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RECYCLING INDUSTRIAL ARCHITECTURE:

THE REDEFINITION OF THE RECYCLING PRINCIPLES
IN THE CONTEXT OF SUSTAINABLE ARCHITECTURAL DESIGN

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ABSTRACT

The aim of this thesis is the elucidation of the concept of architectural recycling as an environmentally sustainable alternative to demolition and preservation. More precisely, the research aim relates to the redefinition of recycling design principles in the context of the sustainable architectural design. The process of architectural recycling was placed in the context of a sustainable architectural design, as the global concept of sustainable development is imposed as a general context for all building related questions in the last few decades. Given that only a small percentage of a total building stock is made out of new work, it is not enough to develop strategies and principles for a sustainable design only for the new projects, but for the existing buildings as well. Industrial architecture is the most appropriate type of architecture for the research on architectural recycling due to its physical characteristics, i.e. large flexible spaces with great adaptability potential.

The focus of this research is on the exploration and redefinition of the recycling design principles. More precisely, the focus is on the creation of the so-called 'recycling model', consisting of three redefined recycling design principles, which stem from the analogy between the domains of biology and architecture. The analogy was conducted in a systematic manner, applying the set of criteria which refer to structure, material, form and spatial organisation, i.e. their relationship between both existing building and new intervention.

The general research hypothesis refers to the advantages of the architectural recycling over demolition and preservation, seen as the most frequently applied methods of dealing with the existing building stock. This assumption is based on the view that processes of demolition and replacement simply contribute to the endless circle of production, consumption and waste, given that the building sector constitutes one of the biggest waste streams produced in Europe, and is unquestionably the biggest polluter. On the other hand, preservation persists in maintaining status quo and prevents the building to adapt to changing condition through alterations and change of use. Therefore, architectural recycling is presented as an environmentally sustainable alternative to both demolition

and preservation. The second hypothesis refers to the adequacy of biological analogies for the definition of the recycling design principles. It is assumed that the biological concept of symbiosis is the most adequate one for the definition of the possible relationships between the original industrial building and the new intervention, i.e. recycling design principles. The final research hypothesis refers to the relationship between the physical characteristic of an underused industrial building and the most environmentally sustainable design principle for its recycling. It is assumed that in order for the recycling intervention to produce least environmental damage, the original building should be exploited to a high degree. Hence, it is assumed that the election of the most environmentally sustainable recycling design principle depends on the current conditions of the existing industrial building, i.e. structural and material condition.

In the first place, concepts relating to architectural interventions (ranging from preservation to destruction) are critically analysed. A systematic review of the concepts of preservation, restoration, destruction and sustainable design, is presented based on the sources by John Ruskin, William Morris, Eugène Viollet-le-Duc and Rem Koolhaas, respectively. The analysis enabled the elucidation of the concept of architectural recycling as 'preservation through change', in the context of a sustainable architectural design.

Secondly, the industrial architecture is understood as a field for the exploration of the topic of architectural recycling due to its characteristics, i.e. large spaces, open plan, structurally robust, made out of strong materials, flexible and adaptable. Architectural and social importance of industrial architecture as well as the concepts of architectural ruin and industrial aesthetics are analysed in this research phase. Once the importance of the industrial architecture, both architectural and social, and its adaptability potential was identified the research then focuses on the design principles of recycling, described in contemporary literature on the practice of architectural recycling. Hence, four selected sources, Brooker & Stone (2004), Feireiss & Klanten (2009), Jäger (2010) and Rogić (2009), are analysed and compared, according to the criteria of structure, material, form and spatial organisation, with the aim of understanding the characteristics of each set of design principles and identifying the similarities and differences between them.

Finally, the conceptual 'recycling model', consisting of three new redefined recycling design principles, based on the analogy between the concepts used in both biology and architecture, is presented. From the concept of symbiosis, chosen as one which truly represents the analogy between biology and architecture (particularly recycling the architecture), stem three redefined design principles of recycling, namely: commensalism, mutualism, and parasitism. The value of such a model is seen in its multidisciplinary character and its systematic approach to the topic of recycling architecture, i.e. the principles embedded in this model relate to the aspects of structure, material, form and

spatial organization. The 'recycling model' provides a fresh understanding of how an extensive range of physical characteristics of an existing building can be considered in a systematic way in order to provide the guidance for choosing the most environmentally sustainable recycling design principle. Once the conceptual model has been created, the research focusses on its evaluation in the contemporary practice of recycling the industrial architecture through the selection of three case studies. Each of the three cases ('Fabra i Coats', Barcelona, Spain; 'Centro de Monitorização e Interpretação Ambiental – Casa dos Cubos', Tomar, Portugal; and '192 Shoreham Street', Sheffield, England) corresponds to one of the three redefined recycling design principles. Through selected 'good practice' examples the principles which constitute the conceptual model are validated and the relationship between the physical characteristics of a particular industrial building and the most environmentally sustainable design principle for its recycling is identified.

The research confirmed the theses that recycling of the industrial architecture is an environmentally sustainable alternative to demolition, on the one hand, and preservation, on the other. The thesis that the design principles of recycling stem from the analogy between the fields of biology and architecture is also confirmed. Lastly, in order to produce least environmental damage the recycling intervention should exploit the host building to a high degree, thus, physical characteristics of the original building determine which design principle is the most environmentally sustainable one for its recycling.

The contribution of this research is firstly seen in the confirmation of the view that the recycling of the industrial architecture is environmentally sustainable alternative to both demolition and preservation, as opposed concepts. Secondly, this research provides the systematic overview of the contemporary approaches to existing building stock, and elucidates possible relationships between the original building and the new intervention, observed through the criteria of structure, material, form and spatial organisation. Finally, the research presents the 'recycling model' composed of three redefined recycling design principles, which determines the link between the physical characteristics of an existing building, on one hand, and the most environmentally sustainable design principle for its recycling, on the other.

Key words: recycling, industrial architecture, design principles, symbiosis, sustainable architectural design

RESUMEN

El objetivo de esta tesis es la explicación del concepto de reciclaje arquitectónico como una alternativa ambientalmente sostenible a la demolición o para la preservación. En concreto, la investigación se refiere a la redefinición del diseño del reciclaje en el marco del diseño arquitectónico sostenible. La idea general del desarrollo sostenible se impone a todas las preguntas relacionadas con la construcción durante las últimas décadas. Teniendo en cuenta que sólo un pequeño porcentaje de los edificios existentes está realizado de obra nueva, es evidente que no es suficiente desarrollar estrategias y conceptos de diseño sostenible sólo para los proyectos nuevos, sino también para los preexistentes. La arquitectura industrial con grandes espacios flexibles y con un gran potencial de adaptación, es la tipología más adecuada para la investigación del reciclaje arquitectónico.

El estudio se enfoca en la exploración y redefinición del diseño del reciclaje, concretamente, en la creación de un modelo de reciclaje. Este se compone de tres principios redefinidos del diseño, que surgen de la comparación entre los campos de la biología y la arquitectura. La analogía se llevó a cabo de manera sistemática, aplicando el conjunto de criterios que se refieren a la estructura, los materiales, la forma y la organización espacial, es decir, su relación entre el edificio existente y la nueva intervención.

La hipótesis general de la investigación se refiere a las ventajas del reciclaje arquitectónico sobre demolición o preservación, desde la perspectiva de los métodos más aplicados en las intervenciones de edificios existentes. Ésta se basa en la idea, que los procesos de demolición y sustitución simplemente contribuyen al interminable círculo de la producción, el consumo y los residuos. El sector de la construcción constituye uno de los mayores flujos de residuos producidos en Europa y es sin duda el mayor contaminador. Por otro lado, la preservación impone mantener el 'status quo' e impide el edificio adaptarse a las nuevas condiciones, por consiguiente, el reciclaje arquitectónico se presenta como una alternativa ambientalmente sostenible, en comparación a la demolición o a la preservación. La segunda hipótesis consiste en comprobar las analogías biológicas para la definición de los conceptos del diseño del reciclaje. Se supone que el concepto biológico de 'simbiosis' es el más adecuado

para la definición del nuevo diseño del reciclaje, es decir, la concreción de las relaciones entre el edificio industrial existente y la nueva intervención. La última hipótesis se refiere a la relación entre las características físicas de un edificio industrial y el concepto de diseño ambientalmente sostenible para su reciclaje. Cuando el edificio tiene un alto uso intensivo, la intervención de reciclaje tiene un menor impacto ambiental. La elección del principio de diseño más sostenible ambientalmente depende de las condiciones, estructural y material, del edificio industrial existente.

En primer lugar, se analizan los conceptos relacionados con las intervenciones arquitectónicas que van desde la preservación hasta la destrucción. La revisión sistemática de los conceptos de conservación, restauración, destrucción y el diseño sostenible, están basados en las fuentes de John Ruskin, William Morris, Eugène Viollet-le-Duc y Rem Koolhaas, respectivamente. El análisis permite aclarar el concepto de reciclaje arquitectónico como la 'conservación a través del cambio', siempre en un contexto del diseño arquitectónico sostenible.

En segundo lugar, la arquitectura industrial es el campo perfecto para la exploración del reciclaje arquitectónico. Las características físicas de grandes espacios de planta abierta, estructuras sólidas, materiales resistentes, flexibles y adaptables lo definen como la tipología más adecuada. En esta fase de la investigación se analizan los conceptos de estética industrial, de ruina arquitectónica, de importancia social y de la importancia arquitectónica de los edificios industriales. Una vez identificada la importancia de la arquitectura industrial, a nivel social, de capacidad de adaptación y de las novedades arquitectónicas, la investigación se centra en los conceptos de diseño del reciclaje, descritos por la literatura contemporánea, sobre la práctica del reciclaje de la arquitectura. Por lo tanto han sido seleccionadas cuatro fuentes, Brooker y Stone (2004), Feireiss y Klanten (2009), Jäger (2010) y Rogić (2009). Se analizan y comparan según los criterios de estructura, material, forma y organización espacial. El objetivo es entender las características del conjunto de conceptos de diseño e identificar las similitudes y diferencias entre ellos.

Por último, se presenta el 'modelo de reciclaje' conceptual, que consiste en tres nuevos conceptos de diseño del reciclaje, basado en la analogía entre los conceptos utilizados en la biología y la arquitectura. Desde el concepto de simbiosis, elegido como uno que verdaderamente representa la analogía entre la biología y la arquitectura del reciclaje, derivan tres principios de diseño de reciclaje: comensalismo, mutualismo y parasitismo. El valor de este modelo se ve en su carácter multidisciplinar y su enfoque sistemático al tema del reciclaje de la arquitectura. Los principios incorporados en este modelo se refieren a los aspectos de la estructura, material, forma y organización espacial. El 'modelo de reciclaje' proporciona una nueva comprensión de cómo una amplia gama de características físicas de un edificio preexistente se puede considerar de manera sistemática. La finalidad

consiste en orientar la elección del concepto de diseño de reciclaje más ambientalmente sostenible. Una vez que el modelo conceptual se ha establecido, la investigación se centra en su evaluación en la práctica contemporánea de reciclaje de la arquitectura industrial, a través de la selección de los tres casos de estudios. Cada uno de los tres casos ('Fabra i Coats', Barcelona, España; 'Centro de Monitorização e Interpretação Ambiental – Casa dos Cubos', Tomar, Portugal; and '192 Shoreham Street', Sheffield, Inglaterra) corresponde a uno de los tres conceptos de diseño de reciclaje redefinidos. A través de los ejemplos seleccionados se validan los principios que constituyen el modelo conceptual. De la misma manera se identifica la relación entre las características físicas de un edificio industrial determinado y el concepto de diseño más ambientalmente sostenible para su reciclaje.

El estudio confirma la tesis que el reciclaje de la arquitectura industrial es una alternativa ambientalmente sostenible para la demolición, por un lado, y la preservación, por el otro. De la misma manera se confirma la tesis que afirma que los principios de diseño de reciclaje se derivan de la analogía entre los campos de la biología y la arquitectura. Por último, con el fin de producir menor impacto ambiental, la intervención del reciclaje debería comportar un uso intensivo del edificio, por lo tanto, las características físicas del edificio original determinan qué concepto de diseño es el más sostenible ambientalmente para su reciclaje.

La contribución de este estudio es la confirmación del supuesto de que el reciclaje de la arquitectura industrial es una alternativa ambientalmente sostenible a los opuestos de la demolición y la preservación. En segundo lugar, esta investigación proporciona la revisión sistemática de las aproximaciones contemporáneas de los edificios preexistentes, y aclara las posibles relaciones entre el edificio original y la nueva intervención. Esta relación se observa a través de los criterios de estructura, material, forma y organización espacial. Por último, la investigación presenta el 'modelo de reciclaje' compuesto por tres conceptos de diseño redefinidos, que determina la relación entre las características físicas de un edificio existente y el principio de diseño más ambientalmente sostenible para su reciclaje.

Palabras clave: reciclaje, arquitectura industrial, conceptos de diseño, simbiosis, diseño arquitectónico sostenible.

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1. INTRODUCTION

Problem and subject of the research

The research subject refers to the topic of recycling, i.e. design principles of recycling of the existing building stock (particularly the industrial architecture), in the context of the sustainable architectural design. However, such specific research subject should be firstly explained in more general context. Namely, current trends in city development, such as rapid urbanization, the spread of poverty in urban areas and, for the first time in history, the fact that most people live in cities, do not lead to sustainable communities (Perić, 2013). Such trends have led to the ecological crisis reflected in the climate change, pollution and decrease of non-renewable resources. Construction industry is responsible for the consumption of about 50 per cent of the natural virgin materials, more than 40 per cent of the produced energy, and around 80 per cent of prime agricultural land (Edwards, 2005). The waste associated with the construction and demolition processes constitute one of the biggest waste streams produced in Europe (Cepinha, Ferrão & Santos, 2007). By overexploiting resources, a society may compromise its ability to meet the essential needs of its people in the future (Jochem, 2004). The environmental sustainability, as one of the components of a sustainable development, was recognized as especially important for this research, considering the impact the building sector has on the environment. Thus, sustainable architectural design laid down the principles for the design of sustainable buildings.

However, it is not enough to develop principles for a sustainable design only for the new projects. The existing buildings must also be taken into account given that structural issues are usually not the reason why buildings come to their end-of life, but rather the shift of the building's original purpose, making the existing building unsuitable for new roles and functions (Lee, Trcka & Hensen, 2011).

Edwards (2005) highlights that existing buildings are central to any strategy for carbon-emission reduction. Buildings are durable goods which can reach 100 years or more of useful life and building renewal can extend the use of the existing buildings with diverse benefits, such as the exploitation of the existing urban infrastructure (with no need for new site development) and the lesser generation of residues in relation to a totally new construction (Cepinha, Ferrão & Santos, 2007). The process of readapting existing building for other purposes has a number of benefits, such as saving new materials from being used, and cutting the associated environmental impacts of producing and transporting those materials (Lee, Trcka & Hensen, 2011). Edwards (2005) explains that in a sustainable city, brownfield sites are exploited and existing buildings recycled. Historic buildings and structures can help enhance a neighbourhood's identity, and large industrial sites should be converted to commercial, cultural or residential use (Edwards, 2005). As only a small percentage of the total building stock is made up of new works, it is essential that, through repurposing, we consider what can be done with what we already have if we are to significantly benefit the sustainability agenda in the future.

Therefore, it is assumed that for the solution of problems concerning the negative effects of the building sector on environment a new approach to the existing building stock is needed. Interventions aimed at repurposing and improving existing buildings, i.e. architectural recycling, as an alternative to construction of new buildings, prevent the occupation of more soil and unnecessary use of more energy and materials. Architectural recycling refers to the process of altering the existing building, by using all of its available, useable material, in order to make it suitable for the new function. It is important to mention that unlike other terms which relate to intervention on the existing building, recycling implies the notion of change. Through such a process original building is altered, in order to make the accommodation of new function possible, while using as much of the original buildings' material as possible. This process increases the working service life of existing buildings, and so the rentability of the resources already applied (Cepinha, Ferrão & Santos, 2007). Extraction, processing and transport of the new material is diminished through the process of recycling. Thus, the need to manufacture new components and products is lessened which has direct economic and environmental advantages (Couto & Couto, 2007). Recycling is also seen as a process which can mediate between the radical stasis, reflected in the rigid rules of preservation, and the radical change which new construction implies.

Industrial complexes are the most appropriate examples for the research on architectural recycling, due to their physical characteristics, i.e. large flexible spaces with great adaptability potential. Made of durable materials, laid on an open plan which allows for a great number of reconversion schemes and, due to the expansion of the city, usually located in the central city areas, industrial buildings can be repurposed for a great variety of new

uses. Besides their physical characteristics, which make them the perfect candidates for architectural recycling, industrial buildings are significant in many ways: these buildings were testing field for structural and material innovations; they are the bearers of identity of the neighbourhoods and towns and they play an important role in the urban renewal of cities; industrial aesthetic was responsible for the emergence of new trends and styles in both art and architecture.

Architectural literature on interventions executed upon the existing buildings usually deals with the categorization and classification of projects according to rather subjective and vague criteria. The results of such studies are mainly catalogues, as a very useful database for projects dealing with the exiting architecture. However, while consecutive, consistent studies have been made in the field of building construction and physics aimed at improving building performances, the lack of research focused on the design of the intervention on the existing building (beyond catalogisation) is evident. Hence, through the comparative analysis of a body of literature in the field of recycling the industrial architecture, the deficiencies of the current definitions of specific design principles are highlighted. More precisely, the research focuses on the relationship between the physical characteristics of the original industrial building and new intervention. Furthermore, the analysis is conducted based on the strict criteria (structural, material, formal and spatial relationship) between the original building and the new intervention. Such a thorough critical analysis on the existing recycling design principles used in the practice of recycling the industrial architecture serves as a base for the central research focus. Namely, after the profound analysis on existing recycling design principles and their implementation in the architectural practice, the research is directed towards the redefinition of recycling design principles and the creation of the so-called 'recycling model' (consisting of the redefined recycling design principles).

There are two main characteristics of the 'recycling model'. Firstly, the model is based on the principles used in the field of biology, i.e. the redefined recycling design principles stem from the analogy between the domains of biology and architecture. Secondly, such an analogy is derived in a systematic manner, thus limiting possible inconsistencies and simplifications. In other words, the analogy refers to the highly precise apparatus for the operationalisation of the redefined recycling design principles in the practice of recycling the industrial architecture. More precisely, the translation of the principles used in biology into the field of architecture is possible due to the clear criteria for examination of the redefined recycling design principles. The criteria again referto structure, material, form and spatial organisation, i.e. their relationship between both original building and new intervention, thus building up the coherency with the previous analytical research part. In practical terms, the model serves for providing the link between the physical characteristics of underused buildings, on the one hand, and the design principle most

environmentally sustainable for its recycling, on the other. In other words, the model provides a fresh understanding of how an extensive range of physical characteristics of an existing building can be considered in a systematic way in order to provide the guidance for choosing the most environmentally sustainable recycling design principle. Finally, the research subject focuses on the evaluation of the conceptual 'recycling model' in the contemporary practice of recycling the industrial architecture, through the selection of three case studies, where each case corresponds to one of the redefined recycling design principles as constituents of the 'recycling model'.

Research objectives

As research addresses the notion of recycling in architectural practice, the research firstly aims at elucidating the concept of architectural recycling as a viable alternative to both demolition and preservation. Having in mind the current research in the field of architectural recycling (lacking the precise identification of recycling design principles), the second most important research aim relates to the redefinition of recycling design principles in the context of the sustainable architectural design. This is done according to: 1) the analogy between the field of biology and architecture, and 2) the clear set of criteria relating to the aspects of structure, material, form and spatial organisation.

According to previous general research aims, the research tasks are defined as following: 1) analysis of the conceptual research framework; 2) analysis of practical research in the domain of recycling the industrial architecture; 3) forming the multidisciplinary research background, by drawing the analogy among the concepts used in biology and architecture; 4) bridging the gap between conceptual and empirical research, by operationalisation of biological principles into the architectural domain; and 5) testing the conceptual model into architectural practice.

The research objectives are summarized in the following:

1. Exploration of the concept of architectural recycling as environmentally sustainable alternative to demolition and preservation. This implies the analysis of the deficiencies of different types of architectural intervention (ranging from preservation to destruction), as well as the effect of the new construction on our environment. Hence, the conceptual framework is observed through the lens of sustainable architectural design.

2. Identification of existing recycling design principles in architectural practice. Based on a thorough overview of the body of literature in the field of recycling the industrial architecture, it is necessary to explore and explain current relationships between the original building and new intervention according to the clear set of criteria - structure, material, form and spatial organisation.

3. **Examination of the possibility of implementing the biological concepts into architectural field.** This implies the identification of the extent to which the analogy between the fields of biology and architecture can be drawn, thus making the firm multidisciplinary research background. More precisely, the aim is to redefine the recycling design principles, thus formulating the 'recycling model'.

4. **Translation of the biologically derived principles into architectural domain.** This implies the precise formulation of characteristics that each redefined recycling design principle possesses. More precisely, the aim is to elaborate a clear set of criteria for analysis of both the original building (using the criteria of structure and material) and for new intervention (using the criteria of structure, material, form and spatial organisation).

5. **Evaluation of the redefined recycling design principles in the practice of recycling the industrial architecture.** This practically implies to the determination of the relationship between the physical characteristics of the given industrial building and the most environmentally sustainable design principle for its recycling.

Research hypotheses

The general research questions lead to the formulation of research hypotheses. The first set of research questions examines the viability of both preservation and demolition processes, and their effect on the environment. It is important to consider advantages of the alternative solutions for constant replacement of the existing building stock while considering the sustainability agendas. It is also interesting to note two polar and radical ideas on intervening with the existing architecture - preservation as a radical stasis and demolition as a radical change.

The second set of questions refers to the analogy between the fields of biology and architecture. It is important to note different types of analogies drawn to architecture and to highlight the relationship between the biology and architecture which shaped the architectural and urban practice throughout the history and still continues to do so. Therefore, it is of great importance to systematically analyse the biological analogies used to explain both architectural and urban processes.

The third set of questions refers to recycling the industrial architecture as a process which mediates between radical change and radical stasis. It is important to consider the relationship between the use of the original buildings' material and the level of the environmental sustainability of the recycling intervention. It is also important to determine whether and to what extent physical characteristics of a given industrial building determine which design principle is the most environmentally sustainable one for its recycling.

Based on the above mentioned research questions, the following hypotheses are formulated:

1. Recycling the industrial architecture is environmentally sustainable alternative to demolition, on the one hand, and preservation, on the other.

Through architectural recycling a whole range of environmental problems can be avoided, such as: land, material and energy loss, as well as increase in landfill waste and global warming gases. In fact, architectural recycling saves the embodied energy of building materials, while negative environmental impact associated with excavation, production and transportation of the new materials is avoided. At the same time land as a non-renewable resource is preserved and the production of waste, associated with demolition and new construction, is minimised.

2. Design principles of recycling the industrial architecture stem from the analogy between the fields of biology and architecture.

Through the analogy between biology and architecture the importance of both 'symbionts', i.e. original industrial building and new intervention, is accentuated. More precisely, even though we assume that as a result of the architectural intervention, i.e. intervention of recycling the industrial architecture, predominance of the 'new' (new intervention) over the 'old' (original industrial building) may occur, the concept of symbiosis in architecture (which stems directly from the domain of biology) accentuates the importance and the value of the original building. This is of crucial importance for the research in the field of recycling the industrial architecture. Determining the relationship between the original building and environmental sustainability leads to the following hypothesis.

3. Physical characteristics of the original building determine which design principle is the most environmentally sustainable one for its recycling.

It is assumed that the most environmentally sustainable recycling intervention is the one which exploits the host building to a high degree. Therefore, the choice of the recycling design principles to be applied should be done according to the current conditions of the original industrial building, i.e. structural and material condition, if the least environmental damage is to be induced.

Structure of the research and applied methodology

The complexity of the research topic requires the application of several scientific research methods. The methods are used in accordance with the defined hypotheses and the structure of the research.

The first part of the research refers to the preliminary exploration of conceptual research framework (i.e. the concept of recycling in architecture and its relation to other design

concepts) as the basis for the formulation of both research problem and subject. This phase is based on the analysis of different approaches in dealing with the existing building stock. The method of critical analysis of sources addressing the concepts of preservation, restoration, destruction and sustainability, are also applied in this phase of the research. More precisely, a systematic review of the concepts of preservation, restoration, destruction and sustainable design, is presented based on the sources by John Ruskin, William Morris, Eugène Viollet-le-Duc and Rem Koolhaas, respectively. In this way the position of the architectural recycling, as a method of a 'preservation through change' in the context of a sustainable architectural design, is elucidated. Body of literature on the topic of recycling the architecture, as well as the reports from international conferences, their resolutions, conventions and recommendations, related to the theme of intervening with and repurposing of the existing architecture is also analysed in this phase of the research.

In the second part of the research, the focus is on the industrial architecture, understood as a field for the exploration of the topic of architectural recycling. Opposing views towards industrial buildings, mainly those of Hübsch, Schinkel, Le Corbusier and Banham, are presented and analysed. The concepts of architectural ruin and industrial aesthetics are explored through their association with broader concepts of continuity, memory, authenticity and identity. Architectural and social importance of industrial buildings and their conversion possibilities are also analysed in this research phase. The main method to be used is the content analysis of the sources by previously mentioned authors, as it is particularly appropriate for the understanding and analysis of concepts and ideas described in the written format. The research then focuses on the design principles of recycling, described in contemporary literature on the practice of architectural recycling. The comparative analysis of four selected sources, dealing with recycling design principles, is conducted with the aim of understanding the characteristics of each set of design principles and identifying the similarities and differences between them. In order for the analysis to be truly comparative, clear set of criteria (applied to each of the analysed design principles) is determined, i.e. the analysis is conducted according to the criteria of structure, material, form and spatial organisation. Comparative analysis represents the starting point for the later redefinition of the design principles of recycling.

The third part of the research aims at the redefinition of the previously analysed recycling design principles, and the formulation of the so-called 'recycling model'. The model consists of three new, redefined design principles of recycling. This research phase has a multidisciplinary character, i.e. the base for the formulation of the 'recycling model' is the analogy among the concepts used in both biology and architecture. The reason behind choosing the field of biology as a proper domain for its analogy with the architecture relates to profound critical overview of embeddedness of urban and architectural practice in a broader context of social and natural sciences. Thus, the main concept truly representing

the analogy between biology and architecture (particularly recycling the architecture) is the concept of symbiosis. From this concept stem three redefined design principles of recycling, namely: commensalism, mutualism, and parasitism. After the elaboration of the conceptual 'recycling model', the research focus shifts to the evaluation of the model in contemporary practice of recycling the industrial architecture. Through selected 'good practice' examples the principles which constitute the conceptual model are validated and the relationship between the physical characteristics of a particular industrial building and the most environmentally sustainable design principle for its recycling is identified. The method of multiple-case study, i.e. cases that occur in different places and at different times, but with the same subject of research, has been selected as a particularly appropriate method for this phase of the research. Therefore, each redefined design principle is assessed through one selected case of recycling the industrial architecture. Finally, the re-evaluation of the contemporary practice of recycling the industrial architecture, i.e. the classification of the selected projects according to newly defined recycling design principles, is presented.

In the concluding part of the research, the systematization and interpretation of the obtained results, in relation to the research hypothesis, is presented. Contribution of the research, dilemmas, constraints and opportunities for further research are also highlighted.

Expected results

The research results can be divided in two groups - conceptual and practical.

Firstly, the main research result is the confirmation of the view that the recycling of the industrial architecture is environmentally sustainable alternative to both demolition and preservation, as opposed concepts.

Secondly, from the point of view of architectural practice in the domain of recycling the industrial architecture, the research provides the systematic overview of the contemporary approaches to existing building stock. More precisely, the critical analysis of the existing recycling design principles is important for the understanding of the possible relationships between the original building and the new intervention observed through the criteria of structure, material, form and spatial organisation.

Based on a thorough overview of architectural practice, research results relate to the conceptual domain again. Namely, the major research results are directed towards the redefinition of the design principles of recycling in the context of the sustainable architectural design. In other words, research shows that in order for the recycling intervention to be as environmentally sustainable as possible, the selection of the adequate

design principle should be done according to the physical characteristic of the original building.

Finally, it is assumed that this thesis represents only a framework and basis for future research, greatly needed in time when technology progress, environmental degradation and society's needs imply constantly changing conditions.

II THE NOTION OF INTERVENTION IN ARCHITECTURE

Since the research subject relates to the recycling of the industrial architecture, as a sustainable alternative to demolition and replacement, the following chapter is devoted to the notion of intervention in architecture, i.e. any permanent or temporary spatial manipulation aimed at preserving, improving or transforming a given space. Thus, the first subchapter focuses on different approaches in dealing with the existing building stock. Namely, opposed concepts of architectural preservation, i.e. radical stasis, and destruction, i.e. radical change, are analysed as two extremes in dealing with the existing buildings. Furthermore, the analysis of the concepts of preservation, on one side, and destruction, on the other, elucidates the concept of architectural recycling and its positioning between these two polar concepts – stasis and change.

Within the second subchapter, the research focuses on the concept of architectural recycling as a method for reaching the sustainable architectural design. Thus, in the first place, the concept of a sustainable architectural design, with its principles and strategies, is presented and analysed. Based on the thorough overview of the body of literature in the field of sustainable architectural design the notion of recycling is presented as a crucial method which ensures environmentally sustainable design. In addition, architectural recycling is elaborated as a process providing the continuity of the existing facilities' utilization through the alteration of their use. In short, the notion of architectural recycling as a preservation through change is interpreted.

2.1. Preservation vs. Destruction of Architecture

This subchapter aims at analysing two concepts, i.e. two extremes related to the topic of architectural interventions: 1) preservation as a radical stasis and 2) destruction as a radical change. More precisely, two polar ideas will be analysed through the writings and statements of its supporters, mainly those of John Ruskin, Eugène Viollet-le-Duc and Rem Koolhaas. The analysis of the concepts of preservation, and destruction, enables the

formulation of the concept of architectural recycling as ‘preservation through change’, viewed as a sustainable response to rapidly changing conditions.

In the first place, it is important to present accurate definitions of terms associated with different kinds of architectural interventions. Systematic overview of the terminology related to architectural interventions makes the identification of similarities and differences between the concepts possible. Thus, in the following lines, the terms ranging from preservation to destruction, are elucidated.

Adaptation. According to The Australia International Council on Monuments and Sites (ICOMOS) “Charter for Places of Cultural Significance - The Burra Charter”, adaptation refers to the modification of a place in order to suit the existing use or a proposed use. This process is acceptable only when the adaptation has minimal impact on the cultural significance of the place and should involve minimal change to significant fabric, achieved only after considering alternatives (ICOMOS, 1979, Article 21). Douglas (2006) explains that the word ‘adaptation’ is derived from the Latin *ad* (to) and *aptare* (fit). According to the same source, the term “include any work to a building over and above maintenance to change its capacity, function or performance (i.e. any intervention to adjust, reuse or upgrade a building to suit new conditions or requirements)” (Douglas, 2006: 1). Douglas (2006) points out that “the term has also been commonly used to describe improvement work such as adaptations to buildings for use by disabled or elderly people” (Douglas, 2006: 1).

Adaptive reuse – In the “Preservation Strategy No. 3” (Heritage Canada Foundation, 1983) adaptive reuse is defined as a process of recycling of an older structure often for a new function, which usually involves extensive restoration or rehabilitation of both the interior and exterior. Kincaid (2002) refers to this term as a “potential for buildings to be adapted to different uses” (Kincaid, 2002: 1). According to Iselin and Lemer (1993) the term refers to conversion of a facility or part of a facility to a use significantly different from that for which it was originally designed.

Conservation – According to the “Burra Charter”, conservation includes all the processes of looking after a place in order to retain its cultural significance (Article 1.4). International Council of Museums Conservation Committee (ICOM-CC) in the preprints of the “15th Triennial Conference” (Allied Publishers, 2008) highlight that conservation implies all measures and actions aimed at safeguarding the tangible cultural heritage while ensuring its accessibility to present and future generations. ICOM-CC state that these measures and actions should respect the significance and the physical properties of the cultural heritage item (ICOM-CC, 2008). In “Australia Centennial Parklands Conservation Management Plan” (Centennial Park and Moore Park Trust, 2003) this term refers to all the processes of looking after a place so as to retain its natural, indigenous and cultural significance and includes protection, maintenance and monitoring. In the same document it is explained

that conservation involve preservation, restoration, reconstruction, reinstatement or adaptation and will be commonly a combination of more than one of these. According to Feilden (1982), “conservation implies keeping in safety or preserving the existing state of a heritage resource from destruction or change, i.e. the action taken to prevent decay and to prolong life” (Feilden, 1982: 3). In “The Operational Guidelines for the Implementation of the World Heritage Convention” the term preservation and conservation are used interchangeably to refer to the “State of preservation/conservation” section of the nomination form (UNESCO February 1996: 20, Paragraph 64 (d)). In “The Nara Document on Authenticity” the term ‘conservation’ is defined specifically with reference to the cultural heritage, i.e. conservation is seen as: “all efforts designed to understand cultural heritage, know its history and meaning, ensure its material safeguard and, as required, its presentation, restoration and enhancement” (Larson 1995: xxv). According to Weaver and Matero (1997), architectural conservation prolongs the life and integrity both of the architectural character (its form and style), and of its constituent materials (such as stone, brick, glass, metal, and wood). Conservation involves the professional use of science, art, craft, and technology as preservation tools (Weaver & Matero, 1997).

Demolition / Destruction – In Webster’s II Dictionary (1988) ‘demolition’ is defined as tearing down completely or doing away with completely, and ‘destruction’ as an act or process of damaging something so badly that it no longer exists or cannot be repaired. In Architecture these terms imply tearing-down of buildings and structures using different methods, depending on the physical characteristics of a given building and its site. Unlike ‘deconstruction’, which implies selective dismantlement of building components, and preservation of valuable elements for potential future use, ‘demolition’ and ‘destruction’ imply a complete clearing of the site of its buildings.

Preservation – According to the “Burra Charter”, preservation means maintaining the fabric of a place in its existing state and retarding deterioration. Canadian Association for Conservation of Cultural Property (CAC) and the Canadian Association of Professional Conservators (CAPC) within the document “Code of Ethics” (CAPC, 2000) consider that the term implies all actions taken to retard deterioration of, or to prevent damage to, cultural property. Preservation involves management of the environment and of the conditions of use, and may include treatment in order to maintain a cultural property, as nearly as possible, in a stable physical condition. In the “Preservation Strategy No. 3” (The Heritage Canada Foundation, 1983) preservation is referred to as a generic term for the broad range of processes associated with the restoration, rehabilitation and adaptive re-use of historic structures which include variety of activities, such as identification, evaluation, interpretation, maintenance and administration. The “Operational Guidelines for the Implementation of the World Heritage Convention” do not specifically define preservation, but use this term interchangeably with conservation, safeguarding and

protection (UNESCO, 1996). According to Weeks and Grimmer (1995), the term is defined as the act or process of applying measures necessary to sustain the existing form, integrity and materials of an historic property.

Protection – In “The Secretary of the Interior’s Standards for Historic Preservation Projects with Guidelines for Applying the Standards” (U.S. Department of the Interior, 1979) the term is defined as the act or process of applying measures designed to affect the physical condition of a property by defending or guarding it from deterioration, loss or attack, or to cover or shield the property from danger or injury. According to the same source, in the case of buildings and structures, such treatment is generally of a temporary nature and anticipates future historic preservation treatment; in the case of archaeological sites, the protective measure may be temporary or permanent. In “Convention on the Protection and Promotion of the Diversity of Cultural Expressions” (UNESCO, 2005) ‘protection’ is referred to as adoption of measures aimed at the preservation, safeguarding and enhancement of the diversity of cultural expressions.

Reconstruction – “Preservation Strategy No. 3” (The Heritage Canada Foundation, 1983) refers to ‘reconstruction’ as the piece-by-piece reassembly of a structure either in situ or on a new site, which can be the result of disasters such as wars and earthquakes or caused by land use changes which necessitate the relocation of a building. According to the same source, this process involves the re-creation of a non-existent building on its original site and is based upon historical, literary, graphic and pictorial as well as archaeological evidence, using both modern and/or traditional methods of construction. Reconstruction means returning a place to a known earlier state and is distinguished from restoration by the introduction of new material into the fabric (The Burra Charter, 1979). This term implies processes through which a vanished building, structure or objects are reproduced in the exact form and detail as it appeared at a specific period of time (U.S. Department of the Interior, 1979). According to Weeks and Grimmer (1995), reconstruction re-creates vanished or non-surviving portions of a property for interpretative purposes.

Recycling – Ontario Ministry of Municipal Affairs and Housing in “Making Better Use of the Existing House Stock: A Literature Review” (1982) defines the term as the act of re-using or adapting existing buildings, materials or components for a similar or new purpose. According to the same source, since this activity may include many other activities such as renovation, retrofitting, rehabilitation, reconstruction and restoration, it can therefore be called an umbrella term. According to Douglas (2006) the term refers to transforming or re-utilizing a redundant or other underused/unused building or its materials for more modern purposes.

Refurbishment – According to Douglas (2006), the term is used to describe a wide range of adaptation work. Douglas (2006) explains that “in one of the Energy Efficiency Office’s Best Practice Programme publications (GIR 32, 1995), four types of ‘refurbishment’ were

identified: major repair, acquisition and rehabilitation, conversion, and re-improvement” (Douglas, 2006: 2). In the “Management Guide CTV038 for the Low Carbon Refurbishment of Buildings” (Carbon Trust, 2007) it is stated that refurbishment covers a wide range of activities, from relatively minor works to very significant changes to the fabric or internal layout of a building. According to Watt (1999) the term refers to modernizing or overhauling a building and bringing it up to current acceptable functional conditions. Douglas (2006) explains that it is usually restricted to major improvements primarily of a non-structural nature to commercial or public buildings, though some refurbishment schemes may involve an extension.

Rehabilitation - National Research Council of Canada in “Building Rehabilitation Process Study” (NRC, 1982) explains that rehabilitation is usually carried out in order to extend a building’s life and/or its economic viability, and may involve more adaptation than conservation, but will still preserve most of the building’s original features. According to the same source, this process may be done to the exterior as well as the interior of the building, may be referred to as major or minor and may involve upgrading, modification, remodelling, rebuilding or retrofitting, and repairs. Heritage Canada Foundation, in “Preservation Strategy No. 3”, (Heritage Canada Foundation, 1983) highlights that rehabilitation extends the structure’s useful life through alterations and repairs while preserving its important architectural, historical and cultural attributes, and is often used interchangeably with renovation to describe the modification of an existing building. In “The Secretary of the Interior’s Standards for Historic Preservation Projects with Guidelines for Applying the Standards” (U.S. Department of the Interior, 1979) the term is defined as the act or process of returning a property to a state of utility through repair or alteration which makes possible an efficient contemporary use while preserving those portions or features of the property which are significant to its historical, architectural, and cultural values. In the “Glossary of Key Expressions Used in Spatial Development Policies in Europe” (CEMAT, 2006) the terms ‘urban rehabilitation’ and ‘restoration’ imply regenerating and conserving the built heritage or the urban environment, including the ecosystems. In addition to the refurbishment of historical buildings and townscapes, such activities also comprise the modernisation and upgrading of technical facilities and the respect of environmental and security norms and standards.

Remodelling - In the “Preservation Strategy No. 3” (Heritage Canada Foundation, 1983) the terms is defined as a process which involves the upgrading or replacing of interior components frequently in rooms such as a kitchen or bathroom. HeritageBC in “Heritage Terms & Definitions” defines the term as a process which involves upgrading or replacing interior parts and features, and which tends to be done more for aesthetic reasons rather than functional ones. According to the same source, remodelling may involve the removal and refinishing of interiors to make them indistinguishable from new structures, as well as applying architectural details from different, usually earlier periods.

Restoration – In the “International Charter for the Conservation and Restoration of Monuments and Sites – The Venice Charter” (ICOMOS, 1964, Article 9) the term restoration refers to a highly specialized operation which aims to “preserve and reveal the aesthetic and historic value of the monument and is based on respect for original material and authentic documents”. This process “must stop at the point where conjecture begins, and in this case moreover any extra work which is indispensable must be distinct from the architectural composition and must bear a contemporary stamp” (The Venice Charter, 1964, Article 9). In the “Burra Charter” restoration implies returning the existing fabric of a place to a known earlier state by removing accretions or by reassembling existing components without the introduction of new material. In the “Preservation Strategy No. 3” (The Heritage Canada Foundation, 1983) the term is defined as the process of returning a building or site to a particular period in time. According to the same source, the degree of intervention and the removal or replacement of parts may be determined by an historical event associated with the building or by aesthetic integrity. According to (Douglas, 2006), restoration is normally restricted to major adaptation work to dilapidated, derelict or ruinous residential or public buildings. In “The Secretary of the Interior’s Standards for the Treatment of Historic Properties: With Guidelines for Preserving, Rehabilitation, Restoring & Reconstructing Historic Buildings” it is highlighted that restoration focuses on the retention of materials from the most significant time in a property’s history, while permitting the removal of materials from other periods. This process recovers the form and details of a property and its setting as it appeared at a particular period of time by means of the removal of later work or by the replacement of missing earlier work (DIANE Publishing, 1995). Actions comprised under restoration are based on respect for the original material (ICOM-CC, 2008).

Reuse – Webster’s II Dictionary (1988) defines the term as: to use again. In the “Design Guidelines for Department of Defense Historic Buildings and Districts” (DOD, 2008) the term is referred to as the use of a material more than once in its same form for the same purpose.

Revitalization – In the “Preservation Strategy No. 3” (Heritage Canada Foundation, 1983) the term is defined as the process of economic, social, and cultural redevelopment of an area or street. Urban regeneration and revitalisation aims at transforming the obsolete socio-economic base of certain urban areas into a more sustainable socio-economic base through the attraction of new activities and companies, modernisation of the urban fabric, improvement of the urban environment and diversification of the social structure (CEMAT, 2006). Watt (1999) explains that this term refers to extending the life of a building by providing new or improving existing facilities, which may include major remedial and upgrading works.

Two opposing concepts, i.e. preservation and destruction, representing the extremes in architectural interventions, are most frequently applied. Preservation implies actions aimed at maintaining the building in its existing state and thus, advocates the retention of the status quo. At the other end of the scale, destruction implies complete tearing-down of the building and clearing of the site. In the following subchapters, these two concepts are further analysed.

2.1.1. Preservation – radical stasis

Burman (1995) points out that the instant you make any kind of intervention, however subtle, to a building you change it. He underlines that the most influential contribution to the debate about the philosophy of repair in the 19th century was made by John Ruskin. According to the same source, the most important of Ruskin's many writings which refer to buildings, and the preservation of buildings, is "The Seven Lamps of Architecture" (1849) and, in particular, chapter "The Lamp of Memory" where Ruskin introduces the idea of trusteeship: "(...) it is again no question of expediency or feeling whether we shall preserve the buildings of past times or not. We have no right whatever to touch them. They are not ours. They belong partly to those who built them, and partly to all the generations of mankind who are to follow us" (Ruskin, 1849: 163). In "The Lamp of Sacrifice" Ruskin (1849: 24) refers to buildings as a legacy of builders given that "all else for which the builders sacrificed, has passed away-all their living interest, and aims, and achievements" except for, "one evidence [that] is left to us in those grey heaps of deep-wrought stone" - their buildings. He argued that the architecture of the past should be recognized as inheritance and preserved as a living memory. More precisely, Ruskin equals the term restoration with destruction, and explains it as "the most total destruction which a building can suffer: a destruction out of which no remnants can be gathered; a destruction accompanied with false description of the thing destroyed" (Ruskin, 1849: 161). He considered that restoration work would cause greater damage than the actual decay of the building. Also, Ruskin believed that "death was the final fate of all beings and things in this world and that the physical ruin of the object should be the result of a more suggestive process than that rational intervention which might try to recover the 'formal unity' of the work" (Mozas, 2012: 8). Furthermore, instead of recreating its original form, the memory of what a building could have become should be cherished (Mozas, 2012). He concludes that "it is impossible, as impossible as to raise the dead, to restore anything that has ever been great or beautiful in architecture" (Ruskin, 1849: 161). In his "Seven Lamps of Architecture" Ruskin (1849: 162) refers to restored building as a "lie from beginning to end". Namely, describing the process of restoration Ruskin (1849: 162) writes: "But, it is said, there may come a necessity for restoration! Granted. Look the necessity full in the face, and understand it on its own terms. It is a necessity for destruction. Accept it as such,

pull the building down, throw its stones into neglected corners, make ballast of them, or mortar, if you will; but do it honestly, and do not set up a Lie in their place". Furthermore, he believes that "every form of noble architecture is in some sort the embodiment of the Polity, Life, History, and Religious Faith of nations", and should therefore be preserved in its original state (Ruskin, 1849: 165).

Burman (1995) highlights that Ruskin was, together with William Morris, who wrote the famous "Manifesto" (1877), one of the founding fathers of the Society for the Protection of Ancient Buildings (SPAB). In the "Manifesto", Morris (1877: para. 3), whose views were shaped by those of Ruskin, explains the concept of restoration as a "strange and most fatal idea, which by its very name implies that it is possible to strip from a building this, that, and the other part of its history – of its life that is – and then to stay the hand at some arbitrary point, and leave it still historical, living, and even as it once was". Morris (1877: para. 4) also refers to restoration as a forgery and explains that in earlier times when the repairs were needed they were always "wrought in the unmistakable fashion of the time; a church of the eleventh century might be added to or altered in the twelfth, thirteenth, fourteenth, fifteenth, sixteenth or even the seventeenth centuries; but every change, whatever history it destroyed, left history in the gap, and was alive with the spirit of the deeds done midst its fashioning". Furthermore, in the process of restoration those who perform this act possess no guide or evidence for bringing the building to a specific time. Thus, the process of deciding what to keep and what to destroy relies on whims and guesses of those who perform restoration (Morris, 1877). Finally, during "destruction and addition, the whole surface of the building is necessarily tampered with; so that the appearance of antiquity is taken away from such old parts of the fabric as are left, and there is no laying to rest in the spectator the suspicion of what may have been lost; and in short, a feeble and lifeless forgery is the final result of all the wasted labour" (Morris, 1877: para. 4).

Ruskin (1849) thought that architecture cannot be separated from morality, which is expressed both in terms of the use of materials and honesty in construction. In "The Seven Lamps of Architecture", Ruskin (1849: 98) writes: "(...) a direct falsity of assertion respecting the use of material is as wrong and deserving of reprobation as any other moral delinquency". He considered adaptation as the destruction of a "beautiful form", an act which will "infect that form itself with the vulgarity of the thing to which you have violently attached it" (Ruskin, 1849: 98).

Contrary to Ruskin and Morris, who argue that any restoration work simply destroys the building and its integrity, Eugène Viollet-le-Duc believed in restoration, i.e. the conservationist school of thought based on the assumption that historic buildings could be improved, and sometimes even completed, using current day materials, design, and techniques. In his seminal work "On Restoration", Viollet-le-Duc (1875) explains that:

“The term Restoration and the thing itself are both modern. To restore a building is not to preserve it, to repair, or rebuild it; it is to reinstate it in a condition of completeness which could never have existed at any given time” (Viollet-le-Duc, 1875: 9). Reiff (1971: 27) argues that “this does not mean that he [Viollet-le-Duc] replaces what has never existed, but that a railing changed in the fourteenth century, chapel decorations that had faded away by the sixteenth, and stained glass and statues destroyed in the eighteenth, would all be restored to their original state, although they had never actually coexisted”. According to the same source, the term restoration implies the process of bringing back all possible elements of a building to its original state. Viollet-le-Duc (1875: 46) highlights that “in restorations there is an essential condition which must always be kept in mind. It is, that every portion removed should be replaced with better materials, and in a stronger and more perfect way. As a result of the operation to which it has been subjected, the restored edifice should have a renewed lease of existence, longer than that which has already elapsed”. Mozas (2012) points out that Viollet-le-Duc’s rational approach was opposed to Ruskin’s romantic historicism. Also, Viollet-le-Duc “had no qualms about pulling down any additions from other impure times from the building he worked on which had hindered the rise of the Gothic as the supreme style” (Mozas, 2012: 8).

However, Viollet-le-Duc, just like Ruskin, praised honesty in architecture. He believed that the outward appearance of a building should reflect rational modes of construction (Viollet-le-Duc, 1875). Summerson (1963) argues that Viollet-le-Duc applied a rational approach, reflected in the view that styles of the past had already been glorified, that mere adoption was not enough, and that the role of the architect is to study the masterpieces of history, reduce them to the process of argument, and apply that argument to the current state of affairs. According to the same source, this new approach would not revert back to earlier, idealized social conditions, as in the case of Ruskin, but this new synthesis of form would serve the current ones, and would use materials of the current age. In terms of building material Viollet-le-Duc (1875: 47-48) writes: “Each stone that is taken out ought, therefore, to be replaced by one of better quality. Every system of cramping that had to be replaced should be exchanged for a continuous tie-rod in the same position; for it is not possible to change the conditions of equilibrium in a building that has lasted six or seven centuries without risk”. In other words, if the restored building consists of the older section and the newer addition, both should preserve its distinctive characteristics and remain distinguishable. Finally, in case two constructions of different periods are to be restored, “the distinct jointing of the two parts” is to be preserved, so that it stays apparent what was added afterwards (Viollet-le-Duc, 1875: 44).

According to Viollet-le-Duc (1875) special attention should be paid to the structure, and the architect entrusted with the restoration should be very well acquainted with the given building’s structure – “its anatomy, its temperament; for it is essential above all things

that he should make it live” (Viollet-le-Duc, 1875: 49). In Viollet-le-Duc’s (1875: 51) point of view, the restoration can be compared to war, i.e.: “It is a war that has to be carried on – a series of manoeuvres which must be modified every day by a constant observation of the effects that may occur”. More precisely, assumption or guess during the restoration process is very dangerous and, thus, a clear plan for the restoration is the most important element in the whole process. For that same reason it is essential that restoration architect possesses a great deal of knowledge concerning the period, methods of construction, and materials before starting the project (Viollet-le-Duc, 1875). Namely, restoration has to synthesize four different fields of study: “natural science (best represented by Georges Cuvier’s studies of anatomy and geology), philology (its major attainment residing in the tracing of all indoeuropean languages to a common root), ethnology (that studied the differences among races and their aptitudes, a subject that Viollet-le-Duc was to take up in his later “*Histoire de l’habitation humaine*” in relation to architecture), and archeology (which followed the analytic method)” (Costa Guix, 1988: 52). Costa Guix (1988 : 57) summarized the four fields, which according to Viollet-le-Duc represent elements needed to be incorporated in a restoration:

“1. Ethnic. The modern architect belongs to a certain group that has a strong interrelation with a territory and its resources, with a character or idiosyncrasy that is fundamentally the same as that of the builders of the past; 2. Grammatical. Partly as a result of the preceding reason, the architect can learn the grammar or principles of the historic monument, especially when it is a national monument, because the ‘grammar’ is abstract enough to last through generations and centuries; 3. Archeological. The architect can study the monument in history and in relation to other monuments or buildings; 4. Organic. The architect can understand the building as a perfect body with an inner logic – a system where form, structure and use are intimately related. The restoration, therefore, could never be partial. Any intervention in a part of the monument will ‘resound’ throughout the system.”

