing (right), courtesy of Foster and Partners (Appendix B).

#### 4.3.4. Westminster Arcade

The Westminster Arcade is in downtown Providence, Rhode Island. The building was originally built in 1828, and it was the first enclosed shopping mall in the United States. In the late 20th century, however, this shopping center declined economically. It was closed several times for renovation and rehabilitation to make changes. As it was declared as a National Historic Landmark in 1976 (also listed on the National Register of Historic Places in 1971), several plans for renovation were drawn up to keep the facade intact.

In October 2013, the Westminster Arcade reopened as a residence which has retail stores at the ground level and micro units on the second and third floor. The preserved facade comprises six massive Ionic columns and a triangular pediment (Westminster Street facade), which is recognized as a historic building by the public. The Arcade is a long and narrow shaped building connecting two streets. The building summary for the Westminster Arcade follows (see Table 7).

Westminster Arcade	
Location:	Providence, Rhode Island, U.S.
Original built:	1828 (Architect: Russell Warren)
Original Use:	Shopping mall
Adaptive reuse:	2013
Architect:	Northeast Collaborative Architects
New Use:	Residential (micro-loft), Commercial
Top Height:	3-story



photo courtesy of the author

Table 7. Building Summary, Westminster Arcade.

According to Table 18, the historic shopping mall is transformed into an attractive mix-used building with commercial, office, and residential use. With the type ‘insertions’

(see Table 19), this building meets current requirements by providing small retail stores and small residential units in downtown. Figure 14 shows a main avenue at the ground level with small retail stores and offices. The decorated cast iron railings on the second, third floor hallways are protected and preserved. An extended skylight provides natural sunlight for shopping and each entrance of the micro apartment units.



Figure 14. Commercial area at the ground level (left), photo courtesy of the author.  
Section drawing (right), courtesy of Northeast Collaborative Architects.

#### 4.3.5. Rotermann's old and new flour storage

This building was used for flour storage and is located in the industrial area for food production in Tallin, Estonia. Under heritage protection, the historic limestone building is preserved and obtained its new addition at the top and adjacent to the old one in 2009. Information about this building is in Table 8.

Rotermann's old and new flour storage	
Location:	Tallin, Estonia
Site Area:	1,447m <sup>2</sup>
Original built:	1904
Original Use:	Industrial building (Flour Storage)
Adaptive reuse:	2009
Architect:	HGA
Gross Floor Area:	9,002m <sup>2</sup>
New Use:	Office, Commercial, Storage, Parking lots
Top Height:	7 stories



photo courtesy of Martin Siplane

Table 8. Building Summary, Rotermann's old and new flour storage.

Figure 14 represents a concept diagram at the design phase, second floor plan drawing, and photo of outer facade. The diagram shows that architects planned to reuse the existing old building by making an addition at the top and a new volume with a juxtaposition intervention. This building comprises two specific adaptive reuse typologies; 'stacks' and 'juxtaposition' (see Table 19). The new building provides underground parking, retail stores at the ground floor, offices at the upper levels, and flour storage.

As shown in the floor plan, it is easy to recognize the old structures and new forms standing next to each other. The architect, HGA (Hayashi – Grossschmidt Arhitektuur),

describe that this project can be divided into three volumes; the old flour storage with two additional stories, the new flour storage, and atrium space connecting the two. The old and new addition can be distinguished by their materiality and colors; the old limestone and cor-ten steel. They explain the color of cor-ten steel as a response to the existing industrial context (HGA (Hayashi – Grossschmidt Architektur) 2018) (see Figure 15).

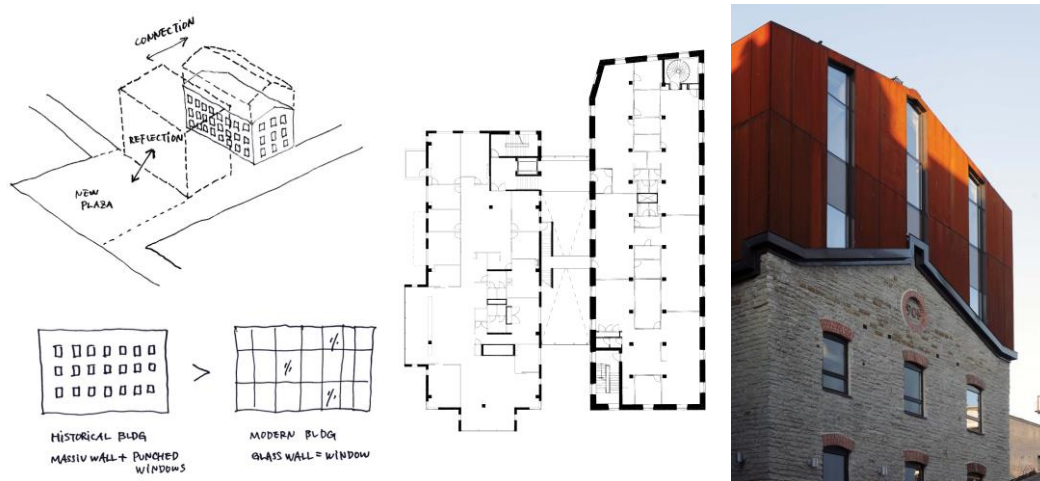


Figure 15. Design diagram, second floor plan, outer view from the left. Drawings courtesy of HGA and photo courtesy of Martin Siplane.



#### 4.3.6. Neues Museum

The Berlin Neues Museum was substantially damaged in the World War II, and it was reconstructed by David Chipperfield Architects starting in 2003 with the ‘weavings’ strategy (see Table 19). It was reopened in 2009, but, there were several debates about the difference in traditional conservation. Some were concerned with the loss of the building’s historic form and status (Wikipedia 2018b).

Neues Museum	
Location:	Berlin, Germany
Original built:	1855 (Architect: Friedrich August Stüler)
Original Use:	Museum
Adaptive reuse:	2009
Architect:	David Chipperfield Architects in collaboration with Julian Harrap
New Use:	Museum
Top Height:	102 ft (31 m)



photo courtesy of David Chipperfield Architects

Table 9. Building Summary, Neues Museum.

Lluís Hortet, director of the Mies van der Rohe Foundation, explained that the new architectural intervention contributes to the re-use of their heritage with improvements in functional qualities (Minner 2011). The adaptive reuse strategy did not conceal the difference between the old and new. It could make creative spaces with old and new materials. The museum was positively evaluated by the public because of its successful approach to preservation of the old and new architectural elements. Figure 16 shows an

architectural concept sketch by the architects and a photo of the interior view which represents the separation of the old and new.

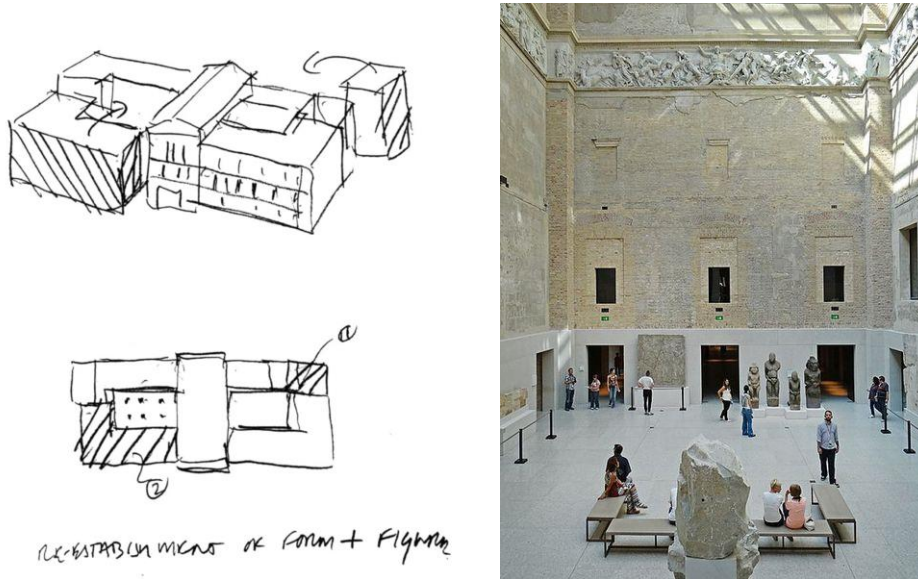


Figure 16. Concept sketch drawn by David Chipperfield Architects (left), drawing courtesy of David Chipperfield Architects. Interior view of the Neues Museum (right), photo courtesy of Jean-Pierre Dalbéra.



#### 4.3.7. Antwerp Port House

The new Port House in Antwerp is an adaptive reuse project by Zaha Hadid Architects, 2016. An abandoned fire station is converted into a new headquarters for the port's staff members that previously worked in separate buildings around the city (Archdaily 2016).

Antwerp Port House	
Location:	Antwerp, Belgium
Original built:	1855
Original Use:	Fire station
Adaptive reuse:	2016
Architect:	Zaha Hadid Architects
Gross Floor Area:	12,800 m <sup>2</sup>
New Use:	Headquarter of port, Library, Auditorium, Commercial, Residential



photo courtesy of Helene Binet

Table 10. Building Summary, Antwerp Port House.

Figure 17 shows its facade which represents the relationship between the old and new addition. The irregular geometry is stacked on the original building serving as an example of the '*parasite-stacks*' type. The new form appears to be partially supported by the old structure which plays a visual role as a base. According to the section drawing, a core is inserted into the center of the existing building and transfers the loads from the new structure to the ground ('*insertions*' type) (see Table 19), along with additional structure on the outside of the old building.

The abandoned fire station was transformed into new offices by adaptive reuse strategies. The new addition has a significantly different form and materiality compared to

the historic building. The floating building does not touch the old facade directly. However, the core does touch the building directly, as it penetrates the roof.

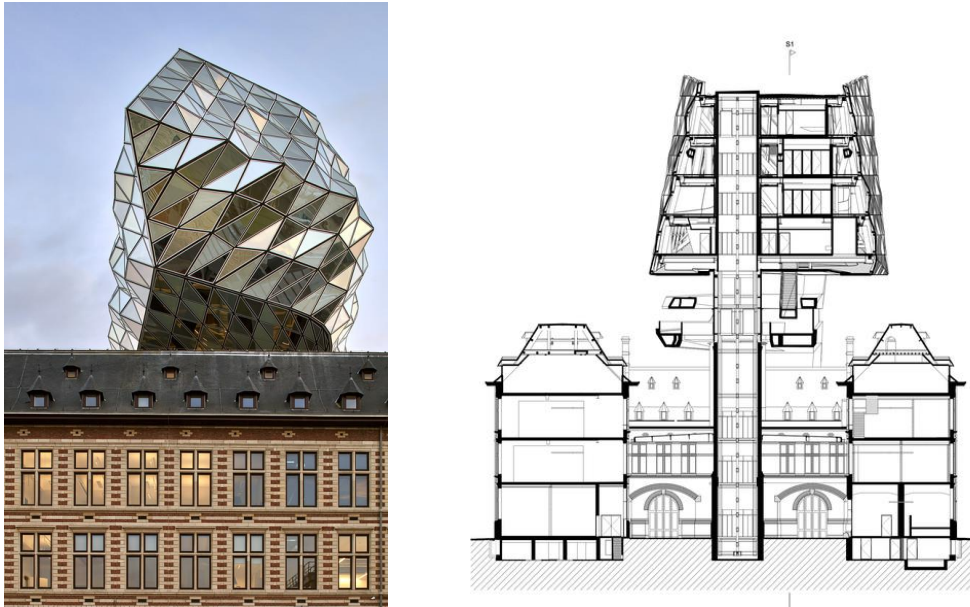


Figure 17. Facade elevation, photo courtesy of Hufton+Crow (left), Section drawing courtesy of Zaha Hadid Architects (right).