Viollet-le-Duc believed that the architect needs to produce a new, living entity rather than recompose a corpse, meaning that “he must make a monument meaningful for his own time, for the historical and national concerns” of the present (Costa Guix, 1988: 57). Frampton (1982: 64) argues that Viollet-le-Duc proposed “not only models but also a method which would theoretically free architecture from the eclectic irrelevances of historicism”. According to the same source, his ideas explained in “*Entretiens*” became an inspiration to the avant-garde of the last quarter of the 19th century, and his thesis, “in particular its implicit cultural nationalism, had its most pronounced impact on the works of the Catalan Antonio Gaudi, the Belgian Victor Horta and the Dutch architect Hendrik Petrus Berlage” (Frampton, 1982: 64).

Unlike Ruskin, Viollet-le-Duc had put his theories into practice. One of his most important works, and the one he was most criticised for, carried out in collaboration with Jean-Baptiste-Antoine Lassus, was the restoration of Notre-Dame de Paris, undertaken in 1845.

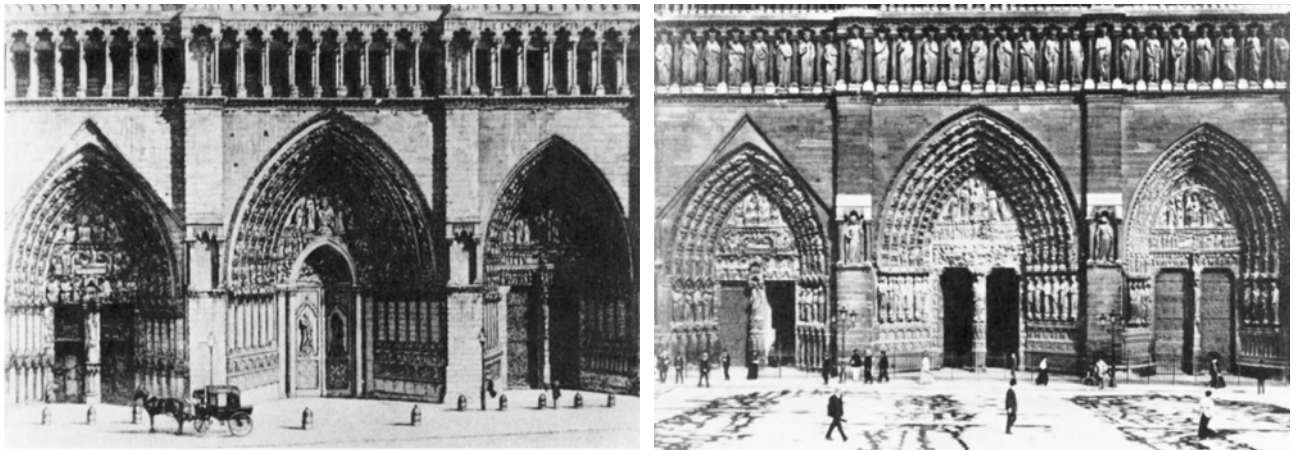


Figure 2.1.
Notre-Dame, portals
before and after the
restoration
(Source: Reiff, 1971)

The full extent of the Viollet-le-Duc's restoration is most apparent in the façade of the building, as he had to replace over sixty statues and incorporate a number of additions (Reiff, 1971). Also, three west portals of Notre-Dame suffered two major mutilations. Namely, the first one happened in 1771, "when Soufflot cut an arched opening in the central tympanum, removing most of the reliefs of the first two registers (the Resurrection, and the Weighing of the Souls), as well as the jambs", while the second one, occurred in 1793, "when the revolution destroyed almost all the sculpture on the facade" (Reiff, 1971: 17-18). According to Reiff (1971), when Viollet-le-Duc and Jean-Baptiste-Antoine Lassus submitted their project for the restoration in 1843, they pointed out that one of their main goals was the replacement of the façade sculpture (Figure 2.1). These sculptures were to be replaced by the copies of the appropriate sculptures from other cathedrals of the same period, so that the correct style for each of the three portals is assured (Reiff, 1971).

Reiff (1971) explains that in representing the statues of different periods, Viollet-le-Duc drew on different sources, and that a real effort has been made to capture the differences in style and present them clearly. Even though the most natural supposition concerns Viollet-le-Duc's creation of the missing figures from his own imagination, in reality "Viollet-le-Duc chose his sources with scholarly care and intelligence, with due attention to the original iconography, and copied the works he had chosen very closely" (Reiff, 1971: 26). According to the same source, Viollet-le-Duc's methods "placed the restoration on a scientific level and not a personally creative one" and "the only place for artistic intervention was in the replacing of parts of which no traces at all remained". In those cases, the architect first had to get familiar with "the building's style, and then borrow appropriately from some other structure of the same date, proportions, and type." (Reiff, 1971: 27-28). Unlike Ruskin and Morris, who advocated conservation and preservation, Viollet-le-Duc (1875) believed that these actions should only be applied to ruins which would have no other purpose but that of a historic monument. Any other buildings that would serve a function should be restored. In other words, "the best means of preserving a building is to find a use for it" (Viollet-le-Duc, 1875: 63).

In 1844, Viollet-le-Duc was put in charge of restoring the Saint-Nazaire and Saint-Celse basilica in Carcassonne. He subsequently undertook a complete study of the fortifications (Figure 2.2. Left). The city of Carcassonne, identified as the finest example of medieval military architecture, became one of the biggest restoration sites in Europe. The first interest for Carcassonne, which rose towards the middle of the nineteenth century, was

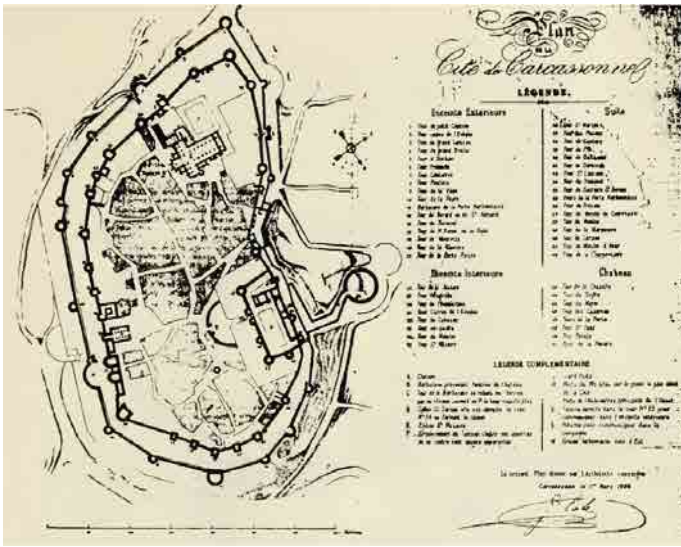


Figure 2.2.
Left
Plan of the City of Carcassonne. Signed G. Cals, Carcassonne, 1 March 1866. (Source: Costa Guix, 1988);
Right
Church Saint-Nazaire. West front restored by Viollet-le-Duc. (Source: Costa Guix, 1988).

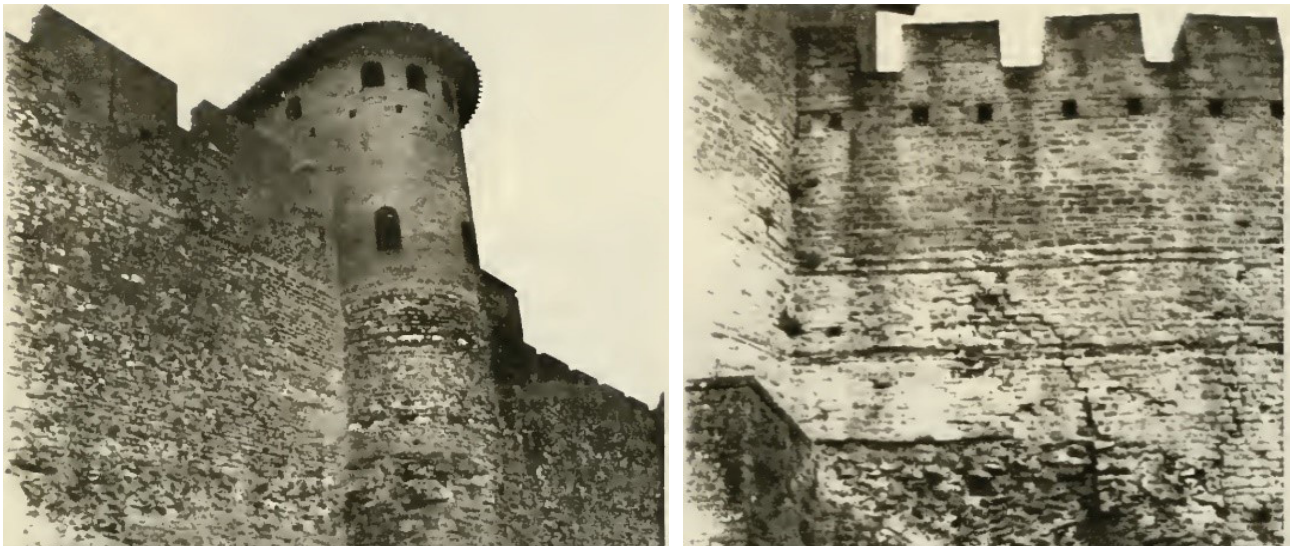
that of the archaeologist, as the fortress “was never understood as the physical document of a city of the past, but rather as a monument – an example of military architecture to be preserved according to the growing science of medieval scholarship” (Costa Guix, 1988: 1).

The urban dimension of Carcassonne was not present in the Viollet-le-Duc’s project, who saw the restoration as an opportunity to learn about medieval military architecture (Costa Guix, 1988). This approach to restoration implied anti-urban activities, i.e. ‘*dégagement*’, through which “all the habitations attached to the walls, or within the perimeter of servitude, were destroyed” (Costa Guix, 1988: 2). According to the same source, the city of Carcassonne suffered destruction, on a number of occasions throughout its history, followed by building campaigns (the 1228-39, 1240, and 1280-87 campaign). The fortress also changed its function on a number of occasions, from a prison, an arsenal, and storage place of weapons and food for the army, in the thirteenth century, to warehouse, from 1659 (Peace of the Pyrenees between France and Spain) until the nineteenth century, and consequently in 1804, it became a town quarry . The building that first shed light to Carcassonne was the former cathedral of Saint-Nazaire which demonstrates two distinctive styles and was classified as a historic monument in 1840 by the ‘Commission des Monuments historiques’. Finally, the Commission entrusted Viollet-le-Duc in writing a report on the cathedral and its ongoing restoration by the local architect Champagne and consequently, in 1844, commissioned him for the restoration of Saint-Nazaire (Figure 2.2. Right) (Costa Guix, 1988).

Figure 2.3.
Left
Narbonnaise gate. Interior elevation. Current state. Watercolor. 0.628 X 0.925 m. Signed Viollet-le-Duc, 30 December 1848;
Right
Narbonnaise gate. Interior elevation. Restoration project. Watercolor. 0.337 x 0.248 m. 30 December 1848. Fonds Viollet-le-Duc (Source: Costa Guix, 1988)

In 1846 Viollet-le-Duc was commissioned to prepare a report on the Narbonnaise gate (Figure 2.3.), the principal entrance to the fortress, which led to a first project of restoration for the gate and its towers (Costa Guix, 1988). Eventually, Viollet-le-Duc was commissioned for a more extensive report on the whole Cité where he pointed out that all





parasitic constructions that obstructed the tilt-yard and the walls need to be removed (Costa Guix, 1988). This process of removing ‘parasitic’ construction from the surroundings of the Cité lasted until 1909. Costa Guix (1988) explains that the most problematic part of the construction was that of the tower coverings, given that no conclusive proofs exist, whereas it remains a matter of interpretation based on two main arguments. The first argument, according to Costa Guix (1988), dictated by common sense, is that roofs have gentle slopes and are sheathed in ceramic tiles, given that this was habitual in southern France. The second was Viollet-le-Duc’s argument revolved around the idea that in the medieval campaigns, northern military engineers, sent to Carcassonne, brought their own methods and applied septentrional roofs of steep conical shape and covered with black slate (Costa Guix, 1988). Costa Guix (1988: 12) points out that “in the first restoration project for the Narbonnaise gate, of 1849, Viollet-le-Duc was proposing the use of glazed coloured tiles as a covering, but he changed his mind for the final report of 1853, choosing slate and a more pointed profile for the roofs”.

Viollet-le-Duc believed that “through the concept of ‘unity of style’ an analogical link with the remote past could be established and its principles be brought to the present” (Costa Guix, 1988: 28). Costa Guix (1988: 29) explains that this concept was a key element in Viollet-le-Duc’s restorations of religious architecture, “where the structure became the principal element in determining a state of the building consistent with its architectural ‘principle’”. According to the same source, some towers were consisted of three different ‘strata’, i.e. the Roman foundation, the Visigothic body, and the thirteenth-century construction as a finish (Figure 2.4.).

Due to the relative autonomy of different parts of the fortress Viollet-le-Duc decided to provide stylistic unity ‘vertically’, i.e: “(…) if the remains of a tower belonged to the Visigothic period, the tower would be completed with a Visigothic covering. There is, therefore, a single logic pervading the understanding or interpretation of the architectural monument, its restoration project, and the vicissitudes of its execution” (Costa Guix, 1988: 38). According to the same source, “Carcassonne is an excellent example of an architectural intervention that, in spite of meeting the most rigorous levels of archeological accuracy of its time, is a full expression of its contemporary architectural thought” (Costa Guix, 1988: 68).

Figure 2.4.
 Left
 Charpentiere tower.
 Right
 Wall and Sanson tower, showing Roman-Visigoth masonry and battlements as restored by Viollet-le-Duc. Photograph. December 1986.
 (Source: Costa Guix, 1988)

Burman (1995) states that “International Charter for the Conservation and Restoration of Monuments and Sites – The Venice Charter” begins with a series of definitions which have provided a quarry for debate ever since. For instance, Article 6 of the Venice Charter states: “The conservation of a monument implies preserving a setting which is not out of scale. Wherever the traditional setting exists, it must be kept. No new construction, demolition or modification which would alter the relations of mass and colour must be allowed”. Rogić (2009) explains that although the type and extent of change to the existing building fabric has been the central theoretical debate of architectural conservation, the consensus always existed regarding the idea that the intervention must be minimal. However, there are different opinions on the importance of the existing building stock and especially on the role of the preservation. This is elucidated in the following subchapter.

2.1.2. Destruction – radical change

“What happens if all architecture older than 25 years is scraped? An entire territory is liberated as a strategic reserve. The city can think of itself in terms of creative transformation.”

(OMA, Cronocaos Exhibition, 2010)

According to Koolhaas, a dichotomy is created for the architects by the rapid urbanization and the increasing difficulty of building in heritage areas (Fairs, 2014). Koolhaas points out that “unbeknown to us, a large part of the world’s service is under a particular regime of preservation and therefore cannot be changed” which means that “the world is now divided into areas that change extremely quickly and areas that cannot change” (Fairs, 2014: 223). According to the lecture¹ by Ippolito Pestellini, associate at OMA-AMO, preservation is expanding, both in terms of scales and typologies (2011). Namely, tracing an evolution of the typologies of what is being preserved, from the 18th century to the present time, revealed that from ancient monuments we began preserving basically anything. This included everything from monuments to casinos or even highways. What is particularly important, preservation has changed the scale over time as well, from individual buildings to entire portions of land (Figure 2.5.) (Pestellini, 2011). This view can be traced back to Koolhaas’s essay “Preservation is Overtaking Us”, published in 2004, where he stresses that “the scale of preservation escalates relentlessly to include entire landscapes” (Koolhaas, 2004: 2). In the same essay, Koolhaas explains that the interval or the distance between the present and what was preserved changed drastically: “In 1818, that was 2,000 years. In 1900, it was only 200 years. And now, near the 1960s, it became twenty years” (Koolhaas, 2004: 2). Rogić (2009) points out that due to the ‘heritagisation’² of the past, the field of architectural conservation has blossomed in the last fifty years. This particularly relates to the vernacular buildings, from farmsteads to industrial buildings, while shift in the conservationists’ traditional view of what is considered a monument can be seen in the conservation charters from the late 1970s and 1980s³ (Rogić, 2009).

¹ The lecture “Preservation/ Destruction: OMA – CRONOCAOS”, was given in the Royal Academy of Arts, UK in 2011, concerning OMA’s exhibition on the Venice Biennale in 2010 named CRONOCAOS,

² The process by which heritage is constructed

³ UNESCO Recommendations Concerning the Safeguarding of the Beauty and Character of Landscapes and Sites (1962); Recommendations Concerning the Protection at National Level of the Cultural and Natural Heritage (1972); ICOMOS The Florence Charter (Historic gardens and landscapes) (1981); Charter on the Conservation of Historic Towns and Urban Areas (1987).

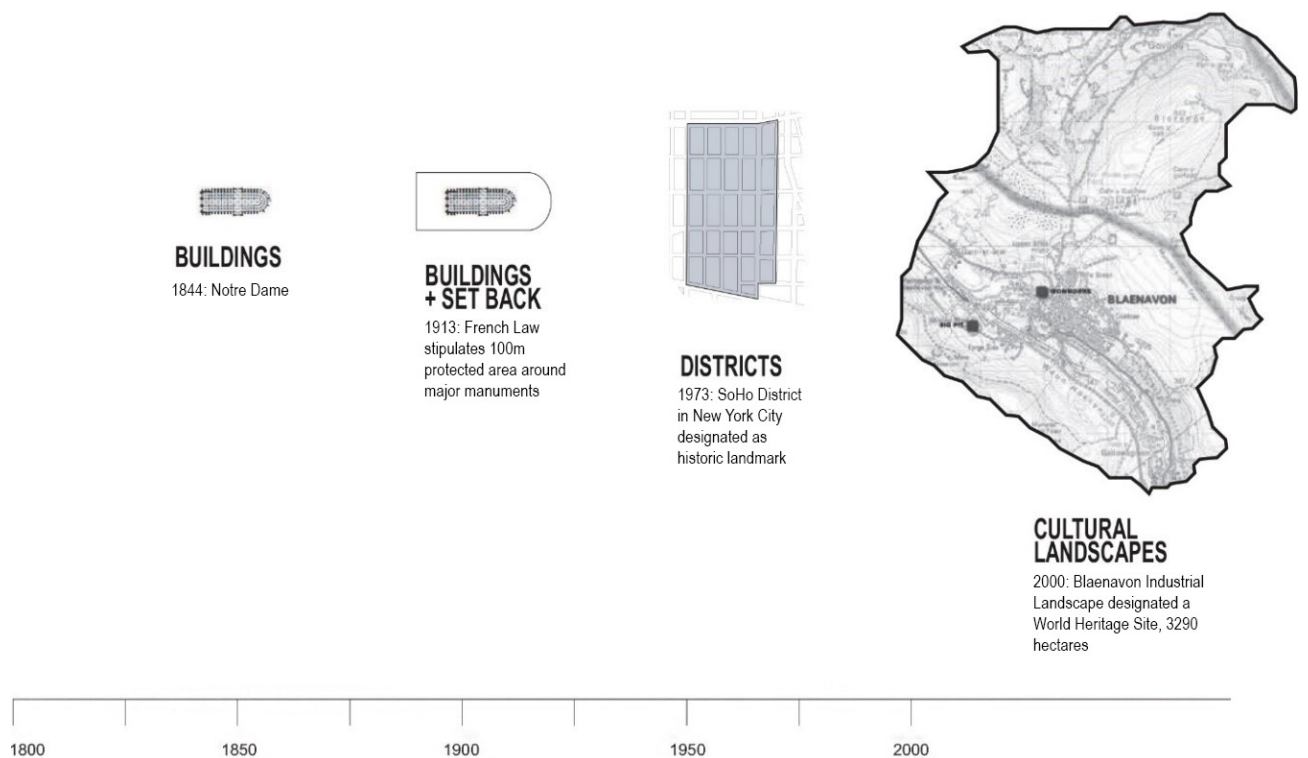


Figure 2.5.
Expansion of the scale
of preservation
(Source: Koolhaas,
2003)

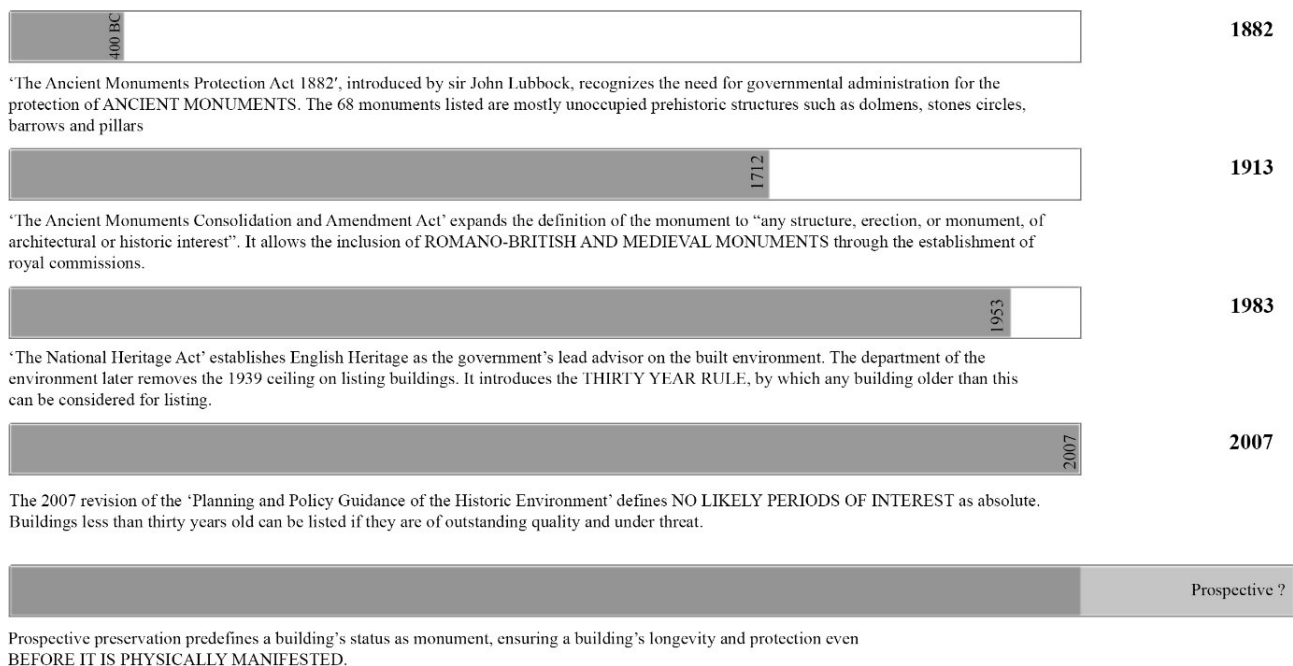
According to the same source, this shift is expressed in two ways: 1) the expansion of the focus of interest from an individual building to entire built areas and sites, and 2) the inclusion of buildings formerly considered of low cultural interest, as vernacular buildings (Rogić, 2009). Koolhaas (2004) points out that preservation is no longer a retroactive but a prospective activity. Namely, the phenomenon of preservation escalated to the point that today, we can think about preserving things in the very moment they are produced.

Pestellini (2011) highlights that there is an exponential increase of UNESCO sites. More precisely, if all the territories, from monuments to cultural landscapes, which are on the UNESCO list, are summed up, the result shows that approximately 12 percent of the world is under some kind of protection, i.e. cannot be changed due to a very strict regime of preservation it is subjected to. The criteria for the selection of buildings for preservation laid down in the first declaration of preservation were very exact and clear. However, Pestellini (2011) argues the arguments became more vague, imprecise and elastic and now they allow a lot of free interpretation, enabling for the territory under preservation to expand all over the world (Figure 2.7). Also, around the historical centres, construction is subjected to a very strict set of rules, which usually do not allow the new architecture, or architecture with a new or modern style, to be built. This condition creates a ‘fake’ or a ‘historical blur’ where new and old cannot be separated and which has no historic identity (Pestellini, 2011). Finally, preservation, because of its non-ability of transforming places, leads to a specific situation where places are left vacant. This situation occurs due to the fact that reusing existing materials and structures demands too much effort in terms of bureaucracy (Pestellini, 2011).

OMA (2010) argues that as the scale and importance of preservation escalate each year, the absence of a theory and the lack of interest invested in this domain becomes dangerous. Therefore, a list of ambiguities and contradictions, concerning preservation has been developed by the OMA (2010), which includes the following:

- Selection criteria are by definition vague and elastic, because they have to embrace as many conditions as the world contains;
- Time cannot be stopped in its tracks, but there is no consideration in the arsenal of preservation of how its effects should be managed, how the 'preserved' could stay alive, and yet evolve;
- There is little awareness in preservation of how different cultures have interpreted permanence, or of the variations in material, climate and environment, which in themselves require radically different modes of preservation;
- With its own undeclared ideology, preservation prefers certain authenticities. Others – typically, politically difficult ones – it suppresses, even if they are crucial to understanding history;
- Through preservation's ever-increasing ambitions, the time lag between new construction and the imperative to preserve has collapsed from two thousand years to almost nothing. From retrospective, preservation will soon become prospective, forced to take decisions for which it is entirely unprepared;
- From a largely cultural concern, preservation has become a political issue, and heritage a right – and like all rights, susceptible to political correctness. Bestowing an aura of authenticity and loving care, preservation can trigger massive surges in development. In many cases, the past becomes the only plan for the future;
- Preservation's continuing emphasis on the exceptional – that which deserves preservation – creates its own distortion. The exceptional becomes the norm. There are no ideas for preserving the mediocre, the generic.

Figure 2.6.
Changing criteria
for the selection
of buildings for
preservation
(Source: Pestellini,
2011)



OMA (2010) is stressing that a new system, mediating between preservation and development, is needed. The increase of the scale and scope of preservation calls for the development of a theory of its opposite: not what to keep, but what to give up, what to erase and abandon. Through the phased demolition the idea of permanence of contemporary architecture can be dropped, revealing the tabula rasa, beneath it, ready for liberation (OMA, 2010). Pestellini (2011) explains that one of the OMA's strategies towards preservation is to approach preservation on the opposite side, i.e. destruction. More precisely, the destruction is seen as a method for preserving specific area of context. OMA (1991) argues that the 'existing' in Europe creates the ambiguous condition. This ambiguity is created because Europe is seen as the Old World, the continent of history, where all its substance, even the most mediocre, is given a historic value, and is subjected to preservation (OMA, 1991). As a response to UNESCO's "Convention Concerning the Protection of the World Cultural and Natural Heritage" (1972), OMA developed the "Convention Concerning the Demolition of World Cultural Junk" (2010), at the 12 International Architecture Biennale, which revolves around the following statements:

- Noting that cultural heritage and natural heritage are overwhelming us not only through the increasing need for identity and or history, but also by changing social and economic condition which aggravate the situation with ever more formidable phenomena of preservation;
- Considering that the proliferation of cultural or natural heritage constitutes a risk of trivializing the heritage of all nations of the world;
- Considering that protection of this heritage at the national level has at its disposal enormous economic, scientific, and technological resources in the country where the property to be protected is situated;
- Recalling that the ideas of the organisation provide that it will liberate oversaturated urban territory through the demolition of junk, and recommending to the nations concerned the new opportunities that will emerge;
- Considering that the existing international conventions, recommendations and resolutions concerning cultural and natural property demonstrate the importance, for all the people of the world, of actively demolishing junk, to whatever people it may belong.
- Considering that parts of the cultural or natural heritage are insignificant and transient and therefore need to be demolished to facilitate the growth and development of mankind as a whole;
- Considering that, in view of the magnitude and speed of the global potential to produce junk, it is incumbent on the international community as a whole to participate in the removal of cultural and natural heritage that constitute Insignificant Universal Junk,

by the granting of collective assistance which, although not taking the place of action by the State concerned, will serve as an efficient complement thereto;

- Considering that it is essential for this purpose to adopt new provisions in the form of a convention establishing an effective system of collective demolition of cultural and architectural heritage that constitute Insignificant Universal Junk, organized on a permanent basis and in accordance with modern scientific methods.

The concept of 'junk architecture', i.e. architecture which bears no meaning or has no value and should be destroyed, was elaborated by Koolhaas (2002) in his "Junkspace". Namely, he argues that even though we have built more than all previous generations together, we have added nothing, just reconfigured. In addition, Junkspace, i.e. space produced by actions such as restoration, rearrangement, reassembly, revamp, renovation, revision, recovery, redesign, and respect, is endless and never closed. Koolhaas (2002: 182) refers to restoration as "the process that claims ever new sections of history as extensions of Junkspace". Furthermore, "history corrupts, absolute history corrupts absolutely" and "colour and matter are eliminated from these bloodless grafts: the bland has become the only meeting ground for the old and the new". According to the same source, we started with renewing what was depleted but now we are trying to resurrect what is gone. Junkspace is also produced through a "Default Preservation - the maintenance of historical complexes that nobody wants but that the Zeitgeist has declared sacrosanct" (Koolhaas, 2002: 184). Koolhaas (2002: 182) explains the process of preservation in the following way:

"Laughable emptiness infuses the respectful distance or tentative embrace that architects maintain in the presence of the past, authentic or not. Invariably, the primordial decision is to leave the original intact; the formerly residual is declared the new essence, the focus of the intervention. As a first step, the substance to be preserved is wrapped in a thick pack of commerce and catering-like a reluctant skier pushed downhill by responsible minders. To show respect, symmetries are maintained and helplessly exaggerated; ancient building techniques are resurrected and honed to irrelevant shine, quarries reopened to excavate the 'same' stone, indiscreet donor names chiselled prominently in the meekest of typefaces; the courtyard covered by a masterful, structural 'filigree'- emphatically uncompetitive-so that continuity may be established with the 'rest' of Junkspace."

In OMA's project for the transformation of the existing urban fabric of La Défense, Paris, the entire territory has been seen as a strategic reserve, an expansion zone, which can allow the city to modernize itself constantly (OMA, 1991). Pestellini (2011) explains that some of the fabric of La Défense is the product of a very cheap process and can be referred to as 'junk architecture'. The strategy OMA developed was to remove the existing tissue, which was regarded as irrelevant, allowing the city to grow on the area liberated by the demolition (Figure 2.7). Economic viability of a building expires after 20, 25 or at the most 30 years, and thus, the strategy involves the process of demolition, every 25 years,

leaving the space for the new development (OMA, 1991). This approach would control the size of the city as well (Pestellini, 2011). The strategy involved the projection of a grid over the entire area (Figure 2.8.). Through this grid a new system of selective demolition, as buildings meet their successive expiration dates, will be applied (OMA, 1991). The grid will act as a filter, preserving the objects which are selected to stay (the University at Nanterre, Wogensky's prefecture, the new Parc André Malraux), accommodating their geometries and generating a string of hybrids along its perimeter to achieve coherence. The presence of this grid does not imply homogeneous density, as it will incorporate the coexistence of solid and void, density and emptiness (OMA, 1991).

However, in a number of their projects OMA has dealt with the existing structures in a less radical way. In the projects concerning renovation and redefinition of a landmark building, Fondaco dei Tedeschi⁴ (Figure 2.9.) in Venice, in 2010, less invasive approach was chosen. Pestellini (2011) points out that in Venice, due to its World Heritage status granted by UNESCO in 1974, any transformation within the city is extremely difficult. As a result of the extremely strict regulations, it is very challenging to apply a certain degree of alteration, that adaptation and change of function imply (Pestellini, 2011). Considering that the building has constantly reshaped itself, the authenticity cannot be held as an argument (Pestellini, 2011). The OMA office developed the 'preservation of change' strategy for this project, i.e. preservation of the possibility to readapt itself (Pestellini, 2011). In the latest evolution, the building was to become a contemporary trading post, i.e. a modern department store, with the three major areas of commerce-free public space (OMA, 2010). Pointing out that department stores have historically been incubators for the arts, OMA strived, in this project, to re-establish this relationship between art and commerce (Figure 2.10.)

OMA has left the building's profile intact, and the galleries untouched so that they can form a public promenade. Concerning building's structure, 75% of the Fondaco's structure is to be preserved and unchanged, as well as the crucial historic elements like the corner rooms (OMA, 2010). The strategy involves the adaptation and activation of the rooftop, enabling views to the Grand Canal and Venice's dense roofscape. The existing shortcuts through the courtyard, used by

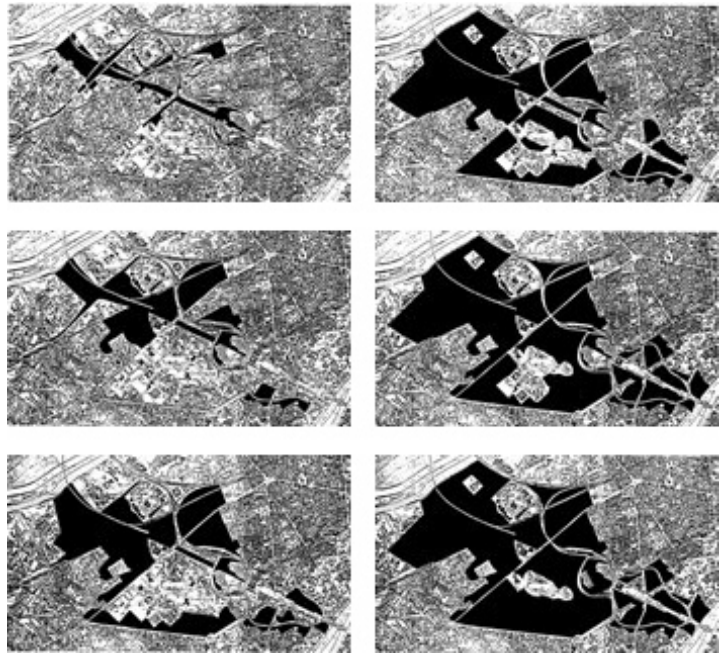


Figure 2.7.
Process of liberation
of La Défense, Paris
(Source: OMA, 1991)

⁴ The Fondaco dei Tedeschi was constructed in 1228, as a trading post for German merchants, and changed its function to a customs house under Napoleon in 1806. With its 11000m² it is one of Venice's largest buildings. The building has been destroyed by fire and rebuilt in the 16th century and again radically altered in 1930s.

Figure 2.8.
The Grid
(Source: OMA mission grand axe, 2014)

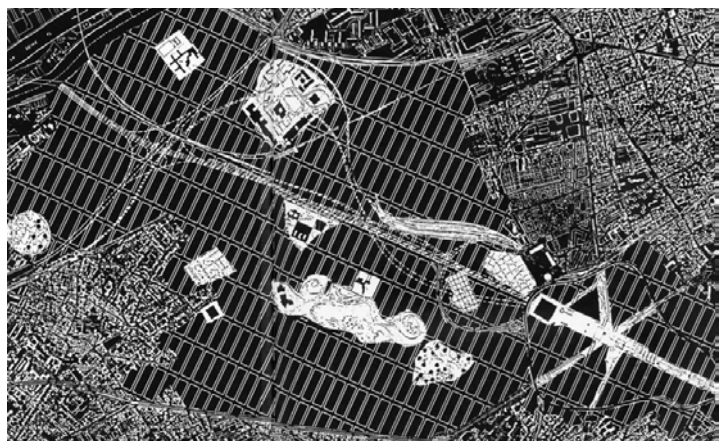




Figure 2.9.
The Fondaco dei
Tedeschi
(Source: OMA, 2010)

local inhabitants and tourists, are also retained in the project. The courtyard becomes a public hub (Figure 2.11.), with escalators, reaching to the galleries, which can be lifted up to free the space for public events, such as film screenings, performances or meetings (OMA, 2010).

Within another project by OMA, – the Curatorial Master Planning and general staff building extension for the Hermitage (a former palace in St. Petersburg, commissioned by the Hermitage Guggenheim Foundation in 2003), the preservation has been applied in its purist form. The study revolved around the concepts of ‘inaction’ and ‘resistance to change’. These concepts have been seen as means of maintaining a degree of the authenticity, which, according to OMA (2003), has so frequently being erased during the process of modernization. The role of architect was questioned as well, proposing a more archaeological approach to the current condition. As a consultant for the Guggenheim - Hermitage Foundation on scenarios for the museum’s future, OMA explains that, instead of imposing the new, the goal is to apply discrete changes which would allow the building to function better (OMA, 2003). Pestellini (2011) points out that Hermitage did not go

Figure 2.10.
Ripple effects of the
Fondaco cultural
program
(Source: OMA, 2010)



through the same process of modernisation, as many other museums around Europe, because of the specific historical development of St Petersburg. The fact that none of the rooms of the Hermitage were large enough to house big exhibitions was considered a quality by OMA as this would mean keeping the building, as much as possible, as it is (Pestellini, 2011). Pestellini (2011) highlights that the adopted strategy was to neglect the necessity to modernise, which conditions the characteristics of the space and the way the art is displayed. Therefore, it was suggested that the dilapidated spaces, currently present in the Hermitage, should be left in the state they were found (Figure 2.12.). The decay and the dilapidation of the spaces would be used



Figure 2.11.
Moving escalator
(Source: OMA, 2010)

to enhance the exhibited masterpieces (Pestellini, 2011).

Therefore, even though OMA proposed demolition as a response to preservation, the office recognised the potential of preservation and even applied it to the extreme level in the above mentioned project, leaving the space affected by decay as it is and using it as a source of inspiration. By using the original building's material and structure in the above presented projects, OMA provided the implementation of the new function and avoided the unnecessary demolition.

• • •

Two radical concepts, extremes, in dealing with the existing building, - preservation as a radical stasis and destruction as a radical change, have been analysed in the subchapters above. Two polar approaches to preservation have been presented through teachings of Ruskin and Viollet-le-Duc. Ruskin believed that buildings are a legacy and a living memory which should be preserved without alterations. For him, restoration equals destructions, as change, however small, alters the building fabric and produces a lie. For Ruskin the only honest way to deal with the existing buildings is to preserve it in its original state. Morris shared Ruskin's views on restoration. He adopted Ruskin's principles of honesty and further developed them in SPAM Manifesto. Contrary to Ruskin and Morris, Viollet-le-Duc believed that restoration improves and completes existing buildings. He argues

Figure 2.12.
Hermitage Museum.
General staff building
extension.
(Source: OMA, 2003)



that in restoration, removed elements should be replaced with new, better and stronger materials. While Ruskin and Morris view restoration as a process which removes the original spirit and beauty of the building and replaces it with a modern forgery, Viollet-le-Duc sees restoration as a method for bringing a building in a new state which never existed before. Viollet-le-Duc's views on restoration differed greatly from Ruskin's and Morris's as he believed that restoration was appropriate if a building served a modern purpose. Thus, he believed in preservation of building through change of use. In this way the continuity of building occupancy would be enabled. Unlike Ruskin, both Viollet-le-Duc and Morris have put their theories into practice. For Viollet-le-Duc, his restoration projects served him as a polygons for testing and confirmation of his theories. Thus, while Ruskin and Morris promoted radical stasis as the only honest way of dealing with the existing building, Viollet-le-Duc introduced a degree of change which allowed the given building to be adapted and used again.

On the other hand, according to Koolhaas, destruction has been seen as an answer to over-preservation which escalates relentlessly and claims new buildings and territories every year due to its elastic and vague selection criteria. He points out that preservation has become progressive action which rapidly limits construction due to its strict regimes. Koolhaas argues that through demolition space can be liberated and should serve as a strategic reserve. He argues that all architecture that bears no meaning and is a product of a cheap processes should be considered as 'junk architecture' and therefore demolished. According to Koolhaas, the process of demolition should be considered a repetitive action, which needs to be implied every 25 to 30 years, corresponding to the buildings economic viability expectancy. However, as demonstrated in the above analysed projects, OMA opted for preservation on a number of occasions and in various scales. Thus, recycling existing spaces and implying as minimal a change as possible to the existing building, has been recognised by OMA as a desirable and viable design strategy.

2.2. Sustainable Design

In the previous subchapters, polar ideas regarding architectural interventions have been analysed, i.e. preservation – radical stasis and destruction – radical change. The following subchapter introduces the concept of architectural recycling as a sustainable alternative to demolition and replacement. Thus, in the first place the sustainable development paradigm and its connection to construction industry will be analysed, while presenting the principles of sustainable architectural design. The aim of this part of the research is to underline the benefits of the architectural recycling as a midpoint between radical stasis and radical change, simultaneously highlighting its importance as a principal method for reaching sustainable architectural design.

In the second subchapter recycling is analysed through its connection to avant-garde movements, namely, Archigram and Metabolism. Through this analysis recycling is viewed as a method which provides continuity and progress at the same time.

2.2.1. Sustainability and the built environment

The year 2000 marked the shift in the urban-rural population ratio. For the first time in world history, urban population exceeded the rural one. Today, of a global population of 7.125 billion⁵ people, almost 60 per cent live in cities. This drift of a human population from countryside to cities entails the intensification of urban problems and puts pressure on housing land, water and energy supplies, as well as sewage and waste capacity. Thus, as the human species becomes more urbanised we consume more, waste more and pollute more (Edwards, 2005). Therefore, sustainability and sustainable architectural design should undoubtedly be one of the guiding strategies behind all future briefs. In the following subchapter, the concept of sustainable development and its relationship to the construction industry will be analysed. Consequently the concept of a sustainable architectural design will be presented.

⁵According to United States Census Bureau (USCB).

Sustainable development – the concept

According to Szokolay (2004), coal was the most important energy source since the 18th century, i.e. our industrial civilisation has been built on coal. Further, in early 20th century the oil production started and its use has rapidly grown with the introduction of the internal combustion engine as used in cars, trucks, aeroplanes but also in stationary applications. Also, the rate of discovering new oil reserves is rapidly decreasing: from a peak of 49×10⁹ barrels p.a. (1960) to 6 × 10⁹ (1995) (Szokolay, 2004). The world's energy supply by region, comparing the 1997 data with the forecast for 2020, can be observed in the Figure 2.13.

The oil production by regions, as well as total, from 1930 to the middle of this century, is presented in the Figure 2.14. The figure predicts that demand will exceed supply and that production will decline. This phenomenon is referred to as 'rollover', and according to Szokolay (2004), such rollovers have already occurred in some regions, e.g. around 1970 for the USA and Canada, and in 1986 for the UK and Norway. Szokolay (2004) further highlights that the 'big rollover' on the world scale is forecast by some for 2020 and that the International Energy Agency (IEA) predicted, in 1998, that it will occur between 2010 and 2020.

Edwards (2005) argues that the environment is increasingly stressed by our economic

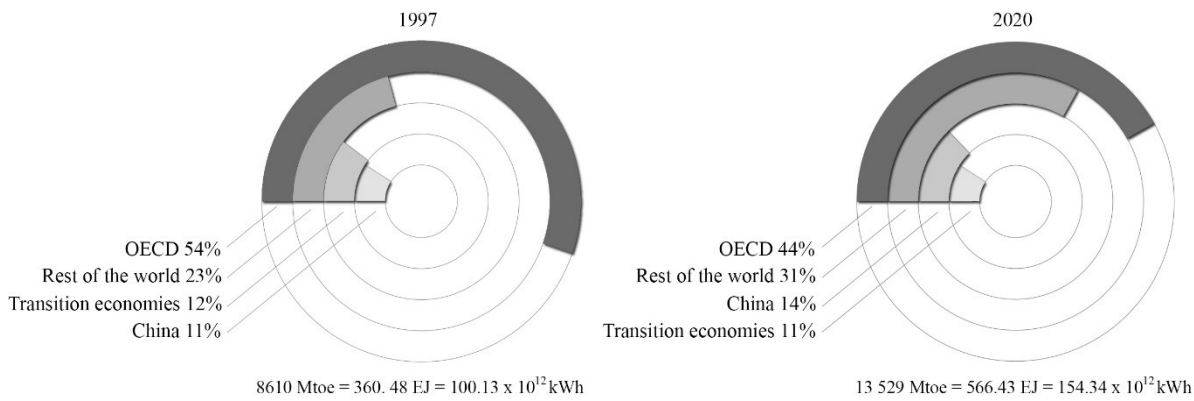


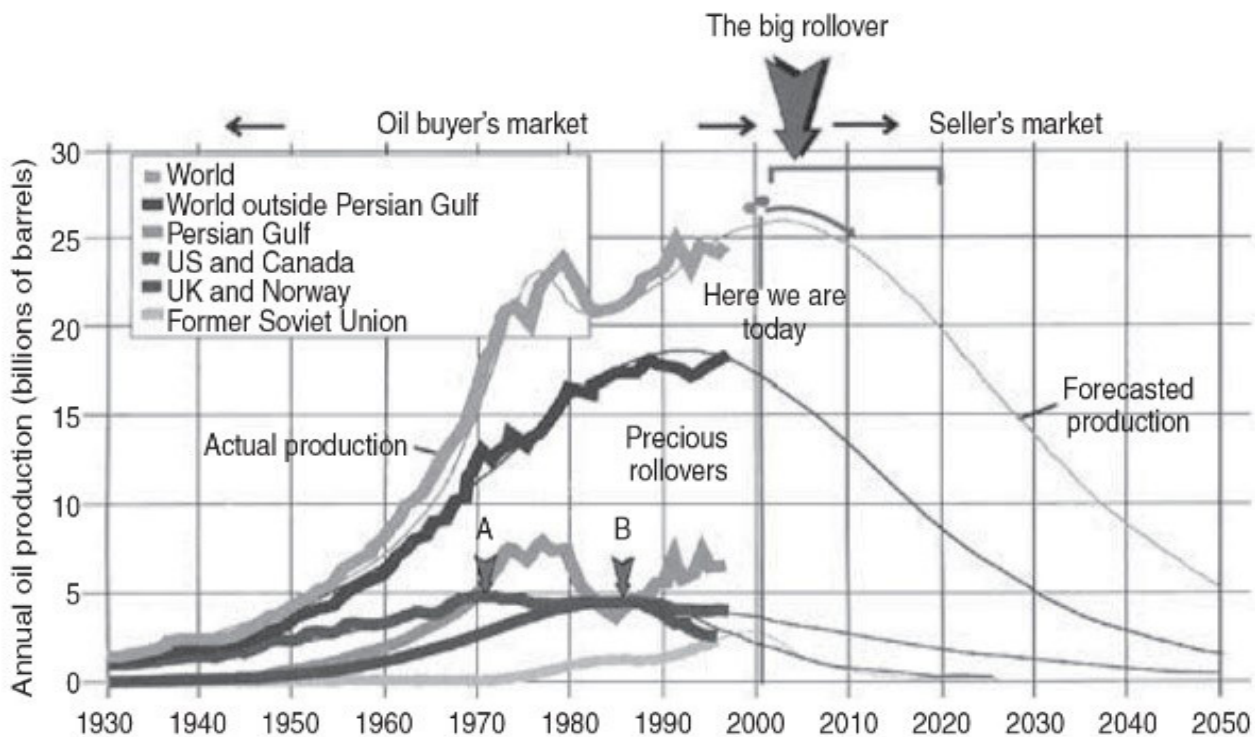
Figure 2.13.
 World energy supply,
 by region: 1997 data
 and 2020 forecast
 (Source: Author
 according to Szokolay,
 2004)

success and population growth; by 2050 it is anticipated that the human race will have four times the environmental impact it had in 2000 (based on a 2 per cent annual economic growth and a global population of 10 billion). Szokolay (2004) explains that environmental degradation was already the main concern of the Stockholm UN (United Nations) conference in 1972. In 1973, the OPEC oil embargo brought home the realisation of the finite nature of our fossil fuel supplies. In the same year, the RIBA (Royal Institute of British Architects) initiated the long life, lose fit, low energy (LL/LF/LE) movement, which states that it would be ecologically beneficial to erect buildings which last, which are designed in a way to remain adaptable for changed uses and which use little energy in their operation (Szokolay, 2004). The “Brundtland report” (WCED, 1987, Towards Sustainable Development, para. 1) introduced the term Sustainable Development and defined it as: “development that meets the needs of the present without compromising the ability of the future generations to meet their own needs”. Gauzin-Müller (2002) highlights that, according to the Rio-92 conference, the sustainable development may be based on three principles:

- complete material life cycle assessment;
- development and use of renewable raw materials and energy; and
- reduction of the amounts of materials and energy used in the extraction and exploration of natural resources, and the recycling or final destination of the residues.

Figure 2.14.
 History and
 forecast of world
 (and regional) oil
 production. A = USA
 and Canada, B = UK
 and Norway.
 (Source: Szokolay,
 2004)

This concept was accepted internationally, being usually divided into three domains: social,

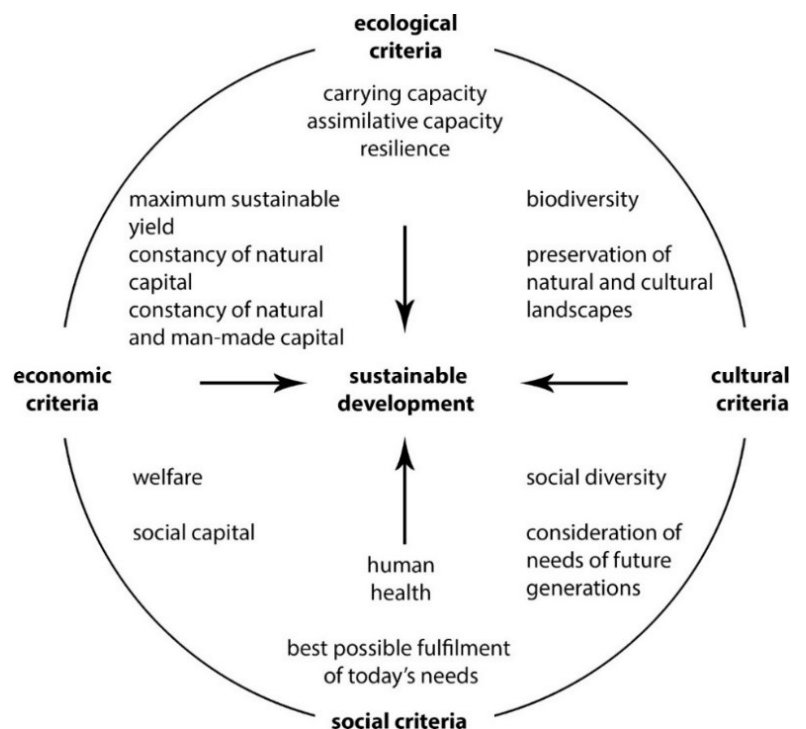


economic and environmental. According to König, Kohler and Lützkendorf (2010), the ecological dimension of sustainability concerns the preservation of our basis for life and means limiting the strain on our resources to the ecologically acceptable level, which is fixed by the long-term preservation of the stock of natural resources. The economic dimension, defined in “Blueprint for Green Economy” (TPF Group, 2007) contains three main criteria: consideration of the value of the environment; extension of the time horizon; and, equity between people and generations. The production and consumption processes should meet ecological requirements and will therefore work as a long-term cost-avoidance strategy (König et al., 2010). Western Australia Council of Social Services (WACOSS) in “Model of Social Sustainability” (WACOSS, 2008) states that social sustainability occurs when the formal and informal processes (systems, structures, and relationships) actively support the capacity of current and future generations to create healthy and liveable communities. Therefore, socially sustainable communities are equitable, diverse, connected and democratic and provide a good quality of life. Social sustainability consists of following six dimensions: equity, diversity, interconnected/social cohesions, quality of life, democracy, and governance and maturity (Anand & Sen, 1996). König et al. (2010), introduces a fourth important dimension which should be added to the common three mentioned above – the cultural dimension of sustainability, which refers to the conservation of non-material, cultural values for future generations (Figure 2.15). He stresses that cultural diversity is as essential for the identity of societies as biodiversity is for the nature.

Sustainable development and the construction industry

The influence of human activity on numerous subtle changes in the environment over time is becoming increasingly clear, from the bleaching of coral reefs and the polluting of oceans by regular oil spills, to the damage of human health caused by harmful processes, materials and buildings (Cepinha, Ferrão & Santos, 2007). Out of all resources consumed across the planet fifty per cent are used in construction, as shown in the Figure 2.16., which makes it one of the least sustainable industries in the world. However, contemporary human civilization depends on buildings for its continued shelter and existence even though our planet cannot support the current level of resource consumption (Edwards, 2005). The definition of the sustainable development coined in the “Brundtland report” (WCED, 1987)

Figure 2.15. Dimensions of Sustainability (Source: König et al., 2010)



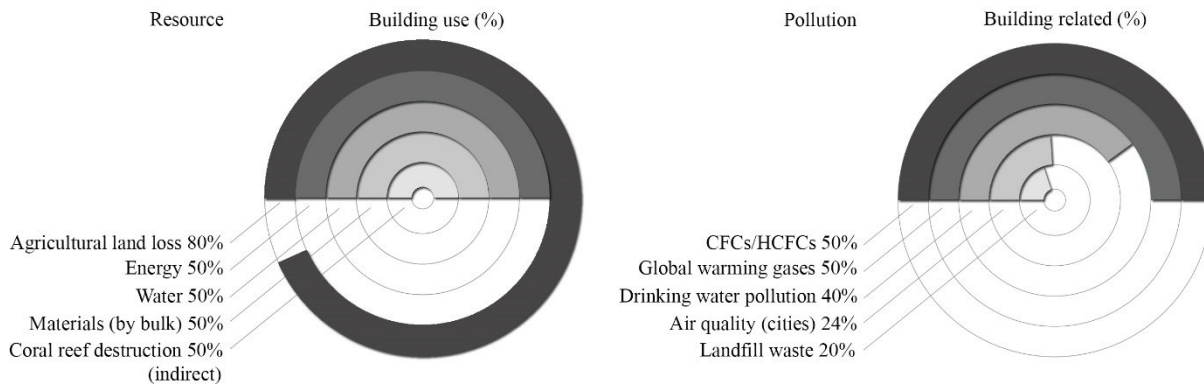


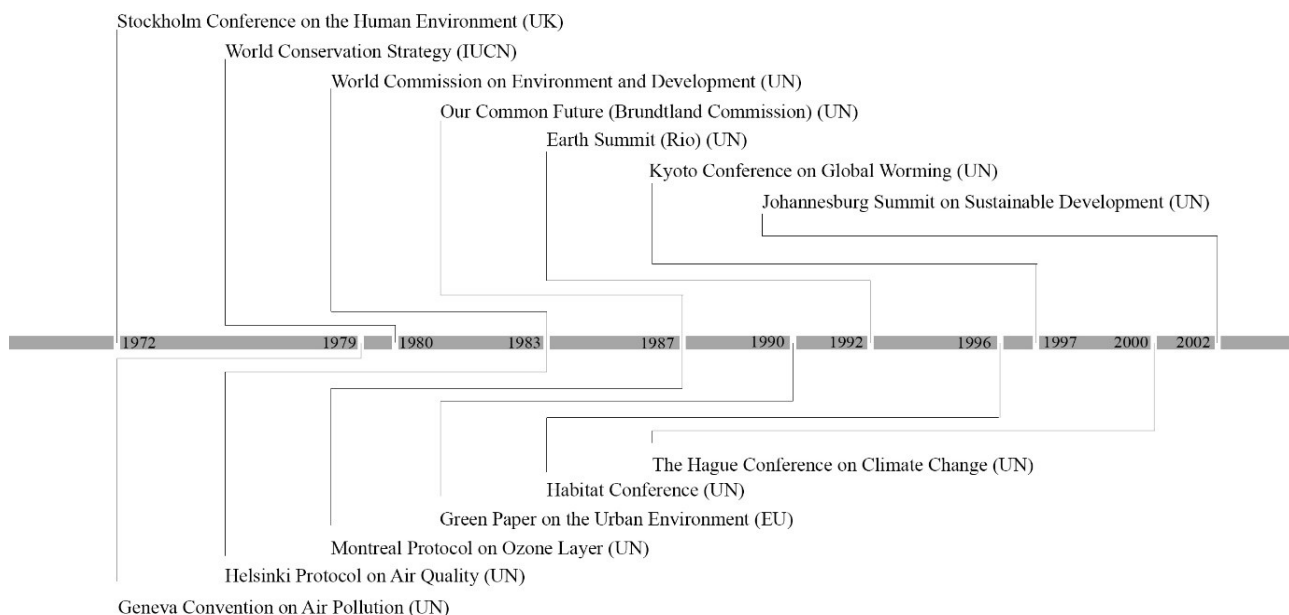
Figure 2.16.
Global resources used in buildings and global pollution
(Source: Author according to Edwards, 2005)

has spawned a series of sub-definitions to meet particular sectorial needs. For example, Foster and Partners defines the sustainable design as the process of creating energy-efficient, healthy and comfortable buildings, flexible in use and designed for long life (Edwards, 2005). The Buildings Service Research and Information Association (BSRIA) refers to sustainable construction as a process of creation and management of healthy buildings based upon resource efficient and ecological principles (Edwards, 2005). The ‘Earth Summit’ (1992), United Nations Conference on Environment and Development (UNCED), included environmental degradation and resource depletion into their agenda. The discourse was broadened in “Agenda 21”, and the “Rio Declaration” laid down the principles of sustainable development. With the “Declaration of Interdependence for a Sustainable Future” at the Chicago Congress of the International Union of Architects (IUA) in 1993, architecture also joined the movement, and many national bodies and institutions of architecture began producing energy and environmental policies (Szokolay, 2004). Figure 2.17. presents chronological overview of major global environmental agreements.

The International Council for Research and Innovation in Building and Construction (CIB) presented the Agenda 21 on Sustainable Construction. This document confirms the importance of the construction industry in the issue of sustainability (Cepinha et al., 2007). Given that buildings and cities are long-lived (Figure 2.18.), they play a fundamental role in the realisation of sustainable development (Edwards, 2005).

The link between the sustainable development and the construction industry is extremely important considering the impact of this sector on all dimensions of the sustainable development; 1) contribution to national wealth – economic dimension, 2) offer of the raised number of work ranks – social dimension, and 3) raised tax of natural resources consumed and environmental loads produced – environmental dimension (Cepinha et al.,

Figure 2.17.
Major global environmental agreements
(Source: Author according to Edwards, 2005)



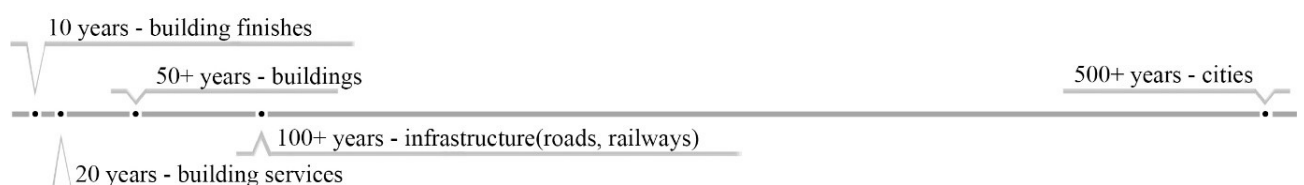
2007). As stated earlier, about 50 per cent of the natural virgin materials are consumed, at the world-wide level, by the construction industry, which is far beyond the sustainable level. More than 40% of the produced energy is consumed, in The Organisation for Economic Co-operation and Development (OECD) member countries, throughout the live cycle of the buildings, and approximately one third of the GGE (Greenhouse Gas Emission) total emissions are produced by the built environment (OECD, 2003). Edwards (2005) stresses that this percentage is even higher. Namely, 60 per cent of all resources globally go into construction (roads, buildings, etc.), nearly 50 per cent of energy generated is used to heat, light and ventilate buildings and a further 3 per cent to construct them. Further, 50 per cent of water used globally is for sanitation and other uses in buildings, 80 per cent of prime agricultural land, lost to farming, is used for building purposes, 60 per cent of global timber products end up in building construction and nearly 90 per cent of hardwoods (Edwards, 2005). The environmental capital locked in buildings is enormous, as is the waste footprint, making them one of the biggest users of raw material. The waste produced from the construction and demolition activities constitute one of the biggest waste streams produces in Europe (Cepinha et al., 2007).

The concept of sustainable construction appeared with the gradual recognition of the importance and environmental responsibility of the construction sector. This concept was for the first time mentioned in the ‘First Conference on Sustainable Construction’, by Charles Kibert, and was defined as “the creation and responsible management of a healthy built environment based on resource efficient and ecological principles” (Cepinha et al., 2007: 115). According to Cepinha et al. (2007), the sustainable construction aims at fulfilling two main objectives: 1) minimize the negative impact of the constructions on the environment and, simultaneously, 2) create and maintain healthful environmental conditions for the users of buildings or surrounding populations to the develop project. The sustainable construction considers the materials, the ground, the energy and the water as its main resources (Cepinha et al., 2007). Kibert (2008) defined five basic principles of the sustainable construction in the following way:

- reduce the consumption of resources;
- reuse the resources to the maximum;
- recycle materials of the end of life of the building and to use recycled resources;
- protect the natural systems and its function in all the activities; and
- eliminate the toxic materials and by-products in all the phases of the life cycle.

United Nations presented another definition of sustainable construction and defined it as a “holistic process, looking to recover and keep harmony between natural and built environment and to create habitability conditions that affirm the human dignity and encourage the social and economic equity” (Cepinha et al., 2007: 116). The 6th

Figure 2.18.
Typical lives of
different aspects of
construction
(Source: Author
according to Edwards,
2005)



Environment Action Programme, at the European level, is clear about implementing sustainability in the construction sector, which leads to the definition of the “Thematic Strategy on the Urban Environment” with four specific areas of act: 1) urban design, 2) urban management, 3) sustainable construction, and 4) transport (Cepinha et al., 2007). Moreover, the only way to approach sustainability in the built environment, and meet the changing needs of the users, is through informed design (Kincaid, 2003). According to Kincaid (2003: 94), physical sustainability objectives are defined in the following way: “From a physical standpoint, sustainability of the built environment is concerned with the level at which energy transformation, material extraction and ecosystem impact can be allowed to occur in perpetuity in the creation and use of buildings and infrastructure”. Further, it is stressed that only 1% to 2% of the total building stock of the UK is made up of new works in a typical year, and that the percentage of new works is even lower for roads and streets, and lower still for railways. Finally, “these facts inevitably mean that we have to look at what can be done, through general refurbishment and adaptive reuse, with what we already have if we are to significantly benefit the sustainability agenda in the next 20 years” (Kincaid, 2003: 95).

Sustainable Architectural Design

The “Declaration of Interdependence for a Sustainable Future”⁶ (IUA/AIA, 1993: para. 3) addressed the sustainable design in the following way:

“Buildings and the built environment play a major role in the human impact on the natural environment and on the quality of life; sustainable design integrates consideration of resource and energy efficiency, healthy buildings and materials, ecologically and socially sensitive land-use, and an aesthetic sensitivity that inspires, affirms, and ennobles; sustainable design can significantly reduce adverse human impacts on the natural environment while simultaneously improving quality of life and economic wellbeing”.

This declaration laid down the principles and recommendations architectural profession should stick to, stating that members of the world’s architectural and building design professions, individually and through professional organisations, should commit themselves to:

- place environmental and social sustainability at the core of our practices and professional responsibilities;
- develop and continually improve practices, procedures, products, curricula, services and standards that will enable the implementation of sustainable design;
- educate our fellow professionals, the building industry, clients, students and the general public about the critical importance and substantial opportunities of sustainable design;

⁶ Written at the World Congress of Architects in Chicago, 18–21 June 1993.

- establish policies, regulations and practices in government and business that ensure sustainable design becomes normal practice;
- bring all existing and future elements of the built environment – in their design, production, use and eventual re-use – up to sustainable design standards.

According to De Garrido (2010), a truly sustainable architecture is one that meets the needs of its occupants, in any time and place, without jeopardizing the welfare and development of future generations. Furthermore, sustainable architecture involves using strategies with the aim at: optimizing resources and materials; reducing energy consumption; promoting renewable energy; minimizing waste and emissions; minimizing the maintenance, functionality and cost of buildings; and improving the quality of life of their occupants (De Garrido, 2010). The objectives that constitute the pillars upon which sustainable architecture is based, according to De Garrido (2010), are:

- optimization of natural and artificial resources;
- reduction of energy consumption;
- promotion of natural energy sources;
- reduction of waste and emission;
- improving the quality of life for building occupants;
- reduction of building maintenance costs.

Thus, the level of sustainability of a construction depends on the degree to which each of these objectives is attained. Furthermore, a list of 12 groups of generic architectural actions, to be executed in order to achieve a truly sustainable architecture, has been created. Each group represents a declaration of principles of sustainable architecture, and is divided into a set of directly applicable actions for the everyday design process of an architect: protecting the environment; protecting fauna and flora; ensure human nutrition; change human lifestyle and cultural values; improve human welfare and quality of life; optimize resources; promote industrialization and prefabrication; minimize emissions and waste; encourage the use of renewable natural energy; reduce energy consumption; reduce cost and maintenance; and changing transport systems (De Garrido, 2010). Finally, new architecture should be more flexible, simpler, brighter, healthier, and more functional. The “Whole Building Design Guide” (WBDG) has established a set out rules and principles regarding sustainable design. WBDG’s objectives are to: 1) avoid resource depletion of energy, water, and raw material; 2) prevent environmental degradation caused by facilities and infrastructure throughout their life cycle; and 3) create liveable, comfortable, safe, and productive built environments. Principles defined in the WBDG are: “1) optimize site potential; 2) optimize energy use; 3) protect and conserve water; 4) use environmentally preferred products; 5) enhance indoor environmental quality; 6) optimize operations and maintenance procedures” (as cited in Kubba, 2012: 46). Edwards (2005) also defines sustainable development design principles at various levels in the following way:

- At city level:
 - compaction;
 - streets reclaimed from traffic;
 - increased density in suburban areas;
 - intensification of use where areas are well serviced by public transport (nodes and sub-nodes);
 - four-storey housing;
 - legibility
- At neighbourhood level:
 - diverse pattern of land uses;
 - safe and friendly streets;
 - keep historic buildings;
 - cycle routes; tram routes/corridors;
 - use local energy sources.
- At local level:
 - design with nature (parks, streets, etc), biodiversity;
 - use derelict land/buildings first; strengthen green belts and green corridors.
- At building level:
 - design for low environmental impact (locally, regionally, globally);
 - design for durability;
 - design for reuse;
 - maximise renewable energy use;
 - self-sheltering layouts; energy management under users' control;
 - design with climate;
 - design for health;
 - learn from vernacular practices.

In the contemporary architectural vocabulary, sustainable building design is frequently referred to as green design. The Leadership in Environmental and Energy Design (LEED), organization for design, operation and construction of high performance green buildings, highlights that some of the common features of green built projects are:

- reuse an existing structure rather than build a new one;
- deconstruct rather than demolish, if all or part of an existing structure must be replaced;
- reuse materials from the old structure where possible;
- consider using salvaged materials from other sources;
- use materials made from recycled content where possible;
- recycle as much project waste as possible;
- use building materials efficiently;

- use energy efficiently.

Rob Watson, founding father of LEED and an international pioneer in the modern green building movement, highlights: “Buildings are literally the worst thing that humans do to the planet. Nothing consumes more energy; nothing consumes more materials; nothing consumes more drinking water, and human beings spend up to 90% of their time indoors so if they are getting sick from their environment, in fact, they are getting sick from their indoor environment not from their outdoor environment” (as cited in Kubba, 2012: 385). According to Office of the Federal Environmental Executive (OFEE) green building is “the practice of 1) increasing the efficiency with which buildings and their sites use energy, water and materials, and 2) reducing building impacts on human health and the environment, through better siting, design, construction, operation, maintenance, and removal-the complete building life cycle” (as cited in Fischer, 2010: 6). The Environmental Protection Agency (EPA) defines green building as, “the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building’s life cycle from siting to design, construction, operation, maintenance, renovation, and deconstruction” (as cited in Fischer, 2010: 6). In this way the design and construction practice would be improved since the buildings we build would last longer, cost less to operate, facilitate increased productivity and better working environments for workers or residents and would improve the built environment so that the planet’s ecosystems, and communities can live a healthier and more prosperous life (Kubba, 2012). According to Kubba (2012), some of the primary benefits of building green, include: reduced energy consumption; reduced pollution; protection of ecosystems; improved occupant health and comfort; increased productivity; reduced landfill waste.

Components of the sustainable architectural design

According to the International Council for Research and Innovation in Building and Construction –CIB (1999), the construction industry and the built environment are the main consumers of resources, energy and materials. Within the European Union (EU), buildings are estimated to consume approximately 40% of total energy (and also to be responsible for some 30% of CO₂ emissions) and to generate approximately 40% of all man-made waste (CIB, 1999). All the above mentioned definitions of sustainable, green, building design confirm that only through parallel consideration of site, energy, materials and wastes can truly sustainable architecture be conceived. According to Szokolay (2004) these four components constitute the basis of a sustainable architectural design.

First, the land is a non-renewable resource and all building activity disturbs the land. These disturbances should be minimised and its use should be avoided whenever possible, which would lead to the preservation of the biodiversity (Szokolay, 2004). Szokolay (2004) highlights that the use of already disturbed derelict land or the rehabilitation of neglected

or disturbed land is desirable. Preservation and cleaning-up of land, as a non-renewable resource, has become a key issue in Europe. Protection and reuse of land and sites, and the need for brownfield development are powerful drivers for new approaches to sustainable city planning (Roaf & Horsley, 2004).

On the other hand, the energy conservation is a central concern in the quest for sustainability, as it is expected that, by the year 2050, the world doubles its use of energy (Edwards, 2005). European Commission (EC) declared that the sustainable design is one of the priorities for the future of the construction sector (EC, 2007). In order to achieve the sustainable construction, one of the main points that had to be addressed is the improvement of the energy performance in buildings. Thus, first, we have to recognize the amount of energy used to construct the building, and minimize it through good practices, as well as consider the type of energy used, looking, whenever possible, for renewable sources (Cepinha et al., 2007). By improving the energy performance of buildings a vast set of objectives can be reached, such as: “1) reduction of the global needs of energy production; 2) reduction of the emissions of carbon dioxide, and consequently of GGE; 3) improvement of comfort in households and workplaces; 4) contribution for cleaner cities; 5) improvement of urban regeneration; 6) improvement of the health of the population and promotion of the social inclusion; 7) increase the standards of living of the European citizens” (Cepinha et al., 2007: 116). As buildings are responsible for about 40-50% of the energy use in each member state of the EU, it makes them the main users of final energy (Cepinha et al., 2007). The residential sector is responsible for two thirds and the commercial sector for one third of the use of the energy in the buildings (Cepinha et al., 2007). Szokolay (2004) explains that energy is used in buildings at two levels, as: 1) Operational energy (O), annually used for heating, cooling, ventilation, lighting and servicing the building, and 2) Capital energy (C) or energy embodied in the materials and building processes. The embodied energy is defined as “the total amount of energy of a single type required directly and indirectly to produce the substance of interest” (Costanza, 1979: 7). In the 1970s, efforts were focused on reducing the operational energy use, but in the last few decades improved buildings resulted in a reduction of the operational energy consumption and now the major concern shifted to the reduction of the embodied energy (Szokolay, 2004). Explaining the embodied energy, Costanza (1979: 9) gives the following example:

“For example, oil mined and delivered to the point of use would have more embodied energy (that consumed by the recovery and transportation process) than oil in the ground. (...) A ceremonial mask would have more embodied energy than the piece of wood from which it was carved and would also presumably do more work by performing an important symbolic function in the ceremonies of the culture of its manufacture.”

Given that there are large differences in published data regarding embodied energy, Szokolay (2004) combines two methods generally used in calculating this type of energy: 1) analytical method (which follows the processes from gaining the raw material through

various stages of manufacture and transportation to the installation in the final product, the building, and adds up all the energy used) and 2) statistical method (which examines the particular industry of a country, a state, or a region, attempts to establish the total energy use by that industry as well as its total output; dividing the latter by the former gives the embodied energy per unit mass), and divides building materials into three broad categories: low, medium and high energy materials, as shown in the Figure 2.19.

<i>Low</i> <1 kWh/kg	Sand, gravel	0.01
	Wood	0.1
	Concrete	0.2
	Sand-lime brickwork	0.4
	Lightweight concrete	0.5
<i>Medium</i> 1–10 kWh/kg	Plasterboard	1.0
	Brickwork	1.2
	Lime	1.5
	Cement	2.2
	Mineral wool	3.9
	Glass	6.0
	Porcelain	6.1
<i>High</i> > 10 kWh/kg	Plastics	10
	Steel	10
	Lead	14
	Zinc	15
	Copper	16
	Aluminium	56

The concept of embodied energy highlights the high energy transport costs of bulky materials as stone, aggregates, brick, and concrete products and the high energy processing costs of some commonly used lightweight materials like aluminium (Edwards, 2005). Edwards (2005) stresses that the embodied energy of a bricks would drive a car five miles. Therefore, the consequences are enormous for the millions of bricks created and wasted every year. Further, a reused brick saves on the excavation of clay, the baking of bricks (consuming fossil fuels and causing air pollution), and landfill waste at end of life (Edwards, 2005). Today we are well aware of the strong link between people, buildings and climate (Figure 2.20.), and their interaction which defines our energy needs (Roaf, Horsley & Gupta, 2004).

A number of research within building material ecology have been focused on the avoidance of known hazardous substances with negative ecological impact, and today, embodied energy is widely accepted as an evaluation parameter for the environmental sustainability of different building materials (König et al., 2010). In the last years, significant progress has been made in the field of the energy requirement of new buildings. However, the main problem lies in the upgrading of the existing building stock (König et al., 2010).

Besides the land and the energy, material is the one of the basic components of a sustainable architectural design. Due to the exponential growth of the population (as our society gets more developed the standards and requirements get each time bigger) the search and consumption of the materials increased to a hallucinating rhythm, whereas the amount of available resources presented a completely inverse scene (Yeang, 2001). Through the extraction, processing, transport, use and disposal, materials used in construction industry have enormous environmental impact. Natural resources used in construction, as roads and buildings, account for about one-half of all resource consumption in the world (Edwards, 2005). According to Szokolay (2004), material selection must be influenced by the embodied energy, but also by a number of other issues affecting sustainability of their use. Lawson (1996) developed a method which gives an ‘environmental rating’ of various

Figure 2.19.
Embodied energy
of some building
materials in kWh/kg
(Source: Szokolay,
2004)

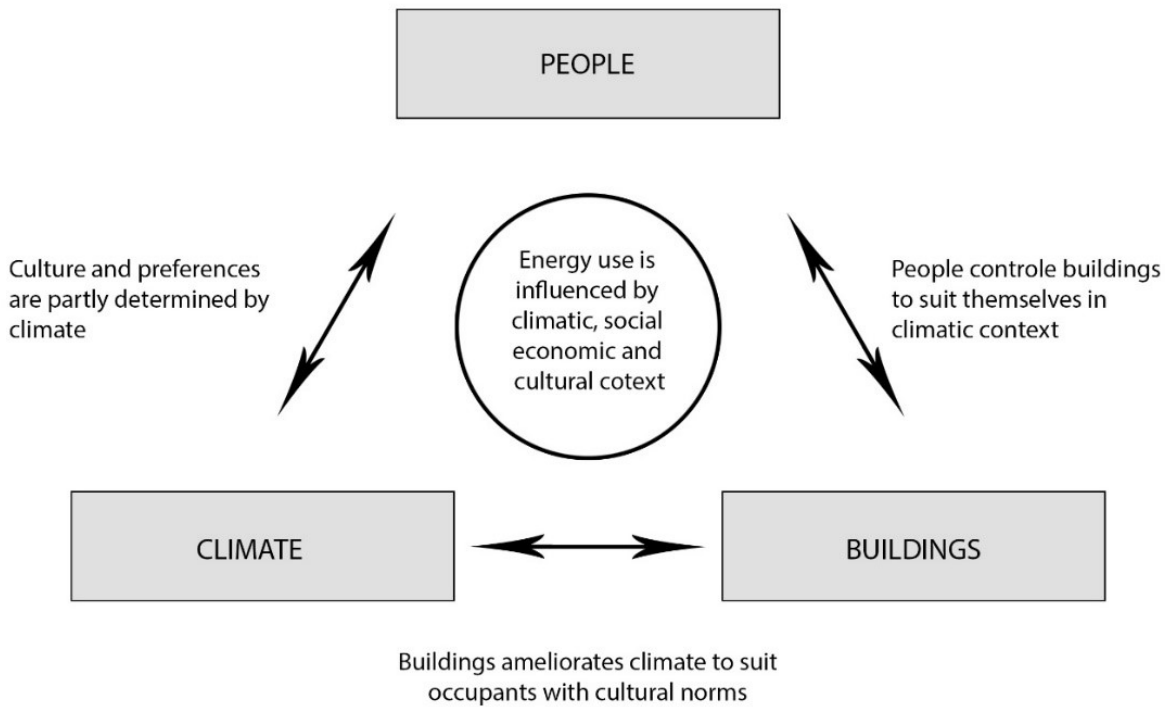


Figure 2.20. The three-way interaction between climate, people and buildings that dictates our energy needs (Source: Roaf et al., 2004; according to Fergus Nicol)

building products on a straightforward 5-point scale: 1: poor, 2: fair, 3: good, 4: very good and 5: excellent (Figure 2.21).

Lastly, our towns and cities produce huge amounts of waste, which includes solid (refuse or trash), liquid (product of our sanitary arrangements: the discharge of baths, showers, basins, kitchen sinks and laundry tubs) and gaseous (mostly motor vehicle emissions and the discharge of power stations) wastes, and architects can have a strong influence on how wastes are disposed (Szokolay, 2004). Furthermore, the average waste produced is about 1 kg/pers.day in the UK, 1.5 kg/pers.day in Australia and up to 2.5 kg/pers.day in the USA. Collection, handling and disposal of waste is a problem, given that we are running out of space for the creation of garbage dumps (Szokolay, 2004). Combination of cheap energy, technical sophistication and abundance have caused excessive waste, and according to some predictions, global waste production will double over the next twenty years (De Graaf, 2012). Puckett stresses that “we must realize that when we sweep things out of our lives and throw them away... they don’t ever disappear, as we might like to believe. We must know that ‘away’ is in fact a place (...) where people and environments will suffer for our carelessness, our ignorance or indifference” (as cited in Fabiani, 2012: 198).

The ‘3R’ strategy

If the current world population increases to 10 billion by 2050 as predicted, the human race will have four times the environmental impact than it has today (Edwards, 2005). Environmentalists have long advocated the ‘3R’ (Reduce, Reuse, and Recycle) strategy, for reaching sustainable objectives and sustainable design. In the following lines, each of the principles is briefly described.

Reduce principle stresses the need for the society to reduce the demands made on all non-renewable resources (fossil fuels, water, mineral ores, agricultural land, and geological deposits), and provide extra time to develop alternative supplies (Edwards, 2005). According to Edwards (2005: 134), “the consumer-led economy may benefit share process and create global employment but it strips the environment of its resource capital”. In other words, as the economic capital grows the natural capital decreases. Finally, the architects and engineers task is to create a better balance in buildings resource use and performance (Edwards, 2005).

Reuse principle advocates the idea of a building as a capital asset which should be used over and over again, over generations and across changing building use priorities (Edwards, 2005). Reuse can be applied on the whole building or the building elements from which it is made. According to the same source, a building is more likely to be reused if:

- it makes good use of natural light and ventilation;
- it is well serviced by infrastructure of various kinds (public transport, utilities, etc.);
- it does not contain toxic materials;
- it is well constructed, preferably using ‘natural’ materials;
- it has attractive spaces and character, and
- it has access to renewable energy resources (solar, wind).

Recycle principle promotes rescuing the useful parts of a material by extraction and re-manufacture. Recycling aluminium for example, entails melting aluminium scarp and reforming the material into further useful products (aluminium structural members, clips, etc.) (Edwards, 2005). Recycling, unlike reuse, requires further energy in the re-forging process but is preferable to the total loss of the material, thus, construction materials, especially those with high embodied energy (steel, aluminium, lead, copper), should be commonly recycled (Edwards, 2005). As building sector currently demands more than 40% of EU total energy use, considerable savings could be achieved by the use of 3R⁷ strategy and future-oriented refurbishment of the existing building stock. This would have the potential to make a major contribution to the goals stated in the EU Green Paper on the European strategy for the security of energy supply and the White Paper on energy for the future (Jochem, 2004).

	Raw material availability	Environmental impact	Embodied energy	Product life span	Freedom from maintenance	Product re-use potential	Material recyclability
Plantation-grown sawn softwood	4	4	4	3	2	2	1
Hardwood from native forests	2	2	5	4	3	4	1
Wood fibre hardboard	4	4	2	3	2	1	3
Medium density fibreboard (MDF)	5	4	3	3	3	3	2
Particleboard (chipboard)	5	4	3	3	3	1	4
Plywood	4	4	3	4	3	3	1
Glued laminated timber	4	4	4	4	3	4	2
Plastics (synthetic polymers)	3	2	3	4	4	1	3
Stabilised earth (cement or bitumen)	4	5	4	3	3	1	5
Building stone (sawn)	3	2	3	4	4	4	3
Clay bricks	4	3	4	5	5	2	3
Cement-concrete products	3	3	4	5	5	1	3
Fibrous cement (pine fibre)	4	4	3	5	5	1	1
Glass	3	3	3	5	4	3	4
Steel	4	3	3	4	3	3	5
Aluminium	4	1	1	5	4	2	5
Copper	2	1	2	5	5	1	5
Lead and zinc	2	1	2	5	5	1	5

Note: No attempt should be made to add up these numbers. The rating is purely qualitative and in the original no numbering is used. Here it is simply a convenience or short-hand to identify the qualitative rating.

Figure 2.21. Environmental rating of various building products (Source: Szokolay, 2004)

⁷ The fourth ‘R’- Recover, was added more recently addressing the need of the human habitat to be repaired and recovered from contamination. Cities have become the global focus of pollution and waste. Much of this pollution originates in buildings or as a consequence of the need to travel to buildings, so any strategy for recovering cities needs to encompass the contribution building design can make to healthier living (Edwards, 2005).

In architectural terms, recycling refers to the process of altering a given building in order to make it suitable for new function. Through this process vacant and underused buildings are adopted to the newly emerging market needs, the embodied energy of building materials is saved and the environmental impact associated with excavation, production and transport of new materials is avoided. Thus, architectural recycling enables the continuity of the building occupancy through change.

2.2.2. Recycling: A preservation through change

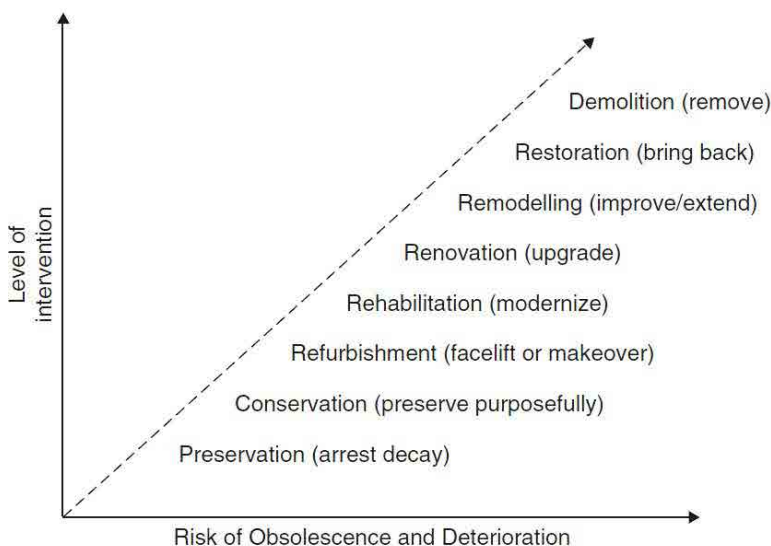
“According to Darwin’s Origin of Species, it is not the most intellectual of the species that survives; it is not the strongest that survives; but the species that survives is the one that is able best to adapt and adjust to the changing environment in which it finds itself.”

(Meggison, 1963: 4)

The Oxford Dictionary defines recycling as *using again*. However, while reuse means using again in the same way, recycling implies the element of change, i.e. starting a different cycle. Through the process of recycling, materials are changed into new products. As already presented in the Glossary of building intervention-related terms, according to Douglas (2006), recycling refers to transforming or re-utilizing a redundant or underused building or its materials for more modern purposes. Also, options for dealing with the existing building can range from basic preservation works at one end of the spectrum to almost complete reconstruction at the other (Figure 2.22.). According to the same source, interventions such as refurbishment, rehabilitation, remodelling, renovation, retrofitting, and restoration are found in between these two extremes. Viganò (2012) points out that recycling is not just reusing, and highlights that, if we follow the analogy with the organic world, recycling puts forward a new life cycle. Ricci (2012) argues that recycling means creating new values and new meanings and points out that unlike conservation, which embalms the image of architectural or urban space, when recycling is carried out the change itself is the value. Thus, the fundamental difference between recycling and many related terms is the notion of shift of the original function or purpose. Therefore, in this research the term *recycling* refers to the process of intervening with the existing building, on different scale,

and with different intensity, with the aim of making the building suitable for the new function. Through the analysis of ideologies and projects of Archigram and Metabolism movements, architectural recycling is viewed as a process that provides continuity and progress at the same time.

Figure 2.22.
The range of interventions
(Source: Douglas, 2006)



Ciorra (2012) points out that “architecture itself is a recyclable material, which among other things we’ve always known how to recycle” (Ciorra, 2012: 18). According to Ricci (2012), architecture and cities have always recycled themselves – Split, the *Teatro di Marcello* in Rome or the *Duomo* in Syracuse are just a few of the most obvious manifestos of recycling. Due to their constant recycling, i.e. continuous transformation, ancient remains as *Acropolis*, the *Colosseum* or the Temples of Agrigento, have survived (Ferlega, 2012). Edensor (2005) explains that “Christopher Woodward draws upon the compellingly rich and diverse evocations of Rome’s famous Coliseum by writers and artists over many centuries, portrayals which highlighted the numerous uses to which the site was put” (Edensor, 2005: 22). According to Ferlega (2012), the practice of reuse has also been the practice of transformation. Through the constant occupation buildings have been saved from the extinction. Temples have been transformed into churches, synagogues or mosques in the whole of Mediterranean and the entire historical areas of cities as Naples, Marseilles, Damascus, Istanbul, Athens and Rome have been subjected to the process of recycling (Ferlega, 2012). Thus, the phenomenon of recycling was not limited only to individual buildings and was not constrained within their walls. The opening up of the ruins of antique, the forums as Diocletian’s Palace in Split, the Roman amphitheatres in Nimes and Arles and the great sacred walls of the Temple of Jupiter in Baalbek, or of the Temple of Baal in Palmyra, has led to the creation of a new forms of public space (Ferlega, 2012). This phenomenon has branched out to include elements of infrastructure as well, such as aqueducts. These elements have been recycled for various purposes as bridges like the *Pont du Gard* in Provence, or residences like those in *Ephesus* and *Évora*, and have also been assigned with the function of identification, becoming landmarks and symbols of the city (Ferlega, 2012). According to the same source, the recycling mechanism endured, it was not interrupted by the modern world, and the nineteenth-century palaces, castles and religious complexes soon became museums, schools, hospitals or town administrations.

Archigram. Ciorra (2012) argues that the foundations of the architectural recycling ideology can be found in some impressive figurative *ballon d’essai* by the Archigram or the Radical Architects. Archigram, formed by a group of British architects (Warren Chalk, Peter Cook, Dennis Crompton, David Greene, Ron Herron and Michael Webb) based at the Architectural Association, dominated the architectural avant-garde in the 1960s and early 1970s with its neo-futuristic, pop-inspired visions of the future. With ten issues of Archigram magazine, published in London between 1961 and 1974, the group explored the impact of the emergent technologies to the architectural field through drawings, experimental models, projects and propositions (Cabral, 2013). The recognisable aesthetic of the Archigram Group has its origins in “the nineteenth-century industrial architecture, twentieth-century manufacturing, military apparatus, science fiction, biology, technology, electronics, constructivism, pop art, cutaway technical illustration, psychedelia, and the

English seaside-which would serve as an inspiration for an architectural movement, high-tech, and feed into the stream of postmodern/deconstructivist trends of the 1970s, 1980s and 1990s” (Sadler, 2005: 8). Michael Webb argues that Archigram raised the notion of flexibility to the next level, by envisioning adaptation on a daily and even hourly basis (Cook, 1999). He gives an example of Archigram’s competition entry for the Monte Carlo Entertainment Centre (1969), which was envisioned as a giant underground room with a domed roof. This room contained various components, such as “toilets and coatrooms modules, banks of bleacher type seating, movie screens, bars, and even a model of the Monaco Grand Prix track” (Cook, 1999: 3). These separate units could be assembled together to create different spaces for variety of uses, from an art exhibit, movie premiers, restaurant to a small hockey arena (Cook, 1999). The project combined three major technical features: “first, a concrete shell generating a continuous covered space; second, a set of ‘robot’ facilities designed to support a variety of activities, from a circus to a car race; and third, a green park developed above it all” (Cabral, 2013: 419). The park was imagined as ‘cybernetic forest’, a concept which Archigram group developed in their magazine, implying electronic serviced landscape where nature and invisible electronic devices are merged (Cabral, 2013). According to Cabral (2013: 420), “the entire space was designed like a stage, in which mobile devices, arranged as an outer ring of services, could quickly move and transform the organization and interior appearance of the assembly hall”.

Archigram primarily dealt with the ideas of change and expendability. The group praised the mass-production and believed that its inherit qualities are repetition and standardization of parts which can be interchangeable depending on the individual needs and preferences. Cook (1999: 17) argues that the idea of the mass-produced expendable component dwelling is not new, but has its roots in:

“(…)Le Corbusier’s efforts in collaboration with Prouvé and with Prouvé’s own bits and pieces, with Buckminster Fuller’s Dymaxion bathroom and the Dymaxion deployment unit, Alison and Peter Smithson’s House of the Future at the Ideal Home Exhibition of the 1955, Ionel Schein’s prefabricated hotel units and the Monsanto Plastic House in Disneyland [and also with] work done by the Metabolist Group in Japan and Arthur Quarmby in England”.

The Plug-in Capsule Home project sustains the idea of the expendability which was further developed in the Plug-in City project. This project combines removable housing elements in one concrete megastructure (Figure 2.23.). Archigram raised an argument in favour of expandable buildings in the second and third issue of their magazine, and the question that followed was the logical evolution of this concept – “What happens if the whole urban environment can be programmed and structured for change?” (Cook, 1999: 36). The Plug-in City is envisioned as a large-scale network structure which consists of various units planned for obsolescence (bathroom, kitchen, living room floor: 3 year obsolescence; living rooms, bedrooms: 5-8 year obsolescence; location of house unit: 15 years’ duration;

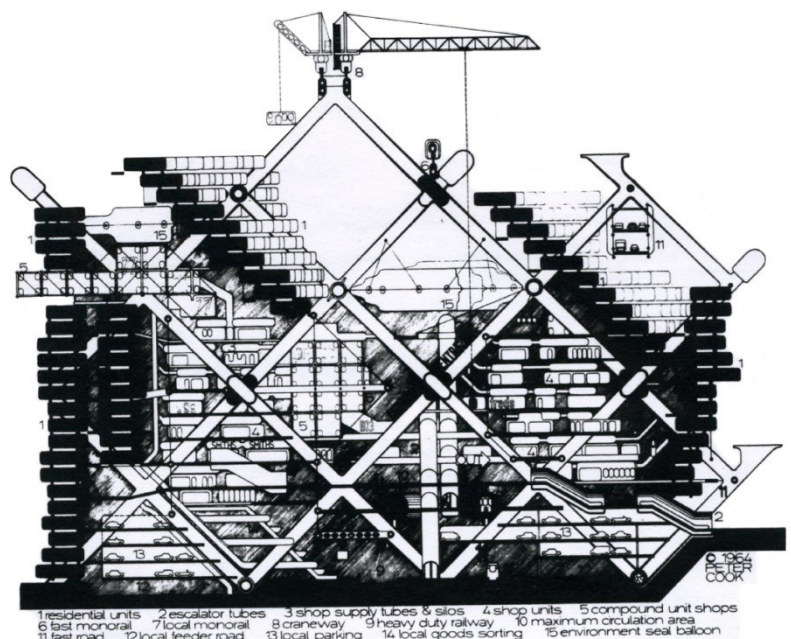
immediate-use sales space in shop: 6 months; shopping location: 3-6 years; workplaces, computers, etc.: 4 years; car silos and roads: 20 years; main megastructure: 40 years) and placed and manoeuvred by the means of cranes (Cook, 1999). The Plug-in City revolves round the idea of replacement of one function by another, while occupying the same space (Cook, 1999).

Plug-in City aims at keeping cities viable in time of rapid change (Sadler, 2005). Thus, Archigram envisioned a flexible design completely adaptable to people's needs and the constantly changing conditions. The structure can build and re-build itself, on a regular basis, by altering the function of its parts to one which is currently needed. Even though the units of the Plug-in City are planned as expendables, i.e. to last only a short period of time and get replaced, the megastructure is conceived as a flexible entity which adapts easily to new conditions.

Metabolism. The vision of the city as a living entity which can transform by adapting its elementary components is also associated with Metabolism, the post-war Japanese architectural movement. The roots of the metabolists' beliefs can be traced back to the Japanese Shinto religion and with its teachings about the endless changeability of all things. The principles of these teachings are represented in the Kanji, Japanese writing system adopted from China, whose characters represent both the noun and the verb in the same time (Nitschke, 1964). In this way, the characters support the belief that in nature there is no isolated and abstract phenomena which would correspond to the form of a noun (Figure 2.24.). For the Chinese, nouns and verbs are the same: things in motion and motion in things. Furthermore, the words in the Chinese language are left flexible, given that things and functions are not formally separated, so that they can constantly change and adapt (Nitschke, 1964).

Chinese pragmatism, Indian metaphysical thought and Shino sensibility towards nature are brought together, in Japanese Zen, in the philosophy of active creativity (Nitschke, 1964). These principles are seeded in the Japanese home design, also present in the Metabolist's proposals, which supports the idea of highly changeable and functionally flexible space that allows the change in the arrangement of rooms, flexibility of function, and the mutual relationship between the inner and outer (Nitschke, 1964). Nitschke (1964) points out that the nature in Japan, due to its restless spirit, earthquakes and fires, calls for the restraining from the construction and creation of solid elements, and directs to constant change and

Figure 2.23.
Plug-in City: typical section 1964
(Source: Cook, 1999)



transformation. According to the same source, for that very reason a group of architects and urban planners, that saw the human society as a living process and suggested through their projects an active ‘metabolic’ development of our society, called themselves Metabolists (μεταβολη, in Greek – change, mutation, revolution, cyclic transformation). On the World Design Conference, held in 1960 in Tokyo, the group, formed by Kiyonori Kikutake, Masato Ohtaka, Fumihiko Maki, Noriaki (Kisho Kurokawa) and Noboru Kawazoe, presented its publication “Metabolism 1960: Proposals for a New Urbanism”, a manifest containing a number of visionary projects and essays (Wendelken, 2000). Kenzo Tange and Arata Isozaki were also affiliated to this group even though they never became formal members. The group proclaimed their architecture as an offspring of the Japanese tradition and the inevitable product of science (Wendelken, 2000).

The term ‘Metabolism’ combined the language of nuclear physics, biological regeneration and Buddhist reincarnation, while rejecting nostalgia (Wendelken, 2000). Also, it represented a continuation of a post-apocalyptic discourse of the 1950s about the death of the Japanese culture in the bombing of Tokyo and nuclear explosion in Hiroshima. In the introductory statement of their manifesto, Metabolists explain the reasons for choosing this particular term in the following way (as cited in Lin, 2011: 16):

“The reason we use such a biological word, metabolism, is that we believe design and technology should be a denotation of human society. We are not going to accept metabolism as a natural historic process, but try to encourage active metabolic development of our society through our proposals”.

A new organism has to be able to grow and evolve and so, individuals, house and city become parts of one single organism. (Wendelken, 2000). Furthermore, flexibility and adaptability installed in Metabolists’ projects were a direct expression of the power and autonomy of individuals. According to the same source, the post-war Metabolists’ essays were specific as they pointed that architectural shapes, materials and landscape were not important any more in the defining of the characteristics of Japanese architecture but only the change contained in processes of death and birth, which takes a central place in the Japanese culture. Their ideology accepted and praised rapid physical change. Wendelken (2000) explains that due to a general paralysis in the application of a big-scale projects in Tokyo and a critical condition of the city infrastructure, Metabolists completely abandoned the existing city and decided they needed to start from the scratch. Tange’s famous project for the Tokyo bay from 1960 expresses this view. Metabolists rejected any visual connection to the past, which was not only the consequence of the international modernism but also an answer to war destruction and post-war discrediting of values from the time before the war (Wendelken, 2000). They celebrated continuous change and adaptability. The ideas of flexibility and growth, present in Metabolist’s projects, were shaped by the Kikutake’s use of attachable modules in his Sky House from 1958 (Figure 2.25.). In this project Kikutake raised large central space on pillars, high above the ground,

Figure 2.24.

Gradual development of character ‘Eki’. The first shape represents the lizard whose nervous system allows for a rapid change of his skin colour. His abstract meaning was first ‘to change’ and then ‘to exchange’ in the commercial sense. As these changes in skin colour appeared with great speed and ease, the same character was used to represent ‘easy’ and as this change was used to deceive the enemy, the ideogram meant ‘safe’ as well. Prophets in the ancient Chine observed the changes in nature to predict the future, hence, the character got another meaning, ‘to predict’

(Source: Nitschke, 2005)



which could expand by using *movenets*, i.e. elements that could be attached below the floor as bathroom, storage or a removable room for children (Wendelken, 2000).

The ‘capsule’, an international symbol of the Metabolists, emerged just before the end of the 1960s. Wendelken (2000) argues that the capsule was also the reflection of the survivor architecture: minimal shelter conditions, miniature shacks built after the war and the ever present military presence in the post-war period. According to the same source, there is a direct relationship between the autonomy given to the ‘capsule’ or ‘unit’ in regard to the ‘skeleton’ and the personal traumatic experience of life under the totalitarian regime. Lin (2011) explains that combination of a megastructure, as the permanent base, and a number of individual units attached to it and subject to more frequent replacement are typical characteristics of the Metabolists’ designs. Thus, this combination became the trademark of their architecture. The capsule as an architectural element was developed mainly by Kisho Kurokawa, who believed that capsule buildings represent the fulfilment of the Metabolist ideas (Wendelken, 2000). His Nakagin Capsule Tower (Figure 2.26.) is one of the most famous examples of capsule architecture.

Kurokawa designed his building for ‘urban nomads’, or as he stated “homo movens: people on the move”, as a response to the increasing mobility that characterised an emerging global city (Lin, 2011). This was an experimental project which aimed at facilitating change and renewal through periodic replacement of capsule housing units (Lin, 2011). The building is composed of three basic components: the main structure (two ferroconcrete shafts, eleven and thirteen floors high), which would, according to Kurokawa, last at least sixty years; the moveable elements (144 prefabricated, self-contained modules - ‘capsules’), which are supposed to last twenty-five to thirty-five years; and the service equipment, utilities (Lin, 2011). According to Kurokawa the life span of the capsule does not depend on its mechanical properties but on the social ones, reflecting changing human needs that require periodic alterations (Lin, 2011). Bridges connect two concrete towers on every three floors and contain circulation and service spaces. They also represent a base onto which capsules are attached. The capsules, measuring 7.5 x 12.5 x 7 foot, are attached by the four high-tension bolts and can be connected and combined to create larger spaces (Figure 2.27). They are also autonomous units and can be removed and replaced easily without affecting the whole

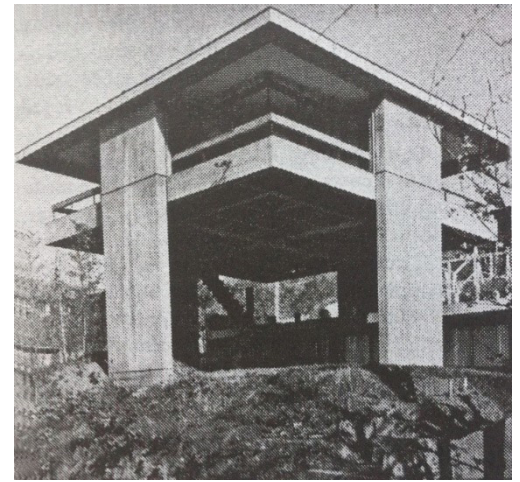


Figure 2.25.
Sky House, Tokyo.
1958.
(Source: Wendelken,
2005)

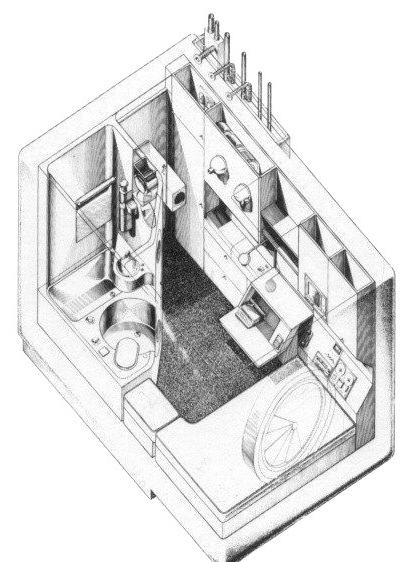


Figure 2.26.
Kisho Kurokawa,
Nakagin Capsule
Tower, Tokyo, 1972.
(Source: Lin, 2011)

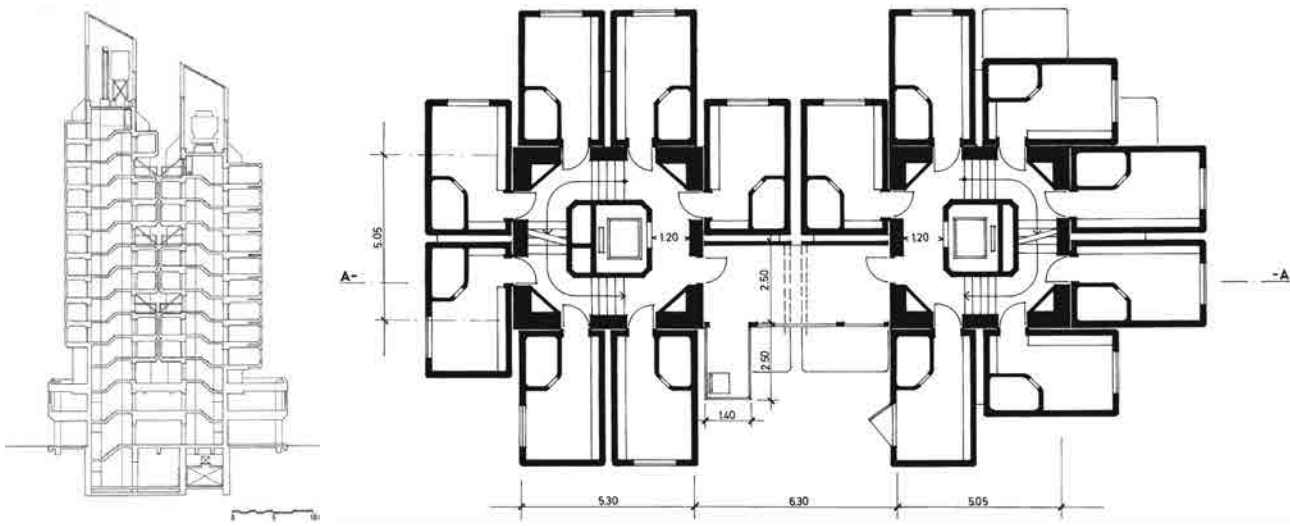


Figure 2.27.
Section and a typical
plan of Nakagin
Capsule Tower
(Source: Lin, 2011)

structure. The seemingly random pattern of capsule arrangement and its incomplete look, or as Kurokawa called it ‘aesthetic of time’ reflects Metabolists’ central ideas about the city as a process (Lin, 2011). Hence, the structure allows for upgrading and recycling of its units.