The old central courtyard is covered with a glass roof and it can be used as the main reception area for the new headquarter. As shown in Figure 18, people can perceive carefully restored and preserved original materials. The balance between the new extension and the existing building make a new form of space. The new extensions provide restaurants, meeting rooms, library, residences for the employees, and an auditorium (see Table 18).



Figure 18. The old fire station's courtyard, photo courtesy of Tim Fischer.

#### 4.3.8. School of Design, The Melbourne University

The new Melbourne School of Design building was built in 2014 with the 'transplanting' typology. Most parts of the building comprise contemporary design elements, but there is one interesting concept involved in this project. The new contemporary building uses one portion of the old building facade which was the former Bank of New South Wales (Archdaily 2015).

School of Design, The Melbourne University	
Location:	Melbourne, Australia
Original built:	1938
Original Use:	Education
Adaptive reuse:	2014
Architect:	NADAAA, John Wardle Architects
Gross Floor Area:	15,772 m <sup>2</sup>
New Use:	Education
Top Height:	5-stories



photo courtesy of NADAAA

Table 11. Building Summary, School of Design, The Melbourne University.

Figure 19 shows photos and a concept diagram related to adaptive reuse of the old facade. The transplanted part of the facade was used as not only as a new envelope but also a design idea. From the facade pattern and window openings, the architects wanted to extrude them to make dynamic space and extend to its design studios. The new design of the school building provides design studios, research areas, exhibition spaces, and a café. The preserved facade has no spatial aspects, but it would give design or architecture students a creative inspiration.

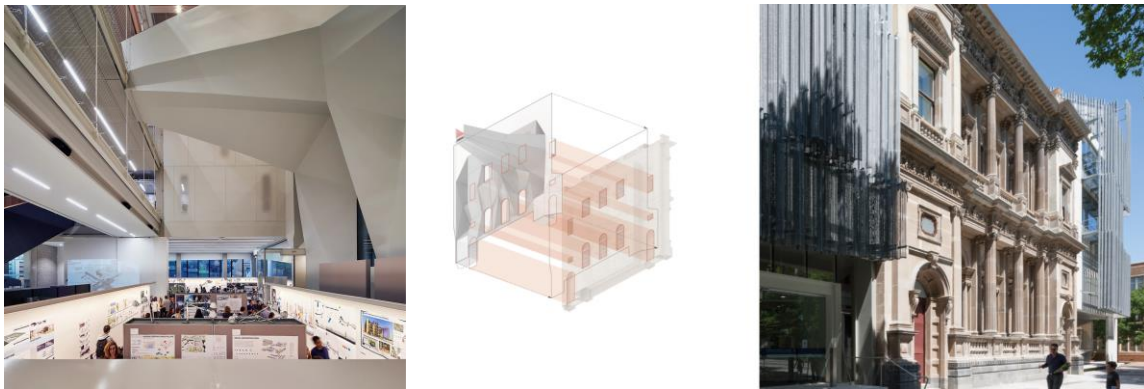


Figure 19. From the left, design studios, concept diagram, old building facade, School of Design, the Melbourne University, diagram and photos courtesy of NADAAA.

#### 4.3.9. Apple Store, Upper East, New York

Recently, Apple Inc. makes efforts to provide a new customer experience with renovation, restoration, and adaptive reuse of historic buildings. To honor its efforts, President Peg Breen in the New York Landmarks Conservancy said that “We thought that it was important to highlight how they can marry high tech with distinguished architecture.” (Keane 2016).

The Apple store on the Upper East Side was completed in 2015 after reusing the 1920s former U.S. Mortgage & Trust Bank. According to Bohlin Cywinski Jackson, they considered four principal component; 1) preservation and restoration of the exterior, 2) reconstruction of historic finishes, 3) sensitive alterations, 4) substantial upgrades to building services (Bohlin Cywinski Jackson 2015).

Apple Store, Upper East, New York	
Location:	Manhattan, New York City, U.S.
Original built:	1922
Original Use:	U.S. Mortgage & Trust (Architect: Henry Otis Chapman)
Adaptive reuse:	2015
Architect:	Bohlin Cywinski Jackson
New Use:	Commercial (Apple Store, Upper East Side)
Top Height:	2-stories



photo courtesy of Peter Aaron

Table 12. Building Summary, Apple Store, Upper East, New York.

This building would be categorized by ‘insertions’ type. New designed space was inserted into the historic building (see Table 19). The original function, office, was changed into the commercial space for selling or displaying smart devices. With the adaptive reuse

strategy, it provides historic significance and a new spatial experience with the old structures and materials for their customers (see Figure 20).



Figure 20. Interior view, Apple Store in Upper East side, New York. Photo courtesy of Peter Aaron.

#### 4.3.10. Caixa Forum Madrid

Caixa Forum Madrid was opened in 2008 after the adaptive reuse of the old electrical station in Madrid, Spain. The building is used as a museum and cultural center. The new extension and the old facade materials can be easily distinguished by color and texture. Herzog & de Meuron, Swiss architects, had a strategy to combine an old abandoned electrical station with new functions above the historic facade.

Based on adaptive reuse typologies, it comprises three types; *'insertions'*, *'parasite-stacks'*, and *'weavings'*. It used the structure of an old existing building as the base of the new addition (*'parasite-stacks'*). At the ground level, architects lifted the old building to create an under pathway (*'weavings'*). The new functional program includes a museum that fits into the old existing structures (*'insertions'*).

Caixa Forum Madrid	
Location:	Madrid, Spain
Site Area:	20,817 ft <sup>2</sup> (1,934 m <sup>2</sup> )
Original built:	1922
Original Use:	Electrical station
Adaptive reuse:	2008
Architect:	Herzog & de Meuron
Gross Floor Area:	11,000 ft <sup>2</sup> (118,069 m <sup>2</sup> )
New Use:	Museum, Cultural center
Top Height:	92ft (28m)



photo courtesy of Duccio Malagamba

Table 13. Building Summary, Caixa Forum Madrid.

From Madrid and the rest of the world, the museum is attractive to many people. Because of not only cultural programs in the museum but also the building itself, it has been a positive impact on attractions (DIVISARE 2008). The brick walls of the original building and new additions provides specific experiences at the street level (see Figure 21).





Figure 21. Outdoor view (left), CaixaForum, photo courtesy of Ismael Alonso. External facade (right), photo courtesy of Simon Garcia.

An abandoned industrial building was transformed into a creative design museum. It would provide cultural space, art museum, restaurants and bars, and offices. Furthermore, the historic material attracts people to come to this building for learning and enjoying.



#### 4.3.11. Zeitz Museum of Contemporary Art Africa

The largest contemporary art museum in Africa, Zeitz Museum of Contemporary Art Africa (Zeitz MOCAA) was completed in 2017 in Cape Town, South Africa. The museum was designed by Heatherwick Studio. It was rehabilitated and got a new life through adaptive reuse of the historic Grain Silo. Carving the monumental structure of the old Silo, the space was transformed into creative museum space. The old industrial building was abandoned because of its functional loss.

Zeitz MOCAA	
Location:	Cape Town, South Africa
Original built:	1921
Original Use:	Grain Silo Complex
Adaptive reuse:	2017
Architect:	Heatherwick Studio
Gross Floor Area:	102,257 ft <sup>2</sup> (9,500 m <sup>2</sup> )
New Use:	Art Museum, Office, Hotel, Commercial, Academic
Top Height:	9-stories



photo courtesy of Iwan Baan

Table 14. Building Summary, Zeitz MOCAA.

As shown in Figure 22, the silos' dense tube structures are carved to be used as galley spaces with its concrete features. New exhibition spaces inserted into the old structures (*'insertions'* type) and new additions were built above the original Silo building (*'parasite-stacks'* type). The new additions changed from the concrete facade to glass glazing panels (*'weavings'* type). The extension spaces are used as the Silo Hotel.

This new museum is known as Africa's Tate Modern, it provides contemporary art museum with 100 galleries, offices, boutique hotel, restaurants, and academic space. The Heatherwick Studio planned to preserve the original industrial heritage. Simultaneously,

they produced large open spaces and experimental galleries by excavating some parts of the old structures. The abandoned and private industrial building was transformed into a creative museum and public space with adaptive reuse ideas.



Figure 22. Inside view (left) and outer view (right), courtesy of Iwan Bann.

#### 4.3.12. Tate Modern

Tate Modern is a modern art gallery in London. It is the largest museum of modern and contemporary art in the world. In 2017, over 5.6 million people visited the Tate Modern. This building is well-known as a former power plant (Bankside Power Station was built in 1947). It was closed from 1981 - 2000, and it reopened to the public as the Tate Modern. Adaptive reuse of original structure and materials is more attractive to visitors and locals, and it has become an impressive cultural icon.

Herzog & de Meuron converted the Bankside Power Station to the Tate Modern. At the design phase, architects had to consider significant alterations for the new uses (Wong 2017). I categorized the Adaptive reuse pattern of Tate Modern as ‘insertions’, ‘parasite-stacks’, and ‘juxtaposition’ (see Table 19). New functions and layers were inserted into the huge volumetric space of the power plant (*‘insertions’* type), and the new addition was topped at the old building (*‘parasite-stacks’* type). In 2016, the Switch House was also designed by Herzog & de Meuron. It is an extension type providing additional display spaces (*‘juxtaposition’* type).

Tate Modern	
Location:	Bankside, London, UK
Site Area:	258,334 ft <sup>2</sup> (24,000m <sup>2</sup> )
Original built:	1947, 1963
Original Use:	Power Station
Adaptive reuse:	2000, 2016 (extension)
Architect:	Herzog & de Meuron
New Use:	Museum, Performance, Education, Office, Retail, Public space
Top Height:	325ft (99m), Central chimney, 11-stories (the Switch House)



photo courtesy of Fred Romero

Table 15. Building Summary, Tate Modern.

It created galleries, public spaces, and educational spaces while preserving the facade and the materials of the industrial building. The original turbine hall was converted into a unique space for exhibition. The large volume of the industrial building was able to be converted to exhibition spaces. Figure 23 represents ‘the Weather Project’ installation art by Olafur Eliasson. He took advantage of this space with a high quality exhibition (Jones 2013).



Figure 23. Outside view (left), photo courtesy of Hayes Davidson and Herzog & de Meuron. ‘The Weather Project’ by Olafur Eliasson in 2003 (right), photo courtesy of Richard Holt.

#### 4.3.13. Bunny Lane House

As I discussed the Bunny Lane house earlier, this house was approached with the ‘wraps’ strategy. The old original cottage was wrapped and encased with a new modern style skin. At the outer view, it is hard to see the original facade. The space between the old and new facade is used for the new house. The original rooms of the old cottage were transformed into new spaces, different rooms for use. As this method intends to enclose the entire original structure, it possibly had characteristics of energy performance improvement. In addition, it is a possible solution for historically preserving the old elements completely. This typology will be evaluated by several categories in Chapter 6: Analysis and Discussion.

Bunny Lane House	
Location:	Bernardsville, New Jersey, U.S.
Original built:	1890s
Original Use:	Cottage
Adaptive reuse:	2001
Architect:	Adam Kalkin
New Use:	House
Top Height:	3-story




photo courtesy of Peter Aaron

Table 16. Building Summary, Bunny Lane House.

#### 4.3.14. Higgins Hall, Pratt Institute

The Higgins Hall at the Pratt Institute is a home for design schools. As I introduced this building with the ‘juxtapositions’ characteristics, its different materials help distinguish two masses and spaces. The parallel spaces which were added are used as semi-public rooms; design studios and exhibition galleries. It obtained a characteristic of flexibility after adaptive reuse. The building summary is in Table 17.

Higgins Hall, Pratt Institute	
Location:	Brooklyn, New York City, U.S.
Original built:	1869
Original Use:	Academic
Adaptive reuse:	2005
Architect:	Steven Holl
New Use:	Academic, Architectural studios, Gallery
Top Height:	5-stories



photo courtesy of David Sundberg

Table 17. Building Summary, Higgins Hall, Pratt Institute.

Table 18 represents the comparison of uses in each precedent. All projects that I selected originally had only one use. I divided the original uses into six categories; residential, commercial, office, academic, art, and industrial building. In new uses, I added public use and hotel function categories. Through this research on these projects, this thesis enables results and analysis, revealing that the adaptive reuse of old buildings could have allow for new functions which reflect current trends and mix-used strategies for diverse rehabilitation.

<i>no</i>	<i>project</i>	<i>original uses</i>						<i>new uses</i>							
		<i>residential</i>	<i>commerca</i>	<i>office</i>	<i>academic</i>	<i>art</i>	<i>industrial</i>	<i>residential</i>	<i>commerca</i>	<i>office</i>	<i>academic</i>	<i>public use</i>	<i>art</i>	<i>hotel</i>	<i>industrial</i>
1	Seaholm Power Plant redevelopment														
2	Pearl Brewery Redevelopment														
3	Hearst Tower														
4	Westminster Arcade														
5	Rotermann's old and new flour storage														
6	Neues Museum														
7	Antwerp Port House														
8	School of Design, The Melbourne University														
9	Apple Store, Upper East, NY														
10	Caixa Forum Madrid														
11	Zeitz MOCAA														
12	Tate Modern														
13	Bunny Lane House														
14	Higgins Hall, Pratt Institute														

Table 18. Original and new proposed uses of each building.

As I mentioned above, 14 projects have different types and strategies for adaptive reuse of old buildings which might depend on the site condition, original materials, important parts for preservation, and diverse stakeholders. Most selected projects have two specific typologies for preserving the old structures and facade. Architects should decide which strategy is the best fit for an old site, historic materials, or facade. There are various advantages and disadvantages to applying specific types socially, economically, and environmentally.

no	project	adaptive reuse type								facade increase ratio (the new: the old)
		insertion	parasites	stacks	juxtaposition	wraps	weavings	peeling	transplanting	
1	Seaholm Power Plant redevelopment									diverse
2	Pearl Brewery Redevelopment									diverse
3	Hearst Tower									800%
4	Westminster Arcade									0%
5	Rotermann's old and new flour storage									130%
6	Neues Museum									50%
7	Antwerp Port House									230%
8	School of Design, The Melbourne University									1200%
9	Apple Store, Upper East, NY									0%
10	Caixa Forum Madrid									120%
11	Zeitz MOCAA									180%
12	Tate Modern									130%
13	Bunny Lane House									150%
14	Higgins Hall, Pratt Institute									130%

Table 19. Applied types of 14 adaptive reuse projects and facade increase ratio.



## Chapter 5: Primary Case studies

In this chapter, two case studies of adaptive reuse industrial building are explored; Seaholm Power Plant Redevelopment and Pearl Brewery Redevelopment. Both projects are located in Texas, which has a large amount of energy resources (e.g. leading oil-producing state, producing one-third of the nation's crude oil) (according to U.S.EIA). This thesis investigates their history, formal analysis, functional change, and social value with preserved industrial buildings and those facades.

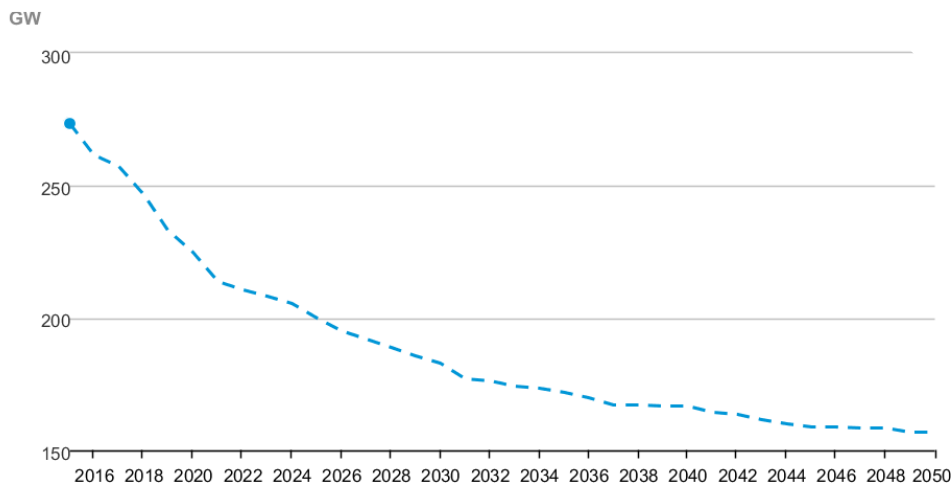


Figure 24. Electricity Capacity: Electric Power Sector: Coal Power only, a source from U.S. Energy Information Administration.

According to Figure 24, electricity capacity by coal power only is now expected to continue decreasing until 2050. In 2015, Texas Energy Production Estimates already indicated that the amount of natural gas used comprised the largest proportion of Texas energy production, followed by Crude Oil consumption. Especially, the quantity of coal consumed is obviously different from usage of the natural gas (Figure 25).

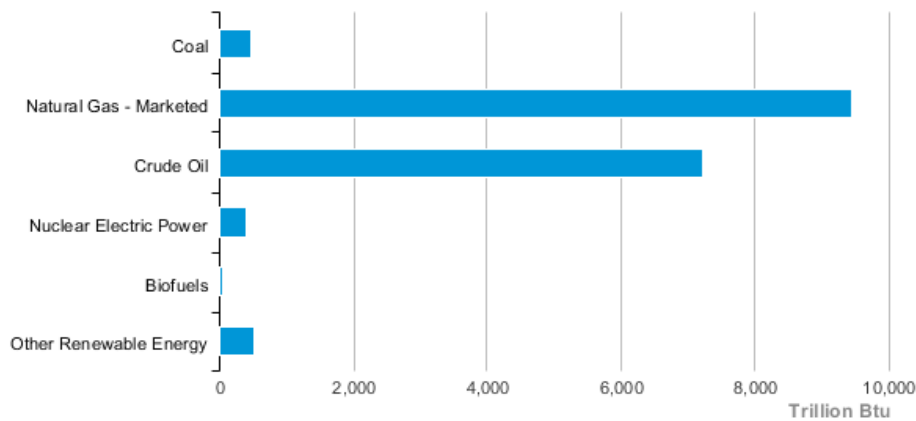


Figure 25. Texas energy production estimates, 2015. Source: Energy Information Administration.

Figure 26 represents Texas energy consumption by end-use sector. The consumption of industrial era is occupied by 50.1% of the total energy use in Texas. Residential and commercial buildings consume the energy by approximately 25.4%. This means that a sustainable approach is required to reduce energy consumption for built environment.

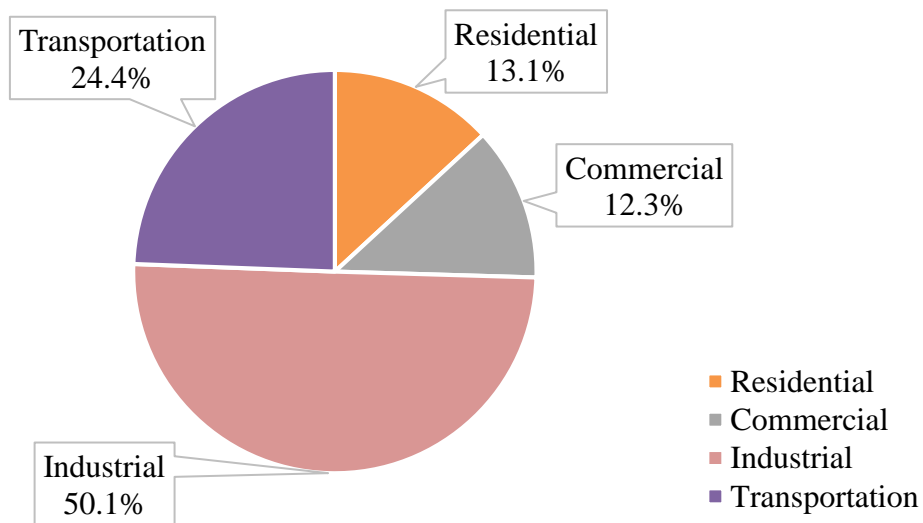


Figure 26. Texas energy consumption by end-use sector, 2015. Source: Energy Information Administration (Appendix C).

## **5.1. Seaholm Power Plant Redevelopment, Austin, Texas, USA**

### ***5.1.1. History***

In Austin, the Seaholm Power Plant redevelopment is significantly evaluated as a representative building of sustainable preservation. As I mentioned above, current coal-fired power plants in the U.S. have been under economic pressure from several reasons such as competence with natural gas prices, low efficiency of coal-fired plants, slow electricity demand growth, and especially environmental concerns from power plants using fossil fuel. The power plants and its sites will be abandoned gradually by the retirement plan in the U.S., and it will be considered as new places for urban communities. There are many potentials for being transformed into cultural spaces, art spaces, residences, and commercial spaces (Douglas 2006; Cantacuzino 1975; Moulin and Boniface 2001; Valančius, Motuzienė, and Paulauskaitė 2015) .

The Seaholm Power Plant is located on the north shore of Lady Bird Lake in downtown Austin (see Figure 27). The site occupies a strategic location in the urban area with access to waterfront. Seaholm power plant stopped providing power to the city in 1989. After the site closed, Austin City Council authorized the decommissioning of the plant and its adaptive reuse. In 2005, the Austin City Council made a master plan for Seaholm Power Development with mix-used redevelopment, including office spaces, local retail shops, residential, and outdoor public spaces (City of Austin 2018). It is listed on the National Register of Historic Places as a Recorded Texas Historic Landmark on July 2013.



Figure 27. Austin Map after Seaholm power plant redevelopment, produced by the author using ArcGIS Pro.

Before the redevelopment of Seaholm Power Plant, it was just generating building for energy production and private space (see Figure 28). After the redevelopment, this strategic location has had tremendous values; economically, environmentally, and socially. A new residential tower, trendy retail stores, and restaurants attract visitors and neighborhoods.



Figure 28. Seaholm Power Plant in 1930. Photo courtesy of City of Austin.

### 5.1.2. Formal analysis and new uses

As I mentioned in chapter 4: Findings, the new Seaholm Power Plant produces residences, retail stores, restaurants, offices, and public spaces (see Table 18). Based on adaptive reuse types that I addressed, this project comprises of ‘insertions’, ‘parasites’, and ‘juxtapositions’ (see Table 19). Figure 29 represents the master plan and perspective rendering view of Seaholm Power Plant redevelopment. The main architectural design company, STG Design, proposed preservation of the original power plant building and transformed the old structures into creative office spaces. It is currently used as a company headquarter which has an eco-friendly image.



Figure 29. Seaholm Power Plant master plan (left) and perspective rendering image (right), courtesy of STG Design.

On the northern site behind the old power plant building, two buildings were designed in the contemporary style. The one building on the western side is for a supermarket, retail stores, and offices. Another building on the eastern side is a thirty-story residential tower. It has 280 condominium units including a gym, parking, pool, and conference room. This tower is a mix-used building, including retail and restaurants on the ground floor, parking garage at the lower level, and residential units and amenities at the upper floors.