In 2007 the decision was made to tear down the building, to which Kurokawa opposed fiercely. He proposed to preserve the Nakagin Capsule Tower through the replacement of capsules. This proposal challenged the Western concept of heritage and preservation, based on the notion that monuments are permanent and fixed in time and specific to the site (Lin, 2011). Lin (2011) explains that through the replacement of capsules the building would no longer be ‘historic’ in the Western sense, as it would no longer be original. However, in Japan, the replacement and transformation of the building “would conform to an understanding of heritage based on the belief that eternity is sustained by change” (Lin, 2011: 25). Therefore, Metabolists viewed the city as an organism, engaged in a constant process of change and evolution and their projects were created to accommodate this change. Metabolists’ designs were embodiments of their urban and social ideas, mainly those of mobility, flexibility and constant change. Both Archigram and Metabolism developed a futuristic design which combined megastructures and cells. Even though Archigram drew its inspiration from a mechanical progress and Metabolists from biomorphic model of transformation, they both praised flexibility and changeability as a way of adapting to rapidly changing conditions.

Ciorra (2012) points out that the roots of the architectural recycling can also be found in a series of projects from late 1970s to the early 1990s which based their identity on the fact that they are products of recycling. According to the same source, on one end of the scale there are masterpieces of the architecture of conceptual recycling – Parc de la Villette, Tschumi’s Le Fresnoy Art Center, and Peter Eisenman’s project for Cannaregio and, on the other, “apparently more artisanal and situationist version of recycling staged by Lacaton & Vassal in the project to transform the Palais de Tokyo from a sleepy municipal museum to a theatre for avant-garde artistic research” (Ciorra, 2012: 19). Mozas (2012) points out that Anne Lacaton’s and Jean-Philippe Vassal’s approach, when working on the Palais de Tokyo (Figure 2.28.), was to have no aesthetic standpoint on the unfinished. They believed that “existing parts, as they appeared, were parts of the whole and that there was no

reason to conceal them” (as cited in Mozas, 2012: 10). The authors are also pointing out that their intention was not to protect by freezing but to put the received heritage to use (Mozas, 2012).

Corbellini (2012) explains that Peter Eisenman’s research begins with “revisiting Italian Rationalism (which in itself is a form of recycling) and obtains further impetus thanks to the potentiality of computer software” (Corbellini, 2012: 123). According to the same source, similar forms of recycling, this time of Russian Constructivism, can be seen in the work of Zaha Hadid and Daniel Libeskind. The project for Cannaregio (Figure 2.29.), designed by Peter Eisenman in 1978, was a response to an international invitation competition launched by the City of Venice. Eisenman explains that his project “was inspired by an unrealized project for a hospital on Cannaregio by Le Corbusier, which was to be located directly on the site of the old abattoir at the northern end of the island”, and stresses that he “merely extended his grid” to his site (as cited in Taylor, 1992: 261). Ciorra (2012) points out that Eisenman’s Cannaregio project is a perfect example of recycling because it is produced by overwriting of three architectural texts: “the plan of the Venetian open space, the modular mesh of Le Corbusier’s project for the Venice hospital, and the architectural punctuation by Eisenman, made up of micro-buildings meaningless in themselves” (Ciorra, 2012: 19). Eisenman (2013) points out that just as Sigmund Freud believed that Rome was built on a series of traces of history that have been sedimented, so does his project for Cannaregio rely on Le Corbusier’s grid which offers one layer of cultural history. Eisenman (2013) believes that superposition of traces allows cities to evolve. Thus, the trace is seen as a key, i.e. the starting point of a project (Eisenman, 2013).

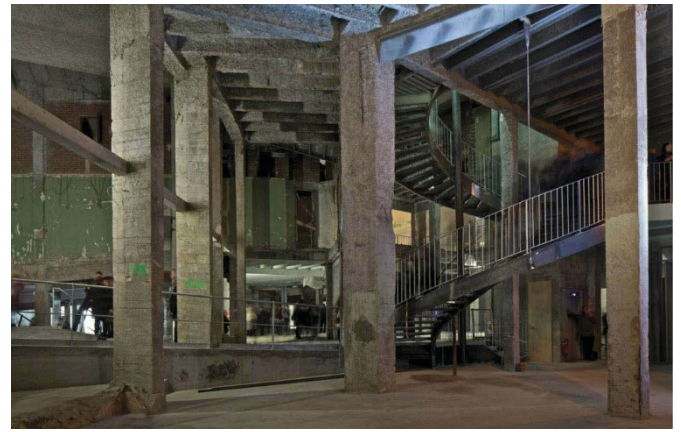


Figure 2.28.
Palais de Tokyo. Paris.
2012
(Source: Mozas, 2012)

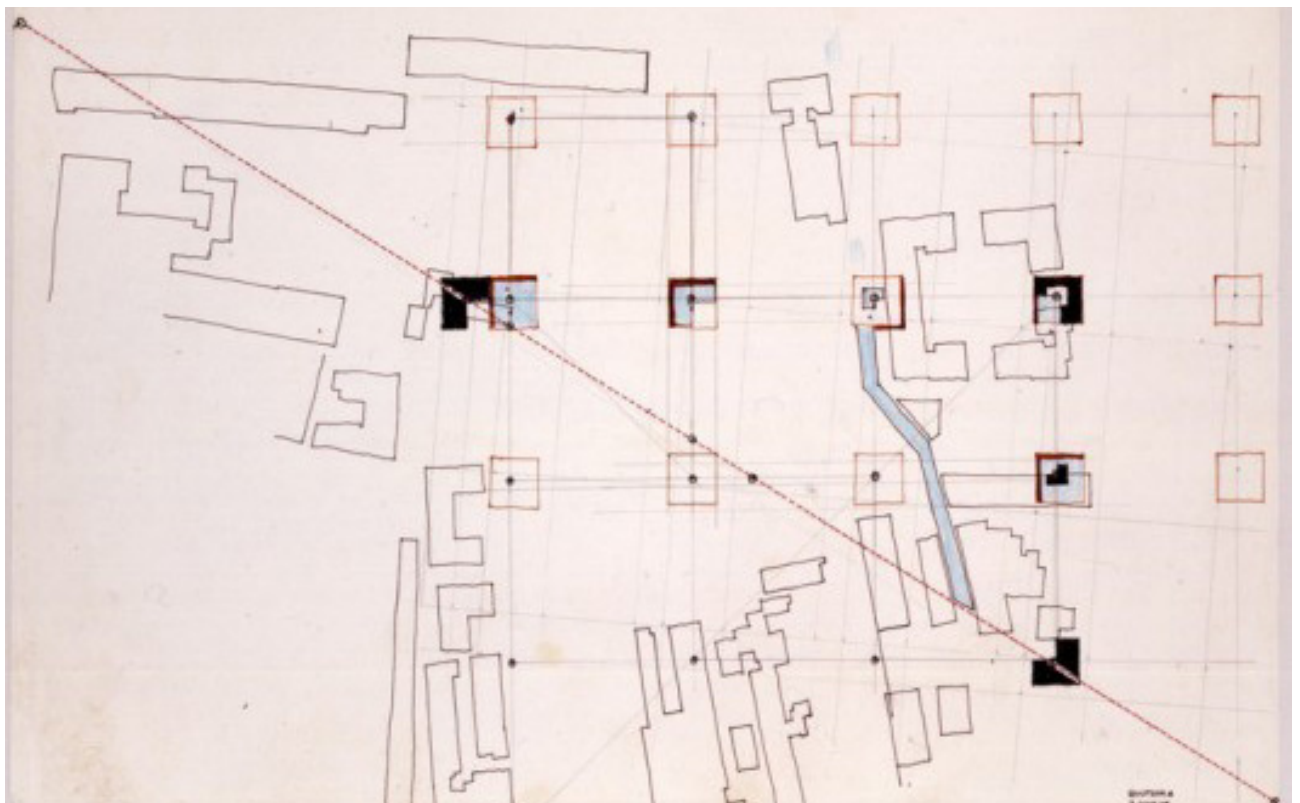


Figure 2.29.
The Cannaregio
Project. 1978
(Source: The
Cannaregio project,
1978)

• • •

The concept of preservation, promoted by Ruskin and later Morris, implies securing and maintaining of the formal and material condition in which the given building is found. Any alterations and upgrading are seen as a lie and a total destruction of the building's integrity. Ruskin believed that the collective memory and history are embodied in buildings which should, therefore, be preserved as found and without alterations. On the other hand, Koolhaas believes that scale of preservation escalates relentlessly. Furthermore, due to its strict rules, preservation limits construction and claims more and more space every year. Therefore, according to Koolhaas, destruction should be applied as a strategy that liberates areas, which can be considered as strategic reserves for new construction.

However, demolition requires additional energy to break the building into smaller, less useful pieces. As the high proportion of this demolished building becomes waste, the stored material and energy is essentially dissipated and lost. To replace the building also entails additional energy and the use of virgin materials inherent in new construction. Building related processes as water pollution, landfill waste, global warming gases, energy, material and land loss, are undisputable proofs of the devastating effects of the construction industry on our environment. As demonstrated in the subchapters above, construction industry is one of the least sustainable industries in the world. This worrying fact was recognised by professionals in various fields which, through summits, conferences and agreements, laid down the principles of the sustainable development and sustainable architectural design. Given that only a small percentage of the total building stock is made up of new works, this inevitably means that existing buildings play a key role in reaching the sustainable agendas. A number of authors (Kincaid, De Garrido, Watson, Kubba, and Szokolay) point out that through the repurposing of what already exist, substantial material, energy and economic savings can be achieved. Through this process the embodied energy of building materials is saved and the environmental impact associated with excavation, production and transportation of the new materials is avoided. By focusing on the existing buildings land, as a non-renewable resource, is preserved and the production of waste, associated with demolition and new construction, is minimised.

The importance of the existing and discarded was also recognised by Kevin Lynch, who in his "Wasting Away", finished and edited by Southworth (1990), writes that we must learn to value decline, decay and wasting and stresses that wastes are full of information. Marini (2009: 249) argues that the role of waste is "no longer regarded as dual, or a shadow of the work, but as space that has the potential to be renewed and transformed". This view was supported by Ferlega (2012) who highlights that what looks like waste today can be of strategic importance tomorrow. Ciorra (2012) points out that, almost thirty years ago, Vittorio Gregotti and Bernardo Secchi explained⁸ that the future of our architecture lies

⁸ In Casabella, 498-499

in modifying what already exists. In “The Death and Life of Great American Cities” Jacobs (1961: 187) explains the importance of the existing old buildings in the following way:

“Cities need old buildings so badly it is probably impossible for vigorous streets and districts to grow without them. By old buildings I mean not museum-piece old buildings, not old buildings in an excellent and expensive state of rehabilitation – although these make fine ingredients – but also a good lot of plain, ordinary, low-value old buildings, including some rundown old buildings”.

Also, it is crucial for the safety and public life of the streets and neighbourhoods that old buildings are re-occupied by “neighbourhood bars, foreign restaurants and pawn shops (...) good bookstores and antique dealers (...) art-studios, galleries, stores for musical instruments and art supplies (...) hundreds of ordinary enterprises”. Further, new ideas and enterprises need old buildings, because there is no space for “chancy trial, error and experimentation in the high-overhead economy of new construction” (Jacobs, 1961: 188). Highlighting the importance of old buildings Jacobs (1961: 188-9) writes:


“The only harm of aged buildings to a city district or street is the harm that eventually comes of nothing but old age – the harm that lies in everything being old and everything becoming worn out. But a city area in such a situation is not a failure because of being all old. It is the other way around. The area is all old because it is a failure”.

Alexiou (2007) highlights that Jacobs promoted mixed use, as a way of preserving the city, before anybody had heard of the concept. Referring to the neglected condition of lower Manhattan in 1961, Jacobs wrote that, in order for the area to come to life, the waterfront should become a great marine museum, followed by restaurants and cultural events as theatres or opera (Alexiou, 2007).

Passive model of preservation, promoted by Ruskin and Morris, no longer meets the needs of the ever-changing society. Explaining the accelerated rhythm of change in today’s society Nye (1996: 237) writes that “yesterday’s technological wonder is today’s banality”. Kincaid (2003) argues that preservationists agendas usually limit the physical change “though much can and should be changed both to visible and disguised elements to adapt to the changing needs of a living community faced with environmental challenges never previously encountered” (Kincaid, 2003: 99). According to the same source, “to suppose then that buildings, or infrastructure of any sort, are fixed and unchanging just because they are established is to oversimplify and potentially to miss the opportunities for growth and change within what seems established” (Kincaid, 2003:99). Already in 1875 Viollet-le-Duc pointed out that the best way of preserving a building is to find a use for it. In order to survive architecture has to be able to change and active preservation model is bridging the gap between rigid rules of passive preservation and demolition. Ada Louise Huxtable (1973) stressed the importance of the active preservation, in “Lessons in how to Heal the City’s Scars”, in the following way: “What we need is continuity ... historic preservation

is not sentimentality but a psychological necessity. We must learn to cherish history and to preserve worthy old buildings ... we must learn how to preserve them, not as pathetic museum pieces, but by giving them new uses". According to Rogić (2009), Conservation Charters recommend keeping buildings in constant use as the best way for its protection and maintenance. In the Article 5 of the "Venice Charter", it is written that making use of monuments for some socially useful purpose facilitates their conservation, as long as the lay-out or decoration of the building is not changed. The Conservation Charters recommend that the best way to maintain or manage a protected building is to keep it in constant use, which for many buildings, particularly the vernacular industrial ones, means change of use (Rogić, 2009). The clash between the stasis and change viewed through the statements of the above mentioned authors is summarised in the Figure 2.30.


Through architectural recycling, which implies the use of the existing building stock and its alteration for the accommodation of new function, buildings are saved from the total demolition and replacement. Marini (2012) explains that "architectural recycling, just like any form of reuse by virtue of a repositioning of material, meaning, relative positions, substantially builds a story, a tale in progress" (Marini, 2012: 178). Viganò (2012) argues that the city is a renewable resource which can be recycled in parts or episodes or as a whole at the end of the different life cycles. According to the same source recycling cities is an essential strategy which "cuts across the scales and themes of the contemporary urban question: the environmental crisis and evermore frequent extreme phenomena, the progressive divide between rich and poor, forced or denied mobility that points towards new exclusion" (Viganò, 2012: 106). Through recycling, cities have repurposed their elements throughout the history. Archigram and Metabolism were some of the avant-garde movements which recognised the potential of the already existing and used it as an essence for the formulation of their ideologies. The practice of recycling is the practice of transformation, i.e. recycling demands change – the right amount of change. Through this transformation a new, viable use is affiliated to the disused building. Thus, recycling cannot be compared to preservation, which persists in maintaining status quo, nor to total replacement of a given building. Through this process a balance is searched for between the radical stasis and radical change. In the time of rapid transformation and economic, social and environmental crises the theme of recycling, i.e. preservation through change, becomes crucial.



Kevin Lynch
1990

"wastes are full of information"


Wasting Away



Rem Koolhaas
2004

"the scale of preservation escalates relentlessly"


Preservation is Overtaking Us



Jane Jacobs
1961

"Cities need old buildings so badly it is probably impossible for vigorous streets and districts to grow without them. By old buildings I mean not museum-piece old buildings, not old buildings in an excellent and expensive state of rehabilitation—although these make fine ingredients—but also a good lot of plain, ordinary, low-value old buildings, including some rundown old buildings"


The Death and Life of Great American Cities



Ada Louise Huxtable
1973

"What we need is continuity . . . historic preservation is not sentimentality but a psychological necessity. We must learn to cherish history and to preserve worthy old buildings . . . we must learn how to preserve them, not as pathetic museum pieces, but by giving them new uses"


Lessons in how to Heal the City's Scars



John Ruskin
1849

"Do not let us deceive ourselves in this important matter; it is impossible, as impossible as to raise the dead, to restore anything that has ever been great or beautiful in architecture."

The Seven Lamps of Architecture



Eugène Viollet-le-Duc
1875

"To restore a building is not to preserve it, to repair, or rebuild it; it is to reinstate it in a condition of completeness which could never have existed at any given time"

On Restoration

Figure 2.30.
Inertia vs. Action

III RECYCLING THE INDUSTRIAL ARCHITECTURE

In the previous chapter the concept of recycling, as a method of the sustainable architectural design and a viable alternative to demolition and replacement, has been analysed. The following chapter deals with the concept of industrial architecture. Industrial buildings have been seen in this research as a field for the investigation of the topic of architectural recycling. Thus, firstly, in the following pages the definition and characteristics of industrial architecture will be observed through the aspects such as: regeneration, identity, innovation, inspiration, and flexibility. Architectural and social importance of industrial buildings, and the key role of this type of architecture in urban regeneration of cities will be highlighted. It will also be discussed why industrial buildings are especially adaptable to change. The aim of this part of the research is to analyse the influence of the industrial architecture on the history of architecture and consequently to highlight the flexibility and great conversion possibilities of industrial buildings and underline why this type of architecture is especially suitable for change.

Secondly, this chapter focuses on the design concepts, i.e. the design principles of recycling, described in the contemporary literature on recycling the industrial architecture. The investigation strives to determine whether the classification of design principles by different authors follow the same pattern and, regardless of different vocabulary used, recognise the same type of relationships between the new and the old, in terms of structure, material, form and spatial organization. Thus, according to the main research hypothesis, i.e. recycling the industrial architecture as a viable alternative to demolition and replacement, whereas physical characteristics of an underused industrial building determine the most environmentally sustainable principles for its recycling, four sources have been selected, compared and analysed. The analysis of these sources enabled the exploration of the design principles defined and described in the process of recycling architecture. Thus, the following chapter aims at explaining how recycling design principles have been perceived and classified so far. Different authors made different classifications of recycling design concepts. They recognised certain number of design principles based on the relationship

between the original and new structure, material, form and spatial organization. The comparative analysis consists of four research studies, namely those by Greame Brooker and Sally Stone, who particularly dealt with the principles of 'intervention', 'insertion' and 'installation' (Brooker & Stone, 2004), then Lukas Feireiss and Robert Klanten who explored the principles of 'add-on', 'inside-out', and 'change clothes' (Feireiss & Klanten, 2009), Frank Peter Jäger who analysed the principles of 'addition', 'transformation' and conversion (Jäger, 2010) and Tamara Rogić who dealt with the principles of 'coexistence', 'imposition' and 'fusion' (Rogić, 2009). The categorization of previously mentioned recycling principles is conducted with the aim of understanding the logic behind the definition of these principles.

3.1. Industrial Architecture

In The Great Soviet Encyclopaedia (1979) industrial buildings are defined as buildings designed to house industrial operations and provide the necessary conditions for workers and the operation of industrial equipment. Those are the buildings engineered for manufacturing or storing products of the industry. They first appeared during the industrial revolution, when a need arose for large buildings to house machinery and large numbers of workers. Stratton and Trinder (1997) underline that the trigger for the industrial revolution in Europe was the high growth in the population which set in around the middle of the 18th century and produced a gigantic reservoir of workers. In order to supply the basic needs of so many people, more efficient methods of production became necessary. According to the same source, the first spinning frames, created on the British Isles, were followed by mechanical weaving looms, and textile factories. When the process of turning coal into coke iron was discovered, manufacturers had excellent, almost unlimited reserves of fuel at their disposal with which to process iron ore (Stratton & Trinder, 1997). The invention of the steam engine, used to heat the furnace ovens more quickly and effectively, led to the spreading of the factory buildings over the coal regions (Stratton & Trinder, 1997). Bradley (1999) argues that by creating a space and identity for different aspects of the operation, and by addressing the comfort and health of the workers through the control of heat, light, and ventilation, the factory building provided a setting for industrial work. According to the same source, industrial buildings also provided a stable foundation for machinery and a rigid framework for power transmission and material handling. Exploitation of natural light and ventilation in structures with maximum span and strength was the guiding idea behind the design of industrial buildings (Bradley, 1999). Historically, industrial buildings have been referred to by different names, depending on the manufacturing processes they housed, rather than on architectural criteria (Bradley, 1999). In the Dictionary of Architecture and Building (1902) the term 'factory' is defined as abbreviation from manufactory – a building in which

manufacturing is carried on (Bradley, 1999). Pevsner (1976) points out that in England, the word manufacture occurs in 1796 and 1797, and the term factory in 1803. Bradley (1999) argues that around the turn of the twentieth century, factory was favoured by architects and engineers and came into more general use. According to the same source, the 1914 New York State law for factory regulation defined a factory as any place where goods or products were manufactured or repaired, cleaned or sorted. In the following subchapters the importance of the industrial buildings to the history of architecture will be reevaluated through the aspects of regeneration, identity, innovation, inspiration, and flexibility. Both the nineteenth and twentieth century historical sources about how industrial buildings have been described and perceived will be examined.

3.1.1. Regeneration: importance in the urban renewal

Industrial buildings are catalysts of the urban transformation and renewal. Stratton (2000: 18) highlights that the philosophy of regeneration is that “cities have rich resources and values that can be nurtured and revived, and that the benefits of an improved environment and of new jobs will filter down to bring lasting or sustainable benefits to the whole community”. According to the same source, there is a direct link between sustainability and urban regeneration, i.e. the link reflects the view that the most important problems in the urban environment - dereliction, decaying infrastructure, or the various constrained locational qualities, do not cope with the sustainable development (Stratton, 2000).

Nugent (2002) stresses that much of the built infrastructure associated with the traditional industries has fallen into disuse in recent years. Namely, some of the reasons for this are because companies have transferred manufacturing activity overseas to take advantage of lower costs, or because industrial activity has moved to new purpose-built structures in order to meet process changes, to conform to modern working practices or to meet regulatory requirements. This shift caused many companies to leave behind a large stock of redundant buildings, which has declined rapidly through lack of maintenance (Nugent, 2002). These redundant buildings, if left in the state of dereliction, produce devastating economic, ecological and environmental effects such as: loss of economic value of land, development of social pathology (crime, prostitution, and drug addiction), possible source of infection; starting point of numerous environmental noxa (smell, disrupted ecological system, etc.), psychological effect on citizens in the neighborhood and threatened identity (Stojkov, 2008).

A great number of examples show the industrial heritage as a catalyst of an urban regeneration. It possesses large quantities of embodied energy, materials and resources and contributes to the streetscape, character and embodied memory of our communities. Melet and Vreedenburgh (2005: 9) point out that as industries left the city for various

reasons, parts of the city have become assuming a uniform character – “exclusively residential, exclusively for work, exclusively for shopping, or exclusively for production”. According to the same source, a programme has been launched in the Netherlands to bring businesses and people back to the city. This programme involved the transformation of the abandoned industrial estates into fashionable business and residential districts “such as the Eastern Docklands and GWL in Amsterdam, *Kop van Zuid* in Rotterdam, *Laakhaven* in The Hague, and the *Sphinx Céramique* site in Maastricht” (Melet & Vreedenburgh, 2005: 9).

Given that industrial buildings have been included in the category of the historic buildings (which will be further elaborated in the next subchapter), the recommendations for the use of historic building unquestionably refer to industrial buildings as well. The Parliamentary Select Committee on The Role of Historic Buildings in Urban Regeneration (2004) states that “the historic environment has an important part to play in regeneration schemes, helping to create vibrant interesting areas, boosting local economies and restoring local confidence. When historic buildings, including churches and theatres, are no longer needed for their original purpose, they are capable of conversion for a wide range of other purposes” (as cited in Taggart, Thorpe & Wilson 2006: 2). The Committee underlines that historic buildings provide a foundation for the regeneration of many of our towns and cities and that through the regeneration of these buildings a sense of community can be reinforced, an important contribution to the local economy made and that these buildings act as a catalyst for improvements to the wider area. The Committee also states that reuse of buildings, which have historic value, can make an important contribution to the regeneration of the urban areas and underline that reuse of historic buildings have several benefits:

- Act as a catalyst to the regeneration of a neighbourhood or district,
- Boost the local economy and create jobs,
- Reinforce local cultures, instil a greater sense of pride and confidence in a neighbourhood, and
- Achieve better use of natural resources.

The Institute of Historic Building Conservation outlines that “historic buildings have been a positive catalyst in achieving structural economic change, attracting higher value investment and jobs, and providing the context for creative, high quality contemporary design in new development” (House of Commons ODPM, 2004: 6). The United Kingdom Association of Preservation Trusts points out that “very often it has been the example of a successful historic building repair and conversion project that has acted as the hub of a much wider area regeneration process with the footprint provided by the existing building of merit creating a robust and successful framework for further development and organic

growth” (House of Commons ODPM, 2004: 7). The Parliamentary Select Committee on the Role of Historic Buildings in Urban Regeneration (2004) highlights that there is substantial evidence that commercial schemes which reuse historic buildings have a higher value than new-build developments and can form the basis for regenerating a local economy. The Committee also points out that there are numerous examples of the successful regeneration of many towns and cities through the search of new uses for their historic buildings. The historic environment plays an important role in creating jobs, attracting tourists, and supporting small businesses. Buildings in industrial areas act as incubators for small businesses especially in growing sectors of the economy (House of Commons ODPM, 2004). The Civic Trust points out that there is a great positive contribution which improving the historic fabric of areas plays in restoring local confidence as well (House of Commons ODPM, 2004). Power (2013) identified dominant strands of action which cities she analysed (Sheffield, Belfast, Leipzig, Bilbao, Turin, Lille, and Saint-Étienne) adopted to reinstate progress. Among these are:

- Land reclamation and environmental upgrading – Regeneration strategies focused on city’s damaged but potentially viable industrial assets, i.e. contaminated disused industrial land, former mines, redundant steel works, gas works, mills and warehouses. In order to turn polluted and abandoned sites into safe, attractive and usable assets, major public resources, often directed into partnership bodies, are required.
- Physical redesign and restoration of major landmarks – Through this process, civic buildings belonging to former industrial era, i.e. old town halls, theatres, civic halls, public squares, closed-down department stores, factories and warehouses, are given new uses. Reactivation and adaptation of these buildings has become a central theme of regeneration strategies of numerous cities.

During this and the past decade the regeneration of industrial sites represented a central theme of the most important international documents (AGENDA 21, Lisbon Strategy, Aarhus Convention, RESCUE, CABERNET, JESSICA), and this especially refers to the experience in North America (US, Canada) and Western Europe (Perić, 2013). Moreover, Power (2013) highlights that, industrial buildings had a central role in the regeneration schemes. Namely, some of the flagship projects in Bilbao were: Guggenheim Museum on *Abandoibarra* site; waterfront mixed-use redevelopment scheme; revived metro system designed by Norman Foster and further infrastructural projects by renowned architects; upgrading and expansion of metropolitan public transport system; and, refurbishment of its historic old quarter. Power (2013) explains that the flagship initiatives had far-reaching consequences in setting the pace for recovery. According to the same source, the chain effects are not yet fully understood, but urbanists now commonly refer to the ‘Guggenheim effect’ (Bilbao), the ‘Peace dividend’ (Belfast), the ‘Heritage dividend’ (Torino), ‘Industrial heritage’ (Sheffield). All cities analysed, as a result, now seek to reuse their land and

buildings, realising the value of their earlier, often seriously devalued industrial legacies (Power, 2013).

Furthermore, Stratton (2000) underlines that in a great number of cities the industrial heritage seems to be a key to unlocking their potential in both economics and culture. He gives an example of Manchester, Britain's first industrial city according to Friedrich Engels, which recognized the architectural potential of its industrial heritage and then discovered a means to turn this inheritance to good value. Restoration of Liverpool Road Station for the Museum of Science and Industry and the restoration of the Central Railway Station as a major exhibition centre-G-Mex were some of the projects that lead the regeneration of the city (Stratton, 2000). Preite (2013) explains that during the 1990s, a new perception of manufacturing buildings and mills emerged, and industrial sites ceased to be obstacles, and began to be seen as opportunities to be exploited, in order to increase the quality and value of projects. Thus, the industrial heritage became a resource in the regeneration of towns and cities. Preite (2013) highlights that the rehabilitation of the industrial heritage has played a fundamental role in the creation of a new urban landscape. Restored industrial building and industrial areas that have been transformed can develop an enormous cachet, as many examples like warehouses converted to flats in London's docklands and in Liverpool's Albert Dock have shown (Binney et al., 1990). According to Stratton (2000: 127) industrial and science museums, located in run-down industrial and dockside areas, "have evolved to be at the forefront of innovative interpretation and, in some cases, to act as agents of inner-city regeneration". Reutilization of industrial buildings secures long-term opportunities that connect directly to the development and redevelopment of the cities which are at the centre of our economic life (Kincaid, 2002). This process should become central to the renewal and change of cities as is the process of creating new buildings (Kincaid, 2002). Thus, industrial buildings offer a key opportunity for urban regeneration on a very large scale (Binney et al., 1990).

3.1.2. Identity: social significance

Industrial buildings are important local landmarks and bearers or identity of neighbourhoods and towns. Mommaas and Van Boom (2010) highlight that textile factories required space, water, energy, a transport infrastructure for the supply and despatch of goods and people, labour, accommodation and services for the growing community of workers. According to the same source, depending on the phase in which these textile concerns were established (from the water-powered mills of the seventeenth century to the steam-power factories of the nineteenth century), and the spatial context in which this occurred, they exerted an emphatic influence on the design of urban morphology. Mommaas and Van Boom (2010) explain that factories were responsible for the creation

of new and impressive urban identity by the introduction of new language of form. This new language was “sometimes an extension of the traditional, constructed and natural morphology, and sometimes a departure in an entirely different direction” (Mommaas & van Boom, 2010: 42). The concentration of technology, people and infrastructure in factory buildings affected the scale of factory complexes, cities and surrounding regions as well, which consequently lead to a major displacement of people and unprecedented spatial expansion (Mommaas & van Boom, 2010). This phenomenon caused, in some occasions, “rupturing and expansion of the traditional spatial hierarchy beyond the city walls and often far into the countryside, in a prefiguration of later urban sprawl”, and in others “an impressive infilling and knitting together of widely distributed rural communities to form the kind of urban settlement which still gives rise to many spatial ambivalences even today” (Mommaas & van Boom, 2010: 42). The importance of the industrial buildings was also recognized by Louis Mumford. Namely, large structures built for industrial societies in the early stages of their development were icons of the ‘paleotechnical’ paradise of an industrial city (Mumford, 1982). Mumford uses the term ‘paleotechnical’ to explain great urban changes created with the industrialization and the transition from a rural to an industrial culture. According to Binney, Powell and Machin (1990), industrial buildings have an impressive monumentality, sophistication and finesse that can be compared to the best public buildings. Industrial buildings are valuable in several ways: they may be important local landmark, simply by the virtue of their size; they have distinctive architectural features, from the Venetian windows to great ornamental towers and chimneys; they are often very well built; and they are usually very well proportioned with a satisfying rhythm of windows echoed over five storeys or more (Binney, Powell & Machin, 1990).

Explaining the social benefits of heritage, Graham and Howard (2008) refer to David Lowenthal’s four traits of the past: antiquity – conveys the respect and status of antecedence, and underpins the idea of continuity and its essentially modernist ethos of progressive, evolutionary social development; connection between the present and the past – represents an unbroken trajectory, established by certain artefacts in emblematic landscapes created by societies; a sense of termination – reminds us that what happened in the past has ended; sequence – allows us to locate our lives in linear narratives that connect past, present and future. These traits provide familiarity and guidance, enrichment and escape, and “a point of validation or legitimation for the present in which actions and policies are justified by continuing references to representations and narratives of the past that are, at least in part, encapsulated through manifestations of tangible and intangible heritage” (Graham & Howard, 2008: 6). Historic buildings lend character to an area and have deep-seated associations for local residents and communities (House of Commons ODPM, 2004). Godwin (2011) also highlights that local distinctiveness and character is what makes places

special and, by association, their people too. The growing realization of the importance of the industrial architecture consequently lead to the emergence of the ‘industrial heritage’ concept and to the interest in its preservation. Loures and Burley (2012: 226) point out that “significant efforts have been developed in order to define the meaning and the scope of industrial heritage, establishing chronologic parameters and performing several studies, with the objective to define what to preserve and why to preserve it”. According to the same source, the concept of industrial heritage is applicable to every type of industrial activity and to every material or immaterial element created by the industrial society.

Loures and Burley (2012: 226) underline that even though industrial heritage was given a ‘formal’ document regarding its protection in the Nizhny Tagil Charter in 2003, followed by the Monterrey Charter, “some of the principles enounced in several other international charters and conferences, supported by the Council of Europe (COE), the International Council on Monuments and Sites (ICOMOS) and United Nations Educational, Scientific and Cultural Organization (UNESCO) included somehow the protection of industrial buildings and landscapes”. This inclusion of industrial buildings in the above mentioned charters and conferences can be viewed in the Figure 3.1. According to the same source, the list of World Heritage Sites contains today 890 world heritage properties (689 cultural, 176 natural and 25 mixed) considered as having outstanding universal value by the World Heritage Committee, of which over 60 relate to old industry. Loures and Burley (2012: 228) are stressing that landscape architects, architects, designers and other planning professionals, when analysing and re-developing industrial sites, “need to realise that post-industrial, typically part of ordinary or vernacular landscapes, incorporate the passage of time, representing multiple layers of time and cultural activity therefore being part of the identity of a people and a place”. ICOMOS and the International Committee for the Conservation of the Industrial Heritage (TICCIH) explain that human activities of industrial extraction and production can be seen in a great number of sites, structures, complexes, cities, areas, landscapes and routes. ICOMOS and TICCIH point out that this heritage can be active and still in use, but also only as an archaeological evidence of past activities and technologies. Industrial heritage implies not only the “tangible heritage associated with industrial technology and processes, engineering, architecture and town-planning”, it also includes “many intangible dimensions embodied in the skills, memories and social life of workers and their communities” (ICOMOS, XVII Assemblée Générale, 2011: 1).

1964	Venice Charter - International Charter for the Conservation and Restoration of Monuments and Sites, ICOMOS	States on article 1 that: <i>the concept of an historic monument embraces not only the single architectural work but also the urban or rural setting in which is found the evidence of a particular civilization, a significant development or an historic event, This applies not only to great works of art but also to more modest works of the past which have acquired cultural significance with the passing of time.</i>
1972	Paris Convention Concerning the Protection of the World Cultural and Natural Heritage, UNESCO	States on the 1st article of the DEFINITION OF THE CULTURAL AND NATURAL HERITAGE chapter that shall be considered as 'cultural heritage': <i>Groups of buildings: groups of separate or connected buildings which, because of their architecture, their homogeneity or their place in the landscape, are of outstanding universal value from the point of view of history, art or science;</i> <i>Sites: works of man or the combined works of nature and men, and areas including archaeological sites which are of outstanding universal value from the historical, aesthetic, ethnological or anthropological point of view.</i>
1975	European Charter of the Architectural Heritage, COE	States on the article 1 that: <i>the European architectural heritage consists not only of our most important monuments: it also includes the groups of lesser buildings in our old towns and characteristic villages in their natural or manmade settlements.</i> <i>(...) Today it is recognized that entire groups of buildings, even if they do not include any example of outstanding merit, may have an atmosphere that gives them the quality of works of art, welding different periods and styles into a harmonious wholes. Such groups should also be preserved. The architectural heritage is an expression of history and helps us to understand the relevance of the past to contemporary life.</i>
1976	Recommendation concerning the Safeguarding and Contemporary Role of Historic Areas, UNESCO	States on the 1st article of the DEFINITIONS chapter that: <i>(a) 'Historic and architectural (including vernacular) areas' shall be taken to mean any groups of buildings, structures and open spaces including archaeological and paleontological sites, constituting human settlements in an urban or rural environment, the cohesion and value of which, from the archaeological, architectural, prehistoric, historic, aesthetic or sociocultural point of view are recognized.</i>
1980	The Burra Charter, ICOMOS	States on article 1 that: <i>Cultural significance means aesthetic, historic, scientific, or social value for past, present, or future generations.</i>
1987	Charter on the Conservation of Historic Towns and Urban Areas, ICOMOS	States in the 2nd article of the PRINCIPLES AND OBJECTIVES chapter that: <i>qualities to be preserved include the historic character of the town or urban area and all those material and spiritual elements that express this character; especially: a) Urban patterns as defined by lots and streets; b) Relationship between buildings and green and open spaces; c) the formal appearance, interior and exterior, of the buildings as defined by scale, size, style, construction, materials, color and decoration; d) The relationship between the town or urban area and its surrounding setting, both natural and man-made; and e) The various functions that the town or urban area has acquired over time.</i>
2000	Charter of Krakow - Principles for Conservation and Restoration of built Heritages, International Conference on Conservation	States in the preamble that: <i>each community, by means of its collective memory and consciousness of its past, is responsible for the identification as well as the management of its heritage. This cannot be defines in a fixed way. One can only define the way in which the heritage may be identified. Plurality in society entails a great diversity in heritage concepts as conceived by the entire community. The monuments, as individual elements of this heritage, are beavers of values, which may change in time. This variability of the individual values of monuments constitutes each time the specificity of the heritage. From this process of change, each community develops an awareness and consciousness of the need to look after the individual built elements as bearers of their own common heritage values.</i>
2003	Nizhny Tagil Charter for the Industrial Heritage, ICOMOS	
2006	Monterrey Charter for Industrial heritage Conservation, ICOMOS	

Figure 3.1.
International charters
and conferences
regarding heritage
and historic matters
(Source: Loures, 2011)

ICOMOS and TICCIH highlight that industrial heritage is particularly important and critical to the Modern World considering that the global process of industrialisation constitutes a major stage of human history. ICOMOS states that “the industrial heritage consists of sites, structures, complexes, areas and landscapes as well as the related machinery, objects or documents that provide evidence of past or ongoing industrial processes of production, the extraction of raw materials, their transformation into goods, and the related energy and transport infrastructures” (ICOMOS, XVII Assemblée Générale, 2011: 2-3). According to the same source, the profound connection between the cultural and natural environment is reflected in the industrial heritage, which “includes both material assets – immovable and movable – intangible dimensions such as technical know-how, the organisation of work and workers, and the complex social and cultural legacy that shaped the life of communities and brought major organizational changes to entire societies and the world in general” (ICOMOS, XVII Assemblée Générale, 2011:2-3). Stratton and Trinder (1997) argue that industrial buildings can be viewed in several contexts: as architecture, as one development in the history of construction, or as an indication of how production has been organized at different periods. They argue that it can be also seen “as a reflection of how accommodation has been organized to cater for human needs, for working-space, for power, for heating, lighting and sanitation, and for access” (Stratton & Trinder, 1997: 26). TICCIH highlights that the material evidence of the profound changes, induced by the industrial revolution, is of universal human value, and the importance of the study and conservation of this evidence must be recognised. According to Pearce (1989), since 1975 a new concept of conservation has emerged, which treated buildings as documents of social history and as evidence of the way of life of people.

The social importance of the industrial architecture and its role in the preservation of the identity of the place was recognized by the local community in many occasions. The 22@ project in Barcelona aimed at transforming the old industrial area of *Poblenou* has triggered the local community who fought for the preservation of the industrial identity of the neighbourhood. The letter written by the local community directed to the president of the Catalan governments states:

“Barcelona, proud of its present, seems to have forgotten its origins, with risk of endangering its future. The metropolis of today, is inheriting the industrial world: without the factories, on which is constructed our modernity, not the economic raise, nor the modernism or the capacity to lay the foundations - in secrecy antifrancoist - of a society able to respond to the new challenges on a positive way. Recovering the democracy, the re-use of many manufacturing spaces can contributed decisively to the urban renovation. Nowadays, there is the risk of ending up with a ‘tabula rasa’ of the industrial landscapes of more interest than the city has left, in damage of their own renovation: the city of knowledge cannot become a banalized city. (...)” (“A metropolis without history, a country without identity” by Fòrum de la Ribera del Besòs, April 14, 2005)

The same attitude towards the preservation of the industrial past was expressed in one of the manifests of the community:

“Today, neighbours of *Poblenou*, we return to go out to show our rejection and indignation towards the set of aggressions that are taking against the social weave, the historical patrimony and the identity of our district. The necessary modernization of the city cannot be done against the citizens. The present city-planning policy is very questionable and there is not a true industrial policy neither of cultural patrimony. Financiers, constructors, real estate, with the support of the administrations, are planning our future having exclusively in account their own economic interests, while they ignore the opinion and the necessities of the district and the city.” (Out of the Manifest “*Defensem Poblenou, salvem Can Ricart*”, April 28, 2005)

The demands of the local community resulted in the changes of the general plan, which was rewritten jointly by 22@Barcelona and the Barcelona City Council, in accordance with the Industrial Heritage Protection Plan. The importance of the city’s industrial past, as an element which influenced the most the definition of urban spaces, particularly in Poblenou, has been recognized, and led to the modification of the “Barcelona’s Catalogue of Heritage Sites - Modification of the Special Plan for Historical/Artistic Architectural Heritage” in the city of Barcelona. The new 22@Barcelona plan conserves 114 elements of architectural interest. The 22@Barcelona model was promoted as a diverse urban model, where new buildings and public spaces coexist with traces of history and elements representing the neighbourhood’s industrial past.

Cossons (2008) explains that from the 1960s buildings and structures of the industrial revolution period deserved protection in the same manner as those of a pre-industrial date. The author highlights that this recognition came quickly, in response to growing public interest. Cossons (2013: 13) underlines that “across much of Europe, the industrial heritage now takes its place as an acknowledged and valued part of the wider historic landscape, in many cases enjoying legislative protection and enthusiastic public support”. According to the same source, industrial heritage is being seen today as a symbol of national identity. Stratton (2000: 123) argues that industrial museums, a new breed of museums whose appearance was triggered by cultural tourism in 1960s and 1970s, and “decline of traditional industries such as coalmining, ironfounding and textile production”, can give an identity to towns. According to the same source, “mines, factories and mills became a source of public nostalgia, admiration for the energies of miners and potters and the close-knit communities in which they lived out-weighing associations of hard graft and danger” (Stratton, 2000: 123). Hence, the industrial architecture can undoubtedly define the character of a community and provide people with a sense of belonging.

3.1.3. Innovation: architectural importance

Throughout the nineteenth and the twentieth century architecture theorists expressed opposing views towards industrial architecture. Rogić (2009) explains that Heinrich Hübsch, nineteenth century German architect and theorist, neither designed industrial buildings nor considered them worth the architectural discussion. Hübsch (1847) exclaimed that “instead of the monumental churches, the sleek industrial halls built of cast iron will become the architectural prototype – painted in shiny, fashionable colours and appointed with the pseudomonumental, dazzling shine of mirrors and gold-fringed velvet curtains to attract the haute volée” (as cited in Rogić, 2009: 73). Rogić (2009) points out that Hübsch’s attitude towards industrial buildings is obvious, given that he was against the developmental approach to the new style emerging from the structural and decorative use of new materials. More precisely, Hübsch would “regard the stripped (of decoration) facades with large mirror-like windows and hall-like spaces of industrial buildings, resulting from the structural capabilities of iron, as the physical embodiment of the line of thought that he was opposed to” (Rogić, 2009: 73). According to the same source, the eighteenth century architectural theorists regarded industrial buildings as unworthy of any architectural decoration. Blondel (1771) in his “*Cours d’architecture*” states that manufacture should look simple and solid, but according to Milizia (1785) it should look simple but proud, as stated in his “*Principi de architettura civile*” (Pevsner, 1976). Rogić (2009) argues that this comment indicates a change in the architectural appreciation of industrial buildings.

Industrial buildings were not built in Central European countries in so large a number as in England, in the first half of the nineteenth century (Rogić, 2009). Schinkel travelled to England in 1826 with Beuth, “a high civil servant in the Prussian Board of Finance and a great promoter of Prussian trades”, where he was impressed by the multitude of factories and their chimneys (Pevsner, 1976: 277). This image made a strong impression on Schinkel, which can be observed in his sketch made on this journey (Figure 3.2.), and his comment: “factories everywhere, pretty villas of manufacturers” (Pevsner, 1976: 277).

Beuth’s observations, on his previous visit to England in 1823, confirm the scarcity of this type of building in Germany in the 1820s (Rogić, 2009). Impressed by the industrial

buildings, Beuth wrote to Schinkel: “The miracles of the new age are the machines and the buildings for it called factories” (Pevsner, 1976: 277). Schinkel’s design of the Bauakademie in Berlin (Figure 3.3.) expresses

Figure 3.2.
K.F. Schinkel,
sketch of mills in
Manchester, 1826
(Source: Pevsner,
1976)



clearly the influence of the trip to England on his architecture (Rogić, 2009). In this building, all Modernist ideas, especially the one of functionalism, were architecturally expressed for the first time (Pevsner, 1966).

According to Rogić (2009), industrial buildings brought two important changes. First, industrial buildings were the product of the collaboration

between the engineers and architects. Second, these buildings were used as a testing field for structural and material innovations. Rogić (2009) underlines that industrial buildings were mainly designed by the newly emerged profession of the engineer-architect who worked in collaboration with the architect. The collaboration between these two professions was achieved through the division of work: “spatial planning and formal elaboration were the architect’s tasks, while the work on the structure, considered in relation to the spatial and formal, were the engineer-architect’s task” (Rogić, 2009: 76-7). Thus, it is not strange why Le Corbusier acknowledged industrial building as ‘buildings of a particular aesthetics’, considering his appreciation of the work of engineers (Figure 3.4.). Le Corbusier (1931: 29) explains that “architecture is the masterly, correct and magnificent play of masses brought together in light”. He stresses that cubes, cones, spheres, cylinders or pyramids are the great primary forms. The reason why he considers these forms beautiful is because “the image of these is distinct and tangible within us and without ambiguity”, thus these forms can be clearly appreciated (Le Corbusier, 1931: 29). For that reason Le Corbusier considered Egyptian, Greek or Roman architecture a beautiful one, as this is “the architecture of prisms, cubes and cylinders, pyramids or spheres: the Pyramids, the Temple of Luxor, the Parthenon, the Coliseum, the Hadrian’s Villa” (Le Corbusier, 1931: 29). For that same reason he considered cathedral a “not a very beautiful” because it “is not, fundamentally, based on spheres, cones and cylinders” (Le Corbusier, 1931: 30). Le Corbusier (1931: 23)

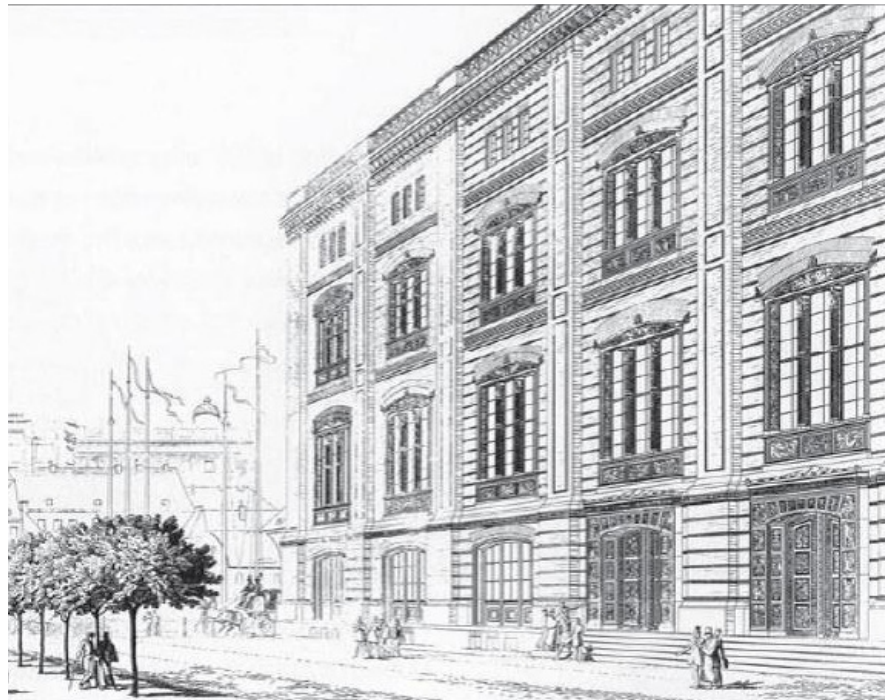


Figure 3.3.
Schinkel's
Bauakademie, Berlin,
1836
(Source: Rogić, 2009)

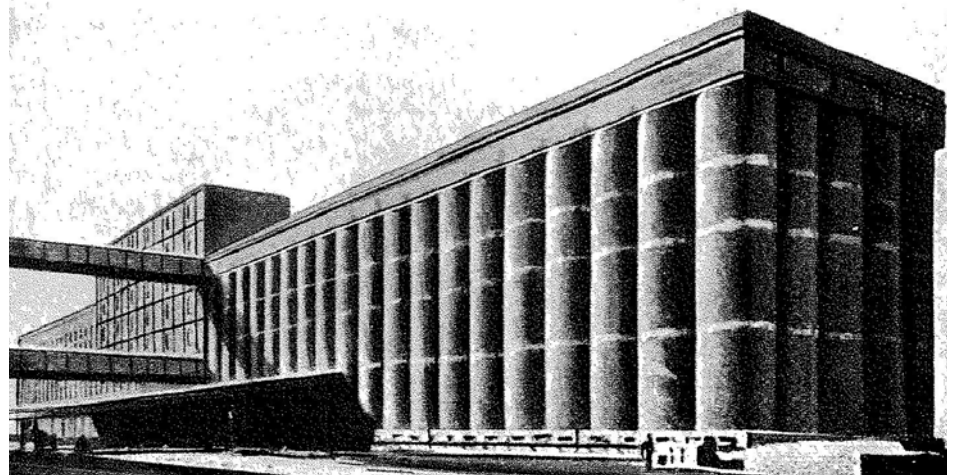
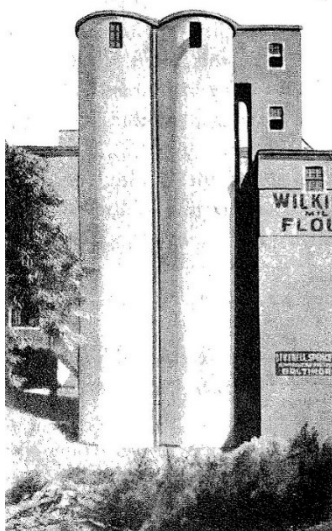


Figure 3.4.
Grain elevator and
store
(Source: Le Corbusier,
1931)

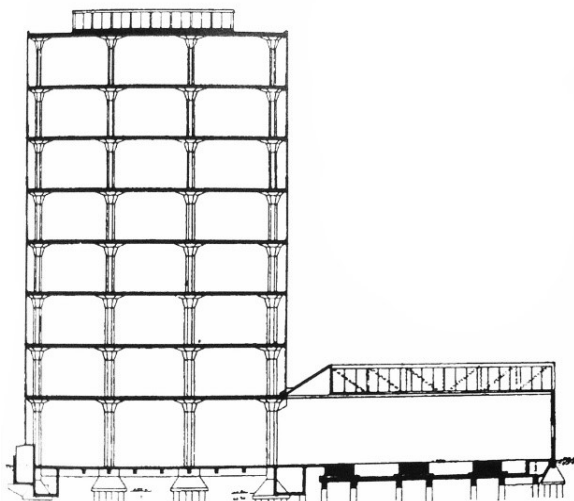
praises the work of engineers because they employ these primary forms “satisfying our eyes by their geometry and our understanding by their mathematics”. He points out that:

“Guided by the results of calculation (derived from the principles which govern our universe) and the conception of A LIVING ORGANIZM, the ENGINEERS of to-day make use of the primary elements and, by co-ordinating them in accordance with the rules, provoke in us architectural emotions and thus make the work of man ring in unison with universal order” (Le Corbusier, 1931:31).