Illustration 5 represents diagrams addressing an analysis of relationship between the old and new buildings. The abandoned power plant building was preserved for providing office function (‘*insertions*’). Two-story building for retail stores and residential tower was added on the industrial site (‘*juxtapositions*’). The new restaurant is placed into the biggest northern boiler structure (‘*parasites*’). Currently the restaurant (four-story, 9,600 ft<sup>2</sup>) specifically provides spatial experiences for people to see harmony between the old structures and the industrial interior design (see Figure 30).

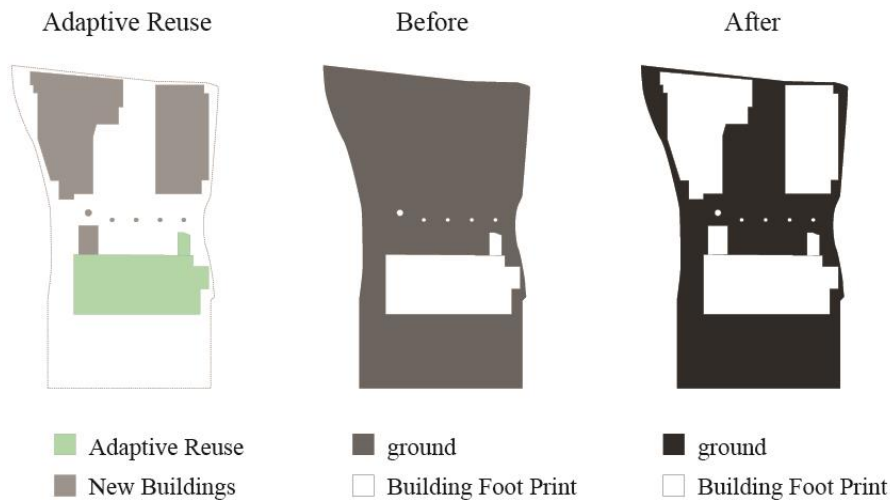


Illustration 5. Diagrams of Seaholm Power Plant Redevelopment, created by the author.

By comparing before and after adaptive reuse, the private industrial space was transformed into open public space among buildings. The black color in illustration 5 represents the outdoor open spaces. Through adaptive reuse strategy, the old power plant and industrial site were changed to provide various functions in a strategic urban area. Building summary is following;

- Office space: 143,151 ft<sup>2</sup>
- Original Seaholm Power Plant: 113,063 ft<sup>2</sup>
- Retail & restaurant: 48,363 ft<sup>2</sup>

- *Residencies: 280 high-rise condo units and 30-story building*
- *The 0.5-acre front lawn event space*
- *0.75-acre plaza (courtyard)*



Figure 30. The restaurant in the original boiler, photo courtesy of the author.

Illustration 6 shows the information about its height and programs in this project. The original building height was kept (three-story) by preservation of the old structures. Two-story commercial building balances its form and materials with the industrial elements. The thirty-story residential building separately stands on the old site. However, its facade which is made up of exposed concrete slabs and terraces seems to harmonize with the old structures' color or materials' texture. Green spaces are planned among three buildings and at the front of the old power plant.

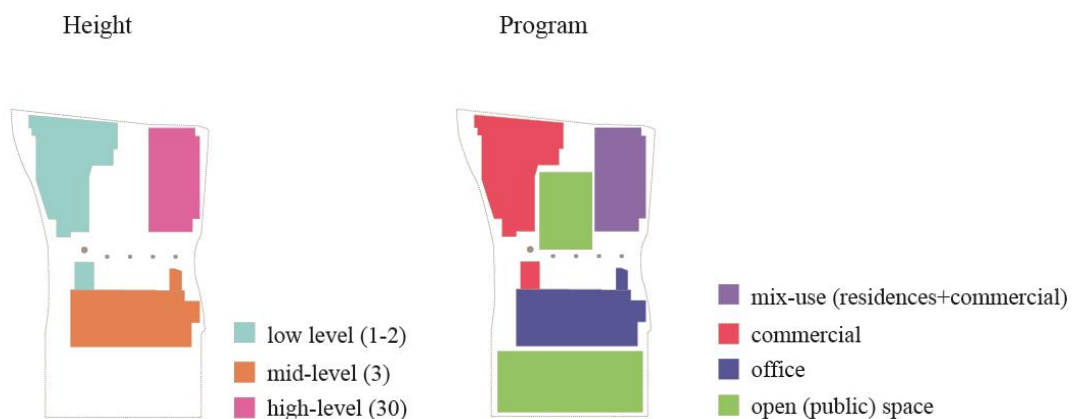


Illustration 6. Height and Program diagrams, created by the author.



### 5.1.3. Social benefits

The facade of the main Power Plant building was preserved and the spaces are reused as private offices. A meaning of the facade has socially positive effects on memory of historic significance. Maintaining the facade materials, signages, and fenestration position helps people to perceive the historic significance of the old power plant building. In addition, this space stimulates on tourism.

The original industrial elements are used as design elements in this project. The term Seaholm become a brand representing sustainable building, preservation, and adaptive reuse in downtown Austin. Figure 31 shows the design elements which were originally industrial structures, valves, or boilers. The old elements were painted blue, orange, or white. Some spots have information panels about the Seaholm history. These creative elements play an essential role in making public attractions and vibrant place.



Figure 31. Design elements in the Seaholm Power Plant project. Photo courtesy of the author (left, center) and STG Design (right).

At the front garden, referred to as the Seaholm lawn event space (see Figure 32), visitors might look at the facade of the old power plant building and new residential towers. It provides social benefits for visitors and local communities to have open public spaces with historic facade and new buildings. The event space can be used for performances,



events, or parties. It is currently open and accepting event reservations (Seaholm Power, LLC 2018).



Figure 32. Old power plant and new tower (left), the Seaholm lawn event space (right) in the Seaholm Power Plant, photo courtesy of the author.

The green spaces still have private characteristics only for residential occupancies. Figure 33 shows that the green courtyard among the buildings is intended to be open to the public. The spaces specifically enable visitors to take a rest with historic materials, facades, and urban textures. In addition, it is probably used as a gathering space and a walkable area for rest or performance for local communities in downtown Austin. As a result, this space provides an unprecedented opportunity to be part of a vibrant downtown neighborhood.



Figure 33. Green space (courtyard) among three buildings (left), photo courtesy of the author. Night view and lighting design (right), photo courtesy of STG Design.

#### ***5.1.4. Sustainable design***

The Seaholm Power Plant redevelopment project has long-term values for sustainable development in Austin. Restoration and adaptive reuse of the old power plant area give positive effects on its surroundings. Mixed-use development and green public spaces provide living quality improvement, new residences, comfortable retail shops, and green features.

The old power plant and low-rise building obtained LEED<sup>6</sup> (Leadership in Energy and Environmental Design) Gold certification. And all three buildings received four stars from the Austin Energy Green Building (AEGB) program for sustainability. LEED is rating system for evaluating the environmental performance of a building. The system encourages market to use sustainable design for environmental value and economic benefits.

Adaptive reuse of the old power plant could reduce embodied energy for the new construction. Sustainable design strategies are involved in this project; rainwater collecting system, greywater management, renewal energy use, energy performance improvement, and reuse of materials/ resources. Preservation methods of the original structure and sites balanced with the sustainable design strategies. This project affects the sustainable development plan, Seaholm district project. Illustration 7 represents sustainable design strategies in the Seaholm district project. This project is started from the adaptive reuse of Seaholm Power Plant to connect to surroundings with sustainable strategies for urban network of greenbelts in Austin.

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<sup>6</sup> LEED is a standard for green building design introduced by the U.S. Green Building Council (USGBC) in 2000. It has four levels of certification; Certified, Silver, Gold, and Platinum.

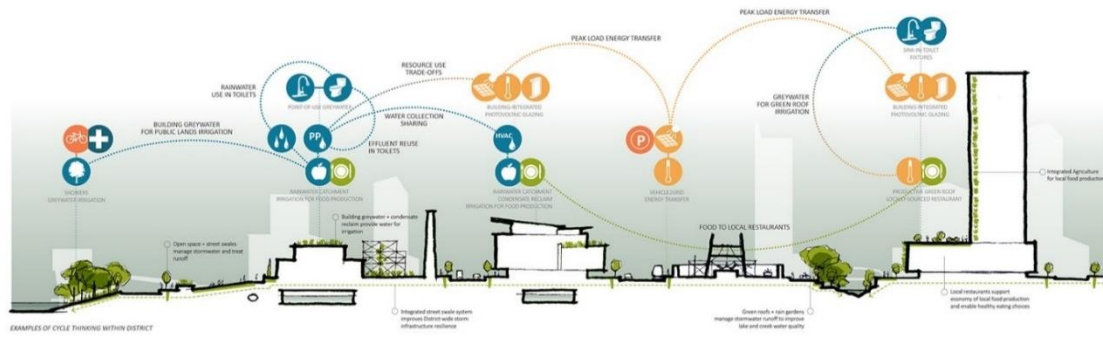


Illustration 7. Sustainable design thinking in Seaholm district project.

## 5.2. Pearl Brewery Redevelopment, San Antonio, Texas

### 5.2.1. History

The Pearl Brewery Redevelopment project is located in the north of downtown San Antonio, Texas (see Figure 34). This site was occupied by a brewing company founded in 1883. Under the leadership of Emma Koehler, San Antonio Brewing Association became the largest brewery in Texas in 1916. However, after the ownership changed several times, this industrial site stopped producing beer in 2001.

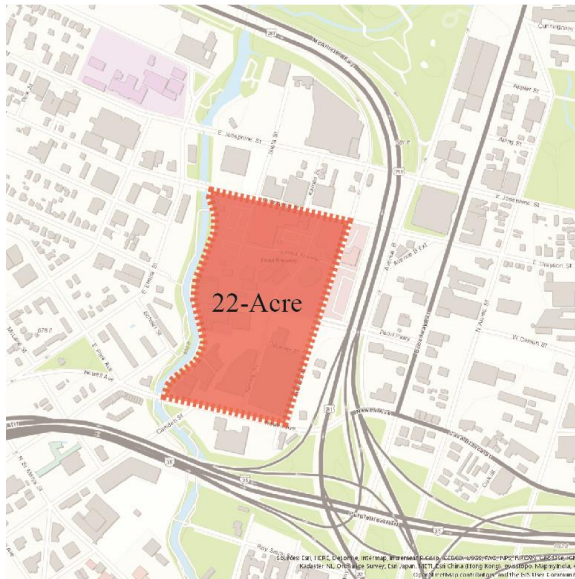


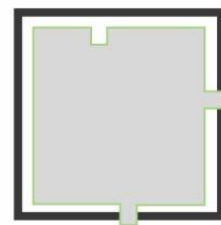
Figure 34. Map of the Pearl Brewery area, produced by the author using ArcGIS Pro.

Since then, new owner, Silver Ventures, Inc. purchased the 22-acre property in 2001. This site was considered to have potentials in economic benefits because of its strategic location which is near downtown San Antonio and easy access to several highways. The Silver Ventures, Inc. decided to use the historic preservation strategies to attract businesses as well as tourists (Wikipedia 2017).



Figure 35. The largest Brewery in Texas, Production reaches over 110,000 barrels per year under the leadership of Emma Koehler – San Antonio Brewing Association becomes the largest brewery in Texas, outpacing Lone Star. Courtesy of Pearl Brewery.

The first tenant in the Pearl Brewery redevelopment was the Aveda institute in 2006, which was transformed from the old brewery's garage built in 1939. In May 2006, Pearl Stable (see Figure 36) was originally opened as a museum and transformed into a wedding venue. The building functioned as a former Pearl corral since 1894 and architects preserved its oval shape with inserted 'skylight cupola' (*'insertions'* type).