Therefore, Le Corbusier (1931:31) considered American grain elevators and factories “the magnificent first-fruits of the new age”. For Le Corbusier the ‘Engineer’s Aesthetic’ and ‘Architecture’ are “two things that march together and follow one from the other – the one at its full height, the other in an unhappy state of retrogression” (Le Corbusier, 1931: 11). According to the same source, the engineer achieves harmony by respecting the laws of economy and using mathematical calculations, while the architect creates an order through the arrangements of forms which affect our senses and provoke emotions, allowing us to experience the sense of beauty. Just like Le Corbusier and Paul Philippe Cret, Albert Kahn believed that engineers play a unique role in the development of the architectural form (Frampton, 2005). Frampton (1982) argues that Le Corbusier saw a confirmation of his utopian socialist convictions in an open and dynamic expression of the Van Nelle Factory (Figure 3.5). On the Factory, completed in 1929, “the structure and the movement systems were explicitly revealed”, and the prime movers were “glazed conveyors, running diagonally between the curtain-walled packing block and the canal warehouse” (Frampton, 1982: 134). Le Corbusier expressed his admiration to Van Nelle Factory, its materiality, bright glass and grey metal which rise up against the sky, its openness to the outside, creating good work conditions in all eight floors, and its promotion of the feeling for collective action and personal participation in every stage of the human enterprise (Frampton, 1982).

Figure 3.5.
Van Nelle Factory,
Rotterdam, 1927-29,
transversal section
showing concrete
mushroom column
construction, and
exterior
(Source: Frampton,
1982)

Rogić (2009) highlights that Le Corbusier’s promotion of the form of industrial buildings as buildings of a particular aesthetics, contained in his Modernist manifesto “*Vers Une Architecture*”, was probably what influenced most the inclusion of industrial buildings into the list of historical influences over the definition of Modernist aesthetics. She highlights that it is “common architectural knowledge that industrial buildings were the ones to



influence most the aesthetics of the architecture of the Modern Movement; the exposed structural system being one of its aesthetic premises” (Rogić, 2009: 78). Rogić (2009) also mentions that there are two branches of influences on Modernism. One branch are Russian industrial buildings introduced to architecture through Russian constructivists and the other includes Le Corbusier’s industrial buildings made in the United States (Rogić, 2009). On the other hand, industrial building bore the most advanced structural achievements (Rogić, 2009). Banham (1986) explains that the grain elevators were an inspiration to modern architects in Europe. Banham, Gropius, Le Corbusier and Mendelson were all impressed with the form of industrial buildings (Rogić, 2009). In his “A Concrete Atlantis” Banham (1986) praises industrial buildings as buildings which pioneered structural innovations. He considers Larkin R/S/T building (Figure 3.6.) a grand building because:

“(…)everywhere one looks there is evidence of great care and ingenuity in dealing with edges and corners, junctions and relationships of materials, and the proportioning of the whole. (...) It is totally self-assured design, as if architects had been designing in this mode for four centuries, instead of four years!” (as cited in Rogić, 2009: 79).

Banham (1986) also considered industrial buildings great buildings because they show ‘obedience to the laws’. Rogić (2009: 79) highlights that Banham’s “A Concrete Atlantis” is the first and one of the very few books which “treats industrial buildings as Architecture, evaluating their architectural merits in their own right”. On the other hand, industrial buildings were testing fields for experimentation with new materials. Public or cultural buildings could not be subjected to these experimentation because of existing building regulations and slow public acceptance of new material (Collins, 1959). After the collapse of the early concrete structures used for dwellings in Paris, the public became suspicious towards the technological capabilities of the new materials and was also questioning the aesthetics of the bare steel or reinforced concrete structures (Rogić, 2009). According to Sir Owen Williams, reinforced concrete should never be used for monumental buildings, as this material is associated with the production of cheap buildings (Rogić, 2009). Hence, nineteenth century engineers and architects could not conduct their experiments, regarding the use of new materials in buildings, on cultural or public buildings and housing, due to legal and cultural obstacles (Rogić, 2009). On the other hand only cultural and public building and dwellings were subjected to these laws.



Figure 3.6.
Larkin R/S/T building
(Source: Banham,
1986)

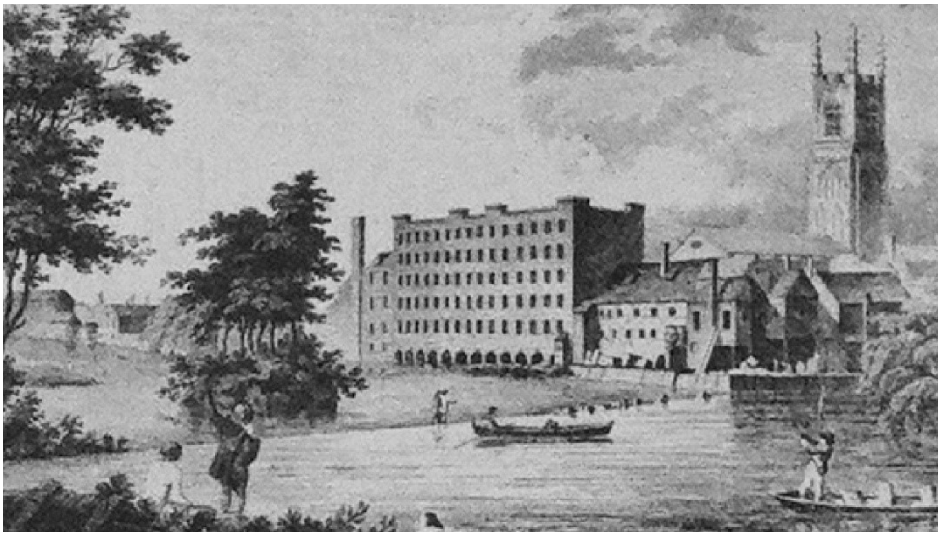


Figure 3.7.
Lumbe's silk mill,
Derby, 1717
(Source: Pevsner,
1976)

Given the fact that the industrial buildings were subject to different or no building regulations at all, structural experiments could be carried out on these building types (Collins, 1959). Pevsner

(1976) explains that one of the earliest and most important mill was Lumbe's silk mill at Derby (Figure 3.7), which was 119 feet long and five storeys high and had the water-wheel with a 23feet diameter. According to the same source, the mill in Derby is the most important "for it stands at the beginning of a series of Derbyshire mills which were for a few decades the structurally most advanced buildings in the world" (Pevsner, 1976: 275).

For Pevsner (1976) the most important innovations and inventions that made industrial progress possible are: 1709 Abraham Darby's coke instead of wood for smelting; 1733 J. Kay's fly-shuttle; 1746 Benjamin Huntsman's crucible process for melting steel; 1760 R. Kay's shuttle drop box; 1764-67 Hargreaves' spinning jenny; 1765 Watt's condenser for steam engines; 1769-75 Arkwright's water frame; 1774-79 Crompton's spinning mule; 1775-81 the Coalbrookdale Bridge, the earliest of all iron bridges, designed by T. F. Pritchard and cast by Abraham Darby; 1781 Watt's steam boiler; 1783 Cort's puddling; 1785 Cartwright's power loom and 1799 Jacquard's loom. Pevsner (1976: 275-6) highlights that these innovations were responsible for the unprecedented industrial progress which can be viewed in the fact that "in 1765 England's output of coal was about 5 million tons, [and] in 1785 over 10" and that "in 1813 England had 2,000 power looms, in 1829 45,000 [and] in 1835 about 250,000". Iron and steel frames allowed the avoidance of the load-bearing walls by carrying the skeleton right into the façade, allowing an iron beam to carry only the weight of one floor (Pevsner, 1976). Pevsner (1976) highlights that the reinforced concrete was made a practical proposition by François Hennebique. According to the same source, Albert Kahn was the most important specialist in concrete factory design. Collins (1959) explains that Kahn and Hennebique first tested their reinforced concrete frame structures on factory buildings.

According to Pevsner (1976: 288), the most "serious and yet appropriate architecture for factories" has been made in Germany. Representatives in this area are the two masterpieces: Peter Behrens's turbine factory for the AEG in Berlin and the Walter Gropius's shoe-last factory (Fagus Werk) at Alfeid (Pevsner, 1976). "The former aspires to monumentality without the slightest touch of academic historicism, the latter started the International Modern with its beautifully proportioned glass wall" (Pevsner, 1976: 288). Banham (1978: 79) points out that the Fagus Werk (1911-1913) (Figure 3.8.), designed by Gropius and




Figure 3.8.
Fagus Werk, Alfeld on
the Leine, Germany
(Source: Fagus
Factory, 2014)

Mayer is “frequently taken to be the first building of the Modern Movement properly so-called, the end of the pioneering phase in Modern architecture”. According to the same source, the glazed blocks, with their windows rising continuously through three stories, are the major innovations. With this building, which was few decades ahead of the usual projects of industrial buildings and which pioneered the use of curtain wall and large glazed surfaces, Gropius gained good reputation and established himself in the architectural profession.

At the symposium on factory design in the *Werkbund Jahrbuch* for 1913, Hermann Muthesius states that “a good deal of engineering structures, bridges, station halls, lighthouses and grain silos, are good aesthetically” (Banham, 1978: 80). Industrial architecture, its forms and aesthetics influenced greatly the direction of the early modern movement and inspired the imagination of artists and architects, “from the voice against ornament by Adolf Loos to the design explorations of the Bauhaus and the sleek lines of the International Style to the explicit expression of construction elements in the work of Richard Rogers and his partners” (Jevremović, Vasić & Jordanović, 2012). Cantell (2005) explains that many industrial buildings are significant primarily for their architecture, as vernacular relics from the industrial age, and as works of prominent early twentieth-century architects, such as Albert Kahn. The above analysed architectural theorists’ views on industrial architecture are summarised in the Figure 3.9.


Figure 3.9.
Industrial
architecture,
criticized and
praised



Le Corbusier
1931

“industrial buildings - buildings of a particular aesthetics”

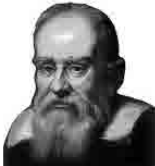
Vers Une Architecture



Peter Christian Beuth
1824

“the miracles of the new age are the machines and the buildings for it called factories.”


Schinkel and Industrial Architecture



Jean-François Blondel
1771

“manufacture should look simple and solid”


Cours d’architecture



Peter Reyner Banham
1986

“Industrial buildings in the United States are simply great buildings and monuments in their own right, because they show obedience to the Laws.”

A Concrete Atlantis



Heinrich Hübsch
1847

“Instead of the monumental churches, the sleek industrial halls built of cast iron will become the architectural prototype-painted in shiny, fashionable colours and appointed with the pseudomonumental, dazzling shine of mirrors and gold-fringed velvet curtains to attract the haute volée.”

In What Style Should We Build?



Francesco Milizia
1785

“simple but proud”

Principi di architettura civile

3.1.4. Inspiration: industrial aesthetics

The appreciation and admiration for ruins is directly related to the notion of the continuity, memory, authenticity and identity. The specific aesthetic of an underused, dilapidated industrial building (Figure 3.10.), i.e. industrial ruin, has been inspiring writers, photographers, architects and artists to explore its potential and hidden values in their work. Its aesthetic has been associated to the broader concepts of ‘nostalgia’, ‘aesthetic of decay’, i.e. the inherent beauty of abandoned architecture that lost its purpose, and the ‘*terrain vague*’.

Huyssen (2006) explains that architectural ruins are especially powerful triggers for nostalgia, i.e. the feeling of longing for something far away or long ago. Ruins produce both temporal and spatial desires which generate nostalgia, given that they present the past still present in its residues but no longer accessible (Huyssen, 2006). Huyssen (2006: 13) points out that “in the ruin, history appears spatialized and built space temporalized”. Further, the reason we are nostalgic for the ruins of modernity is because they still hold “the promise of an alternative future, the promise which has disappeared from our own age” (Huyssen, 2006: 8). According to the same source, the notion of ruin has changed and metamorphosed when the nostalgic lure of the eighteenth century ruins was eliminated by the use of Roman ruins as scenes for open-air opera performances (*Terme di Caracalla* in Rome), medieval castle ruins for conference sites, hotels, or vacation rentals (*Paradores* of Spain, the Landmark Trust in the United Kingdom) or industrial ruins for cultural centres and museums (Tate Modern in London). Huyssen (2006) refers to ruins as ‘secret classicism of modernism’, which privileged montage, dispersion and fragmentation, contrary to classicism in Winckelmann and Goethe’s times which was developed through the ruins of antiquity while aiming at the totality of style. Huyssen (2006) highlights that for Piranesi the height of authentic architecture were the monumental Roman temples,

Figure 3.10.
Aaron Asis. Fisher
Body Plant, Detroit,
Michigan
(Source: Asis, 2012)



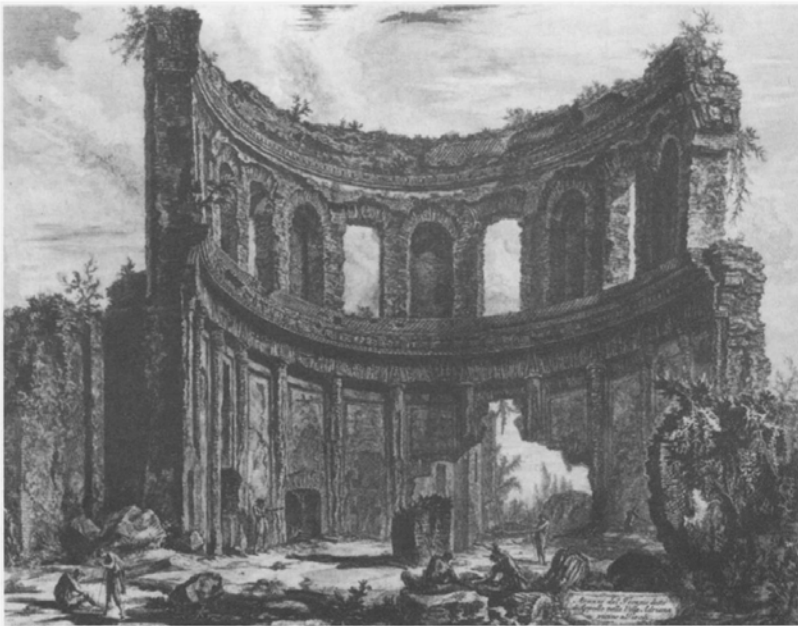


Figure 3.11.
Giovanni Battista
Piranesi. Hadrian's
Villa, Vedute di
Roma, 1768.
(Source: Huyssen,
2006)

palaces, triumphal arches, and tombs of the Via Appia, which he captured in his many volumes of etchings. In these graphics (Figure 3.11.) the ruins, even in decay, were represented as monumental and impressive objects.

Edensor (2005) points out that ruins contain the promise of the unexpected. As the original use of these buildings has passed, their

curious spaces allow imaginative interpretations and are “ripe with transgressive and transcendent possibilities” (Edensor, 2005: 4). According to the same source, “ruins offer spaces in which the interpretation and practice of the city becomes liberated from the everyday constraints which determine what should be done and where, and which encode the city with meanings” (Edensor, 2005: 4). The author explains that ruins epitomise transgression and the collapse of boundaries and disintegration of the ordered. Namely, “while ruins always constitute an allegorical embodiment of a past, while they perform a physical remembering of that which has vanished, they also gesture towards the present and the future as temporal frames which can be read as both dystopian and utopian, and they help to conjure up critiques of present arrangements and potential future” (Edensor, 2005:15). The author points out that “the disciplinary, performative, aestheticized urban praxis demanded by commercial and bureaucratic regimes which are refashioning cities into realms of surveillance, consumption, and dwelling – characterised by an increase in single-purpose spaces – is becoming too dominant” (Edensor, 2005: 17). For that reason Edensor (2005) praises ruins for their ability to violate these orderings. Ruins as ‘chaotic spaces’ produce a stark contrast to ‘controlled spaces’; these spaces challenge the normative, established and standard spacing of things, practices and people, exceed the boundaries between outside and inside, and offer alternative to how and where things should be situated and used. Edensor (2005: 19) points out that “the contingent, ineffable, unrepresentable, uncoded, sensual, heterogeneous possibilities of contemporary cities are particularly evident in their industrial ruins”.

Sola-Morales (1995: 119) used French expression ‘*terrain vague*’ to define “empty, abandoned spaces in which a series of occurrences have taken place”. Due to the lack of the adequate translation into English, Sola-Morales (1995) explores the etymology of the French expression. He explains that unlike the English word ‘land’, the term *terrain* implies a more urban quality, and is greater and less precisely defined while the term *vague* refers to empty, unoccupied, vacant, but also free and available. Sola-Morales (1995: 120) points out that “the relationship between the absence of use, of activity, and the sense of

freedom, of expectancy, is fundamental to understanding the evocative potential of the city's *terrains vagues*". The author refers to these spaces as places of promise, possibilities and expectation but also imprecision and uncertainty. Though the eyes of the urban photographers, from John Davies to David Plowden, Thomas Struth to Jannes Linders, Manolo Laguillo to Olivio Barbieri, these spaces, which are internal to the city yet external to its everyday use, have been captured (Sola-Morales, 1995). These peculiar spaces, in which the memory of the past overpowers the present, "industrial areas, railway stations, ports, unsafe residential neighbourhoods, and contaminated places" exit outside of the "city's effective circuits and productive structures". In other words, these spaces are "mentally exterior in the physical interior of the city" (Sola-Morales, 1995: 120). According to the same source, "the presence of power invites one to escape its totalizing presence; safety summons up the life of risk; sedentary comfort calls up shelterless nomadism; the utopian order calls to the indefiniteness of the *terrain vague*" (Sola-Morales, 1995: 121). The author argues that there is a strong link between these spaces in the interior of the city and the contemporary art. Filmmakers, sculptors of instantaneous performances, and photographers find inspiration in the "margins of the city precisely when the city offers them an abusive identity, a crushing homogeneity, a freedom under control" (Sola-Morales, 1995: 122). Architecture and urban projects, whose ultimate goal is the introduction of order, limits, form and identity "dissolve the uncontaminated magic of the obsolete in the realism of efficacy". Consequently, the author concludes that architecture should act in the *terrain vague* through the attention to continuity, "continuity of flows, the energies, the rhythms established by the passing of time and the loss of limits" (Sola-Morales, 1995: 122-123).

Architectural ruin was the exploration and experimentation field for Gordon Matta-Clark, a trained architect, who used neglected, derelict buildings slated for demolition, as his raw material. Like many artist in 1970s, Matta-Clark left the confined space of art gallery to work on the urban environment. These artists, just like Paris Situationsits, in 1968, made relocations or simply maps of their walks and saw their work as public intrusions or cuts in the seamless urban fabric (Graham, 1992). Influenced by the surrealist tradition, Matta-Clark celebrated the unconscious, the irrational in the urban environment (Attlee, 2007). Through these acts the induced habits of the urban masses were interrupted and concealed realities unrepressed (Graham, 1992). Instead of building with expensive materials, Matta-Clark makes architectural statement by removing, subtracting in order to reveal existing aspects of the ordinary buildings, reversing in that way the capitalist consumption of marketable material in the name of progress (Graham, 1992). Matta-Clark was "opening up structures to light and air and burrowing beneath the surface of the street to explore, photograph and film the catacombs, sewers and viaducts concealed there" (Attlee, 2007: 12). By carving out sections of buildings and using them as canvas for its art, the artist revealed their hidden elements and provided new ways of perceiving space. Matta-Clark's

work is popularly known as ‘building cuts’ – “sculptural transformations of abandoned buildings paradoxically constructed through the cutting and virtual dismantling of a given architectural site” (Lee, 1998: 65). Matta-Clark believed that his cuts can liberate areas from being hidden and thus open up socially hidden information beneath the surface (Graham, 1992). Explaining his work Matta-Clark points out:

“(…) breaking through the surface [to create] repercussions in terms of what else is imposed upon a cut it was kind of the thin edge of what was being seen that interested me as much, if not more than, the views that were being created the layering, the strata, the different things that are being served. Revealing how a uniform surface is established. The simplest was to create complexity without having to make or build anything” (as cited in Graham, 1992: 378).

Lee (2001) argues that “labyrinthine, vertiginous, and disorientating in their scale and projection, Matta-Clark’s building cuts interrogated the relationship between art and place at their very foundation” (Lee, 2001: 2). These cuts, usually in vernacular apartments or two-family houses, “reveal private integration of compartmentalized living space, revealing how each individual family copes with the imposed social structure of its container” (Graham, 1992: 379). According to Attlee (2007) Matta-Clark’s works can be seen as dramatic, gravity-defining walk-through sculptures.

Matta-Clark’s works have also been referred to as ‘building dissections’. In one of his well-known dissections, *Splitting* (1974), (Figure 3.12.), Matta-Clark applied a vertical cut which is conventionally used to produce an architectural section in orthographic drawing (Walker, 2004). By moving through the dissected building, through stories, and over the split, the visitor’s experience would change, challenging in this way the view of the form as a bearer of the absolute truth (Walker, 2004). Matta-Clark explains that in *Splitting* “what the cutting’s done is to make the space more articulated, but the identity of the building as a place, as an object, is strongly preserved, enhanced” (as cited in Graham, 1992: 379). The artist referred to his work as ‘anarchitecture’ (anarchy + architecture): “Most of the things that I have done that have ‘architectural’ implications are really about non-architecture ... anarchitecture...We were thinking about metaphoric voids, gaps, left-over spaces, places that were not developed ... metaphoric in the sense that their interest or value wasn’t in their possible use” (as cited in Walker, 2004: 115). In one of the art cards on which he drafted the

statements related to anarchitecture Matta-Clark wrote: “Anarchitecture working in several dimensions (sic)... keeping it an ongoing open process... not finishing, just keeping going and starting over and over” (as cited in Walker, 2004: 116).

Figure 3.12.
Gordon Matta-Clark.
Splitting. 1974.
(Source: Walker,
2004)



According to Graham (1992), Matta-Clark's most effective work was *Conical Intersect* (Figure 3.13.), in the Parisian district *Les Halles*, at that time under demolition for the erection of the *Centre Pompidou* and luxury housing. In this project a massive conical base of four meters on the diameter was cut out from two seventeenth-century twin townhouses, already slated for demolition (Graham, 1992). The cuts were oriented at a forty-five-degree angle from the street, thus enabling "pedestrians to peer up and through its telescope-like form, radically juxtaposing the ascension of one era's architecture at the expense of another's disintegration." (Lee, 1998: 71). The holes left by the removal of the conical cuts directed the attention of the people on the street and allowed them to look into the interior of the Matta-Clark's intervention, and beyond its interior as well, to other buildings (Graham, 1992). Matta-Clark's 'monument' alludes to the negative effect of progress which breaks the historical continuity between old and new Paris and, through its negative form, mimics both the *Centre Pompidou* and the *Tour Eiffel* (Graham, 1992).

Lee (1998: 68) argues that 'Conical Intersect' presents a paradox for site-specific art as "it recalls the history of that place, as it thematizes the limited communicability of all sites within the space of the city" and "parallel to this, it dramatizes situations where ostensible communities are recognized as dispersed, powerless, outmoded – the terms of what might be called a workless community, a community whose commonality rests on its virtual loss rather than essentialized, shared identities". According to the same source, this project, more than any other Matta-Clark's works, illustrates the tense relationship between the narratives of historical progress, represented in the construction of the *Pompidou Centre*, and the destruction of sites as a necessary prerequisite for construction. Lee (1998:

Figure 3.13.
Gordon Matta-Clark,
Conical Intersect
under construction.
1975.
Photomontage



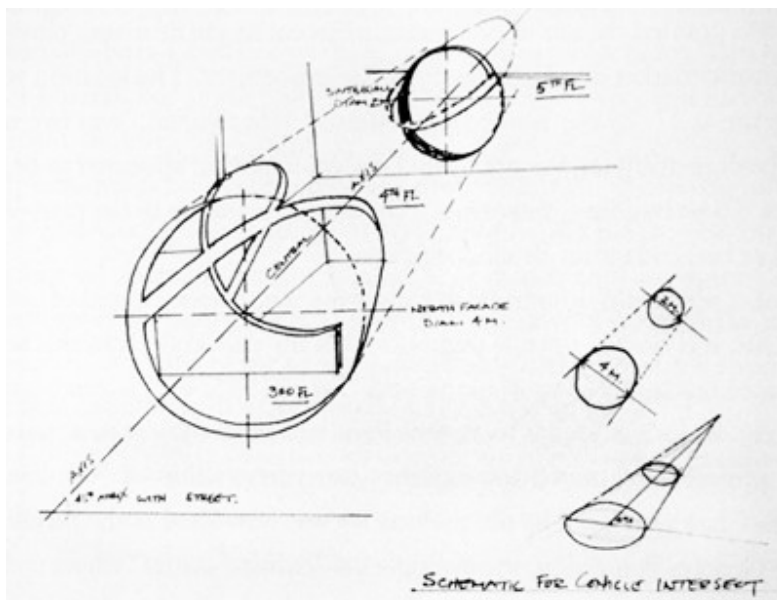
70) explains that “a virtual knot of cut circles appeared to torque around an invisible thread, traveling up and through the twinned houses as it grew smaller in diameter”, as demonstrated, in an abstract way, in the schematic drawing, Figure 3.14. Lee (1998: 70-71) describes the project in the following way:

“Twelve feet in diameter, the center of the major cut on the building’s north façade coincided roughly with the midpoint between the third and fourth floors. The hole was then intersected at several points by other semicircular incisions, forming a more frenetic series of arcs that could be seen by looking up into the space of the building. Generated largely with hammers, chisels, and bow saws—apparently, very few electrical tools were used in its making—the cuts were positioned from wall to floor to ceiling, not unlike the structure of a honeycomb. As a result, the normal coordinates of architectural orientation—plan for the horizontal axis, section for the vertical—were interrupted to a degree that produced a sense of vertigo for the observer inside the building.”

Matta-Clark was interested in “converting a building into a state of mind” which “involved liberating structures from the straightjacket of their maker’s intentions and recycling them as consciousness-altering artworks – ‘making sculpture’, as he wrote in a letter to the New York Department of Real Estate, ‘using the by-products of the land and the people’” (Attlee, 2007: 14). By dismantling and cutting abandoned buildings or buildings condemned to demolition, Matta-Clark raised the question about the economic logic, which promotes rapid expansion of the discipline at the expense of public functions, responsible for the disappearance of the collective memory and therefore, history of those places. Graham (1992: 378-9) argues that “instead of building, restoring, or adding new elements to existing architecture to call attention to the ‘innovative’ or ‘progressive’ elements of each new ‘idea’ manifested in a new work of architecture, Matta-Clark proposes to attack the cycle of production and consumption at the expense of the remembered history of the city”. Matta-Clark rejected the mass production in his work, and by undoing a building, he strived at opening “a state of enclosure which had been preconditioned not only by physical necessity but by the industry that proliferates suburban and urban boxes as a pretext for ensuring a passive, isolated consumer” (as cited in Graham, 1992: 379). Without adding anything, his approach was to subtract from already existing architectural structures, thus,

gaining “newly available historical time/ popular memory of the city” (Graham, 1992: 379). Through the use of building structures about to be demolished, Matta-Clark created de-constructed ruins which “reveal hidden layers of socially concealed architectural and anthropological family meaning” (Graham, 1992: 378). As ruins are

Figure 3.14.
Schematic drawing
for Conical Intersect.
(Source: Lee, 1998)



created each moment, through the demolition and replacement of buildings “as part of the cycle of endless architectural consumption” Matta-Clark’s projects “attached itself to the notion of the instant ruin of today: the demolition”. Further, “Matta-Clark’s work starts by setting up a dialogue between art and architecture on architecture’s own territory”, and “links itself to the urban environment on an experienced political architectural historical basis which includes its relation to itself as a memory of archetypal architectural form” (Graham, 1992: 378). The artist was unquestionably influenced by the writings of Jane Jacobs which promoted the idea of densely paced neighbourhood, stressing that by closely observing urban environment much more can be learned than by imposing a grand new plan (Attlee, 2007). By intervening in the abandoned buildings, i.e. removing parts of walls, floors or ceilings, Matta-Clark produced unexpected spaces with vistas through, out, and around the missing components (Désy & Owens, 2008).

In one of his attempts to build a better homes, than the cardboard ones, for the homeless living under the Brooklyn Bridge in New York, Matta-Clark created a solid wall, i.e. Garbage Wall (Figure 3.15.), by using industrial, manufactured waste found on site. By using a small propane stove, Matta-Clark made experiments to melt wine and beer bottles in order to create bricks which would serve as long lasting structural elements for homeless. Matta-Clark made these walls in front of the homeless people, hoping to get their attention so that they could later copy the technique and remake the walls themselves. According to Lee (2001), Garbage Wall (1970) literalized the equivalence between trash and building. In this work the artist compressed trash into an architectural structure which served as a base for a three-day-long performance (Lee, 2001). Matta-Clark’s early works can be seen as particularly American, since they address “specifically American patterns of consumption and waste (Winter Garden, for instance, addressed the ‘throwaway’ character of post-war American consumer culture)” (Lee, 2001: 198).

By fragmenting or splintering architecture, Matta-Clark creates a sort of reverse Cubism or anti-monument that reconstitutes subversive memory which has been hidden by social and architectural facades (Graham, 1992). Also, unlike conventional monument, Matta-Clark’s monument is profoundly pessimistic, given that it is destined to be demolished and remembered only as a photographic or text representation, as conceptual art. However, his work possesses a communication value, which is precisely the idea of the conceptual art: “The determining factor is the degree to which my



Figure 3.15.
Gordon Matta-Clark,
Garbage Wall, 1971.
New York.
(Source: Lee, 1998)

intervention can transform the structure into an act of communication” (as cited in Graham, 1992: 379). Through material left by Matta-Clark, i.e. drawings, photographs, writings and sculpture, it can be observed how he radically explored and subverted the social environment. Some of the cuts were removed and exhibited as a memory of the piece. These removed sections (Figure 3.16.) display multitude of layers carved by its occupants, and provide insight into lives of people hidden behind the buildings’ outer walls. From the slums of Manhattan to the boulevards of Paris, Matta-Clark’s works “dramatized the temporality of each site, the timeliness of architecture, through marking the disintegration of social space” (Lee, 2001: 2).

Artists gathered around the Anarchitecture group, occupied industrial sites in order to transform these unused spaces in open, participatory spaces which would serve as a source of inspiration for, at that time considered experimental, practices, i.e. photography, film, choreography, dance. In “The Romance of Abandonment: Industrial Parks” Hardy (2005) discusses the aesthetic and qualities of the architecture of the Industrial Age, i.e. plants, mines, mills and factories. Hardy (2005: 32) refers to these buildings as “defunct behemoths of heavy industry” and points out that their rather peculiar aesthetics is the product of their unconventional architectural forms, shaped by the machines and processes they housed. The author points out that “their [industrial buildings] gigantic size and startling juxtapositions also give them a sinister beauty that speaks of prodigious human effort and material transformation wrought by great physical forces”, and highlights that “even silent, they resound with power” (Hardy, 2005: 32). It is the ambiguity and surprise that makes industrial ruins an important cultural element, he argues. Edensor (2005) explains that industrial ruins can become spaces for leisure, adventure, cultivation, acquisition, shelter, creativity as well as spaces where forms of alternative public life can occur – more precisely, industrial ruins are used for:

- Plundering – The process of stripping off assets (machines, furnishings and other surplus material) from derelict factories and recycling them through other industrial plants. These actions do not affect the structure of the building, which, for a time, remains protected from the rain and wind. When the building’s condition deteriorates it become accessible to residents of the informal economy to whom the ruin provides

material that can be sold to junkyards, second-hand furniture stores and scrap metal yards. Through this process the building is stripped of its assets and begins to disintegrate.

- Home-making – The process of deindustrialization, which produced a large number

Figure 3.16.
Matta-Clark’s sections in the Pulitzer’s building by Tadao Ando
(Source: Robert, 2009)



of ruins, coincided with the increase in homelessness in Britain. Depending on their state of dilapidation, ruins are used as a temporary shelters by homeless people. It can be inhabited by individuals or groups depending on the size of the ruin. Material provided by the ruin is used for the creation of temporary homes and furniture.

- Adventurous play – Ruins are unknown spaces amidst a familiar realm, which due to their status of ‘forbidden space’ possess an allure for those who want to venture and explore. Due to their physical characteristics, vast floor spaces, roofing, cellars, lengthy corridors, stairs, pulleys and channels, these spaces contain, especially for children, elements for all manner of playful activities. Marginal spaces of industrial ruin attract urban explorers who are drawn to its architecture and history, as well as to anti-authoritarian nature of such pursuits. However, these unguarded spaces are also inhabited by problematic social groups.
- Mundane Leisure Practices/Ruins as Exemplary Sites – Incorporated into the walks of urbanities, ruins provide unpoliced, extra spaces where everyday pastimes, as part of people mundane practices, habits and activities, are carried out. Through the citizens’ regular routes or contingent travels, the ruins continue to be woven together with the rest of the city. The variety of creative uses of derelict space for leisure practices highlight the dearth of communal areas in many urban realms due to its division into functional spaces and private property. Ruins can, therefore, act as exemplary spaces in which alternative urban practices can be performed.
- Art Space – Ruins provide unsurveilled extensive arias where artists may develop they work. Large portions of vertical surfaces attract graffiti artists who can develop their alternative aesthetics and skills. Drawn to its varied textures and forms, its symbolic qualities, its unusual juxtapositions, and due to the fact that twentieth-century artists have loosened ideas about the constituents of art work, various artists (Robert Rauschenberg, Kurt Schwitters, Joseph Beuys, Tony Cragg and David Mach) have played with the aesthetics of rubbish. The industrial by-products and debris have been used by the members of the sustainable art movement to create ‘an alternative economy’ and make observers to question process of ‘(de)valuation and exclusion’. Derelict industrial buildings are also creatively explored and used by artists as gallery spaces as a dramatic contrast to conventional kinds of display and the spaces in which they occur.

Edensor (2005: 50) concludes that “waste spaces in which ‘nothing happens’, industrial ruins, are thickly woven into local leisure practices ranging from the carnivalesque to the mundane, and have been utilised as exemplary, experimental spaces from which to broadcast possible alternative ecocentric, artistic and social futures in the city”. The raw, dilapidated spaces of industrial ruin are continuously being used in the contemporary art. Ruin and decay was also an inspiration for the Swedish director Christian Larson’s

who collaborated with Antwerp-born choreographer Sidi Larbi Cherkaoui in the creation of a music video (2012) for the Icelandic post-rock band Sigur Rós (Figure 3.17). The dilapidated building has been used as a stage which stands in a stark contrast with the subtlety and fluidity of movement produced by the dancers.

The use of derelict and peripheral spaces for the purpose of art, film-industry and photography was followed by the political and economic utilization (Polyák, 2013). These spaces offer unique possibilities for experiencing urban spaces and can act as a trigger for touristic and real-estate business and socially oriented art projects (Polyák, 2013). The desire for abandoned and disused buildings is further fuelled by the fear of sterility and the eternal presence of objects (Polyák, 2013). Psychogeography, conceptualized by Situationists, praised these hidden, untouched and authentic spaces where ‘drifting’ and adventure can take place.

Artists were also responsible for the changing land use patterns and creation of a new type of living, the loft living. In the older industrial cities of the United States and Western Europe it became fashionable, at the beginning of the 1970s, to live in industrial, manufacturing spaces converted to residences (Zukin, 1982). The canals of Amsterdam, the London docks and the old sweatshop district of New York were among the first to accommodate this new housing style. This form of living grew into a trend and affected the housing market in cities which even lacked this type of building stock. However, the lofts (Figure 3.18.) are an American phenomenon since it is in America that the urban housing market has been influenced the most by the loft living (Zukin, 1982). Due to its large number of manufacturing buildings in downtown and midtown Manhattan and in the waterfront area of Brooklyn, New York was a reference point for loft living (Zukin, 1982). During the 1960s and 1970s, manufacture has left the city of New York, in order to lower production costs, causing the massive abandonment of buildings. Industrial premises, i.e. garment sweatshops, furniture companies, printmaker shops, warehouses, depositories, and factories, moved their activities away from Manhattan to cheaper areas, leaving these building vacant (Schleifer, 2005). This caused unemployment increase and spreading of poverty, which resulted in the rapid escalation of the number of homeless people. By 1970, in an attempt to reverse this problem, the authority decided to change housing laws defining

Figure 3.17.
Sigur Rós: Valtari.
Video snapshot.
(Source: Sigur Rós:
Valtari, 2012)



the urban land use, allowing artists to occupy old warehouses who turned them in their workshops in area south of the city, later known as SoHo (South of Houston). Initially, physical characteristics of industrial buildings, as the large amount of floor space and window area and high ceilings, as well as the relatively low rents, attracted

artists, dancers, musicians and poets to create live-in studios for both work and residence (Zukin, 1982). Those were the people with diverse backgrounds, from different parts of the country, united by their opposition to the war, anti-establishment philosophy and their lack of economic resources. Because of the limited means the artists collaborated and helped each other to carry out their projects in all kinds of alternative or non-traditional spaces.

Zukin (1982) explains that around 1970s industrial aesthetic, i.e. bare wood floors, exposed red brick walls and cast iron façade, became bourgeois chic, as middle and upper-middle class began moving into lofts. According to the same source, the changing status of artists, the rising tide of ecological awareness, historical preservation and industrial archaeology lead to the acceptability of lofts as an alternative to more traditional ways of living and carried the loft market forward. Zukin, (1982) points out that loft market went through two stages: the first stage is connected to the creation of the supply, directly related to the decline of small businesses that had occupied lofts, which, in addition to the modernisation and moving of the industry, lead to the vacancies in loft buildings; artists, seeking living and working spaces at a low rent, were the first tenants and thus supply created demand, which lead to the increase of the rents; the second stage appeared when middle-class people, who had no connection to the art, became interested in lofts, which consequently lead to the increase of the supply as if it was a conventional housing market. This lead to the further increase in the loft rents, which, by 1975, had become competitive with apartment rents (Zukin, 1982).

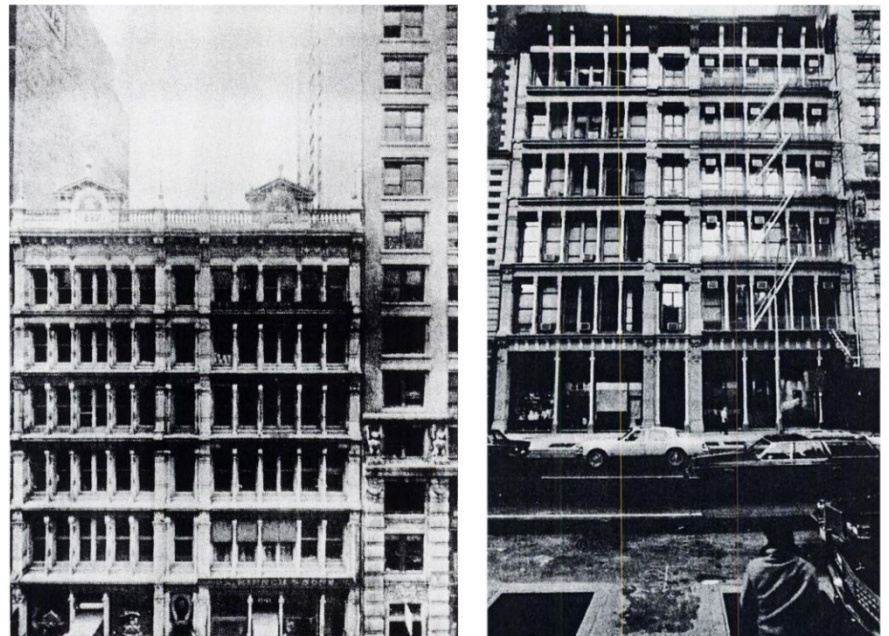


Figure 3.18.
Loft Building in the
Broadway Corridor
before and after the
conversion
(Source: Zukin, 1982)

3.1.5. Flexibility: adaptability to change

Industrial architecture is present in our cities in a verity of scales, from individual factories, or warehouses, industrial complexes until industrial quarters and zones. As Stratton and Trinder (1997: 33) explain, a factory is usually not one single building “but a group of structures clustered round a courtyard, with its outer perimeter ringed by a wall defining the area over which the entrepreneur enjoys hegemony”. Stratton and Trinder (1997) point out that due to high land cost, the need to distribute power and heat, and to minimize the time and effort expended in carrying materials from one process to the next, most textile mills were relatively compact groups of buildings (Figure 3.19).

In the architectural vocabulary the term ‘industrial landscape’ is also present, referring to a much greater scale (Figure 3.20.). According to Tandy (1979), the classification of the landscape as industrial implied a functional, cultural and historic analysis of the territory and industrial infrastructures. Borsi (1975) explains that the industrial landscape is a product of a thoughtful and systematic activity of man, which can be executed in the natural or agricultural landscape, with the aim of developing industrial activities. Through this definition an entire landscape has been recognised as a single ‘element’, in contrast to a single building or a cluster of industrial buildings. In this way the concept of industrial preservation was allowed to expand and accommodate recognized patterns of activity in time and place (Meinig, 1979).

Due to the urban expansion many of the industrial buildings and complexes, “constructed in what at the time were the outskirts of the city, today form units of huge size that have been absorbed by the urban fabric”, as Gasometers of Vienna, Battersea in London, or the former thermal power station in Poble Sec, Barcelona (Ivančić, 2010: 114-15). These buildings are usually located on the banks of rivers and seashore due to their demand for water, needed for the cooling of machinery (Ivančić, 2010). Douglas (2006) explains that the industrial revolution triggered a massive boom in the construction of factory and warehouse buildings, e.g. in Britain, which by the early 1800s became one of the world’s greatest industrialized economies, mills were among the most common types of industrial buildings. Despite their differences in function or size, most 19th century mills and warehouses have several common characteristics (Douglas, 2006):

- multi-storey (i.e. usually over three storeys), with long front and or side elevations of solid load-bearing masonry;
- external walls punctuated at regular intervals with large windows;

Figure 3.19.

Ground plan of Murray’s Mills, Manchester, showing: A. Old Mill, 1798, B. Decker Mill, 1802, C. New Mill, 1804, D. Murray Street block, c. 1804-6, E. Bengal Street block, c. 1804-6, F. canal basin, G. mid-nineteenth-century engine house, H. partly rebuilt engine house of New Mill, I. Doubling Mill, 1842, J. Fireproof Mill, c.1842, K. New Little Mill, 1908, L. site of former engine house, 1802

(Source: Stratton & Trinder, 1997)

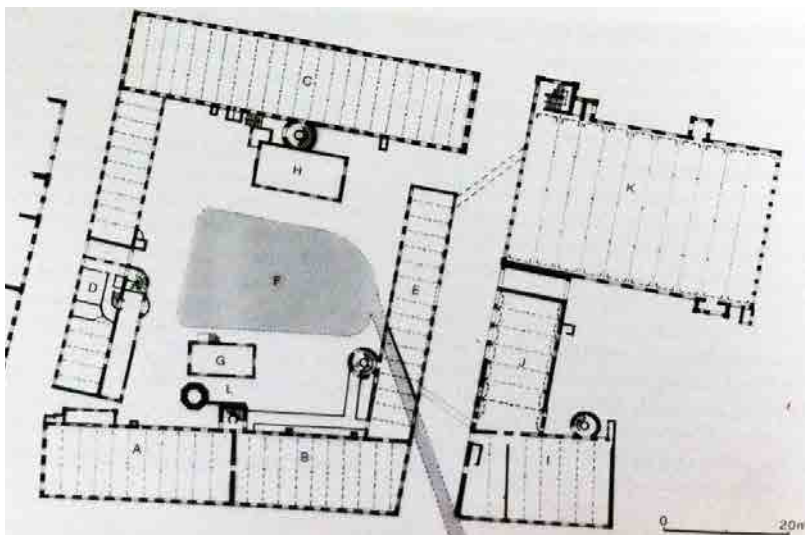




Figure 3.20.
Emscher Park, Ruhr,
Germany
(Source: Emscher
Park , 2014)

- wrought iron or cast iron members in regular bays forming an internal frame supporting the floors;
- built to last over 100 years;
- sited in urban areas adjacent to power source such as water or coal, because the area became urban as a result of the industry attracting people, housing, etc.;
- large spans and open spaces internally;
- structurally robust;
- adequate external space around the building, for access and car parking; and
- occasionally, they contain a basement area suitable for car parking.

Yeomans (1997) highlights that by the early 1900s mild steel replaced wrought iron in framed construction. Douglas (2006) also argues that steel became the principal structural material for factory and warehouse buildings. According to the same source, concrete, in either pre-cast or in-situ form, was also used but could not achieve the large spans as economically and efficiently as steel. After the World War II industrial buildings comprised mainly of skeletal steel frame construction with light-weight cladding for the walls, and the roofs either flat, saw-toothed, i.e. mono-pitched with glazed gable, or north light pitched (Douglas, 2006). According to the same source, some of the common characteristics of industrial buildings built between the 1950s and 1980s are:

- They were often designed and constructed to minimal thermal standards.
- They sometimes comprise a group of connecting buildings, occasionally of differing forms of construction.
- Few industrial buildings are within a city centre. Most of them are situated in the suburban areas.
- They tend to have large roof areas, often either flat or shallow pitched roofs. These are covered either by roofing felt, corrugated asbestos or steel sheeting placed on lightly insulated substrates.
- Industrial buildings are likely to contain most forms of asbestos.
- The fabric of industrial buildings is generally lightweight and thin-skinned, which usually requires thermal upgrading.
- The main factory or warehouse areas are normally single storey with generous floor to ceiling heights.

- Partial demolition internally (e.g. of columns) may be required to accommodate new uses.
- Load-bearing capacity of the building may need to be increased to suit new use or accommodate additional, intermediate, floors.
- Industrial properties are frequently subjected to higher levels of user use and abuse than other types of buildings.
- Levels of contamination in floor slabs and soils are higher than other properties.
- The electrical power supply is single phase, which may not be suitable for some uses.
- Maintenance standards in industrial buildings are generally much lower than for other types of property.

Bradley (1999) point out that only three main types of industrial buildings comprised the factory: 1) production sheds, which served as machine, forge and erecting shops as well as foundries, 2) industrial lofts, which might house the entire factory or be adopted for use as office buildings or pattern storehouses, and 3) the powerhouse. Testing departments, laboratories, storehouses and other functions were housed in buildings so diverse that generalizations about their architectural character are difficult to develop (Bradley, 1999). According to the same source, steel framing, along with the electric drive and the powered travelling crane, transformed industrial architecture. Also, “uniform quality of steel, which could be accurately specified for strength and dimension, contributed to an increasingly systematized approach to industrial building design and construction”. On the other hand, steel introduced a new scale that seemed limitless, restrained only by cost, and not by the strength or availability of materials (Bradley, 1999: 144).

Lepel (2006) explains that for the industrial buildings the strip foundation, made of stone or bricks, were used in the past, while during the 19th century foundations made of concrete or reinforced concrete were implemented. According to the same source, vertical load carrying structures of the earliest industrial buildings were constructed of bricks, stone and wood. Firstly, wooden pillars were used, but due to the span increasing over time, the internal pillars were made of cast iron, rolled steel elements or, from the end of the 19th century, of reinforced concrete (Lepel, 2006). Further, the load of the floors and roof structures was carried by internal columns, pillars or external load carrying walls, and the load carrying walls were combined brick or stone walls or were built as light structures. According to the same source, pure reinforced concrete walls were built from the 1900's onwards. Similarly to the vertical supporting structures, for the horizontal load bearing structures, i.e. floors, the wooden structures were gradually replaced by steel, concrete and reinforced concrete (Lepel, 2006). The application of the skeleton constructions, which can be made by hinged or rigid interconnection of wooden, cast iron, rolled steel beams or lattice girders, is the characteristic of halls and multi-storey buildings (Lepel, 2006). Architectural styles prevailing in the given age and the construction technology

determine the external appearance of the industrial building. According to Lepel (2006), for economic reasons, the façade frequently remains unplastered, though in some cases the bricks are used in combination with stone and plastered surfaces. After the turn of the 20th century the raw concrete and the metal corrugated sheets appeared on the facades and, in time, gained more and more ground (Lepel, 2006). Some of the common characteristics of different types of industrial buildings are presented in the Figure 3.21.