INSERTIONS

Figure 36. The Pearl Stable was the corral space. It was transformed into new space for wedding venue or museum, photo courtesy of the author.



The original brew house with massive beer production in the early twentieth century was transformed into the boutique hotel called Emma in 2015 (see Figure 37). The old facade and materials of the brewery was restored and adaptively reused for hotel facilities, fine restaurants, unique lounge bar, and hotel rooms.



Figure 37. Emma Hotel was transformed from the old brew house, photo courtesy of the author.

Adaptive reuse strategies for the Pearl Brewery redevelopment continues. Several buildings were revitalized and there are still remaining buildings waiting to be redeveloped. The old industrial site and building currently provide various functions and open public spaces for the visitors and local communities in San Antonio.

### 5.2.2. Formal analysis

The abandoned industrial site currently produces residences, retail stores, restaurants, offices, public spaces as well as academic spaces (see Table 18). The buildings' information is following;

- *Hotel: 146 rooms in the brewery tower*
- *Restaurants: 18 restaurants and bars, 109,400 ft<sup>2</sup>*
- *Residences: 410,600 ft<sup>2</sup>*
- *Offices: 121,500 ft<sup>2</sup>*
- *Banquet space: 17,800 ft<sup>2</sup>*
- *Education: 30,500 ft<sup>2</sup>, Culinary Institute of America<sup>7</sup>*

The Pearl project had four adaptive reuse typologies; 'insertions', 'parasites', 'juxtapositions', and 'peeling' (see Table 19). The main architecture design firm, Lake Flato, conducted multi-phase design development to adaptively reuse the existing buildings and transform the site into a vibrant space (Lake|Flato 2018).

Illustration 8 represents two diagrams; the first diagram shows four development phases in this project and the other compares preserved buildings and the addition. Most historic buildings were preserved and restored and reused for new functions. Adaptively reused buildings have a well-balanced out form.

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<sup>7</sup> Culinary Institute of America (CIA) San Antonio campus is serving the education for culinary or baking. It provides diverse and energetic programs for students who are interested in Latin cuisine. The campus also encourages public tours.

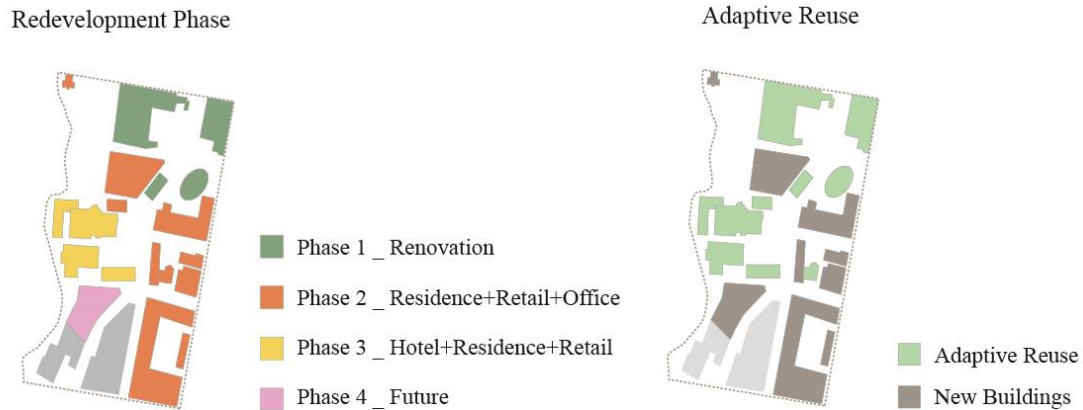


Illustration 8. Pearl Brewery Redevelopment phases (left), and analysis of building types (right), edited by the author.

This project is similar to the Seaholm Power Plant redevelopment. Both projects transform the private industrial space into open public spaces. Illustration 9 shows ‘figure and ground’ diagrams that help understand the various open spaces among buildings. Unlike the Seaholm project, the site is huge and each building has their own orientation and volume. This makes it possible to achieve various public areas, which eventually leads to a vibrant city.

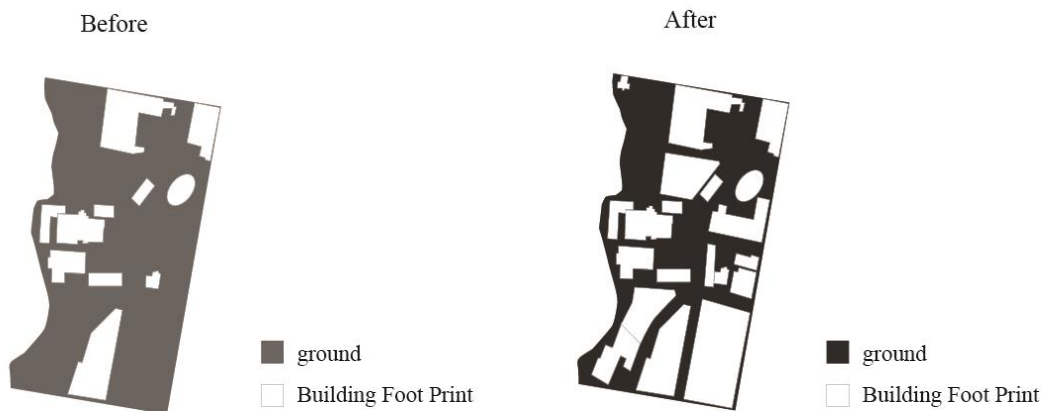


Illustration 9. Comparison of figure and ground diagrams before and after adaptive reuse, created by the author.



Illustration 10 shows the height and new functions of buildings in the Pearl Brewery project. The new hotel is located in the center of the site. With front green spaces, the hotel can be recognized well from the entrance of this project (see Figure 38). The Pearl project has a strategy of containing various mix-used redevelopments in different height and various functions.

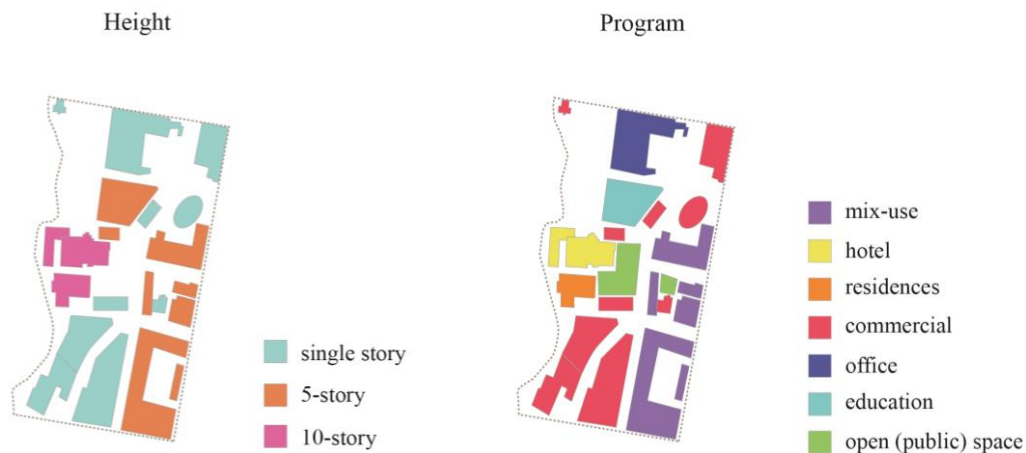


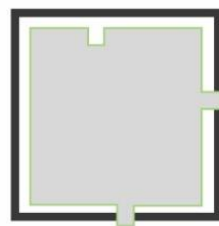
Illustration 10. Height and program diagrams, created by the author.

The Hotel Emma was built inside the old brewhouse. It has 146 uniquely designed rooms, restaurants, and bars. The hotel building itself becomes the tourist's attraction because of its preserved materials and unique spaces.



Figure 38. Hotel Emma outer view at the entrance of the Pearl project (left), the old engine used in interior design (right), photo courtesy of the author (Appendix D).

As I mentioned above, I found four different types of adaptive reuse strategies in this project. Figure 39 shows one fine restaurant among residential buildings. The restaurant was nested into the preserved facade (‘*insertions*’ type). It has an industrial-style interior and its exterior brick facade gives attractions to the public with its historic memory. It can be also categorized as ‘*parasites-juxtapositions*’. A link between the old structure and a contemporary residence is built at the western side. The green open space is around the building, and it is used as an outdoor seating area or performing space (e.g. live music, farmers market).



INSERTIONS



PARASITES-JUXTAPOSITIONS

Figure 39. Preserved facade and the types of adaptive reuse, photo courtesy of the author (Appendix E).

I found an interesting adaptive reuse form in the Pearl site. Figure 40 represents the *'peeling'* type of building, architects intended to preserve the original columns, girders, and industrial water storage of the old building. Rather than keeping its facade, they eliminated the old facade to open up the space. The raw concrete materials and rusty iron makes this space feel like the 20th century. With the Pearl brand logo on it, this space is used for café terraces, music performances, and a farmers market.



Figure 40. Peeling type in the Pearl, photo courtesy of the author.

Figure 41 shows another adaptive reuse type: the *'parasites'* in the boiler house. This building was originally built for boiling with an adjacent chimney. The space is attached to the second level of the old facade, which provides balcony and canopy for the main entrance. The original industrial space is expanded with this strategy. The new boiler house is currently acting as a restaurant and bar, and provides outdoor seating spaces in front of the historic facade. It is possible for visitors to see the original bricks and to have an unique experience.

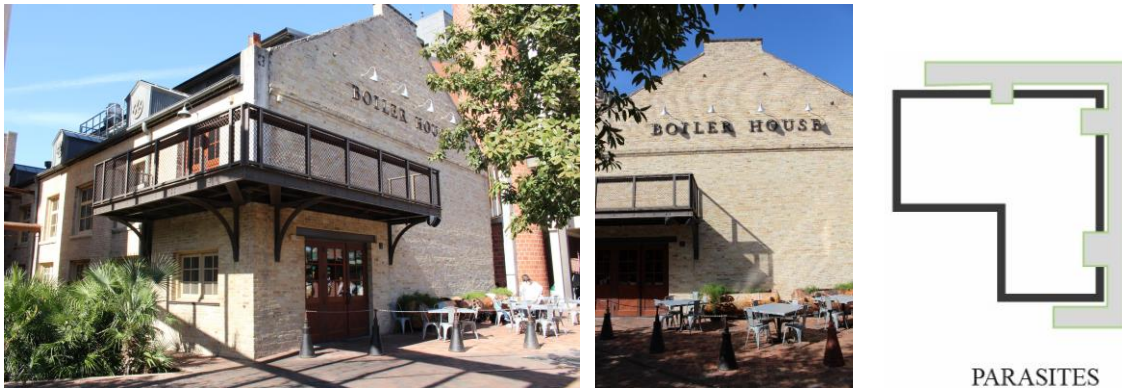


Figure 41. Outer seating space and historic facade, Pearl Brewery Redevelopment, San Antonio, Texas. Photo courtesy of the Author (Appendix F).

The '*parasites*' strategy is applied to hotel Emma. There is a bridge between the hotel and adjacent building's roof which is used as the balcony and pool for the luxury apartment complex. The Pearl project is applied with various adaptive reuse strategies. It effectively helps to preserve the old structures and materials depending on the different buildings or its conditions. It also promotes the Pearl site to be vibrant, active, and open to the public.

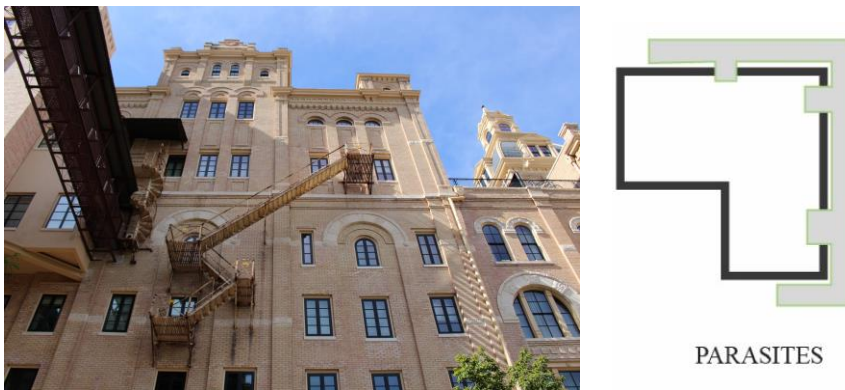


Figure 42. Hotel Emma bridge and the 'parasites' type, photo courtesy of the author.

### 5.2.3. Social benefits

Adaptive reuse strategies help preserve the old facades, materials, and memories and produce positive social impacts on the neighborhoods. In this case, it currently provides open public spaces and green spaces, and it has an effect on the tourists' attractions. Every weekend, a farmers market is held at the green open space in front of the historic brewhouse. It serves local foods for the community. On the green space, there are outdoor seating areas and fountains. Figure 43 shows that children play in the fountains and people sit and relax on the green surface.



Figure 43. Open public space, green space in Pearl Brewery Redevelopment project, photo courtesy of the author (Appendix G).

The industrial elements were used as the design strategies for the Pearl just like the Seaholm Power redevelopment. Figure 44 represents the reuse of industrial elements; the old railways were preserved with a brick paving and the oil or water tanks are used for vegetation. These proposed elements are attractive to the public, and it helps the public recognize the original industrial site before the transformation.





Figure 44. Reuse of industrial elements in the Pearl, photo courtesy of the author.

Few people wanted to live in this area on the northeastern of downtown before the Pearl redevelopment. Because it was known for its low income, high crime rate, and chronic flooding (Biediger 2017). With adaptive reuse strategies, the Pearl itself gave a positive appeal to the public and it was transformed into a livable space with historic significance for the neighborhoods as well as for visitors.

#### ***5.2.4. Sustainable design***

Various kinds of sustainable design strategies were involved in the Pearl Brewery project. Three of the newly constructed projects received LEED Gold certification. In addition, the Pearl Brewery site and buildings reflect its commitment to sustainable design. This includes sustainable site development, water conservation, energy efficiency, rainwater collecting system, industrial materials reuse, and indoor environmental quality (Lake|Flato 2018). By adding specific green spaces among buildings, it creates a vibrant, walkable area, and pedestrian-friendly experience. This project has received several awards for its sustainable design. The awards are following:

- *2009 AIA San Antonio Design Award*
- *2011 Texas Society of Architects Design Award*
- *2012 EcoStructure Evergreen Award*
- *2013 AIA COTE Top Ten Green Project Award*
- *2014 Texas Society of Architects Design Award*
- *2014 AIA National Honor Award for Regional & Urban Design*
- *2015 CNU Global Charter Award*

- *2017-2018 Urban Land Institute Global Award for Excellence*

The juror, AIA Committee on the Environment Top Ten Project Award in 2013, described this project as follows,

*This project is a really strong model for inserting something new into an otherwise derelict neighborhood of abandoned buildings and turning it into something that could revitalize the neighborhood.*

The Pearl project is currently evaluated as a good example of reusing the abandoned industrial site and revitalizing local communities. Sustainable preservation strategies provide the old site with potentials for environmental, social benefits as well as economic development.

## Chapter 6: Analysis and Discussion

In this chapter, this thesis analyzes the eight types of adaptive reuse methods and evaluates them according to seven criteria. Furthermore, this research discusses advantages of adaptive reuse by comparing with new development strategy.

### 6.1. Analysis and Evaluation

Based on fourteen different precedents and their applied typologies, I evaluated each type based on seven different categories comprising: facade increase, social value, economic benefit, environmental performance, spatial increase, heritage preservation, and energetic value. Table 20 represents evaluation scores for each type and criteria. The score is from zero to 100 and is not meant to be taken as quantifiable but rather as a qualitative assessment by the author.

Under the ‘facade increase’ category, the eight types of adaptive reuse are evaluated by comparing facade change ratio. Most typologies have a facade increase after the adaptive reuse, except for ‘*Peeling*’ and ‘*Transplanting*’ types. The ‘*insertions*’ type has a small increase of the facade ratio, for example, as new additions are inserted into the old building by changing a small part of original facade. The ‘parasites-stacks’ type has the most facade increase ratio, and the number 80 have a meaning that facade increase is involved in most of the buildings.

The ‘social value’ category is related to the public’s reception and tourist attraction. Under this category, the scores are significantly similar to the ‘*heritage preservation*’ category. Adaptive reuse strategies are recognized depending on social impacts on the community and visitors. The ‘insertions’ type obtained 80 points because of its characteristic of providing positive effects to social communities. The type tends to keep an old building intact and adds new functions. The type ‘*peeling*’, ‘*transplanting*’, and



'weaving' received scores of 10 or 20. These types might cut off many parts of a building facade more than other types.

Most projects can possibly obtain economic benefits from adaptation strategies and new uses. Leichenko et al. describes that preserving historic buildings has positive economic effects on residential property values (Leichenko, Listokin, and Coulson 2001). The '*stacks*' creates much more space than other types, followed by '*insertions*' and '*parasites*'. The '*transplanting*' typology is used as a part of a building facade, a few spaces are put in to the old building.

<i>Type</i>	<i>facade increase</i>	<i>social value</i>	<i>economic benefit</i>	<i>energy performance improvement</i>	<i>spatial increase</i>	<i>heritage preservation</i>	<i>energetic value (public space)</i>
Insertions	10	80	70	80	10	80	40
Parasites	30	40	60	20	30	50	30
Stacks	80	60	80	50	100	70	40
Juxtapositions	50	50	30	30	50	70	30
Wraps	70	40	20	80	25	30	10
Weavings	40	20	15	40	15	15	30
Peeling	0	10	30	0	0	10	90
Transplanting	5	20	10	20	10	20	20

Table 20. Evaluation of each adaptive reuse type. Unit: score (0 to 100).

The 'energy performance improvement' category indicates potential to promotion of the energy efficiency for an old building facade. '*Insertions*' and '*wraps*' are evaluated by 80 points followed by '*stacks*', with 50 points. These are better at reducing energy consumption because the types have potentials to upgrade their insulations during the design phase. Furthermore, the additions might play a role as insulation. However, the '*peeling*' type has no relationship with energy performance improvement.

The '*spatial increase*' indicates a relationship between additions and new-born spaces. The '*stacks*' type has the highest benefits in terms of creating new spaces, followed by '*juxtapositions*' which received 50 points. Other types influence spatial increase slightly.

'*Heritage preservation*' is evaluated by how much portions of its facade were preserved. Because the '*insertions*' type tends to preserve the most parts of its skin and materials, it scored 80 points. '*Wraps*' received only 30 points despite the fact that the method entirely keeps the original facade intact. This is because this type encloses the original facade, so it is hard to see or recognize the historic wall after adaptive reuse. '*Peeling*', '*weavings*' and '*transplanting*' received low scores because those types intervene many parts of the old facade.

I defined '*energetic value*' as the degree to which the intervention created or encouraged a lively public space. The most effective way to increase the relationships with public spaces is the '*peeling*' strategy. As I mentioned above, the '*peeling*' method creates public open space for outdoor activities. This is followed by the '*insertions*' and '*stacks*' types, which both received 40 points because of their characteristics of promoting the relationships between the old facade and the outdoor public spaces. In contrast, the '*wraps*' strategy gives little effect to the public spaces.

Figure 45 shows the radar charts of individual types according to the evaluation scores. Each type of adaptive reuse strategies is evaluated in terms of the seven different categories. Because these scores and radar charts depend solely on the qualitative study of the several specific projects, its evaluation has limitations. However, the methods can be used for considering what type is the most effective depending on which one of the seven different criteria is the most important to the preservationist, architect or planner, for example.

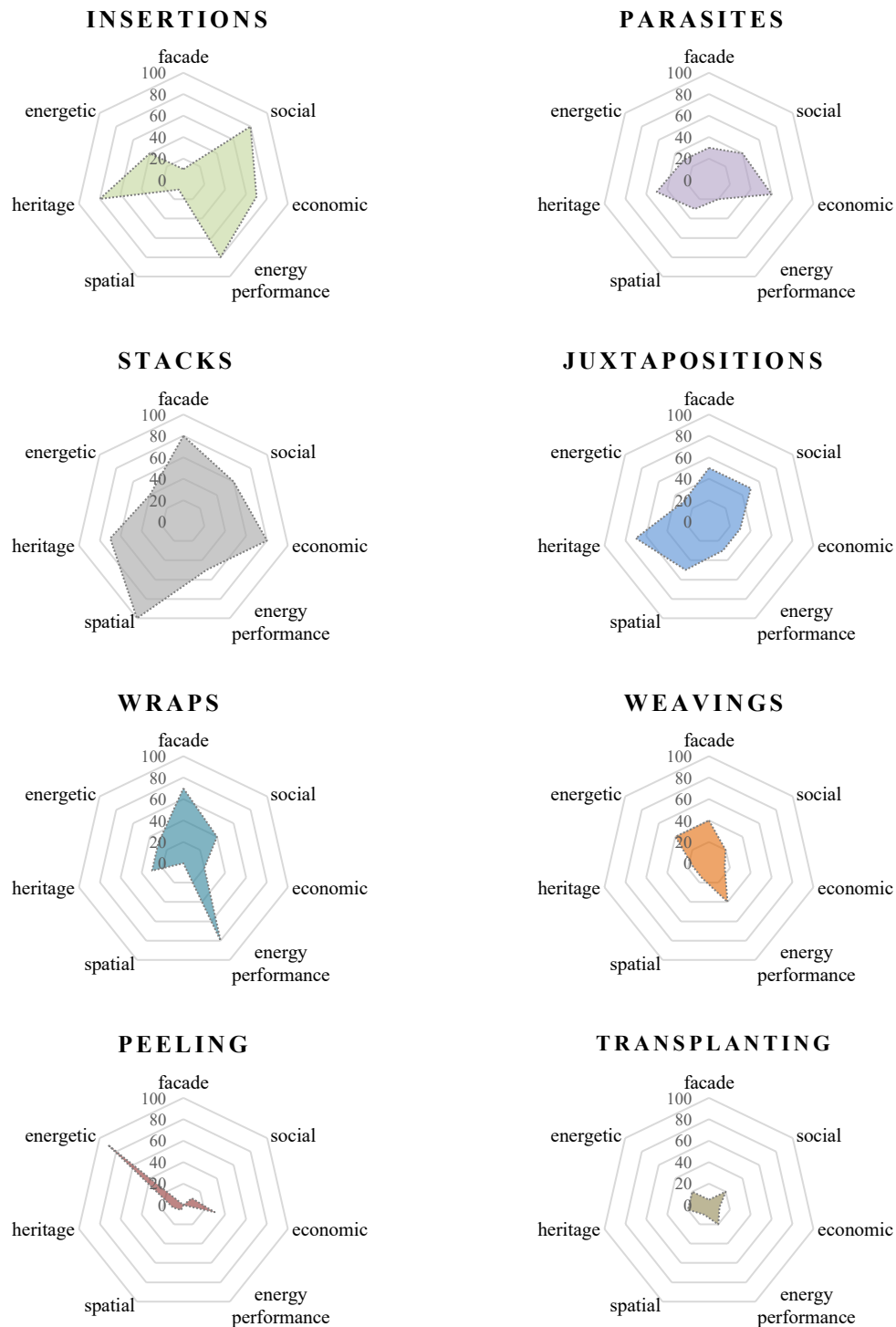


Figure 45. Radar charts based on the evaluation Table 20, created by the author.