Douglas (2002) explains that the decline in the manufacturing sector, the increase in the service economy and the effects of economic and technological influences have resulted in the redundancy of many industrial buildings. The author highlights that adaptation is a key aspect of sustainable construction. Adaptability can be defined as the capacity of a building to absorb minor and major change (Grammenos & Russell, 1997). The five criteria of adaptability, according to Douglas (2002), are:

- Convertibility: allowing for changes in use (economically, legally, technically).
- Dismantlability: capable of being demolished safely, efficiently and speedily – in part or in whole.
- Disaggregatability: materials and components from any dismantled building should be as reusable or reprocessible (i.e. recyclable) as possible.
- Expandability: allowing for increases in volume or capacity (the latter can be achieved by inserting an additional floor in a building, which does not increase its volume).
- Flexibility: enabling minor if not major shifts in space planning – to reconfigure the layout and make it more efficient.

One of the characteristics of industrial buildings is the generosity and flexibility of its space. Cantell (2005) highlights that industrial buildings are especially well suited for reuse due to their large, open spaces. Albert Kahn's Packard Building (Figure 3.22.), the first automobile factory to use reinforced concrete, built in 1903, has a 30 foot spans and demonstrates great flexibility for changes in production.

Industrial buildings are generally extremely adaptable and flexible. Binney et al. (1990) explain that the majority of the industrial buildings are laid on an open plan and can be subdivided, repaired and upgraded for a range of uses, for light industrial and workshop use, for high-tech offices and residential accommodation. Industrial buildings are made to last, and their load bearing walls are solid, made for carrying massive floor loadings. Durability and sturdiness were the first consideration of the builders of industrial buildings. According to the same source, industrial buildings are extremely well-constructed and can usually tolerate long periods of disuse and neglect with minimal maintenance. These buildings, particularly of the 20th century, by their very nature, adapt to radical remodelling (Binney et al., 1990). Some of the common options for the reuse of industrial buildings, according to Douglas (2002), are as follows: preservation as a monument;

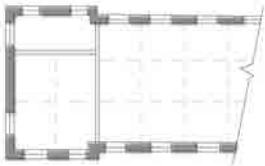

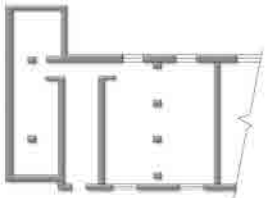
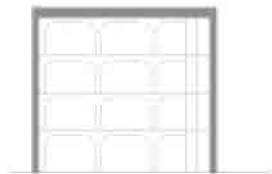
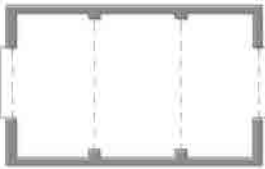

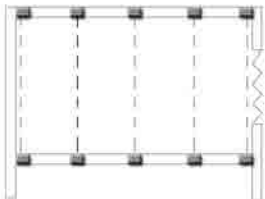

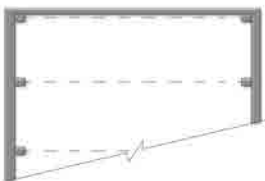

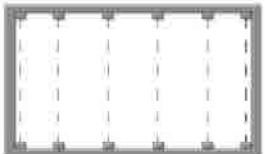

Building type characteristics	Typical floor plan	Typical section	Typical features
Built in nineteenth century to before World War I; Usually built on deep inner city or old rural sites.			Strong form and architectural features; Often good floor loading; Much space available; Some floors can be 5 m or more in height giving space for mezzanines.
Interior framed; Built off roads; usually a mix of buildings. Mix of sizes and shapes of buildings allow different uses; Good basic construction.			Independent structural frames which can often be sound; New cladding can be applied if needed; Usually has facilities that can be upgraded (offices, lavatories).
Universal shed; layout is highly variable; Great potential for reuse and refurbishment; Open layout usually allows easy access.			Easily identifiable building with character; Solid brick walls, easy to change; Traditional construction, often straightforward to repair.
Concrete portal frame shed; Cheap form of building; can be re clad and upgraded			Frame relatively simple to re clad; Access usually straightforward; Cheap building/site; Does not need a lift.
Sawtooth shed built in industrial estates; may be used on a deep site; Large continuous spaces available.			Roof profiles very varied, including steel and concrete, shells, top hat sections with a central raised part, etc.; In urbanised areas of large cities and old Industrial estates; Usually large areas of space available with minimum column interference.
Modern portal shed 'box' built in industrial areas; Usually has better quality landscaping.			Modern buildings, built relatively recently; Should have some amenities; Usually sound structural specification; Relatively easy to re clad and/or upgrade and re roof.

Figure 3.21.

Common Types of Industrial Buildings

(Source: Author, according to Bordass, 1996)

industrial museum; new industrial use; residential use; offices and hotels; sports centre; art galleries. According to Binney et al. (1990), the majority of industrial buildings are valuable in several ways:

- First, they can be important local landmarks, simply by virtue of their size. Many have distinctive architectural features, from the Venetian windows set into the gables of early mills, to great ornaments towers and chimneys.
- Second, they are often very well built, particularly those which are constructed of stone.
- Third, they are usually very well proportioned with a satisfying rhythm of windows echoed over five storey or more.



Figure 3.22.
Packard Building,
Detroit, Michigan
(Source: Jevremović,
Vasić & Jordanović,
2012)

Industrial buildings are suitable for a great variety of uses. Number of examples demonstrate the adaptability of the industrial architecture to a museum use. According to Bordass (1996), industrial buildings, suitable for museum use, tend to be of three distinct types:

- Loadbearing masonry – Typically nineteenth century, usually three to six-storey. Massive construction, often with limited ceiling heights and internal steel, cast-iron or timber columns at close spacings.
- Steel or concrete frame – Multistorey, typically early to mid-20th century, with brick cladding or infill, plus growing use of concrete or lightweight cladding from the 1930s on.
- Single-storey sheds – Many shapes and sizes. Roofs often metal or asbestos cement sheets, not always insulated, often with rooflights. Walls are similar, or of brick or block, at least at low level. Floors usually concrete, not always reinforced and seldom insulated.

Stratton (2000) made a classification of the industrial architecture, it's potential for reutilization as well as restrains according to the typology of building form, in the following way:

- Multi-storey mills and warehouses – These types of industrial buildings offer wide, well-lit spaces and sturdy floor loadings. They can accept a variety of internal treatments, from most simple use of the existing interior spaces to the more interventionist. Typically, early water-powered cotton mills were three or four storeys high, around 22 metres long and 9 metres wide. In a number of projects the multi-storey block

was restored to a pristine state while clearing the surrounding low-lying sheds and workshops that were crucial for such processes as weaving, fulling and dyeing and that also created an enclosed complex of courtyards. Mill conversions are followed by some practical problems as well. A surfeit of industrial floorspace may depress rentals below which can make any re-use viable. Narrow stone staircases and rickety lifts are the only communication units to the upper floors. Many uses, especially residential, will necessitate subdivision, yet the internal character of mills depends on leaving the interiors as open as possible. Breweries and maltings have traditionally been multi-storied structures which create a variety of architectural forms. The tall central spaces created to house tanks, which will remain as voids once all the plant has been removed for scrap, further enhance the re-use potential.

- Daylight factories – Typically dating to the early decades of the 20th century, these buildings were built with a concrete frame and elevations more of glass than masonry. Due to their great durability and good lighting they mostly remained within the industrial use, though often making widely differing products than when first completed.
- Great halls – Huge railway sheds and erecting shops vary in their potential for re-use, largely according to their location. Central urban locations are usually places where the train sheds of railway stations are set, though sometimes they are placed in areas of dubious social status. They can be refurbished within their original use and can be subjected to more fundamental change. Many of the erecting shops, built for the final assembly of railway locomotives, ship's engines or turbines, have become redundant and are set in fringe locations, often cut off from city centres by railway lines or waterways. However, new uses can be found for such huge, often unlisted and largely unappreciated structures. These buildings can be reused as industrial estates, but also as shopping malls or exhibition spaces for museums. The flexibility of the internal space is the key asset for any re-use of these building due to scale of their structure. Similar to erecting shops are the turbine halls of power stations, with their steel frames, wide, open spaces, and overhead cranes. However, they have proved difficult to adapt. Greatest of the great halls are the aircraft hangars, which have proved incredibly useful and adaptable by virtue of their completely open interiors, their fire resistance, and due to the prosperity of civil aviation, and the ease with which they can be relocated.
- Single-storey sheds – This type of industrial buildings is the most successful of virtually all industrial building forms, yet, it is the least understood and appreciated. These buildings derived from agriculture, were used for iron making in the eighteenth century and for cloth and brick production from the nineteenth, and have evolved into the modern metal-framed and metal-clad factory. Due to the lack of conventional windows and partitions and as a result of their low architectural status there is

prejudice against their re-use for offices, community facilities or homes even though these buildings are very adaptable.

- Non buildings – Process-specific industrial structures as opposed to conventional buildings, are typically preserved shorn of accretions, inert, and tidied up as far as funds will permit. An integrated relationship between such structures and the sheds and warehouses, with which they were operationally dependent, has been established in few projects as, for example, the Gladstone Pottery Museum in the Potteries, Staffordshire with its bottle ovens, workshops, offices and showroom, or Blaenavon ironworks in south Wales with its blast furnaces, casting floors, hoist and housing. Due to their scale and the susceptibility to rust of metal structures and pipework, steelworks have proved the greatest challenge out of all non-buildings. Most of steelworks are stabilized and interpreted as monuments, such as German steelworks saved at *Emscher Park* within the Ruhr, or part of *Völklingen* steelworks in Saarland which has become a venue for public events including rock concerts.

Through the analysis of the nature of the site, and the plan, structure and condition of the buildings, Stratton (2000) defines preferred qualities of industrial buildings and sites for reconversion:

- Site coverage – If a building or a group of structures only cover around 60 per cent of a site, a better natural lighting, space for on-site access, and potential for expansion can be provided, making this site configuration ideal one. Furthermore, occupants usually wish to have an open view from their workplace and buildings are also easier to let or sell if they have windows on at least three elevations.
- Plan and configuration – A variety in reuse schemes is provided by the great diversity of industrial buildings. Single-storey type is ideal for industrial use or associated functions such as training workshops or storage, while multi-storey layout is often desirable for office, craft and certainly for residential use. Ideal for many conversion projects is a total floorspace of 4,500–15,000 square metres. Below 1,000 and above 15,000 square metres are more challenging. For ground floors, ceiling heights of around 4.3–4.9 metres are desirable and 3–4.3 metres for upper floors; below 2.4 metres makes many new uses uncomfortable, if not impossible.
- Lighting – If the floor plan is no deeper than 15 metres natural illumination will be adequate during daytime, given that outside light can normally reach around 7.5 metres. Buildings with such a shallow depth are ideal for uses where occupiers are pre-occupied with individual tasks, while deeper buildings can facilitate greater interaction and may be essential to accommodate large machinery or other equipment. Artificial light will be needed for some warehouses, as they can be 50 metres deep. In those cases, cores may be best used for services such as kitchens or bathrooms or can be given a central atrium, typically in the form of a stair well. Internal galleries

can be created with stairs and doorways giving access to the apartments in the case of residential conversions. Even though windows are usually an asset, the curtain walls of twentieth-century factories can create major problems of solar gain, and threaten a lack of privacy for the occupants of newly-created apartments.

- Access – Although most factories have lifts these may be antiquated and unsightly and provision must be made for disabled access.
- Structure and cladding – Condition of the building may fundamentally affect the cost of a renovation project. Even though most factories are robust, vandalism and theft of leadwork and slates can quickly lead to rot and the additional expense of treating or replacing floors and rafters. Calculating the current, actual loads and then relating them to those associated with the proposed new use should be done, especially if a significant increase in loading is anticipated, given that mills and warehouses were built with great reserves of strength, while workshops and sheds may be lighter in their construction. Different materials have their own properties:
 - Timber: readily adaptable but combustible and liable to wet and dry rot if buildings are derelict.
 - Cast-iron: high compressive strength and hence widely used for columns in the nineteenth century, incombustible, resistant to corrosion but brittle. May shatter in a fire.
 - Wrought-iron: high tensile strength so used for beams in the nineteenth century.
 - Steel: strong in compression and tension and more ductile than cast-iron. Corrodes if not protected. Used from the 1880s.
 - Reinforced concrete: strong but resistant to corrosion as long as reinforcement is not exposed. Difficult to cut through or adapt. Patent systems introduced from the 1890s.
- Services – Even though the character of an old building can be retained by refurbishing fittings wherever possible, heating, water supply, sanitation and lifts will typically need to be replaced. The most intrusive changes are usually needed for the housing conversions, as all plumbing and electricity provision has to be duplicated. For restaurants, high standards of food hygiene will be needed and museums require sophisticated systems of security and environmental control.
- Fire safety – When converting industrial buildings fire risks have to be taken into account, especially if meeting halls or sleeping accommodation are being created. Materials that are combustible or fail in a fire might have been incorporated in historic factories and they might have only one staircase. Material properties have to be taken into account: exposed timber members are safe only if they were over-sized; cast-iron can shatter when heated and then rapidly cooled by firehoses; steel loses half its strength when heated to 550°C; intumescent paint and sprayed coating-paint provide fire resistance of one and two hours respectively.

Given that the typology and quality of industrial buildings is so varied, “from Grade I listed mills to lowly and unappreciated sheds”, and that they allow for a grate variety in future functions, designers and clients can both choose to “maintain the industrial image, reinforce a particular aspect of it, or, alternatively, to suppress or adjust the industrial character for a more commercial or homely identity” (Stratton, 2000: 46). Further, due to their scale and robustness, industrial buildings are particularly interesting, as they allow designers to experiment with radical interventions, and provide them the opportunity for originality. This quality of industrial buildings inspired designers, clients and planning agencies to apply radical juxtaposition of old and new at various industrial complexes, such as (Stratton, 2000): *Le Grand Hornu* in Belgium – engineering complex built in 1831 in a neo-classical style, which was partially restored as a ruin and partially converted into office by inserting glass screen walls, by French architect, Bruno Renard; *Zollverein Colliery* in the Ruhr, Germany – colliery buildings built in 1930 which was transformed in a modern display spaces by Foster & Partners who fully exploited the boiler house by placing the works of art even in the interiors of the boilers themselves; The new Centre for Art and Media Technology at Karlsruhe – a concrete-framed armaments factory built in 1918 which was transformed into an art centre by Schweger & Partner who stripped back the concrete frame of any accretions and added new courtyard roofs and a ‘Music Cube’ in steel and glass; The *Fiat Lingotto Factory* in Turin – a car factory converted to a conference centre and hotel by Renzo Piano, by replacing the original fabric, where necessary, with the modern design and by adding a futuristic dome housing a conference room and a helipad; An ironworks in Germany – ironworks converted into a museum, exhibition and congress centre by Günther Domenig who fundamentally changed the space by adding a suspended walkway reaching the full length of the structure; A mundane warehouse in Los Angeles – a warehouse converted into offices, by Eric Owen Moss, who placed a new structure above the warehouse on dramatic pilotis (Stratton, 2000).

The physical characteristics of industrial buildings, their flexibility and adaptability to change allowed the implementation of the abovementioned radical schemes. However, more subtle design philosophies can be applied as well, such as “to rework the architecture to enrich the original industrial image, even though the new function will not involve manufacture or storage” or “to design new additions not in a replication of the original form or a style of our time, but to take an intermediate point – such as adopting the stripped classicism of the 1920s, or the render and metal windows of early British modernism” (Stratton, 2000: 50-51).

• • •

As demonstrated in the subchapters above, industrial buildings have been seen as a testing field for both structural and material innovation. Through such innovations an unseen industrial progress was made possible. The influence of the industrial architecture to the shaping of the modernist aesthetic is indisputable. A number of esteemed architects and theorists recognised the impact of industrial buildings. Furthermore, since 1960s and 1970s, the aesthetics of old industrial buildings have been recognised by artists who occupied these spaces while maintaining its original image. The trend of setting down in formerly unused industrial buildings was responsible for the emergence of the 'Industrial Chic', an interior style developed around the idea that residential spaces can feature exposed structure elements, materials, and functional details, i.e. aesthetics associated with the traditional industry.

Industrial architecture plays an important role in defining the identity of both the place and its inhabitants. Industrial complexes are recognized as the local landmarks and symbols of the cities' vibrant life. Industrial buildings have inspired artists to use them as places to work and live which consequently lead to the emergence of the loft living. Also, industrial architecture plays an important role in urban regeneration. The emergence of the 'industrial heritage' concept demonstrates the growing awareness on the importance of the industrial architecture. Through reactivation and repurposing of industrial buildings cities have transformed and regenerated entire districts. These buildings have become symbols and impetus for urban, economic, social, and environmental change.

Finally, physical characteristic of industrial buildings allow a great number of conversion schemes to be implemented. Open floor plan, great dimensions, prime locations in the urban core, and strong materials, are some of the characteristic which make them ideal candidates for reutilisation through architectural recycling. Hence, industrial buildings are increasingly being considered and used for a variety of new uses. Great number of projects demonstrate the ability of these buildings to adapt to new changing conditions. The generosity and flexibility of its space allows for subdivisions, reparation and upgrading for a number of uses.

3.2. Design principles of recycling the Industrial Architecture

The focus of this part of the research is on the analysis of design principles described by the selected authors. Thus, in the following subchapters the analysis of four sources and their design concepts is conducted: Brooker and Stone (2004) (Intervention, Insertion, Installation); Feireiss and Klanten (2009) (Add-On, Inside-Out, Change Clothes); Jäger (2010) (Addition, Transformation, Conversion) and Rogić (2009) (Coexistence, Imposition, Fusion). Such an analysis aims at understanding of the logic behind the definition of the selected design principles. The mentioned analysis serves as a base for the later comparison of the selected principles, based on the aspects such as: structure, material, formal composition and spatial organisation. This comparative analysis determines the degree of similarity and difference between the principles. Based on the comparative analysis a conceptual model which redefines the design principles of recycling according to structural, material, formal and spatial relationship between the original building and the new intervention is created.

Methodological approach

The main goal of this part of the research is the presentation and understanding of the similarities and differences in the design concepts, i.e. the principles of recycling the industrial architecture, described by the selected authors. The sources for the analysis have been selected according to the following criteria:

- 1. Scale.** The first selection criterion refers to the scale of the projects chosen for the analysis. Namely, in all four publications projects of individual building, i.e. architectural scale (as opposed to building complexes, neighbourhoods, or cities, i.e. urban scale) have been selected for the evaluation and classification.
- 2. Physical change.** The second criterion deals with the integrity of the original building, selected for the intervention. All four sources selected for the analysis are dealing with ways in which original building's appearance can be altered. Their focus is on the physical change which the original building is subjected to by the new intervention. Thus, the focus is not on the static preservation, but on the way in which the 'old' can be transformed to accommodate the 'new'.
- 3. Change of use.** As one of the main goals of this investigation is to highlight the advantages of recycling architecture as a sustainable alternative to demolition and replacement in a rapidly changing society, the final selection criterion refers to the change of the original building's function. All four of the selected sources deal with the buildings which have lost their original function owing to the changing needs of their occupants and, thus, have been redesigned for a new purpose.

As the focus of this part of the research is on the critical analysis of design principles of recycling architecture, described by selected authors, a method of content analysis has been chosen as a scientific method for the investigation. This method is particularly appropriate for the understanding and analysis of concepts and ideas described in the written format. The following subchapter provides the description of the research approach applied in this part of the research and explains in depth the reasons for the selection of the chosen methods. Therefore, the general characteristics of the content analysis method are in the following.

Chosen method: Content analysis

Content analysis is a method used for analysing types of empirical documentation which can be referred to as 'mute evidence', i.e. written text and artefacts (Hodder, 1994). According to Babbie (2010: 530), content analysis is "the study of recorded human communications, such as books, websites, paintings and laws". It is considered a scholarly method by which texts are studied as to authorship, authenticity, or meaning (Joubish & Khurram, 2011). According to Neuendorf (2002: 10), "content analysis is a summarising, quantitative analysis of messages that relies on the scientific method (including attention to objectivity, intersubjectivity, a priori design, reliability, validity, generalisability, replicability, and hypothesis testing) and is not limited as to the types of variables that may be measured or the context in which the messages are created or presented". It is a scientific method, based on a technique of collecting data about different characteristics of the content and form of a symbolic, social communication with the aim of discovering the objective nature of those contents (Mihailović, 2004). This is a highly flexible research method which is applied in qualitative, quantitative, and sometimes mixed modes of research frameworks and employs a wide range of analytical techniques to generate findings and put them into context (White & Marsh, 2006). It is considered as an especially adequate method for this research, as twelve concepts are being analysed and redefined. According to Mihailović (2004), sources for content analysis are:

- Printed texts (books, newspapers, records, slogans, magazines),
- Audio sources (radio, tape-recordings),
- Visual sources (paintings, photographs, drawings, graphics, sculpture, models),
- Audio-visual sources (film, TV shows), and
- Combined sources.

In this research, primary sources for the content analysis are printed texts, i.e. publications dealing with the topic of architectural recycling. Based on the analysis of the content of a certain message or document, conclusions can be drawn about attitudes, opinions and values of the author of the message (Mihailović, 2004). Seven major elements in written

messages can be counted and analysed in content analysis, such as: words or terms, themes, characters, paragraphs, items, concepts, and semantics (Berelson, 1952; Berg, 1983; Merton, 1968; Selltiz et al., 1959). According to Berg (2001), these elements are defined as follows:

- Words. The word is the smallest element or unit used in content analysis, and its use generally results in a frequency distribution of specified words or terms.
- Themes. The theme, in its simplest form, is a simple sentence, a string of words with a subject and a predicate.
- Characters. In some studies, characters (persons) are significant to the analysis, hence, you count the number of times a specific person or persons are mentioned rather than the number of words or themes.
- Paragraphs. The paragraph is infrequently used as the basic unit in content analysis because of the difficulties in attempting to code and classify the various and often numerous thoughts stated and implied in a single paragraph.
- Items. An item represents the whole unit of the sender's message, i.e. an entire book, a letter, speech, diary, newspaper, or an in-depth interview.
- Concepts. The use of concepts is a more sophisticated type than previously mentioned, as concepts involve words grouped together into conceptual clusters (ideas).
- Semantics. In the type of content analysis known as 'semantics', researchers are interested not only in the number and type of words used but also in how affected the word(s) may be, i.e. how strong or weak a word (or words) may be in relation to the overall sentiment of the sentence.

The criteria of selection used in any given content analysis must be sufficiently exhaustive to account for each variation of message content and must be rigidly and consistently applied so that other researchers or readers, looking at the same messages, would obtain the same or comparable results (Berg, 2001). This may be considered a kind of reliability of the measures, and a validation of eventual findings (Selltiz et al., 1967). In this research, the use of several content analytic elements is required. In order to identify subjective definitions of recycling design principles, described by selected authors, the use of a combination of both word and concept elements as content units was necessary. Four sources – publications dealing with the topic of recycling architecture, have been analysed and compared. All four publications have the same form and structure. The projects in all of these publications have been gathered under three categories. Each category elaborates one concept, i.e. design principle dealing with the already existing buildings. For each design principle, a project has been selected, among the number of projects affiliated to this concept by the author who defined it. The project was selected on the base of the clarity of expressing the ideas and characteristics of the design principle it represents. The analysed concept was then evaluated through the selected project. The analysis was broken down in two parts: 1) tectonic and 2) spatial-formal analysis.

Tectonic analysis strives to determine the relationship between the new and the old structure and materials. The criteria for the tectonic analysis are:

- Structure:
 - Old structure retained, no new structure added
 - New structure added, independent from the old structure
 - New structure added, dependent from the old structure
 - Old structure completely replaced
- Material:
 - Exterior:
 - Old and new materials are completely interwoven
 - Clear division between the old and new materials
 - Interior:
 - Old and new materials are completely interwoven
 - Clear division between the old and new materials

The spatial-formal analysis, determines whether the formal composition and the spatial organization of the original building was altered by the new intervention. The criteria for the spatial-formal analysis are:

- Form:
 - Formal logic of the old building is respected-unchanged, no new elements are added
 - New elements are added respecting the old building's formal logic
 - Formal logic of the old building is disrupted
- Spatial organization:
 - Spatial logic of the interior spaces is preserved and unaltered
 - Spatial logic of the interior spaces is altered but depends on the host building
 - Spatial logic of the host building's interior spaces is completely changed

According to these criteria the analysis was conducted on two levels – the so called micro and macro level. Firstly, the analysis on the micro level has been executed. The micro level represents the analysis within one source. This is the evaluation and comparative analysis of three concepts described by one author, or group of authors that constitute one source. Analysis on the micro level aims at highlighting the differences and similarities (according to the previously explained criteria –structure, material, form and spatial organization) among three concepts (design principles) within one source. Thus, it can be determined whether there is a clear distinction between them or not. Each of the four sources has been analysed on the micro level in the described way. Secondly, the comparative analysis of all four sources, i.e. the macro level analysis, has been conducted, based on the same set

of criteria applied in the analysis on the micro level (structure, material, form and spatial organisation). This analysis aims to observe the similarities and differences between concepts defined by different authors. The analysis on the macro level will reveal the contradictions in the definitions of the recycling design principles described in the selected sources and will highlight the necessity for their clear and precise definition. Finally, the aim of such an analysis is to provide the base for the redefinition of the already employed principles of recycling the industrial architecture. This is shown in the concluding part of this subchapter. In-depth analysis, on both macro and micro level, of all four sources, i.e. twelve design principles, is in the following.

3.2.1. Intervention, Insertion, Installation

“When a buildings is reused the most important and meaningful factor in the design is the relationship between the old and the new.”

(Brooker & Stone, 2004: 79)

In their study, “Re-Readings: interior architecture and the design principles of remodelling existing buildings” (Brooker & Stone, 2004), Graeme Brooker and Sally Stone focused on the process of changing a space, a building or a place, whether that’s by architects, interior designers or artists rather than focusing on the function of the new intervention. As Brooker and Stone (2004) explain, the emphasis is on an understanding on “what is there”, on “reading space”, and through that reading, through that analysis changing it, or adding another layer, 21st century layer. They explain that the focus is on reading, and rereading the space, when this new layer of information, this new layer of architecture or design goes onto, into, within, without, around the building. Brooker and Stone (2004) proposed the analysis followed by a catalogue of the possible relationships between the original building and the new elements introduced through the remodelling. The relationship between the old and the new was the criterion for the determination of the design concepts applied in the selected projects. Three categories have been developed based on level of integration between the old building and the new elements. The concepts were described as ‘intervention’, ‘insertion’ and ‘installation’. Each of these concepts implies different level of autonomy of the new elements introduced by the recycling project. Brooker & Stone (2004: 79) define their categories in the following way:

“(..)If the original building wholeheartedly accepts and establishes an intimate relationship with the new design, that is, the two become one, the category is intervention. When the host building allows and accommodates new elements, which are built to fit the exact dimensions of the existing, to be introduced in or around it yet remaining very much unchanged, then the category is insertion; and if the old and new exist together but very little rapport between them is established, then the category is installation.”

The in-depth analysis of the mentioned concepts is given below.

Intervention

In the process of 'intervention' a building is transformed but the old structure and newly introduced elements are completely dependent on each other and intertwined. All the physical characteristics of new elements, such as their size, scale, and position are conditioned by the form of the old building. Thus, the old building dictates how it is going to be reused (Brooker & Stone, 2004). The authors explain that even though this design principle implies a certain degree of change to the original structure, the existing building fully informs the intervention and provides all the necessary information for the reuse process. This change is usually in the form of small alterations, additions and subtractions. Architects have the freedom of simplifying original building in order to impose a certain degree of order or control. However, these changes can also be destructive as architect may remove or stripe away in order to reveal new or hidden meanings (Brooker & Stone, 2004). Regardless of whether these alterations are in the form of minor additions or more destructive subtractions, they are entirely related to the original building. Nonetheless, the style used in the process of intervention is usually completely at odds with the host building, although the character may be balanced (Brooker & Stone, 2004).

One of the examples analysed by the authors in the 'intervention' category was the Museum *Küppersmühle*, in Duisburg, Germany by Herzog and de Meuron (Figure 3.23.). This former brick warehouse, built from 1908 till 1916, has been transformed in Gallery for German art in 1999, as a part of the International Building Exhibition (IBA) Emscher Park. Some 3, 600 m² of exhibition space was created across three storey with 6-meter high ceilings. The connection to the outside was created only through ceiling-high window slits, which perforate the building's listed façade.

The museum has a number of modified gallery rooms and a new circulation area. In order to expose the new function and to stress the building's monumental character Herzog & de Meuron altered the industrial building, especially its façade. By subtracting and eliminating certain parts of the building, architects managed to introduce order and clarity and emphasise the building's character (Brooker & Stone, 2004). In order to open up a number of five-meter gallery spaces, necessary for the exhibition of large works of art, architects removed some of the existing floors. Finished with white walls and stone floors these galleries provide neutral spaces necessary for contemplation of the works of show (Brooker & Stone, 2004).

All parts of the original industrial building, apart from the storage containers, were reused for galleries, offices and a restaurant. The staircase, a prismatic tower, attached to the front of the building is the only new addition (Figure 3.24.). According to Herzog and



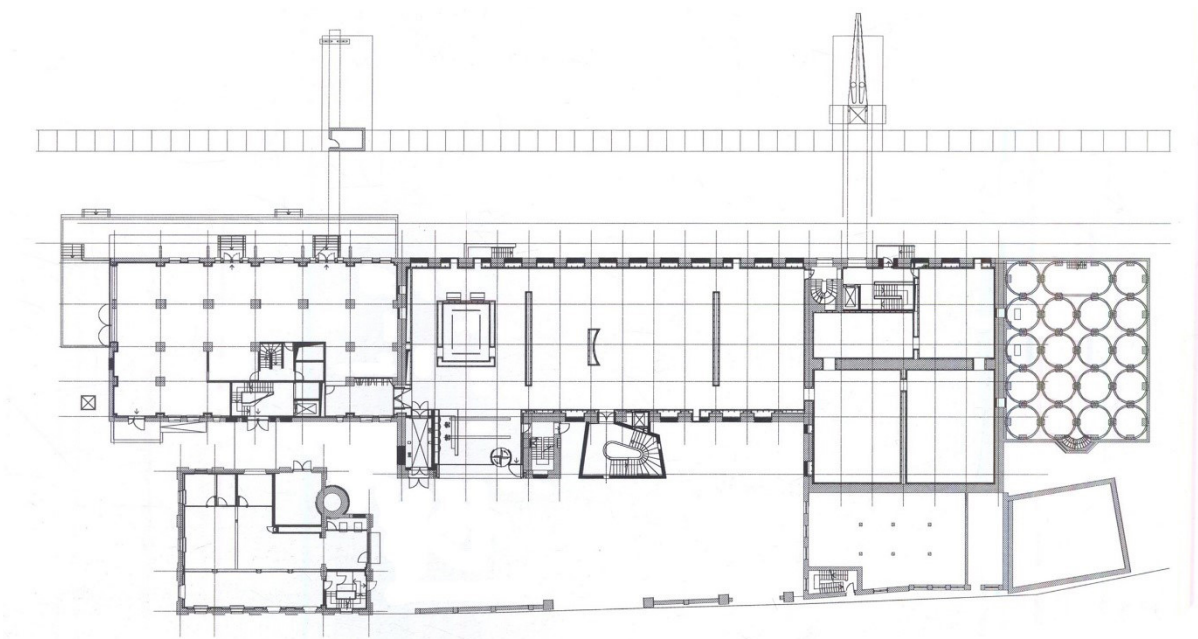
Figure 3.23.
Museum
Küppersmühle,
Duisburg, Germany
(Source: Marquez
Cecilia & Levene,
2005)

De Meuron, “(...) this trapezoidal body is closed by terracotta-coloured stained concrete panels, finished at the top on an angle imposed by the two-sided headwall which hold the public entrance. It is somewhat like a separate building with a spatial quality of its own that comfortably links the three floors of exhibition spaces” (as cited in Mack et. al., 2000: 356).

Removal of floors triggered a much more aggressive intervention on the building’s façade, which broke its symmetry and fenestration rhythm. The harbour-side façade was composed of a series of small arched windows methodologically arranged in vertical stripes, each stripe edged by a brick pier. New openings were placed, regardless of the former arrangement of the façade (Figures 3.25., 3.26.). In order to control the natural light and the view on the harbour architect decided to seal many of the window openings within the central area of the building with the same type of bricks used in the construction of the industrial building.

According to Brooker and Stone (2004), Herzog & de Meuron’s intervention is so successful because the original industrial building determined how the majority of spaces were going to be created and their design increased the scale and verticality of the host building. According to the same source, this design concept implies great dependence of the new elements on the original building. The original building is dominant and the building itself determines how it is going to be reused. The evaluation of the Küppersmühle Museum project according to the criteria for the analysis of the recycling design principles is given below:

Figure 3.24.
Museum
Küppersmühle,
ground floor
(Source: Marquez
Cecilia & Levene,
2005)



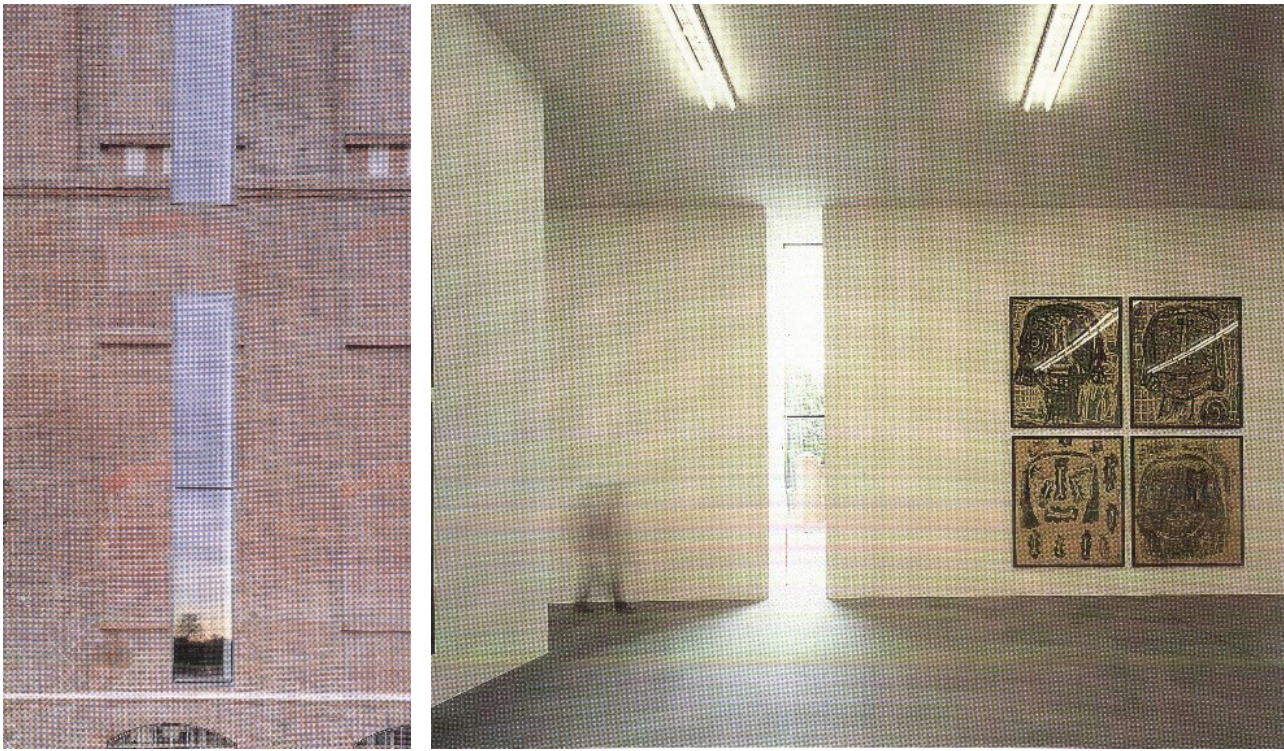


Figure 3.25.
Museum
Küppersmühle, new
windows on the north
façade
(Source: Marquez
Cecilia & Levene,
2005)

- Structure:
 - New structure added, dependent on the old structure
- Material:
 - Exterior:
 - Clear division between the old and new materials
 - Interior:
 - Clear division between the old and new materials
- Form:
 - Formal logic of the old building is disrupted
- Spatial organization:
 - Spatial logic of the interior spaces is altered but depends on the host building

Figure 3.26.
Museum
Küppersmühle, north
elevation and cross
section
(Source: Marquez
Cecilia & Levene,
2005)



Insertion

The process of 'insertion' implies the creation of an intense relationship between the original building and the new elements, where both 'new' and 'old' exist independently. This design concept implies the introduction of a new element into, between or beside an existing structure. The new element has a much greater level of independency and can even be confrontational (Brooker & Stone, 2004). According to authors, this design principle is the most obvious when there is a clear distinction in material, style, language and overall character between the newly introduced elements and old original building. However, new elements, although independent, are also determined by the host building as its particular qualities depend on the scale, dimension, proportion, rhythm and structural composition of the original building. The new elements are built to fit the host building (Brooker & Stone, 2004). For this principle to be at its best, the original building should retain its integrity and should be physically unaltered as much as possible. In this way, new element, which is equally present and dominant, makes a 'dialogue' with the host building and enables a clear distinction between the original and new building (Brooker & Stone, 2004).

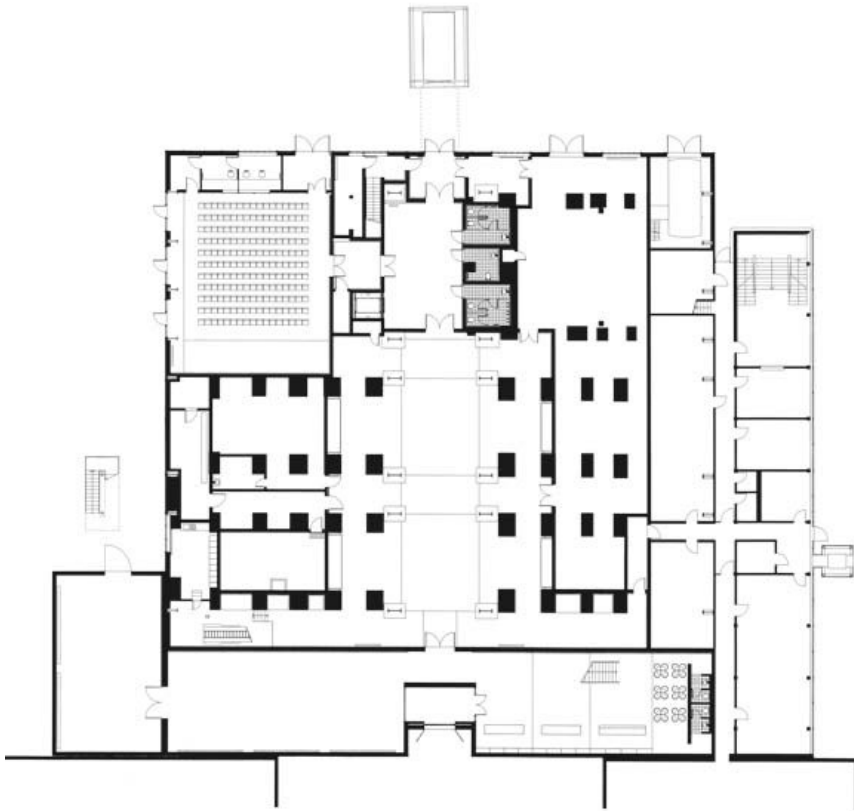
One of the examples, presented by Brooker & Stone (2004), in the 'insertion' category is the conversion of the colliery power plant in Essen, Germany, into German Design Centre. The 5 000 m² power plant, built in 1932, was converted into museum, gallery and offices by Foster Associates in 1997 (Figure 3.27).

The power plant is a part of the Zeche Zollverein, Ruhr valley, the biggest industrial area in Europe, near Essen. This complex is a redundant early-twentieth-century coal-mining complex designed on a colossal scale. The production was stopped in 1986 as the coal production became uneconomical. For 10 years the local authorities did not have the future vision for the site development. However, they bought it from the former owners and declared it part of the industrial heritage of Germany. The central piece of the industrial complex is the red-painted powerhouse with exposed-steel I-beams, and an infill of industrial glazing and red brick. The strategy of the Foster Associates was to adapt this cathedral-like building without fundamentally altering its character.

The first phase of the project was the restoration of the building's façade and removal of the later additions in order to reveal building's original form. One of the five original boilers was preserved as an example of 1930s technology, as well as the overall industrial character of the building. In order to create



Figure 3.27.
German Design
Centre, Essen,
Germany
(Source: Foster +
Partners, 1997)



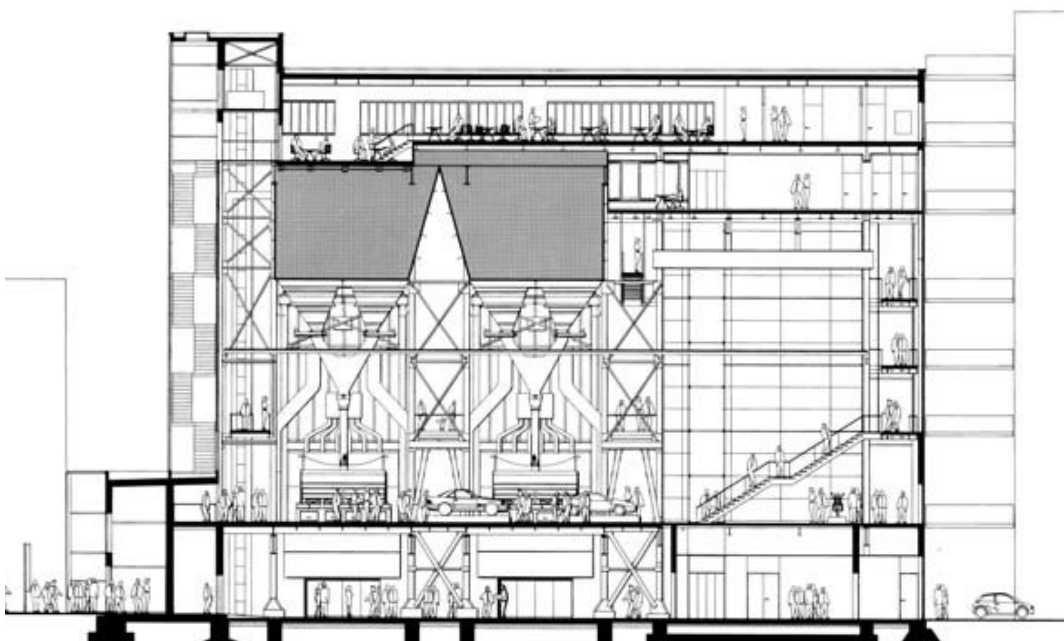
independent gallery spaces, the rest of the boilers were hollowed out and articulated as 'box within a box' while the unstable chimney was demolished. Conference rooms and flexible exhibition spaces were placed in a simple concrete cube (Figure 3.28.). The museum was literally inserted into the engine room of the coal mine. Interior space was left unrestored, and steel columns, beams and pipes were exposed. Thus, the atmosphere of the original building was completely retained (Figure 3.29.).

Figure 3.28.
German Design Centre, Ground Floor
(Source: Foster + Partners, 1997)

New circulation routes and display areas were inserted into the volume of the host building. In this way the original building remained relatively untouched, but its physical characteristics inform the placing of inserted objects. Newly introduced elements contrast the old building and are clearly distinguishable by the textures and finishes (Figure 3.30.). There is a rough transition between the original industrial elements and the sleek, modern newly introduced elements (Brooker & Stone, 2004).

Figure 3.29.
German Design Centre, Section through the boiler house
(Source: Foster + Partners, 1997)

Both the old building and the new element are equally present and dominant. Although the size and the placement of the new elements depend on the physical characteristics of the old building they are both equally strong and expressive. The project of the German Design Centre was evaluated according to the criteria for the analysis of the recycling design principles in the following way:



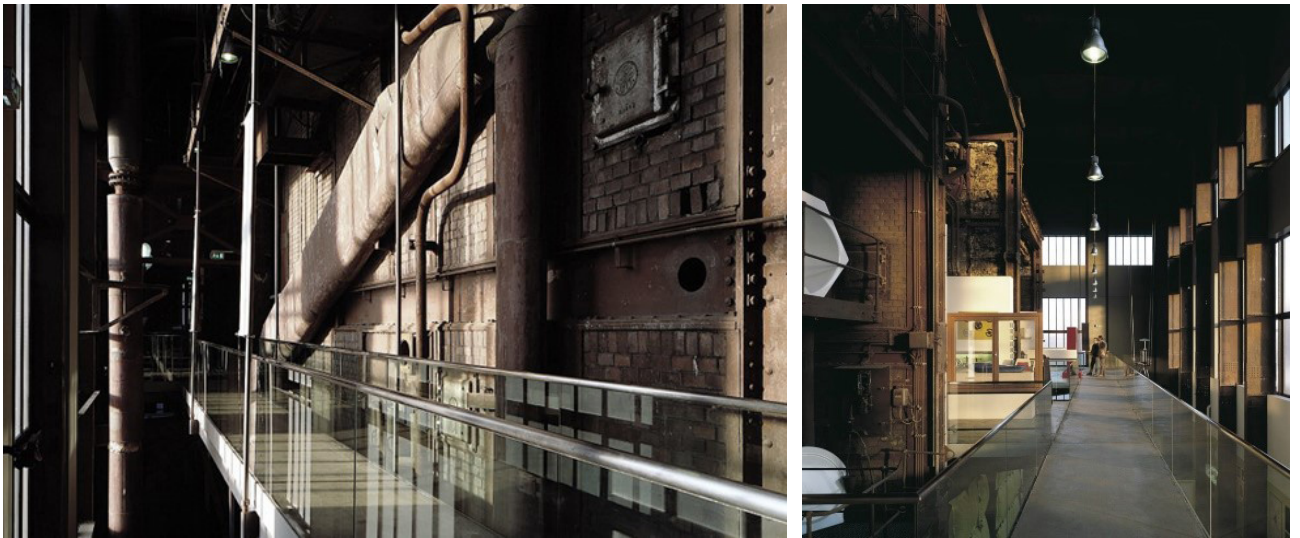


Figure 3.30.
German Design
Centre, Inserted
circulation routes
(Source: Foster +
Partners, 1997)

- Structure:
 - New structure added, dependent on the old structure
- Material:
 - Exterior:
 - Old and new materials are completely interwoven
 - Interior:
 - Clear division between the old and new materials
- Form:
 - Formal logic of the old building is respected-unchanged, no new elements are added
- Spatial organization:
 - Spatial logic of the interior spaces is preserved and unaltered

Installation

According to Brooker & Stone (2004) 'installation' is a process where the elements of remodelling exist independently from the building, i.e. the two simply touch each other. The authors explain that new elements, introduced through this process, are usually dictated by the style or the passion of the commissioned architect or artist. The level of autonomy of the new element is the highest when the design principle of 'installation' is applied. Not only a single element, but a group or series of elements can be introduced to the context of an existing building. These elements are usually of limited size, have a temporary, exhibition character, and do not alter the space in any way. In this process the two are successfully combined without compromising or interfering with each other (Brooker & Stone, 2004). This design concept implies almost no physical modification of the host building. The original building can be repaired or restored but these changes are not related to the new elements. The host building can be seen as a stage for the performance of the new objects which actually expose and reveal the beauty, qualities and possibly



Figure 3.31.
Morton Duplex,
Manhattan, New York
(Source: Warchol,
2000)

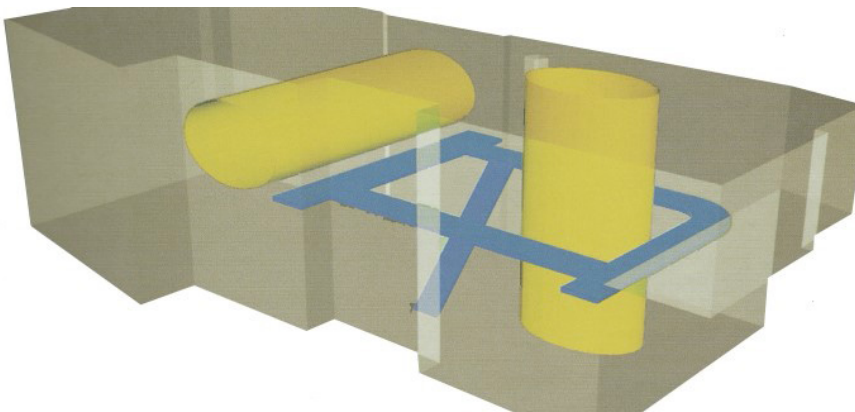
hidden or lost character of the building (Brooker & Stone, 2004). According to the authors, one of the representatives of the design principle of ‘installation’ is the Morton Duplex in Manhattan, New York, completed in 2000, by LOT/EK Architects (Figure 3.31.). This New York based practice is known for its use of ready-mades, industrial containers and other found materials for the creation of spaces. They are internationally recognized for their concept of creating architecture at all scales with shipping containers, making them a building block of highly conceptual buildings for cultural, institutional, commercial, or residential use.

Two petroleum lorry containers were placed in the fourth floor of the former parking garage to create the Morton Duplex. These tanks, cut in two sections, host private arias within the apartment, leaving the rest of the space undivided. As the open plan garage has a relatively high ceiling, architects were able to place one tank, which hosts two bathrooms, one on top of the other, vertically from floor to ceiling. The other tank, containing two sleeping pods, was placed horizontally over the living room (Figure 3.32.). Large doors, operated by hydraulic action, were cut from either side of the tank. In the interior of the tank all plumbing is exposed. A fire escape ladder and raised walkway, made from steel and clear resin, provide access to the mezzanine level (Figure 3.33.). The size of the available space of the original building conditions the scale and the position of the new elements, i.e. the containers are trimmed to fit (Figure 3.34.). Brooker and Stone (2004) highlight that although the previous use of the host building, – parking garage, might have influenced the choice for the new objects, – petroleum lorry containers, the ‘installation’, beyond any doubt, embodies the ideology of the commissioned architect.