Illustration 11 represents a comparison chart of different adaptive reuse types. It helps the architects, planners, and stakeholders to repurpose the old industrial buildings and sites. Comparing the several types with its benefits to different fields, they can consider various methods, positive impacts, as well as mixed strategies.

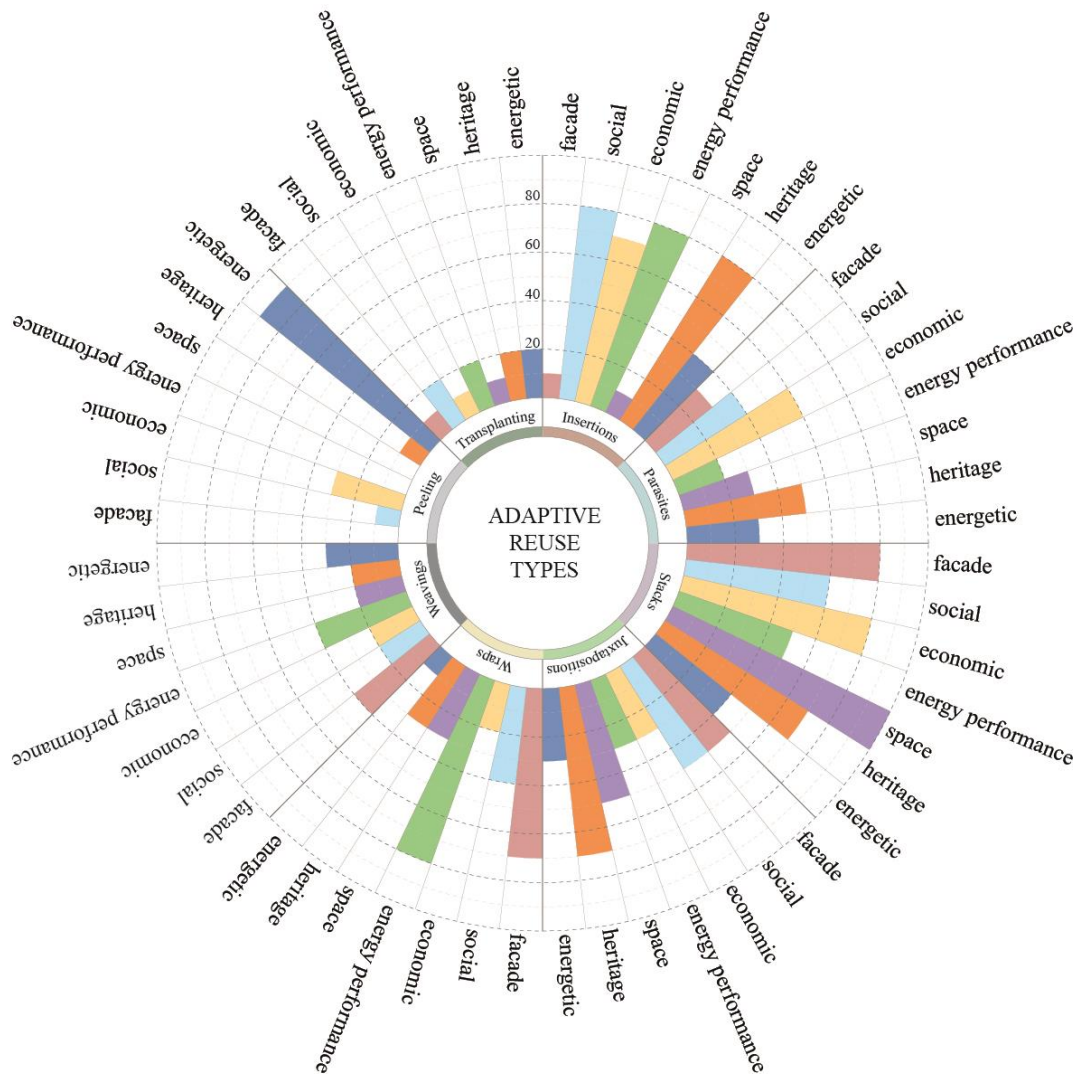


Illustration 11. Comparison of adaptive reuse types, illustrated by author.

## **6.2. Adaptive reuse vs. new construction**

Can the adaptive reuse of abandoned industrial buildings have positive impacts on urban environments, greater than those of new constructions that result from demolishing old structures? Adaptive reuse is associated with a preservation strategy providing new uses into existing buildings without demolition. Depending on the original building condition, the adaptive reuse method might incur higher costs than new construction. In addition, different site conditions, building materials, and preservation guidelines would affect differences in economic results.

Initial costs involved in the adaptive reuse process might be somewhat higher than with new construction. When architects are in the design phase of an adaptive reuse project, they are always met with lack of information about the old structures. By comparing the installed status to the original drawings, they must design or spend extra time fitting new uses into the old structures.

However, with a perspective of long-term goals for the urban environment as a whole, adaptive reuse strategies for industrial buildings can create positive social impacts through making local communities vibrant, active, and resilient. In addition, historic preservation can produce long-term positive economic value through such forms as tourism, tax deduction, preservation investment and jobs (Mason 2005). Some research asserts that the adaptation of a historic building enables better economic viability compared to demolished buildings and new construction (Black 1990). The National Trust for Historic Preservation Green Lab emphasizes that the areas with balanced new and old buildings could have better result in achieving higher population densities compared to only developing new buildings (National Trust for Historic Preservation Green Lab 2014).

## **Chapter 7: Conclusion**

This thesis conducted a formal analysis and explored eight different typologies of adaptive reuse, and evaluated them according to seven different criteria. Most buildings covered in this study had several types applied simultaneously. Each industrial building has different site conditions, building codes, preservation strategies, and surroundings. As a result, architects and planners should appropriately consider and apply the different adaptive reuse strategies to achieve sustainability specific to their goals for their city.

Abandoned industrial buildings have a unique potential for adaptive reuse methods because of their large, open volumes. Furthermore, the industrial site can be converted into mix-used development ideal for producing new uses and increasing urban vibrancy. The adaptive reuse method enables the old industrial buildings to keep their historic significances and to provide new experiential spaces in urban areas.

There are undoubtedly various challenges during the design phase for reusing the existing industrial buildings. Specific preservation guidelines, material concerns, public awareness, new functional requirements, or governmental approval become particular barriers. However, these are short-term, and architects, planners, and stakeholders should consider the challenging factors in balance with the opportunity to contribute to the livable environment in the long-term, through adaptive reuse strategies.

Adaptive reuse methods have important characteristics in not only preserving historic significances but repurposing buildings with new functions. This thesis compared the original uses to new uses. Through the adaptive reuse of industrial buildings and their sites, the original structures can be transformed into appropriate spaces for current needs; vibrant retail stores, livable residences, offices, academic spaces, art exhibition places,

farmers market for local communities, open public outdoor spaces, or hotel facilities. The appropriate functional proposals need to be considered for appropriate redevelopment.

This research identified different criteria for evaluating the adaptive reuse types based on case studies of several successful projects. Adaptive reuse has potential benefits for the triple bottom lines; social, economic development, and environmental protection. In addition, the method creates positive impacts on historic preservation, energy performance of the historic industrial buildings, equitable places, sustainable communities as well as a good relationship with public spaces.

I hypothesized that the adaptive reuse can become a solution for reducing embodied energy using existing materials and sites. The strategy also intends to meet current energy standard. Moreover, the method would allow for the preservation of the memory and culture of sites and buildings, which has an inherent value that goes beyond quantifying. If the old facade of the industrial buildings is kept, streetscape can be kept for visitors and neighborhoods. Especially, new proposed building and sites can be attractive to the public when combined with and in harmony with old structures incorporating new contemporary elements.

Architectural practitioners who deal with the built environment and developers who affect the economic value of architectural projects need to consider the abandoned buildings and places as a driver for potential benefits. The adaptive reuse method possibly prevents urban sprawl by providing attractive spaces in urban centers and would possibly increase and/or preserve tourism, leading to long-term economic benefits to the city. Therefore, the adaptive reuse of industrial buildings and sites deserves particular focus because of the contribution to sustainability. For further studies, I will explore many more successful projects of industrial building adaptation and investigate their relationships to sustainable development.

## Appendices

### Appendix A. Historic Ionic Columns.

Westminster Arcade, Providence, RI.

Photo courtesy of the author, visited at May 17th, 2017.



### Appendix B. Old facade preservation.

Hearst Tower, New York.

Photo courtesy of the author, visited at May 18th, 2017.



### Appendix C. Texas energy consumption by end-use sector 2015.

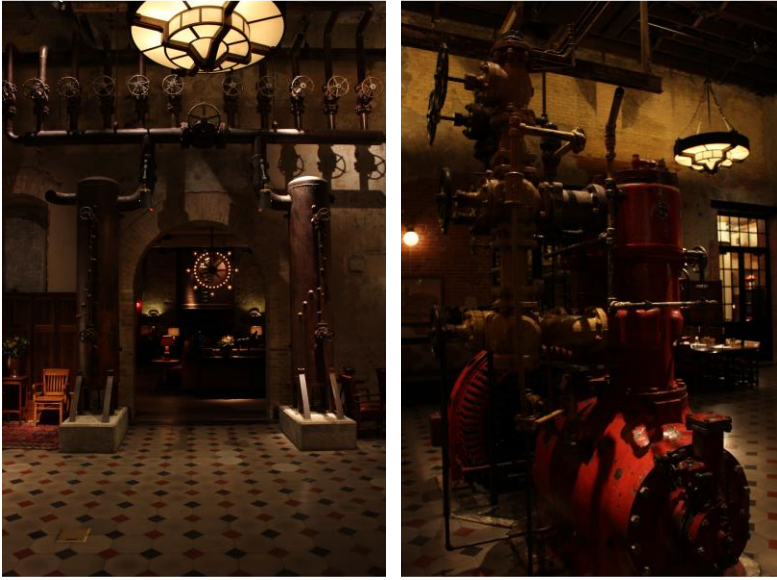
Source: U.S. Energy Information Administration

Category	Energy Consumption by End-Use Sector (trillion Btu)
Residential	1696.3
Commercial	1590.6
Industrial	6471.4
Transportation	3149.3



#### **Appendix D. Hotel Emma, San Antonio, TX.**

The old industrial machines were used for its interior design, photo courtesy of the author. Visited at January 24th, 2018.



#### **Appendix E. Juxtaposition**

The old facade and new added space in the Pearl.

Photo courtesy of the author, visited at July 29th, 2017.



## **Appendix F. Old and New facade.**

Photo courtesy of the author, visited at January 24th, 2018.

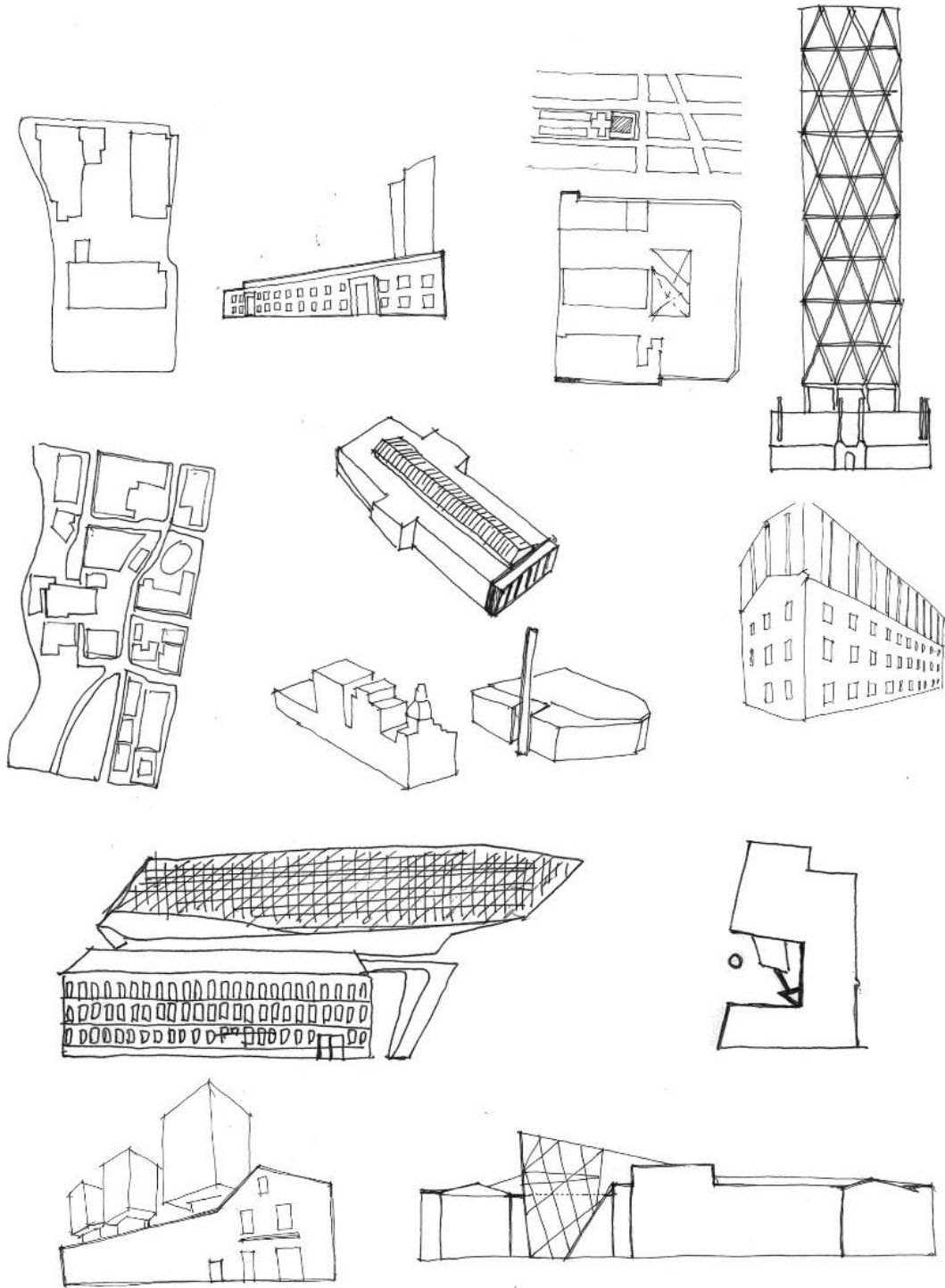


## **Appendix G. Industrial design elements at the outside.**

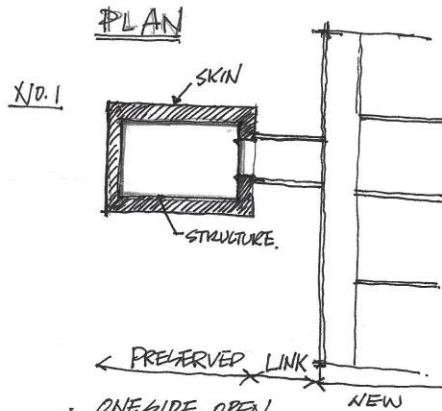
Photo courtesy of the author, visited at January 24th, 2018.



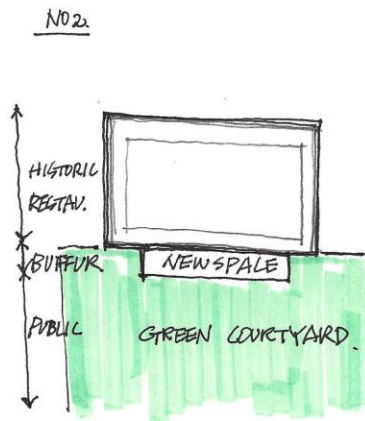
**Appendix H. Sketches for analyzing its facade change in adaptive reuse projects,  
drawn by the author.**



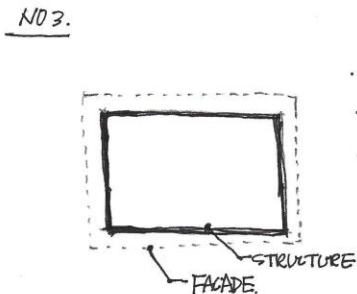
**Appendix I. Sketches and memos for analyzing adaptive reuse projects after site visit, drawn by the author.**



- ONE SIDE OPEN.
  - Rest of main FACADE are preserved.
  - LINK TO NEW BUILDING. WITH HALLWAY or BRIDGE.
- or) PEARL DISTRICT, SAN ANTONIO

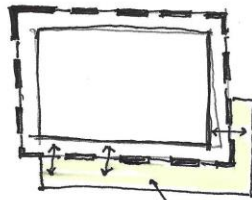


- WHOLE FACADE ARE PRESERVED
  - NEWSPACE ADDED, CANOPY, BALCONY
  - CREATIVE SPACE WAS MADE
- HISTORIC MATERIALS.  
EXPANDED HISTORIC PLAN TO OUTSIDE.



- STRUCTURE WAS PRESERVED.
- FACADE TOTALLY WAS DEMOLISHED.
- CREATE NEW VOID SPACE - EXHIBITION, PERFORMANCE, MEMORY

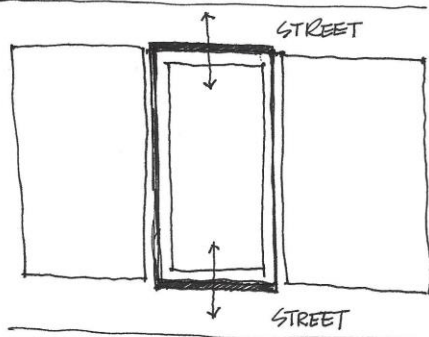
N04.



- STRUCTURE & FACADE (SKIN) PRESERVED.
- BUT, PRESERVE PENETRATION, WINDOW PATTERN, PLACE.
- SOME OPENING RELEASE. + LINK OUTSIDE WITH

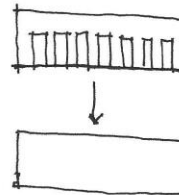
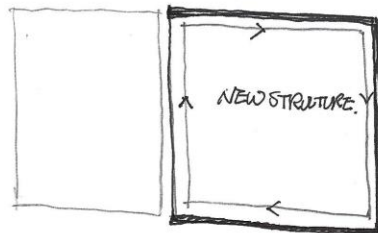
ADDED PLACE, CORRIDOR.

N05.



- WHOLE SKIN ARE PRESERVED.
- BUT, IT DEPENDS ON USE OF BUILDING, IT CHANGES PERSPECTIVE OF BUILDING.  
PUBLIC OR PRIVATE  
↓  
MORE OPENING. CORRIDOR
- MAINLY FOCUS ON THE FACADE THAT ARE FACING ON THE STREET.

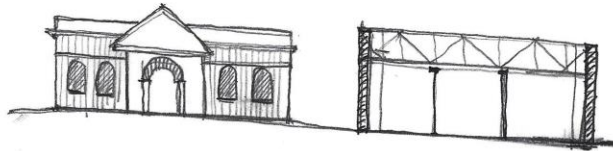
N06. HEART TOWER, NY.



- WHOLE STRUCTURE CHANGED.
- NEW STRUCTURE FOR NEW ADDED OFFICE TOWER.
- PRESERVE FACADE PATTERN, PENETRATION (3-SIDE)

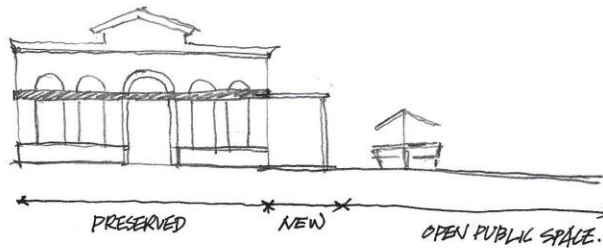
## SECTION & ELEVATION STRATEGIES

### NO1. Material Preservation.



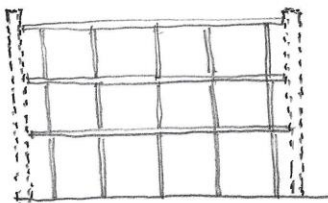
- MAIN MATERIAL PRESERVATION
- MAINTAINANCE.
- SUPPORT STRUCTURE. (INSIDE)
- COLOR.

### NO2. SPACE ADDED



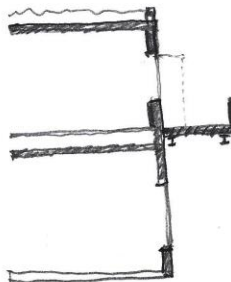
- EXPANDED PROGRAM
- WITH HISTORIC FACADE.

### NO3. PRESERVED STRUCTURE



- ROUGH DESIGN, MATERIAL
- INDUSTRIAL DESIGN
- USE STRUCTURE AS EXHIBITION, PERFORMANCE.

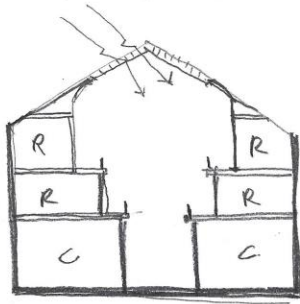
### NO4. PRESERVED PENETRATION



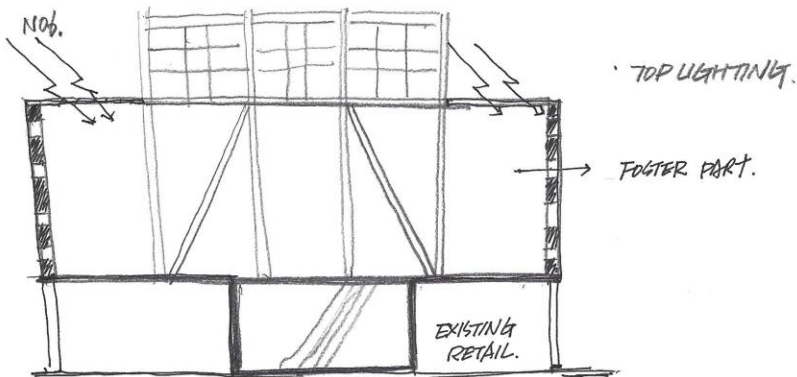
- PRESERVED PENETRATION
- ADDED OUTSIDE KORRIDOR
- BALCONY



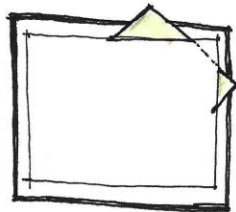
No.5. PROGRAM CHANGE.



- PROGRAM CHANGE. (Commercial → Micro APT)
- PRESERVED OUTSIDE MATERIAL
- MAIN STRUCTURE PRESERVED.
- CHANGED LAYOUT.



No.7.



- SOME STRUCTURE CHANGED OR ADDED
- SOME PARTS OF SKIN WERE DEMOLISHED AND ADDED SPACE, IT AFFECTS NEW FACADE SYSTEM, NEW AESTHETIC. (HISTORIC SIGNIFICANCE + NEW MODERN)

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