Figure 3.32.
Morton Duplex, Tank
placement scheme
(Source: LOT/EK,
2014)

This design principle implies the most dynamic relationship between the old and the new. The newly introduced elements stand out, their architectural style, formal logic and materialization are at odds with the original building. The evaluation of the Morton Duplex

project has been executed according to the criteria for the analysis of the recycling design principles in the following way:



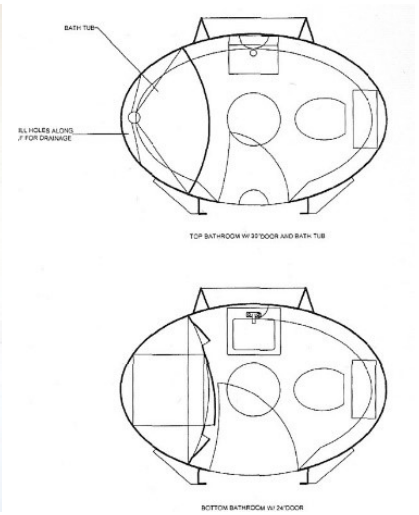


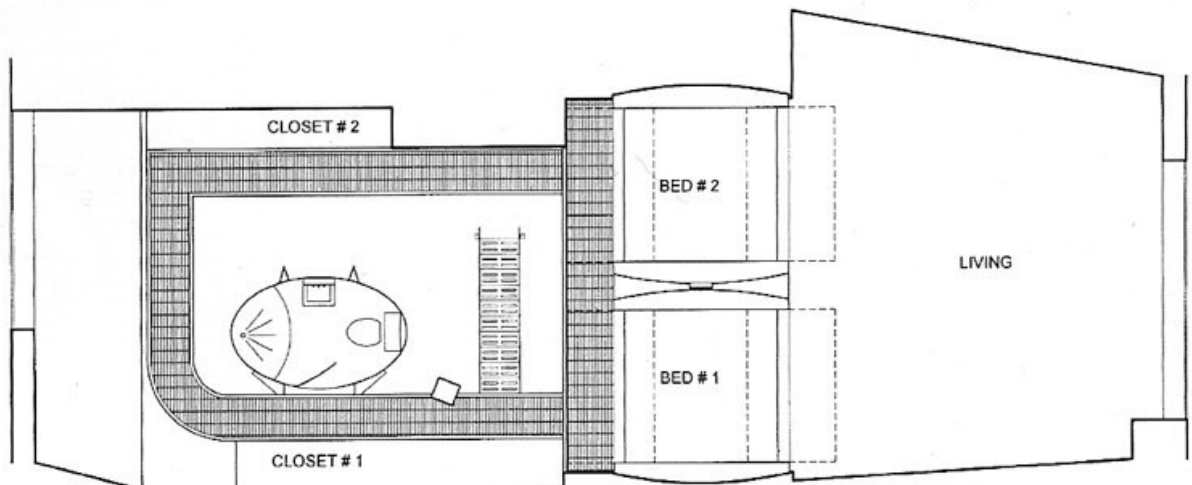
Figure 3.33.
Morton Duplex,
Interior view and the
bathroom tank detail
(Source: LOT/EK,
2014)

- Structure:
 - New structure added, dependent on the old structure
- Material:
 - Exterior:
 - Old and new materials are completely interwoven
 - Interior:
 - Clear division between the old and new materials
- Form:
 - Formal logic of the old building is respected-unchanged, no new elements are added
- Spatial organization:
 - Spatial logic is altered but depends on the host building

• • •

The design concepts of ‘intervention’, ‘insertion’ and ‘installation’ defined by Brooker and Stone (2004) are determined by the relationship between the original and the new building, i.e. the ‘host’ and the ‘intruder’. Depending on the level of the autonomy of the new elements, the recycling projects fall into one of the described categories. This autonomy has been analysed on two levels: 1) in structural-material terms, as the extent to which the new structure is dependent on the old one and new and old materials are interwoven, and 2) formal-spatial terms, as the level to which the original building’s form and spatial organization influenced the newly introduced elements.

Figure 3.34.
Morton Duplex,
Plan-mezzanine
(Source: LOT/EK,
2014)



‘Intervention’ is defined, by Brooker and Stone (2004), as the process which transforms the host building, while new and old elements become completely dependent upon each other. Through this process the original building may be changed. Nonetheless, these changes are informed by the original building – its volume, scale, geometry, and in this process old and new become one. However, in the project selected as one of the representative examples of this design principle – Museum Küppersmühle by Herzog and de Meuron, it is clear that the intervention executed on the façade of the building disrupts the symmetry of the host building and changes its appearance. Inside of the building, a number of floors were removed to provide space for large art pieces. The new element was added in front of the building, - staircase in a form of a prismatic tower, which introduces the new architectural style. It is not clear to which extent the original building can be changed and still fall into this category, but it is evident that all the changes were influenced by the physical characteristics of the old building. In terms of materials used, the materialisation of all the new elements is clearly distinguishable from those of the old settings. In structural terms, new elements depend on the host building.

‘Insertion’ is defined as a process through which a building accommodates new elements, build to fit, but stays very much unchanged. Its exterior remains largely intact, but interior space is subjected to substantial change. Just like in the previous category, the new elements depend on the particular qualities of the host building, yet they have a much greater level of independency and can be even confrontational. The most obvious difference is in material expression as this design principle implies a clearest possible distinction between the old and new. Structurally the inserted elements can both rely on the old building for its support, and can also be structurally independent, without touching the existing structure.

‘Installation’ implies complete separation of old and new, they simply coexist together and very little rapport is established between them. Like with the design principle of ‘insertion’, new elements can be structurally dependent or independent from the host building. In material terms new and old are completely at odds, and have their own formal logic, independent from the original building. Yet the scale and dimensions of the new elements depend on the host building as these elements are usually installed into the old building.

It can be concluded that the design principle of ‘intervention’, even though it allows for a substantial change and disruption of the old building, implies the predominance of the old building as all the characteristics of the new elements depend on the character of the host building. Second design principle, ‘insertion’, preserves the image of the old building but changes substantially its inner spaces, making both old and new equally present and dominant. The third design concept, ‘installation’, implies the highest autonomy of the new elements, both materially and structurally, even though its scale and dimensions depend on the old building’s physical characteristics.

3.2.2. Add-On, Inside-Out, Change Clothes

Lucas Feireiss and Robert Klanten in their study, “Build-On: converted architecture and transformed buildings” (Feireiss & Klanten, 2009), made a collection of contemporary conversion practice in architecture that brings new purpose and function to existing structures. Variety of projects, from radical renovations and adaptations of industrial structures, to individual reconversions of bunkers or abandoned churches are presented as examples of creative transformations of existing structures. The projects selected in this study mark a clear shift within the discipline of architecture, where conversion projects, as well as the design and construction of new buildings from the ground up are regarded as equal (Feireiss & Klanten, 2009). According to the same source, the aim of the study was to prove that some of the most spectacular examples of contemporary architecture can be discovered while working with already existing buildings. Three design concepts are recognised by the authors and, thus, the selected projects are classified under three categories: ‘add-on’, ‘inside-out’, and ‘change clothes’. The first category deals with projects that are adding new elements to the original building. The second category, as its name suggests, presents projects that change the interior of the host building, leaving their original appearance largely intact. The final category is the selection of architectural works that entirely change the original building both programmatically and aesthetically. The analysis and the evaluation of these design principles is presented below.

Add-On

Design principle of ‘add-on’ demonstrates the possibilities of adding architecturally onto existing building. Projects that introduce new elements which extend, penetrate and superimpose onto already existing ones are representatives of this design concept. Great variety of projects are presented in this category, from small scale adding’s to interventions that, by adding new elements, completely change the image of the original building. One of the projects presented in this category, which determines a very dynamic relationship between the old and the new is the *CaixaForum* project in Madrid, Spain, by Herzog and de Meuron. The museum, acquired by the Caixa Foundation in 2001, is housed in a converted 1899 Jesus Carrasco-Muñoz’s power station (Figure 3.35).

Figure 3.35.
CaixaForum, Madrid,
Spain
(Source: Marquez
Cecilia & Levene,
2010)



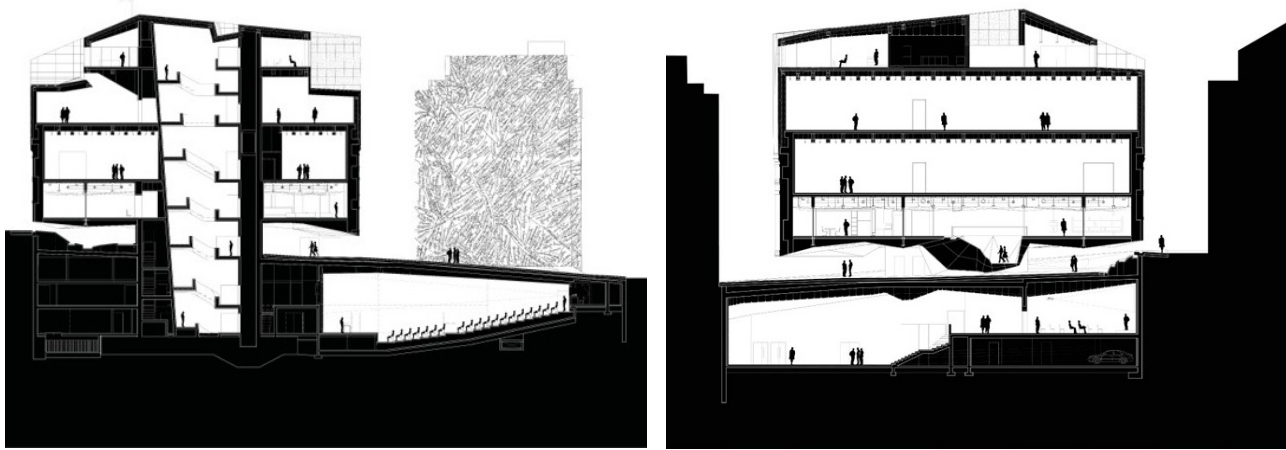


Figure 3.36.

Left: CaixaForum, Section through the staircase

Right: CaixaForum, Section through the plaza

(Source: Marquez Cecilia & Levene, 2010)

Architects explain that the only material of the old power station that they could use was the classified brick shell (Marquez Cecilia & Levene, 2010). The project began with the 'surgical operation' of separating and removing the base and some parts of the building (Figure 3.36. Left) in order to insert the new architectural components of the CaixaForum (Marquez Cecilia & Levene, 2010).

A tense relationship was created between the brick and iron and the removal of the ground floor. In order to further abstract the original building and strengthen its image as a monolithic form, architects filled in the windows. As the building was to become the public building, architects decided it was necessary to create a public space, a small plaza which would enable the structure to breathe. The power station was supported on three concrete cores and granite base was removed to create a covered open space (Figure 3.36. Right).

By removing the base of the building, a covered plaza under the brick shell was created, which appears to float above the street level. This space provides shade to visitors and is at the same time the entrance to the Forum itself (Marquez Cecilia & Levene, 2010). The decision to create a covered plaza also solved a number of problems, such as the narrowness of the surrounding streets, the placement of the main entrance, and the architectural identity of this contemporary art institution (Marquez Cecilia & Levene, 2010). Two underground floors are holding the conference rooms and a large auditorium, while the upper floors hold galleries, restaurant and administrative offices. All floors are connected by a ceremonial, concrete, spiral staircase (Figure 3.37).

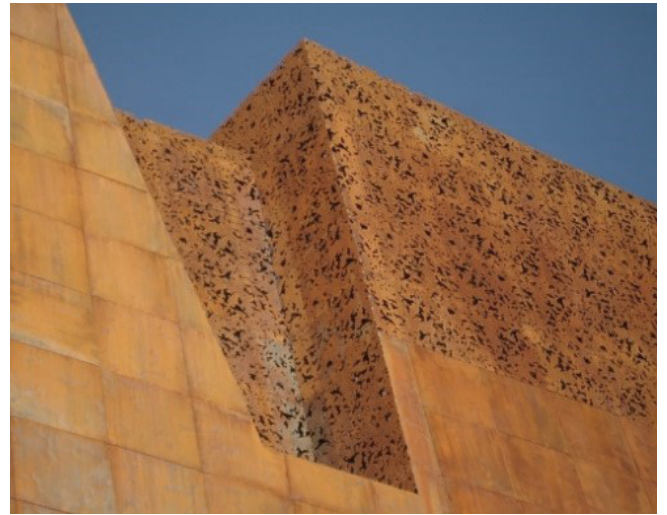
Figure 3.37.

CaixaForum, Spiral staircase

(Source: Marquez Cecilia & Levene, 2010)

There is a clear contrast between the flexible and loft-like character of the exhibition spaces and the spatial complexity of the top floor with its restaurant/bar and the offices. The building was extended upwards in cast iron. The powerful rusty addition was shaped so that it matches the volumes of the surrounding roofscape (Figure 3.38).





The CaixaForum project has been evaluated according to the criteria for the analysis of the recycling design principles in the following way:

- Structure:
 - New structure added, dependent on the old structure
- Material:
 - Exterior:
 - Clear division between the old and new materials
 - Interior:
 - Clear division between the old and new materials
- Form:
 - Formal logic of the old building is disrupted
- Spatial organization:
 - Spatial logic of the host building's interior spaces is completely changed

Figure 3.38.
CaixaForum, Roof
design
(Source: Marquez
Cecilia & Levene,
2010)

Inside-out

Feireiss and Klanten (2009) explain that projects gathered under the category 'inside-out' respect and preserve the host buildings appearance, leaving it largely intact, but alter fundamentally its interiors. This design principle therefore implies small changes to the host building's exterior but large remodelling of its interior spaces.

One of the examples belonging to this category is the Haworth Tompkins's Temporary Theatre space created in a derelict power station in London in 2000. The Almeida Theatre needed a temporary venue for its large scale productions and managed to negotiate a one year lease on a former power station from the developer. The task of converting a power station into a theatre was given to Haworth Tompkins, who was to carry out the project for the lowest possible cost.

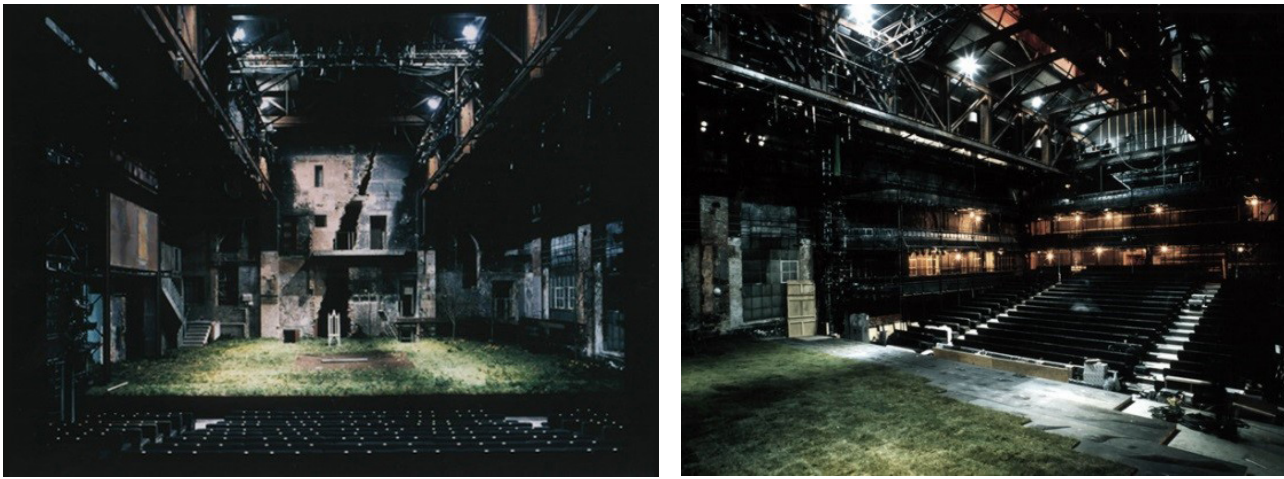


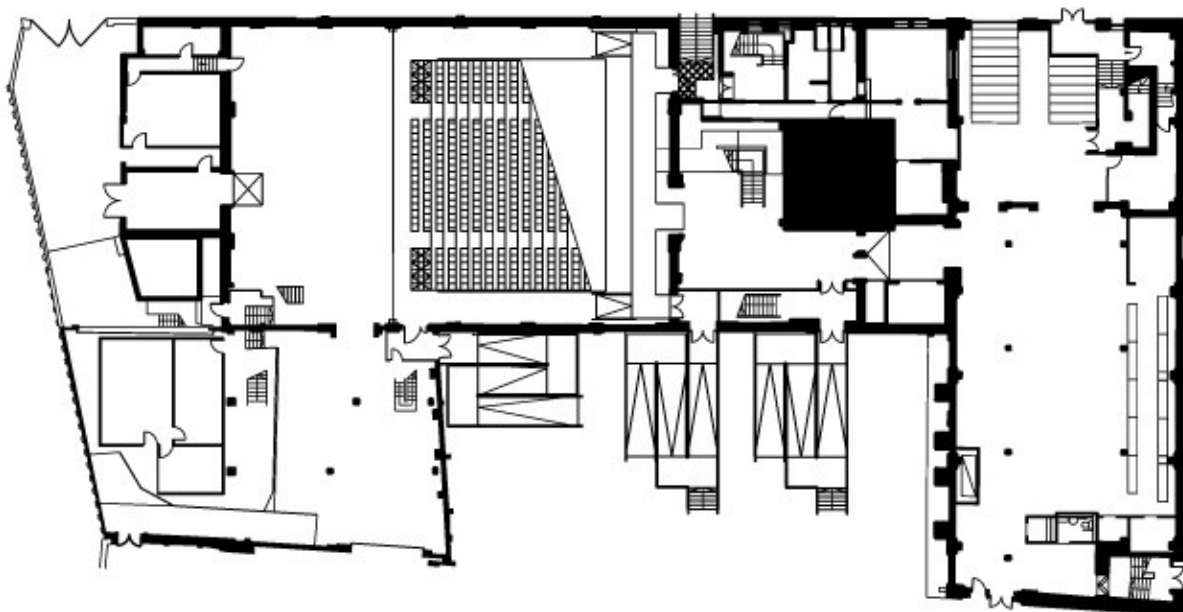
Figure 3.39.
Almeida Temporary
Theatre, London, UK,
(Source: Photograph
of the Almeida
Theatre interior space,
2014)

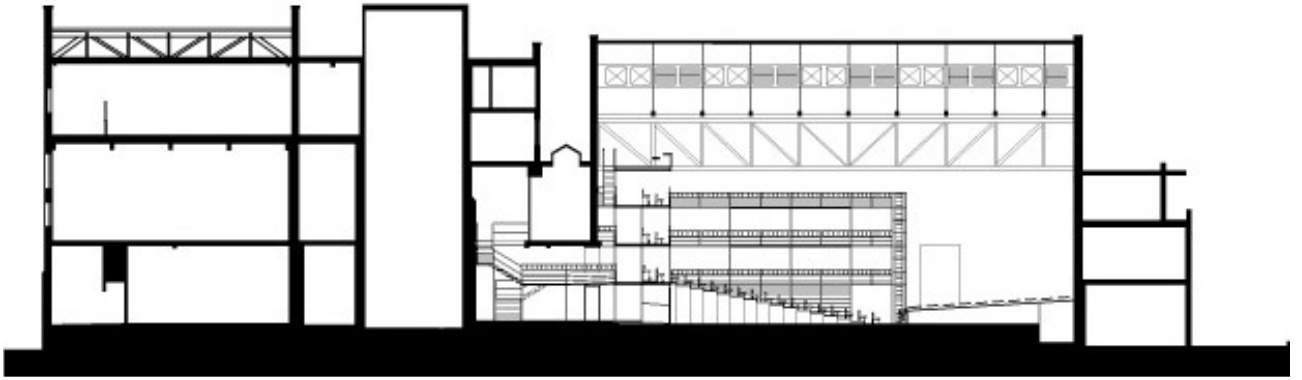
By demolishing an intermediate floor, the great turbine hall was returned to its original volume and the single space with the height of over 25m was created (Figure 3.39.). A large courtyard auditorium was made by installing basic soundproofing and by placing a simple scaffold seating system (Figure 3.40.). According to Feireiss and Klanten (2009), in this project the maximum effect was achieved with a minimum of means. According to the same source an intimate stage and auditorium were created by allowing the old building to become an integral part of the performance (Feireiss & Klanten 2009).

The building was treated almost entirely as ‘found’. The only alterations to the original building fabric were in a form of a simple cut openings and introduction of ramps and staircases, necessary for the completion of complex fire escape and circulation requirements for an audience of 900 (Figure 3.41.). The essential part of the design strategy was to preserve the sense of discovery and risk one feels on first entering a derelict building.

Therefore, this design concept implies a minimal change to the original host building’s external appearance but allows large changes to the building’s interior. The host building’s presence and identity is largely preserved. Alterations done to interior spaces were always informed by the host building itself. Original building’s proportions and dimensions determine the outcome of the intervention. The evaluation of the Haworth Tompkins’s Temporary Theatre project, according to the criteria for the analysis of the recycling design principles, has been conducted in the following way:

Figure 3.40.
Almeida Theatre,
Floor plan
(Source: Drawing of
the Almeida Theatre
floor plan, 2014)





- Structure:
 - New structure added, independent from the old structure
- Material:
 - Exterior:
 - Old and new materials are completely interwoven
 - Interior:
 - Clear division between the old and new materials
- Form:
 - Formal logic of the old building is respected-unchanged, no new elements are added
- Spatial organization:
 - Spatial logic of the interior spaces is preserved and unaltered

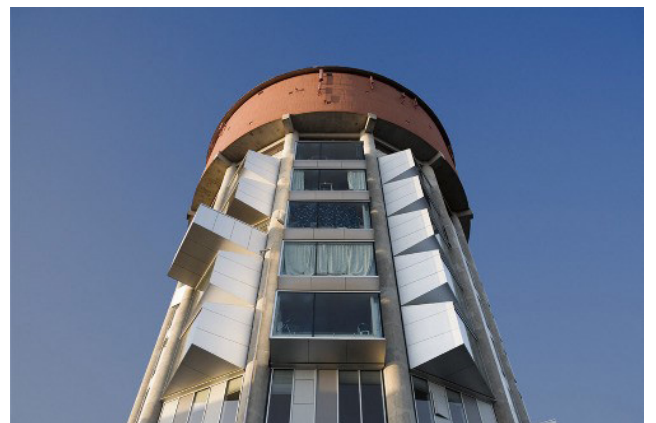
Figure 3.41.
Almeida Theatre,
Longitudinal section
(Source: Drawing of
the Almeida Theatre
section, 2014)

Change Clothes

The third design concept described by Feireiss and Klanten (2009) implies the highest level of transformation of the host building, both of its exterior and interior, programmatically and aesthetically. In this category the projects that entirely change the appearance of the original building are selected. The new intervention has the predominance and the original building's appearance is entirely changed.

One of the examples classified under this category is the *Jægersborg Water Tower* in Ørnegårdsvej, Denmark (Figure 3.43.). Dorte Mandrup Architects won a competition in 2004, and were given the task of transforming the water tower into a mixed-use building comprising a youth centre and small apartments. The architects recognised the strong identity of the tower and its importance as a landmark and decided to preserve the original structure with water tank on the top and twelve peripheral columns. The water tower,

Figure 3.42.
Jægersborg Water
Tower, Ørnegårdsvej,
Denmark
(Source: Eskerod,
2006)



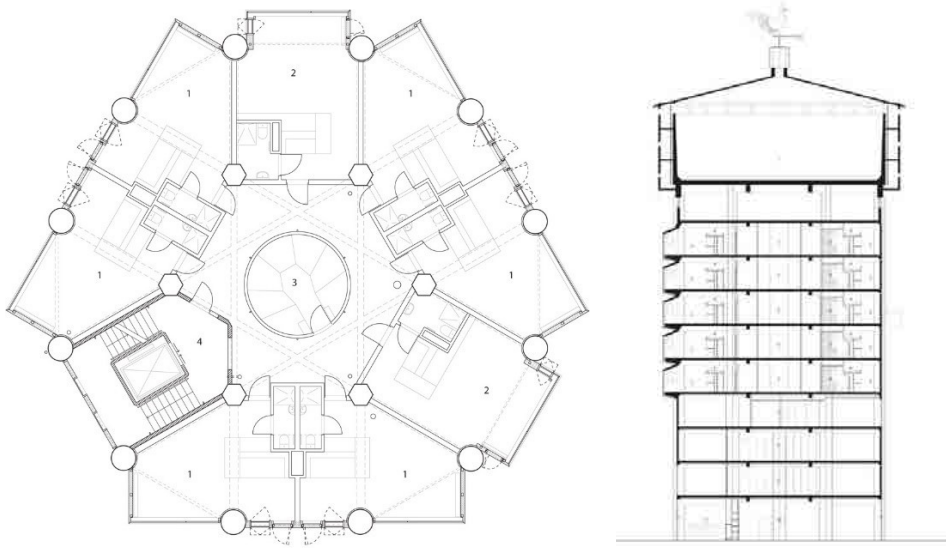


Figure 3.43.

Jægersborg Water Tower, Floor plan – 7th floor and cross section

(Source: Drawing of the Jægersborg Water Tower, floor plan and section, 2014)

reinforced by a concrete beams, between the columns, in a complex geometric star-shaped pattern. In 2006 Dorte Mandrup Architects converted this structure into 1600 m² of student housing and 1280 m² of day care facilities.

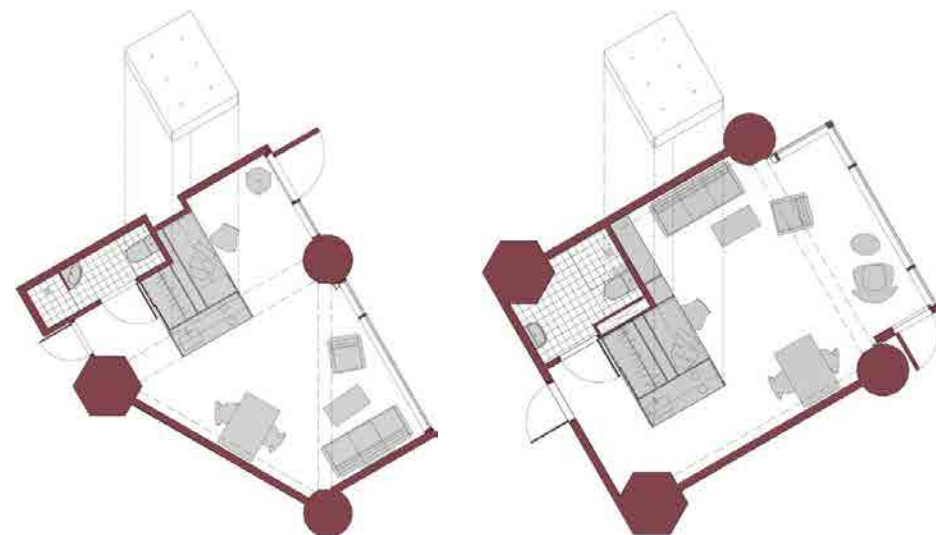
The centre of the structure was left as a common space and storage units around which the residential units were laid out. Each unit is clearly visible, expressed by bay window in a form of a protruding crystal which offers views, brings light deep into the apartments and provides extra space in the small dwellings. The youth centre on the lower floors is divided into large multi-purpose rooms. The ground floor is conceived as a flexible space and can be used for different physical activities. A significant amount of daylight was provided by large windows from floor to ceiling. On the second floor there is a mini club and on the third administration. The 36 youth apartments are arranged from the 4th until the 8th floor (Figure 3.44.). Access to all floors is provided by elevator and original stairs used in case of emergency. The heavy structure, the height of the ceiling and the free plan made the conversion of the water tower possible.

Figure 3.44.

Jægersborg Water Tower, Apartment type A and B

(Source: Drawings of the Jægersborg Water Tower apartment units, 2014)

On the other hand, different spaces needed to be designed in order to solve the problem of a complex geometry. Two type of apartment units, A and B, of 32 m² and 36 m², were conceived and distributed over five storeys (Figure 3.45.). Common spaces with balconies were placed on the 4th, the 6th and the 8th floor. Due to the small floor area and in order to create more free space, the kitchen, bathroom, wardrobe and a small work space were all placed in one large service box-like unit. On top of this unit a bed was placed and even more free space was create. The position of the box together with the bay window defines the space of the apartment.



built in the 1950s, was a large scale structure made of twelve external and six internal concrete columns. These columns carry not only the large circular water tank but serve as a load bearing system for nine concrete floors. The floors are

reinforced by a concrete beams, between the columns, in a complex geometric star-shaped pattern. In 2006 Dorte Mandrup Architects converted this structure into 1600 m² of student housing and 1280 m² of day care facilities.

According to the criteria for the analysis of the recycling design principles the Jægersborg Water Tower project has been evaluated in the following way:

- Structure:
 - New structure added, dependent on the old structure
- Material:
 - Exterior:
 - Clear division between the old and new materials
 - Interior:
 - Clear division between the old and new materials
- Form:
 - Formal logic of the old building is disrupted
- Spatial organization:
 - Spatial logic of the host building's interior spaces is completely changed

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It can be concluded that the relationship between the old and the new was the leading criteria in determining the categories ('add-on', 'inside-out' and 'change clothes') in Feireiss and Klanten's study "Build-On: converted architecture and transformed buildings". The design principle of 'add-on' implies all types of addition that can be executed upon the existing structure. This category is very broad, it contains both projects that simply restore the original structure, by adding elements that follow the formal logic of the original building, and also projects that almost completely change the face of the original building. The project selected as the representative of this design concept, CaixaForum in Madrid, shows that completely different architectural approach was used for the reconversion, both in material, formal and structural terms. The interior of the old building was also substantially changed.

The second category, 'inside-out', according to Feireiss & Klanten (2009), contains projects that change fundamentally old building's interior, but leave its exterior and appearance unchanged. The original image of the building stays almost intact. However, in one of the selected projects for this category, Haworth Tompkins's Temporary Theatre, the new intervention was completely conditioned by the old building's spatial logic. New elements were simply placed in the open space of the derelict power station. New auditorium was made by following the spatial organization of the old building. Thus, it can be concluded that this design concept implies minimal change to the building's exterior and interior

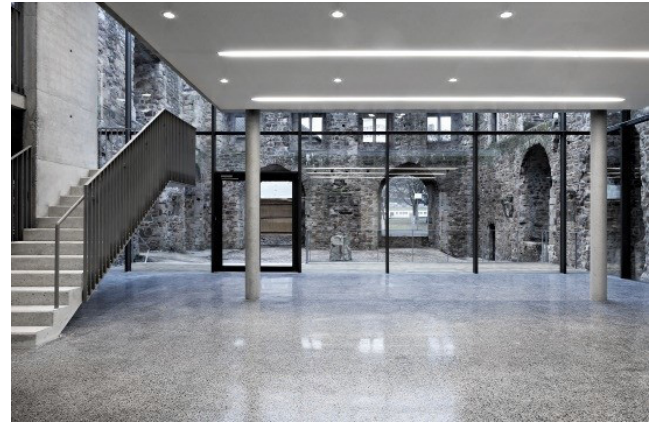
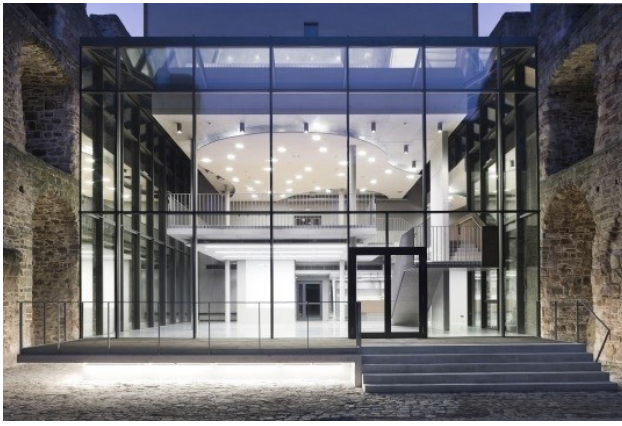
as well, which contradicts the original definition of the 'inside-out' design principle. Therefore, if any changes are made, they are always informed by the old building itself. New elements can be both structurally independent from the old building, following its own spatial logic, or dependant on it, respecting the host building disposition of spaces. Nevertheless, as the new intervention is conducted within the host building, its scope, dimensions, rhythm and scale is completely dependent on the physical characteristic of the host building itself.

The third design principle, 'change clothes', implies the predominance of the new structure. The level of autonomy of the new element is the highest here. This concept implies change not only to the building's interior but exterior as well, changing its appearance completely. However, unlike the principle of 'installation', which confines the change mainly to the building interior, this principle allows for the new element to break the formal logic of the host building's exterior as well. The selected project for this category, Jægersborg Water Tower, clearly shows that, in order to gain more space, apartments units were allowed to protrude from the old building's envelope. Even though this design principle should entirely change the face of the original building, in this project it is evident that the importance of the host building was recognised and its landmark qualities and appearance preserved.

Although the relationship between the old and the new was the leading criterion for the definition of the above analysed design principles, it cannot be said that the predominance of the new elements, i.e. structural, material, formal and spatial independence, escalates from one principle to the other. New elements are executed in materials clearly distinguishable from the old in all three categories. Both the design principle of 'add-on' and 'inside-out' allow for a change of the old building interior. The design concept of 'change clothes', just like the 'add-on', allows for the change of the building's formal logic as well, but should imply the higher level of change to the building fabric. In terms of structural, material, formal and spatial relationship between the old and the new, these two principles are remarkably similar. There is no clear difference in structural dependence of new and old structural elements between these three design principles.

3.2.3. Addition, Transformation, Conversion

In his study, "Old & New: Design manual for revitalizing existing buildings", Frank Peter Jäger (2010) made a classification of design concepts that illustrate a range of different approaches to dealing with existing buildings. Selected projects were grouped in three categories, 'addition', 'transformation' and 'conversion', corresponding to three design principles. According to Jäger (2010: 10), the main criterion for the project selection in his study was their architectural quality, and originality i.e. "a successful and multifaceted connection to 'place' was one consideration, and the conceptual maturity of the treatment of the existing fabric another".



Addition

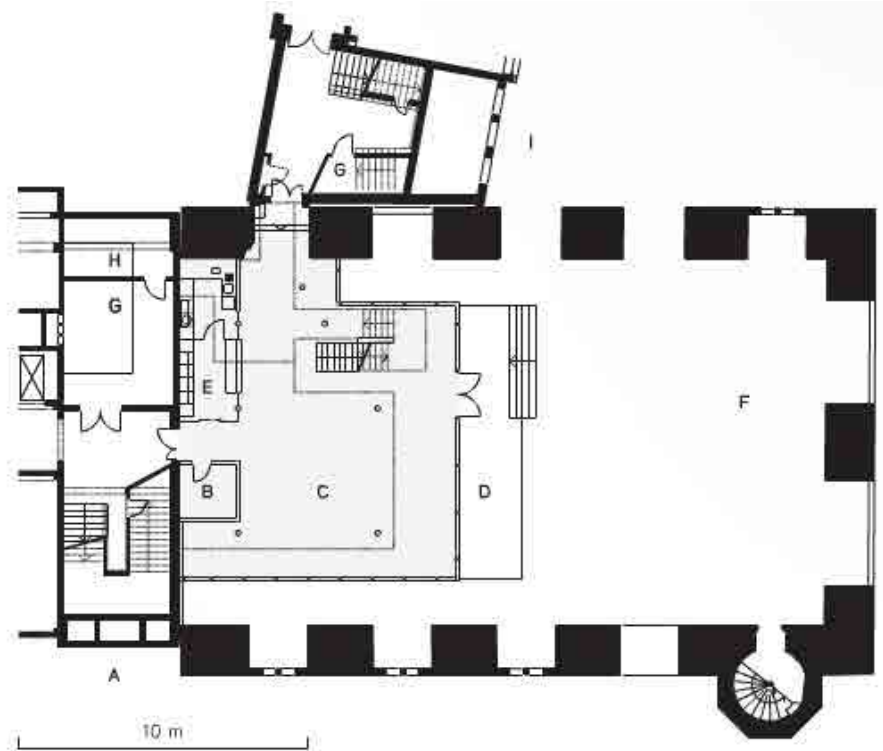
Design principle of ‘addition’ summarizes a multitude of measures, from extending, adding stories, enlarging, integrating until supplementing, rounding off, or enclosing. Upgrading a building, enhancing its appearance and gaining more space is the main aim of this design concept, which consequently leads to merging and creation of unity between the old and new building (Jäger, 2010). The host building informs the new elements. New and old complement each other even though some rough transitions could be created (Jäger, 2010). The author explains that coexistence between new and old is created when the design principle of ‘addition’ is applied. Host building and new element are of the same importance and strength. The new does not overpower the old. One of the selected examples of the design principle of ‘addition’ is the Cafeteria in the *Zeughouse* ruin, by Hans Joachim Neukäter, in Kassel, Germany, built in 2008 (Figure 3.45.). *Zeughouse* is a war-damaged, historical armoury in the city of Kassel, Germany, built in 1582. In 1943, due to the fire, only the external walls of the *Zeughouse* remained.

Figure 3.45.
Cafeteria in the
Zeughouse ruin,
Kassel, Germany
(Source: Jäger, 2010)

Two-thirds of the original building was demolished in 1970s to construct two vocational schools and four-story classroom blocks were added to the corner section of the ruin on two sides (Jäger, 2010). In 1991 external walls of the ruin were refurbished. When the decision was made to integrate a cafeteria into the ruin, Hans Joachim Neukäter designed a glass object, that was inserted into the ruin, which does not compete with the powerful outer walls of the ruin (Figure 3.46.).

Figure 3.46.
Cafeteria, Floor plan
(Source: Jäger, 2010)

The architect explains that three horizontal layers characterise the design concept: the layer of the cafeteria (ground floor); the mezzanine layer above ; and the roof layer (Figure 3.47.). The mezzanine level was created instead of the



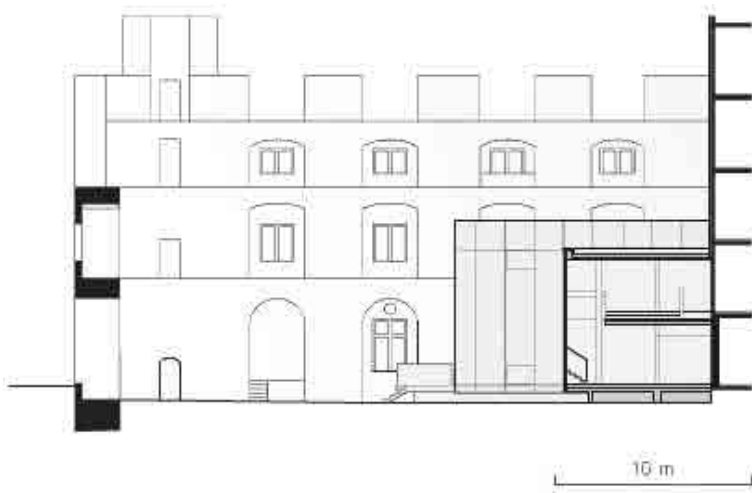


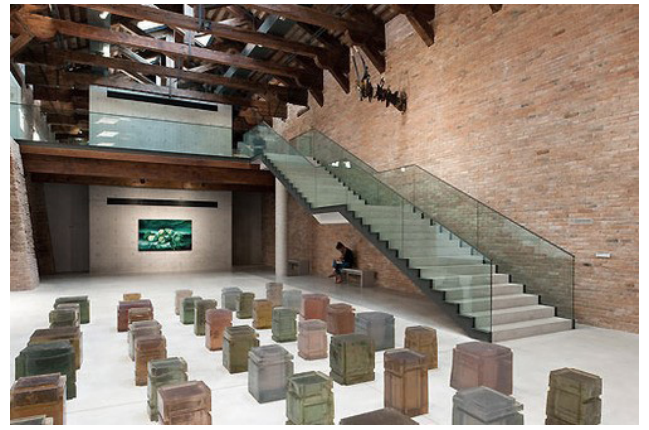
Figure 3.47.
Longitudinal section through the old armour and the cafeteria
(Source: Jäger, 2010)

second full story. In this way the new structure remained as light as possible and its materialization allowed views, from nearly every point, of external walls which were perceived as the real shell of the building (Jäger, 2010). The floor of the original structure, made of 15cm thick sandstone slabs, lies 60cm below the

terrazzo floor of the new building and is left untouched (Jäger, 2010).

Even though the new intervention is formally and materially different from the host building its characteristics are determined by the host building itself, by its scale, dimension, proportion, rhythm and structural composition. These are the factors that influence the character of the new elements. However, regardless of its dependence on physical characteristics of the host building, the new intervention uses clearly distinctive architectural approach in material and formal terms. New and old are clearly distinguishable, “the cafeteria and the ruin complement each other while maintaining their own identities” (Jäger, 2010: 31). The project of the Cafeteria in the Zeughouse ruin has been evaluated according to the criteria for the analysis of the recycling design principles in the following way:

- Structure:
 - New structure added, independent from the old structure
- Material:
 - Exterior:
 - Old and new materials are completely interwoven
 - Interior:
 - Clear division between the old and new materials
- Form:
 - Formal logic of the old building is respected-unchanged, no new elements are added
- Spatial organization:
 - Spatial logic of the interior spaces is preserved and unaltered



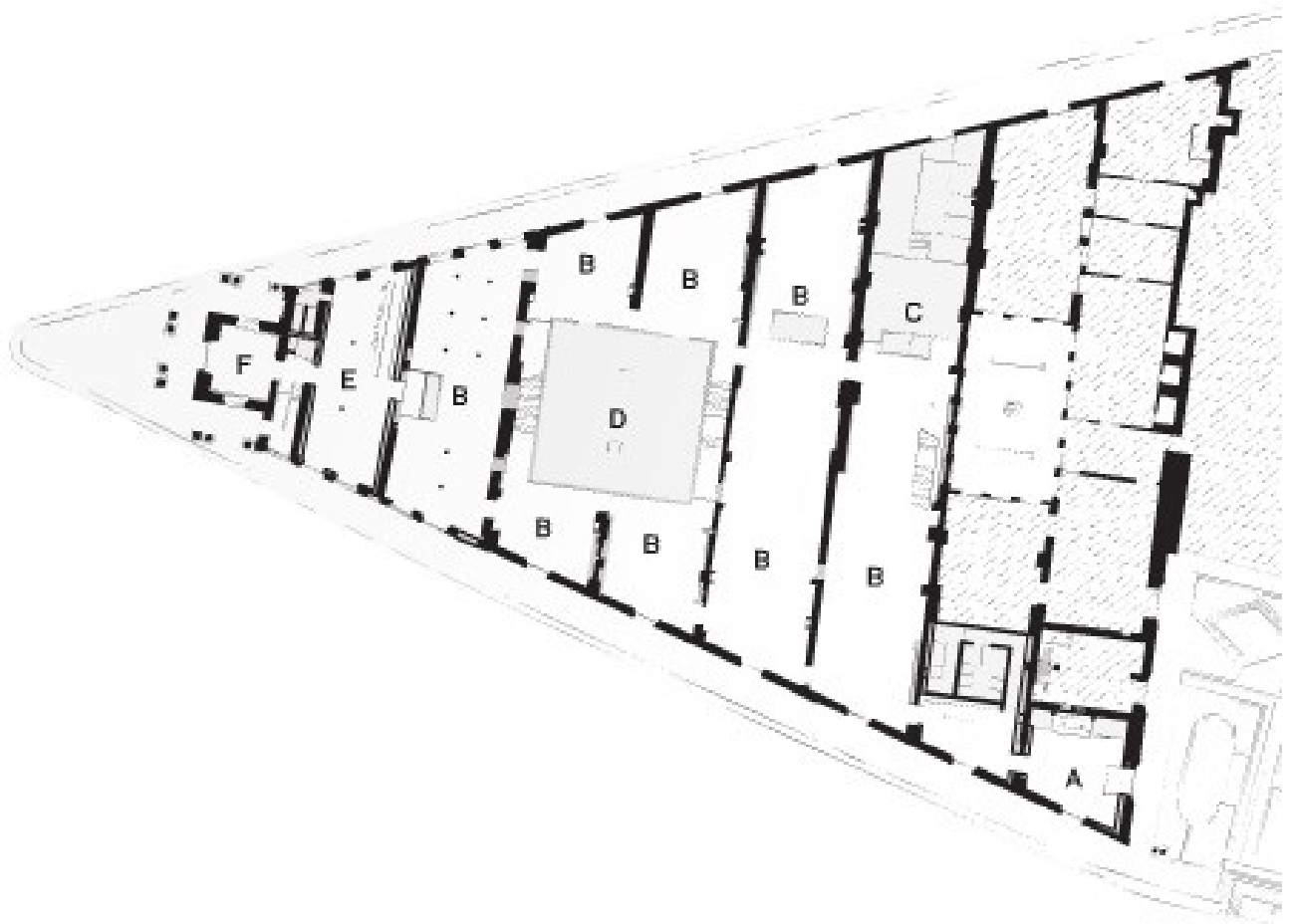
Transformation

The design concept of ‘transformation’ implies a more invasive approach to the original building. By applying this design principle the host’s building appearance is changed as well as its form and structure, thus the boundary between the old and new is dissolved as the change embraces a building in its entirety (Jäger, 2010). One of the examples presented in this category is the conversion of the seventeenth-century Venetian Customs Hall, “Punta della Dogana”, into an contemporary art museum, in 2009, by Tadao Ando Architects & Associates in Venice, Italy (Figure 3.48.).

The *Punta della Dogana* building has a simple and rational structure, and its triangle form directly corresponds to the shape of the tip of Dorsoduro Island. Interior space is divided into long rectangles by a series of parallel walls (Figure 3.49.). In order to recover its original form, at the very beginning of its construction, all partitions that had been added during previous renovations were thoroughly removed.

Figure 3.48.
Punta della Dogana,
Venice, Italy
(Source: Mayer, 2010)

Figure 3.49.
Punta della Dogana,
Site pan and layout
(Source: Jäger, 2010)



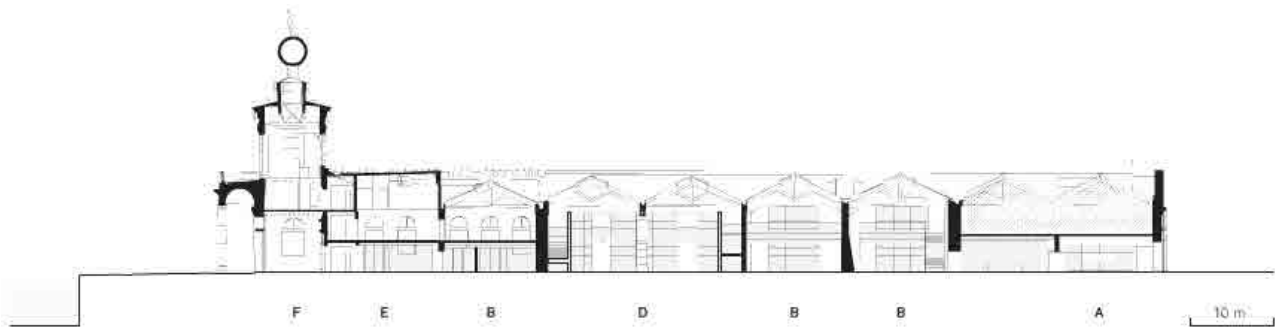


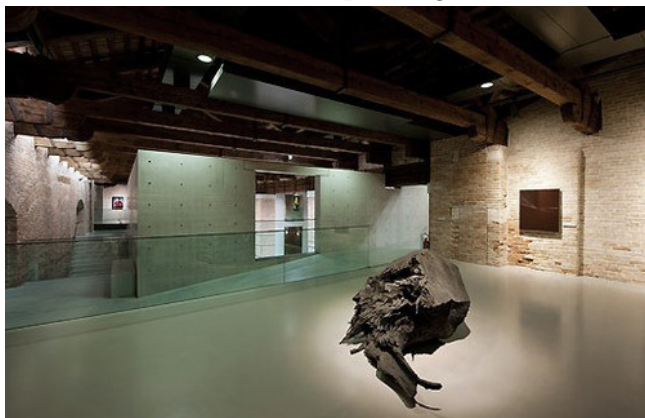
Figure 3.50.
Punta della Dogana,
Section through the
custom building
(Source: Jäger, 2010)

The external appearance of the building was left untouched, walls were left unsurfaced, and the stuccoed brick masonry of the outer walls was restored and secured with stainless steel anchors. Only where it was absolutely necessary, missing bricks were replaced using bricks that were as close as possible to the original ones (Jäger, 2010). The old timber roof structure was restored and a new roof was set atop, as a reminiscent of the original (Figure 3.50.). A concrete cube was placed in the centre of the Punta della Dogana, “a new heart of the building”, in a place where a dividing wall was removed (Jäger, 2010: 69).

Inside the building however, only the original structure remains and a clear contrast between the old and the new was created (Figure 3.51.). Ando used the porcelain-like, polished, exposed concrete and elements of steel and glass to clearly separate new intervention from the irregular brick walls and rough wooden beams of the host building (Jäger, 2010). According to the same source, in this project new and old elements maintain the balance and in that way the existing fabric and the new construction do not compete with one another (Jäger, 2010). Thus, by implying the design principle of ‘transformation’, only the building’s interior was changed, while greatly respecting the spatial logic and organisation of the old. According to the criteria for the analysis of the design principles the *Punta della Dogana* project was evaluated in the following way:

- Structure:
 - New structure added, dependent from the old structure
- Material:
 - Exterior:
 - Old and new materials are completely interwoven
 - Interior:
 - Clear division between the old and new materials
- Form:
 - Formal logic of the old building is respected-unchanged, no new elements are added
- Spatial organization:
 - Spatial logic of the host building’s interior spaces is altered but depends on the host

Figure 3.51.
Punta della Dogana,
Interior spaces
(Source: Mayer, 2010)





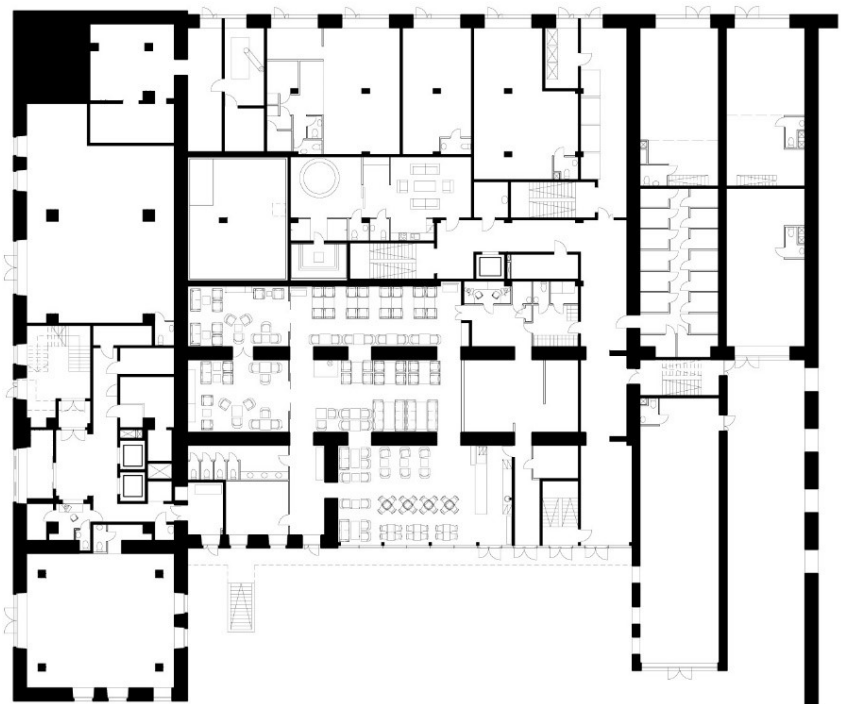
Conversion

Projects gathered in this category present wide variety of schemes in changing the original building function. Jäger (2010: 130) explains that “in all the examples featured here, the traces of the past become aesthetic backdrops for newly established uses”. The example chosen for the analysis, among projects selected in this category, is the Fahle Building (Figure 3.52). This project is a conversion of a former paper factory in Tallinn, Estonia, into apartments, with restaurants and office spaces in 2007 by KOKO Arhitektid. The Tallinn cellulose and paper factory produced 1/3 of the paper used in Russia, but in the beginning of 1990s (after the collapse of the Soviet Union) the factory went bankrupt and lost its function.

Many attempts were made, during ten years, to restore the factory buildings but without success. In 2004 the KOKO Arhitektid were given the task of turning the landmark boiling house into lofts by adding an extension. The objective of the project was to emphasize the factory building by adding a new, modern glass structure, on top of the old building, which would not try to blend in and would offer impressive panorama views. The original structure and perimeter walls were preserved and the spatial organization of the factory building was not altered by the new intervention (Figure. 3.53.). Jäger (2010: 134) underlines that KOKO’s design concept is convincing in its clarity, i.e. “by adding an additional six stories, the prominent location and the tower-like character of the imposing building have been emphasized and, in two senses of the word, overlaid”. The architects of the intervention explain that the new glass addition was built on top of concrete poles within the existing building and that the flooring of the upper floors is made of console plates from which the facade hangs (Figure 3.54.). In material terms, there is a clear separation between the old limestone brick wall and the new glass addition.

Figure 3.52.
Fahle Building,
Tallinn, Estonia
(Source: KOKO, 2007)

Figure 3.53.
Fahle Building,
Ground floor plan
(Source: KOKO, 2007)



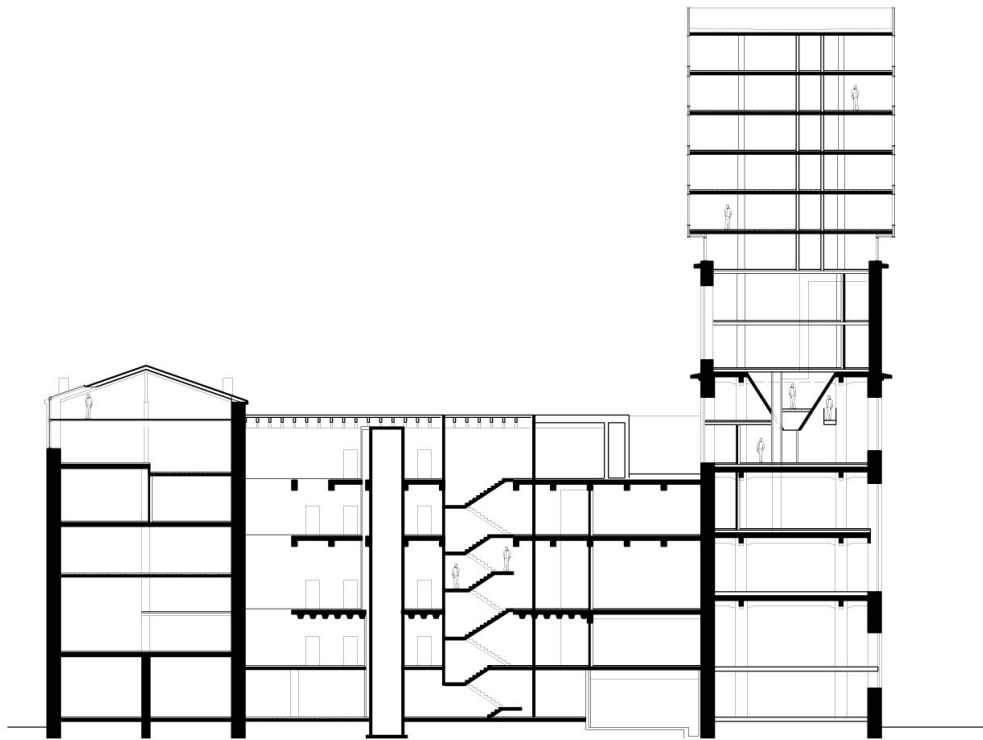


Figure 3.54.
Fahle Building, Cross
section
(Source: Jäger, 2010)

Jäger (2010) notices a subtle transition to the newly added stories marked by setting the ninth floor back one meter behind the edge of the stone façade. He explains that “the setback elegantly establishes a spatial joint between old and new, and also corresponds to the two main cornices of the historical building that serves as a base” (Jäger, 2010: 134). Even though the new intervention follows the formal logic of the host building, in material terms they are completely distinct. Thus, the new intervention is clearly separated from the old building. The Fahle Building project has been evaluated according to the criteria for the analysis of the design principles in the following way:

- Structure:
 - New structure added, independent from the old structure
- Material:
 - Exterior:
 - Old and new materials are completely interwoven
 - Interior:
 - Clear division between the old and new materials
- Form:
 - New elements are added respecting the old building’s formal logic
- Spatial organization:
 - Spatial logic of the host building’s interior spaces is altered but depends on the host

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According to Jäger (2010), the main criterion for the classification of selected projects in his study, “Old & New: Design manual for revitalizing existing buildings”, was the architectural quality and maturity of the treatment of the existing building. Like in previously analysed cases, three categories have been determined, addition – transformation – conversion, each one corresponding to a different level of independency of the new elements.

Jäger’s first category, ‘addition’, implies a multitude of architectural actions that change the original building. However, these actions are always informed by the host building itself. In material terms new and old can be strictly divided, as seen in the selected example for this category - Cafeteria in the Zeughouse ruin. Exterior of the original building is preserved and changes were made only in its interior. In structural terms, new and old are separated in this project, though other projects in this same category show structural dependence on the old building. Examples in this category also show that different architectural styles could be used, i.e. forms which follow its own logic, but can also be influenced by the host building.

The second design principle, ‘transformation’, implies more aggressive approach, and the change to the old building’s structure as well. According to Jäger (2010), in the first category (addition) there is usually clear distinction between the old and new, whereas the principle of ‘transformation’ dissolves the boundary between the old and new. The selected example, *Punta della Dogana*, shows that just like in the previous example, no changes have been made to the building exterior, preserving its appearance completely. New elements are executed in materials different from the host building and the spatial logic of the interior spaces was mostly followed. Other examples in this category show that the change was usually constrained to the old building’s interior where it is clearly recognizable and can both follow or alter the host building’s spatial logic.

The third category, ‘conversion’, also includes wide variety of examples that change the old building function, from projects that add elements, to ones which alter only the host building’s interior. The selected example, the Fahle Building, shows that new addition is conceived in material which separates it clearly from the old building, and is structurally independent. Examples in this category are to great extent influenced by the original building’s formal and spatial logic. It can be concluded that a rather abstract criteria were used to define these design principles and that there is a blurry line which separates one from the other.

3.2.4. Coexistence, Imposition, Fusion

Tamara Rogić in her PhD thesis titled “Converted Industrial Buildings: Where Past and Present Live in Formal Unity”, conducts the analysis of one of the most famous example of architectural reuse - Sir Giles Gilbert Scott’s Bankside Power station into Tate Modern gallery in London, UK. She extrapolated three terms, three conceptually different approaches to intervening with the old, namely ‘coexistence’, ‘imposition’, and ‘fusion’, from the statements of the six architects shortlisted for the second stage of the competition in 1994: David Chipperfield, Renzo Piano, OMA, Herzog & de Meuron, Tadao Ando, and Jose Rafael Moneo.

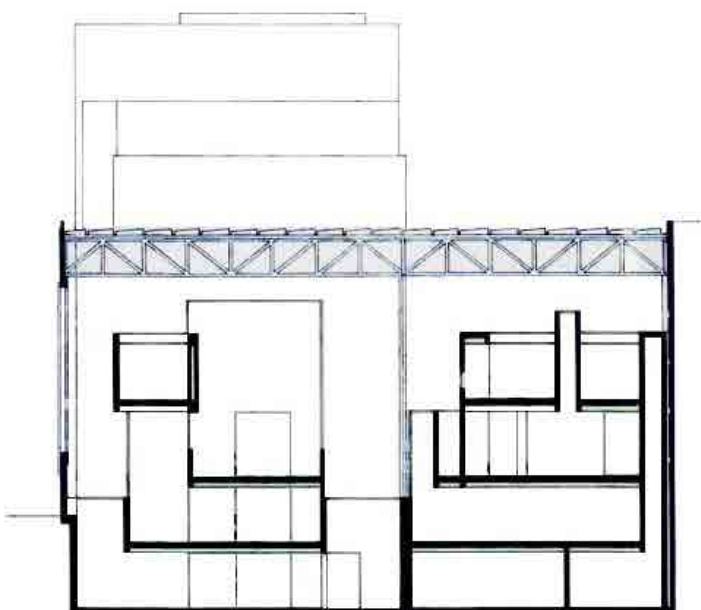
Coexistence

The design principle of ‘coexistence’ has been analysed through the project proposal of David Chipperfield. According to statements made by Chipperfield, the ‘coexistence’ is the design concept applied in his proposal (Figure 3.55.) which implies clear distinction between the old and the new (Rogić, 2009). Chipperfield explains that the aesthetic model he adopted for the intervention is that of the Persian carpet, i.e. “clearly patched and mended over time, in which areas of formal perfection can coexist comfortably with the threadbare” (Rogić, 2009: 117). This concept allows the upgrading of some parts of the building to the most modern technological levels of finish and polish, but, at the same time, permits other parts of the original building to stay unchanged.

Chipperfield explains that two material elements (brick skin and steel cage structure) and certain spatial elements (the composition of windows, volume of the chimney) need to stay present and dominant in the intervention (Rogić, 2009). He defines his intervention as ‘building within a building’. This concept implies the introduction of a sequence of abstract spaces in the volume of the Bankside Power Station. In material terms the concept of ‘coexistence’ is achieved by placing old materials next to the new ones, clearly separating

them, and by revealing their structural nature. In formal terms, the concept is achieved by allowing the spatial logic of interior spaces to be visible on the building’s exterior (Rogić, 2009). Thus, new intervention is clearly visible and easily recognisable. Both host building and the new elements are treated as equal. The concept of ‘coexistence’ is therefore defined as a parallel existence of the old and new. Rogić (2009)

Figure 3.55.
Tate Modern, Section,
Chipperfield’s scheme
(Source: Rogić, 2009)



observes that, in terms of spatial composition of the building's exterior, Chipperfield's proposal follows the principle of 'coexistence' by conserving the spatial logic of the old Power Station and respecting its symmetry. He introduced two same-size wings connected by the cube in the middle, in the exact same place where the chimney of the original industrial building was. (Rogić, 2009). His intervention follows the formal logic and spatial organization of the Scott Power Station and allows for the old and new volumes to coexist.

However, Rogić (2009) notes that in terms of spatial composition of the building's interior Chipperfield's proposal contradicts his interpretation of 'coexistence' by breaking up the single space of the power station with the newly introduced volumes, thus transforming the original building's interior and making it unrecognizable. Thus, it can be concluded that the design principle of 'coexistence' implies the clear separation of old and new in material and structural terms, and preservation of the original building's spatial and formal logic. The evaluation of the Chipperfield's proposal according to the criteria for the analysis of the recycling design principles has been conducted in the following way:

- Structure:
 - New structure added, independent from the old structure
- Material:
 - Exterior:
 - Clear division between the old and new materials
 - Interior:
 - Clear division between the old and new materials
- Form:
 - New elements are added respecting the old building's formal logic
- Spatial organization:
 - Spatial logic of the host building's interior spaces is completely changed

Imposition

The concept of 'imposition' implies the predominance of the new element introduced to the host building. It also implies that the original building's characteristics are not taken into account while designing the new intervention. This design principle has been analysed through the proposal of the Office for Metropolitan Architecture (OMA). OMA's proposal lacks the analysis of the original building and treats the old building as a 'brick box', by retaining its spatial division and the cage steel structure of the turbine hall (Rogić, 2009).

In the north-side central part of the building the old elevation is replaced with a glass 'window' that stretches the entire height of the building (Rogić, 2009).

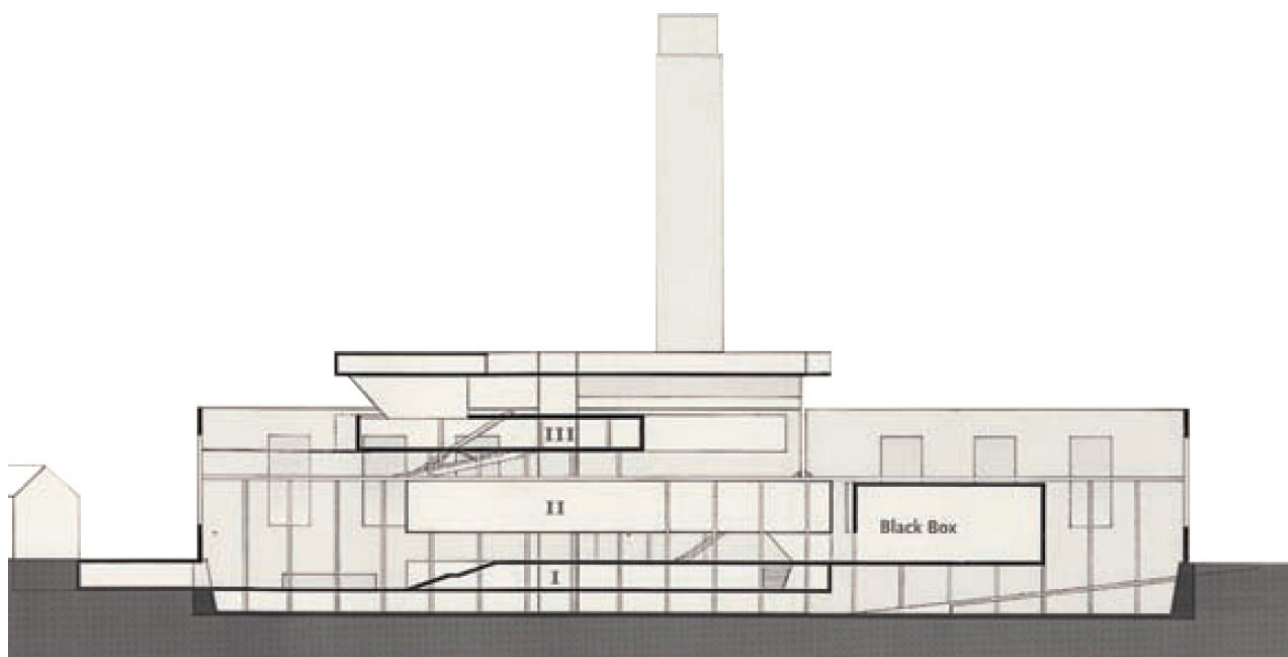
Rogić (2009) notes that in terms of materials used, the old remained present, i.e. the 'brick box' and steel cage, while the structural and environmental function only remained partially. The intervention proposes the insertion of three blocks into the building's interior and one addition in front of the eastern part of the northern elevation (Figure 3.56.) (Rogić, 2009). The spatial logic of the old building was preserved, as all the galleries were placed in once packed boiler house. The turbine hall remained empty as it once was, and all new volumes respect the spatial organisation of the building's interior (Rogić, 2009).

If the design principle of 'imposition' implies the predominance of the new elements introduced into the host building, in terms of spatial logic of building's interior, Rogić (2009) notes the incoherence with this design concept. The spatial organisation of the old building's interior, its character and materiality stayed unchanged. New and old are clearly distinguishable in material terms, but structurally they work together rather than performing separately (Rogić, 2009). However, on the outside, the old building's symmetry was broken not only by the placement of windows but also by the addition of the sixth level which created a new asymmetrical composition (Rogić, 2009). Analysing the OMA's proposal, Rogić (2009: 123) highlights that:

"(...)Retaining the old spatial organisation, as well as the overall architectural character of the existing internal space, the new is more infiltrated into, than imposed on, the old. It is only on the outside that the new overpowers the old by breaking the original symmetrical volumetric composition with an asymmetrical one."

Figure 3.56.
Tate Modern, Section,
OMA's scheme
(Source: Rogić, 2009)

OMA's proposal has been evaluated according to the criteria for the analysis of the recycling design principles in the following way:



- Structure:
 - New structure added, dependent from the old structure
- Material:
 - Exterior:
 - Clear division between the old and new materials
 - Interior:
 - Clear division between the old and new materials
- Form:
 - Formal logic of the old building is disrupted
- Spatial organization:
 - Spatial logic of the host building's interior spaces is altered but depends on the host building

Fusion

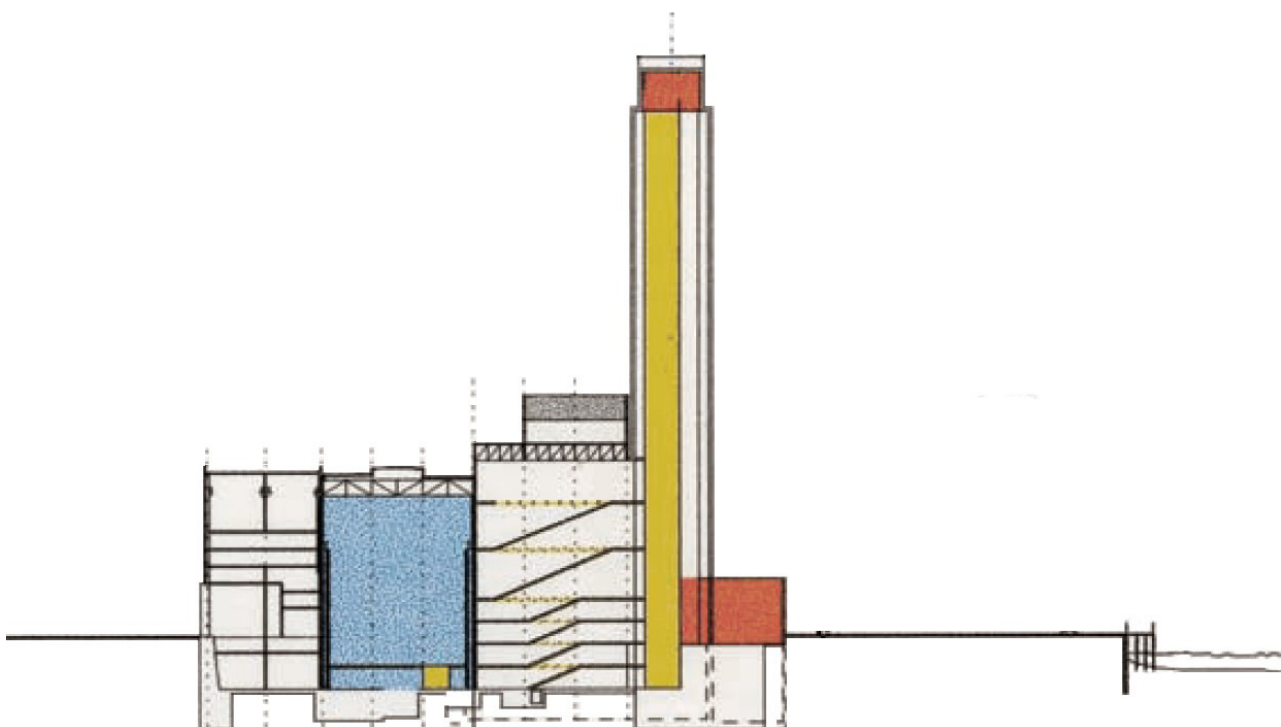
The design concept of 'fusion' was analysed through the Herzog & de Meuron's proposal. This design principle is described as a clear dependence of the new to the old. The spatial composition of the intervention derives from the physical characteristics of the host building. New and old structure work together. In their proposal Herzog & de Meuron recognized the power of the old building and proposed the least drastic change to the buildings fabric. Instead of erasing the elements of the industrial buildings the architects heightened them through a fusion of the old and new (Ryan, 2000). Swiss team highlights that the share building mass, its symmetry, internal tripartite division, chimney, and dimensions and character of individual spaces were the elements that define the Bankside power station and that govern the intervention. In their proposal Herzog & de Meuron respected the tripartite spatial division of the original building by vertically subdividing the boiler house and switch house into a number of floors and by leaving the turbine hall as an enormous void (Figure 3.57.). The only addition to the old building's volume was done at the roof level, in the form of a glass 'light beam' which stretches along the almost whole length of the building, stopping a few meters short of the east elevation (Rogić, 2009).

Rogić (2009) notes that if a design principle of 'fusion' implies a total impossibility of distinguishing old elements from the new, this concept was not followed in material terms as all new elements were made in different and clearly distinguishable materials. According to the same source, in terms of spatial organization new and old are not fused, but new intervention follows and preserves the spatial organization of the old building.

However, she explains that, in structural terms, new and old are depend on each other and work together. Thus, the design principle of ‘fusion’ implies structural dependence between new elements and old building. In material terms new and old are interwoven and new elements do not alter the original buildings formal and spatial logic. The proposal of Herzog & de Meuron has been evaluated according to the criteria for the analysis of the recycling design principles in the following way:

- Structure:
 - New structure added, dependent from the old structure
- Material:
 - Exterior:
 - Clear division between the old and new materials
 - Interior:
 - Clear division between the old and new materials
- Form:
 - New elements are added respecting the old building’s formal logic
- Spatial organization:
 - Spatial logic of the host building’s interior spaces is preserved

Figure 3.57.
Tate Modern, Section,
Herzog & de Meuron’s
scheme
(Source: Rogic, 2009)



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According to Rogić (2009), the analysis between old building and new intervention can be done on two levels: 1) structural-material level, and 2) level of spatial composition. The first level of the analysis refers to building's material and structure, i.e. to what extent are they influenced by the new intervention. The second level indicates the extent to which the spatial organisation of the old building influences and determines the new intervention.

'Coexistence' is defined as parallel existence of the old and new. According to Rogić (2009), all the interventions adopted this approach in terms of materials used. All projects shortlisted for the second phase of the competition clearly distinguish between the old material, brick and steel, and the newly applied materials, usually concrete and glass. However, Rogić (2009) explains that the interventions differ in the level of rendering visible the coexistence of old and new materials. By detaching old and new material in terms of materials' structural and environmental behaviour, Chipperfield presented transparently the way in which old and new materials coexist (Rogić, 2009). The remaining interventions presented different approach. In their proposals there is no clear cut between the old and new materials and they do not have divided roles (Rogić, 2009). 'Coexistence' also implies that the new structure is completely independent from the original one, clearly distinguishable, and that the existing tripartite spatial division of the original industrial building is retained.

'Imposition' implies the predominance of the new elements introduced by the intervention. In material terms, the new and old are clearly distinguishable and confrontational. Structurally, new and old have divided roles. In this process, the spatial composition of the original building is transformed and the symmetry of the original building and the composition of the windows is disrupted.

If 'new' and 'old' are structurally and materially dependent on each other and interwoven, than the concept applied is the one of 'fusion'. Thus, the new and the old structure and materials could not be recognised and work together. In this process spatial composition, i.e. the original tripartite division of the industrial building, is not changed, and new elements introduced by the intervention do not alter the original building's form.

Comparative analysis of the selected sources

In the previous subchapters four groups of design principles of recycling architecture, from four different sources, chosen for the comparative analysis, have been evaluated: 1) Brooker & Stone's 'intervention', 'insertion', 'installation'; 2) Feireiss & Klanten's 'add-on', 'inside-out', 'change clothes' 3) Jäger's 'addition', 'transformation', 'conversion' and 4) Rogić's 'coexistence', 'imposition', 'fusion'. The analysis revealed that the common criterion for the definition of the design principles in all abovementioned groups, was the relationship between the host building and the new intervention, i.e. the level of independency of the newly introduced elements. Thus, in all four sources three categories, corresponding to three design principles, have been determined. The analysis on the micro level revealed that different design principles within one source poses many similar characteristics.

The criteria (material separation and structural dependence on one hand, and formal disruption and change of spatial organisation on the other) used for the analysis on the micro level, i.e. the analysis of the projects within each source, are now used for the analysis on the macro level. This analysis will enable a systematic overview of the characteristic of all four sets of design principles, i.e. twelve design concepts. In this way, the similarities and differences between the analysed recycling design principles can be easily noted and observed. The analysis on the macro level represents the basis for the redefinition of the recycling design principles, i.e. conceptual 'recycling model'. Based on the mentioned criteria the analysis of all twelve design principles was conducted as shown in the Chart 3.1.

The above chart confirms that there is a rather blurry line which defines and separates the evaluated design principles. Many of the design principles, which should be confrontational share the same characteristics. Three groups of principles, combining different previously analysed concepts, can be observed.

The first group of design principles implies the obedience of newly built elements to the host building and minimal change to its appearance. This group contains the following, previously analysed, concepts: 'insertion', 'inside-out', 'transformation', and 'fusion'. The original building governs the intervention and influences the character and physical properties of the new intervention. All properties of the new elements depend on the physical characteristics of the host building. These design principles limit the recycling intervention almost exclusively to the host building's interior, leaving its exterior unchanged.

The second group of design principles, containing previously analysed concepts of 'intervention', 'add-on', 'addition', and 'coexistence', implies a higher level of autonomy of the new elements. However, the host building influences new intervention whose

		Brooker & Stone			Feireiss & Klanten			Jäger			Rogić		
		Intervention	Insertion	Installation	Add-On	Inside-Out	Change Clothes	Addition	Transformation	Conversion	Coexistence	Imposition	Fusion
STRUCTURE	old retained, no new added												
	new added, independent from the old					⊕		⊕		⊕	⊕		
	new added, dependent on the old	⊕	⊕	⊕	⊕		⊕		⊕			⊕	⊕
	old completely replaced												
MATERIALS	Exterior												
	old and new interwoven		⊕	⊕		⊕		⊕	⊕	⊕			
	clear division	⊕			⊕		⊕				⊕	⊕	⊕
	Interior												
old and new interwoven													
clear division	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	
FORM	old unchanged, no new added		⊕	⊕		⊕		⊕	⊕				
	new added respecting the old									⊕	⊕		⊕
	old changed	⊕			⊕		⊕					⊕	
	SPATIAL ORGANIZATION												
old preserved and unaltered		⊕			⊕		⊕						
old altered but dependent	⊕		⊕					⊕	⊕		⊕	⊕	
old altered and independent				⊕		⊕				⊕			

characteristics can derive from the original building itself. The substantial change can be caused to the original building, but always following its formal and spatial logic. Thus, the unity between the old building and the new elements is created. However, even though these principles imply the creation of the harmonious union between the old and the new, through the analysis of the chosen projects representing these design concepts, it was demonstrated that newly introduced elements often have their own formal and spatial logic, confrontational to the old.

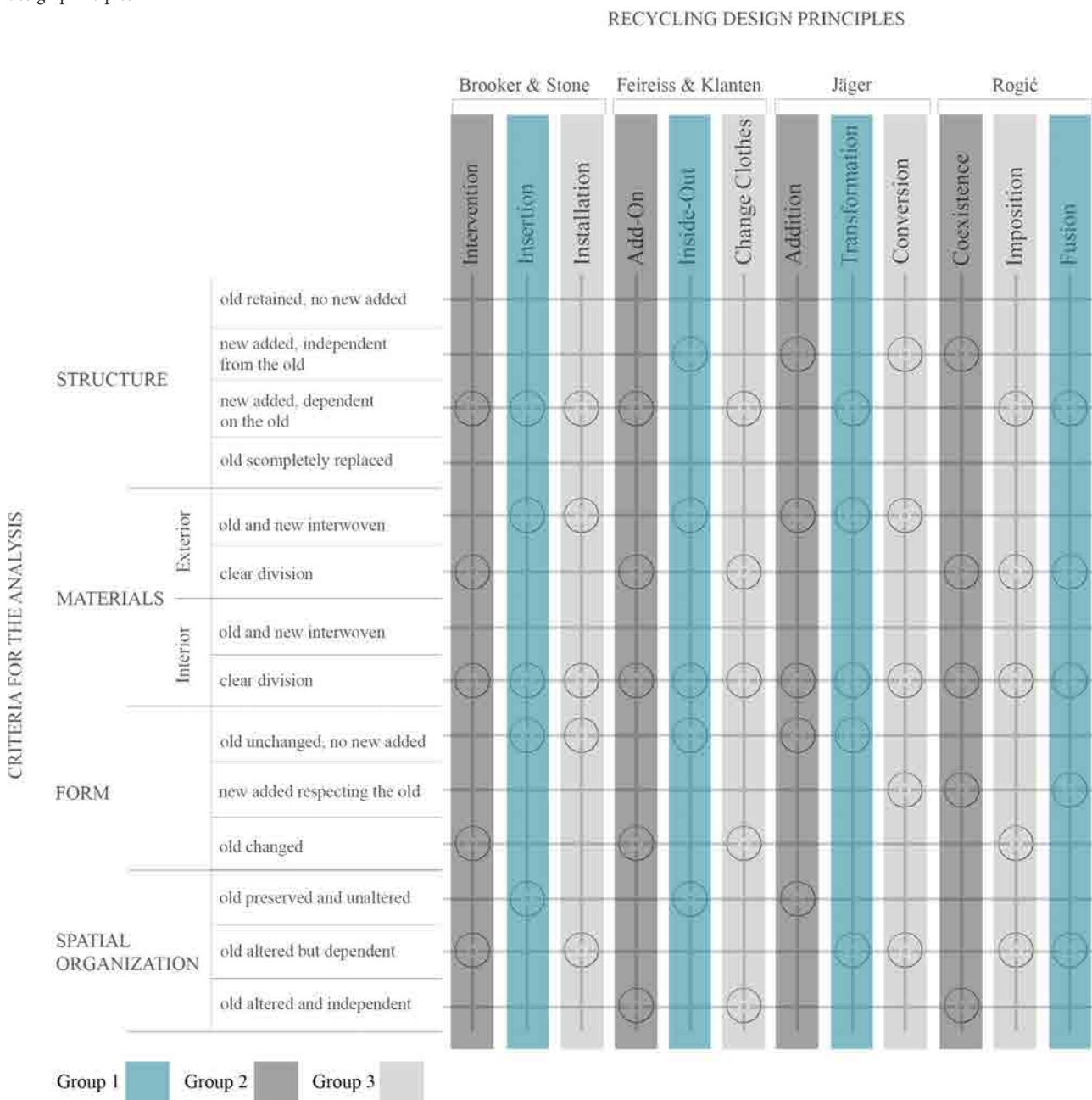
The third group of design principles, which contains the previously analysed concepts of ‘installation’, ‘change clothes’, ‘conversion’ and ‘imposition’, implies the highest level of autonomy of the new elements. New intervention and the host building are confrontational. The physical characteristics of the old building do not determine the new intervention. The new elements are dominant and follow their own spatial logic. However, through the

Chart 3.1.
Analysis of four groups of design principles

analysis of the projects representing these design concepts, it was demonstrated that many of them (as Morton Duplex or Fahle Building) are influenced by the original building and respect its formal and spatial logic. All three groups can be observed in the Chart 3.2.

The conducted analysis revealed that the above definitions of the design principles do not always relate fully to the project selected as their representative. Due to rather abstract criteria for the definition of these design principles and selection of the projects, there is no clear distinction between them and examples from one category can easily fall into another one. This problem calls for a systematization of existing principles and formulation of a clear set of criteria according to which the design principles of recycling would be defined. In order to make the distinction between the recycling design principles clear, precise definitions should be determined. This is the focus of the next chapter.

Chart 3.2.
Three groups of
design principles



IV REDEFINITION OF RECYCLING DESIGN PRINCIPLES

In the previous chapter the comparative analysis of four research studies (Brooker & Stone, 2004; Feireiss & Klanten, 2009; Jäger, 2010; and Rogić, 2009), on the micro and macro level, dealing with the design concepts of recycling architecture has been conducted. The analysis showed that there is a lack of strict differentiation between recycling design concepts and that many of them, which should be confrontational, share the same characteristics. The aim of this chapter is the redefinition of the design principles of recycling architecture and the formulation of the conceptual 'recycling model'. The model, containing three new, redefined design principles of recycling, provides a new understanding of possible relationships between the original building and the new intervention.

The first specificity of the model relates to the fact that new recycling design principles are defined according to the analogy with the field of biology. More precisely, terminology used in biology for the definition of different types of symbiotic associations between the two organisms has been transferred to the field of architecture. Namely, new recycling design principles elucidate possible relationships between the original building and the new intervention. The reason behind choosing the field of biology as a proper domain for the analogy with the architecture relates to the profound critical overview of embeddedness of urban and architectural practice in a broader context of social and natural sciences. Hence, in the following subchapter the correlations between the field of biology and architecture, drawn by theorists and architects, namely those by Georges-Eugène Haussmann, Ildefons Cerdà, Frank Lloyd Wright, John Frazer and Manuel de Solà-Morales, is presented, thus, forming the base for the definition of the new recycling design principles. Secondly, the value of such a model is seen in its systematic approach to the topic of recycling architecture, i.e. the principles embedded in this model relate to the aspects of structure, material, form and spatial organization.

After the conceptual 'recycling model' has been created, the research focuses on its evaluation in contemporary practice of recycling the industrial architecture. More precisely, the aim is to determine whether and to what extent the redefined recycling principles are used in contemporary architectural practice. Thus, this model serves as a

means of evaluation the case studies, i.e. this model shows the extent to which its principles are really applied in architectural practice. Three case studies, corresponding to three recycling design principles, as defined in the conceptual model, have been chosen and analysed. The recycling design principle of ‘commensalism’ has been analysed through the project of ‘*Fabra i Coats*’ in Barcelona, Spain, by Manuel Ruisánchez Capelastegui and Francesc Bacardit Segué. Through the second case study, the *Centro de ‘Monitorização e Interpretação Ambiental – Casa dos Cubos’* project, in Tomar, Portugal, by architectural office Embaixada Arquitectura, the recycling design principle of ‘mutualism’ has been analysed. The third recycling design principle of ‘parasitism’ has been evaluated through the ‘192 Shoreham Street’ project in Sheffield, England, by London based architectural office Project Orange. In this way each of the redefined recycling design principles will be analysed through a corresponding project.

4.1. The Analogy between Biology and Architecture

Sapp (1994: 15) explains that “the use of natural law as the basis for a given view of society became commonplace in social, political, and economic theory”. Cities have long been compared to living organisms. Plato, in his ‘*Politeia*’, written around 380 BC, referred to the city as a ‘*makro anthropos*’, drawing in that way the analogy between the human body and the city. In terms of justice, Plato also makes that correlation between the man and the city by stating that a just man will not be different from a just city. Furthermore, Cerdá (1867) in ‘*General Theory of Urbanization*’ refers to the city as a body, a living organism. Cerdá (1867) explains that the role of the urban planners is both as diagnosticians and surgeons. According to Cerdá, the urban planner should “first be able to distinguish sick areas of the city from those that are healthy, only then can he proceed with a true anatomical dissection of all of them and of all of their constituent parts” (as cited in Fraser, 2011: 89). Choay (1969: 18) in ‘*Modern city: Planning in the Nineteenth century*’ explains that Georges Haussmann transformed modern Paris and revolutionized its streets as arteries in the model of a “general circulation system”. Fraser (2011: 90) highlights that the “application of the biological metaphors to city life was a practice that certainly predated the work of nineteenth-century city planners”, and was even present in the seventeenth-century with the “discovery of the circulation of blood”. Urban critic Richard Sennett (2008) referring to the discoveries of the seventeenth-century writes:

“The scalpel had permitted anatomists to study the circulation of the blood; that knowledge, applied to circulation of movement in streets, suggested that streets worked like arteries and veins; this was thus the era in which planners began to incorporate one-way streets in their designs. Wren’s circulatory city was commercial in intent, aiming to deal efficiently in particular to create streets that moved goods to and from the necklace of warehouses draped along the Thames. But this design lacked the equivalent of a human heart, one central, coordinating square.” (Sennett, 2008:204)

Collins (1965) in 'Changing Ideas in Modern Architecture' reviews the theories and influences that shaped the modern architecture, thus explaining that the attempts of the historians to evolve a new architecture with the analogy of the earlier architecture has failed, which as a consequence forced the theorists to study other types of analogy. According to the same source, these analogies are biological, mechanical, gastronomic, and linguistic analogy. The origins of the biological analogy, Collins (1965: 149) traces back to 1750, when two scientific books were published, "Linnaeus' Species Plantarum (1759), in which the entire vegetable kingdom was classified binominally according to the disposition of the female reproductive organs, or 'styles', and Buffon's Histoire Naturelle (1749), a vast compendium which attempted to incorporate all biological phenomena into a general interpretation of the laws governing the universe". Collins (1965) points out that Buffon's evolutionary vision, i.e. vision that all species must have derived from a single type, was used later by architectural theorists and has two important features:

"(...)The first is that, in hitting upon the idea of evolution, he saw it as essentially a process of degeneration, not of improvement, since his religious beliefs (or his respect for those held by his contemporaries) prevented him from assigning the evolutionary process to any but to lower animals. On the other hand he was the first scientist to distinguish correctly between the 'vegetative' and specifically 'animal' parts of animals, whereby an animal may be regarded simply as a vegetable organism endowed with the power of moving from place to place."
(Collins, 1965:149)

According to the same source, the 'organic life' has come to mean, for architectural theorists, the sum of the functions of the 'vegetative' class. Collins (1965) highlights that according to Lord Kames, regularity ought to be studied in architecture because in organized bodies comprehended under one view, nature studies regularity. The author also explains that at the beginning of the nineteenth century "the asymmetry of plants and viscera, rather than the symmetry of animal skeletons" became accepted as characteristic of organic structure (Collins, 1965:150). The most important proclamation of the evolutionary theory was published by Jean-Baptiste Lamarck who concluded that living forms had not evolved retrogressively, but progressively and that evolution was due to the environment (Collins, 1965). Lamarck wrote that the organs - the form and character of animal's body parts, do not influence its habits and peculiar properties, but contrarily, its habits, manner of life and the conditions in which its ancestors lived designed its body form, organs and qualities (Collins, 1965). According to Collins (1965) the word 'biology' was invented by Lamarck in about 1800, at the same time, the word 'morphology', which included non-living forms, such as rocks, was created by Goethe. Jacob Schleiden's views that life was a 'form-building force' and that the growth of crystals and organisms are the same phenomena was accepted by Herbert Spencer whose biological works influenced Frank Lloyd Wright (Collins, 1965). Frazer (1995) highlights that Sullivan, Wright and Le Corbusier all employed biological analogies, and that the concept of the 'organic' is central

to the twentieth century. In his essay 'In the Cause of Architecture' (1914) Frank Lloyd Wright wrought: "By organic architecture I mean an architecture that develops from within outward in harmony with the conditions of its being as distinguished from one that is applied from without" (as cited in Collins, 1965: 152). Thus the discussion in biology was raised: Does form follow function, or does function follow form? (Collins, 1965). The importance of this discussion to the history of modern architecture is indisputable. Sullivan (1979) states the fact that form follows function is a natural thing. He explains that "all things in nature have a shape, that is to say, a form, an outward semblance, that tells us what they are, that distinguishes them from ourselves and from each other. Unfailingly in nature these shapes express the inner life, the native quality, of the animal, tree, bird, fish, that they present to us; they are so characteristic, so recognizable, that we say it is natural it should be so" (Sullivan, 1979: 207). Wright (1953) supports the idea of Louis Sullivan, his employer and mentor, whom he called his '*Lieber Meister*', and says: "Already it has been said – *lieber meister* declared it – and biology knows and shows us that form follows function" (Wright, 1953: 296). Costa Guix (1988: 53) explains that George Cuvier, in his study of anatomy, established the organic and functional model of natural science, which considered all parts of the biological system interrelated through the precise laws of function: "The anatomist, for instance, could reconstruct an entire digestive system from a single tooth —and from this digestive system (and by studying the natural environment to which it is adapted) even the animal itself". According to the same source, Viollet-le-Duc translated this principle of 'organicity', i.e. each part implied the whole, to architecture, explaining that just as the whole plant or an animal can be understood from one of its parts, so can one profile, an architectural element, explain the whole structure. Viollet-le-Duc believed that the monument is an organic body and "the comprehension of its organic entity permits the architect to undertake its restoration" (Costa Guix, 1988: 55).

Just as biologists implicitly believed in evolution so did the classical architects of the early eighteenth century, "since they believed that the moderns had improved on the Romans, just as the Romans improved on the Greeks" (Collins, 1965:152). Collins (1965) underlines four features that are in common between the field of biology and architecture: the relationship of organisms to their environment; the correlation between organs; the relation of form to function; and the principle of vitality itself. Analysing Claude Benard's discoveries concerning the way the body adapts itself to changing conditions, Collins (1965) argues that a clear parallel can be drawn to architecture.

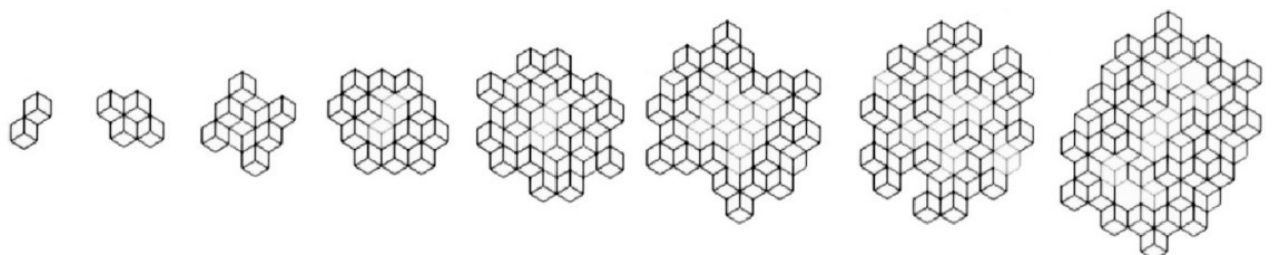
Frazer's 'An Evolutionary Architecture' (1995), is based on the idea that architecture is living and evolving entity. The author investigates fundamental form-generating processes in architecture by studying the process of morphogenesis in the natural world, explaining that "architecture is considered as a form of artificial life, subject, like the natural world, to principles of morphogenesis, genetic coding, replication and selection" (Frazer, 1995: 9). In order to create truly dynamic architecture Frazer (1995) uses genetic algorithms,

cellular automata, emergent behaviour, complexity and loops. More precisely, he describes the emerging field of architectural genetics and makes analogy with the multi-celled relationships found in nature, and their ongoing metamorphosis as a response to changing conditions (Frazer, 1995). The author explains that “the aim of an evolutionary architecture is to achieve in the built environment the symbiotic behaviour and metabolic balance that are characteristic of the natural environment” (Frazer, 1995: 9). Frazer (1995) design is based on algorithms, which, depending on the nature of the information they are given, define the formal result. This method allows the creation of the dynamic and evolving virtual architectural models, which respond to changing environments. Explaining his ‘evolutionary architecture’ Frazer (1995) writes:

“Space, structure and form are the traditional outward expressions of an architectural concept which has developed in the mind of the architect. This idea is taken further in our work. Architectural concepts are expressed as generative rules so that their evolution may be accelerated and tested. The rules are described in a genetic language which produces a code-script of instructions for form-generation. Computer models are used to simulate the development of prototypical forms which are then evaluated on the basis of their performance in a simulated environment. Very large numbers of evolutionary steps can be generated in a short space of time, and the emergent forms are often unexpected.” (Frazer, 1995: 9)

Frazer’s (1995) analogy of evolutionary architecture implies not only a form of development through natural selection, but the tendency to self-organization, metabolism and the laws of thermodynamics as well. He gives the examples of Cheung’s (1993) program-created two-dimensional forms (Figure 4.1.) which produce “ambiguous and sometimes conflicting readings when interpreted as three-dimensional forms” (Frazer, 1995: 17). These forms “develop characteristics which exist in natural systems such as regeneration, cell division and replication (mitosis and meiosis) and memory-transfer between generations” (Frazer, 1995: 17). Natural ecosystems have complex biological structures, “they recycle their materials, permit change and adaptation, and make efficient use of ambient energy” (Frazer, 1995: 16). However, “most man-made and built environments have incomplete and simple structures: they do not recycle their materials, are not adaptable, and they waste energy” (Frazer, 1995: 16). According to the same source, an ecological approach to architecture does not mean replicating natural ecosystems, but applying the general principles of interaction with the environment. Consequently, the model of an evolving architecture should be responsive to evolving, not just in a virtual but in real environment as well (Frazer, 1995). The concept of soft, responsive architecture was analysed by Warren Brodey, who introduced the concept and Nicolas Negroponte, who suggested that “the design process, considered as evolutionary, could be presented to a machine, also considered as evolutionary, to give a mutual training resilience and growth” (Frazer, 1995: 17). According to the same source, there is an ongoing search, in all fields, for the great unification theory (GUT) which would formulate a holistic view of the universe. Frazer

Figure 4.1.
Breeding illusion:
Juanita Cheung, 1993
(Source: Frazer, 1995)



(1995) explains that in the natural sciences this phenomenon can be viewed through two juxtaposed tendencies:

“(…)One is to embrace everything under the umbrella of evolution (or at least evolution in the form of Neo-Darwinism). Evolution of the chemical elements, evolution of physical constants, evolution of information, cultural evolution – evolutionary theory is somehow made to explain all phenomena. The other tendency is to recruit all other developments in science, such as self-organizing systems, to expand the theory of evolution to make a new meta-theory.” (Frazer, 1995: 21)

A significant contribution to current environmental and social problems can be made by this new holistic understanding of nature and science (Frazer, 1995). Stressing the importance of transdisciplinarity, Frazer (1995) quotes William Lethaby, who, in his ‘Architecture. An Introduction to the History and Theory of the Art of Building’ (1911), wrote: “Modern builders need a classification of architectural factors irrespective of time and country, a classification by essential variation. Some day we shall get a morphology of the art by some architectural *Linnaeus* or *Darwin*, who will start from the simple cell and relate to it the most complex structures” (as cited in Frazer, 1995: 21).

Manuel de Solà-Morales (2008) in his ‘A Matter of things’ uses terms as ‘skin’, ‘epidermis’, ‘nerves’, ‘arteries’, ‘acupuncture’ and ‘prosthesis’ to explain architectural and urban processes in the city. The city is seen as living, breathing organism: “Acupuncture or prosthesis? Perhaps both. A systemic understanding is required, of course, which expects the most interesting effects of any intervention to stem precisely from those bundles of nerves and arteries that relate each point in the city with neighbours and strangers” (de Solà-Morales, 2008: 18). Working on the “skin of cities”, he states that the city epidermis is what enables the city to “discern their deepest structures” (de Solà-Morales, 2008: 19). He explains that “the skin of cities is composed of construction, textures and contrasts, of streets and empty spaces, of gardens and walls, of contours and voids”(de Solà-Morales, 2008: 23). Furthermore, even though the “surface of the city, the urban skin, is considered superficial, that is, light, inconsistent, insignificant, incapable of having a content worthy of serious study”, it is precisely in the “urban matter, in the surface of the city” where the “origin and form of any kind of urbanity” lie (De Solà-Morales, 2008: 23-4). The city epidermis can be explained as in the following:


“(…)It is the urban matter that transmits to us, at its most sensitive points and in its most neutral zones, the qualitative energy that accumulates collective character on certain space, charging them with complex significance and cultural references and making them semantic material, social constructions of intersubjective memory. It is the composition of the urban skins that indicates to us their characteristics and their differences, their weight, form, texture, format, their morphology and their tectonics. But we have to look at them insistently and with sufficient attention for them to reveal to us, as Jacques Derrida has already explained, their hidden replies, their caverns.”(De Solà-Morales, 2008: 24)

Solà-Morales (2008) further elaborates the concept of city skin by drawing analogy with the skin of the human body. He explains that, according to the ancient oriental practice of acupuncture (Figure 4.2.), the human skin is the “principal energy transport system, with 361 sensitive points scattered over the surface of the body transmitting their sensory impressions to the rest of the organism, exterior and interior, by means of twelve meridians or pathways” (de Solà-Morales, 2008: 24). The skin of the human body, just as the urban skin, transmits and channels qualitative energy (de Solà-Morales, 2008). Urban acupuncture to de Solà-Morales is a method of treating the urban skin, which, just like in therapeutic acupuncture, occupies, in the first place, with identification and localization of sensitive points, which need adequate energy in order to function properly. He believes that there is a clear analogy between “intervening in the skin of the city and the techniques of acupuncture – not because it involves using needles or making small incisions, but because the epidermis is understood to form a system” (de Solà-Morales, 2008: 25). By applying punctures, pressure, injections the energy is distributed through the skin, which enables the transformation of internal metabolisms (de Solà-Morales, 2008). Therefore, the analogy with the terms originally used in biology was not strange to architects. The references made to the biology by the above mentioned architects and theorists are summarised in the Figure 4.3.

Melet and Vreedenburgh (2004) in ‘Roof top architecture’ compared cities and city related processes with nature. They explain that “evolution and transformation are natural processes that form an unmistakable part of urban development and of culture in general” (Melet & Vreedenburgh, 2004: 18). The authors highlight that throughout the history cities have been under the process of permanent renewal and different architectural styles coexisted and were intertwined. They compared this process of permanent transformation with the natural process of evolution, explaining that “within such a process, selection means adapting to changing circumstances” and highlighting that “if the circumstances had remained unchanged from the first, evolution would have come to a halt at an early stage, before the arrival of homo sapiens” (Melet & Vreedenburgh, 2004: 19). In this way, the authors are stressing the importance of change and adjustment of cities as the response of the ever changing context. They are highlighting that this change can be deliberate or through unforeseen mutations. According to the same source “nature shows that complex systems have a higher chance of survival than simple ones” and “the health of cities also proves to be strongly correlated with the diversity that they offer in a variety of fields” (Melet & Vreedenburgh, 2004: 9). Melet and Vreedenburgh (2004), refer to new intervention and existing building as ‘symbionts’, i.e. organisms that take part in any kind of symbiosis. This view of two structures, - original building and new intervention, as symbionts, i.e. ‘organisms’ that are very closely associated with one another, is used as a basis for the definition of the recycling design concepts in this research. In that sense, it is very important to first shed light to the terminology issue related to the concept of symbiosis.

Figure 4.2.
Acupuncture points
on the human body
(Source: de Solà-
Morales, 2008)






Manuel de Solà-Morales
2008

“epidermis ”
“acupuncture”
“prosthesis”


A Matter of Things



John Frazer
1995

“architectural genetics ”


An Evolutionary Architecture



Frank Lloyd Wright
1914

“organic architecture ”


In the Cause of Architecture



Ildefonso Cerdà
1867

- *“blood circulation”*
- *“urban planners as diagnosticians and surgeons”*

General Theory of Urbanization



Georges-Eugène Haussmann
1860-1870

- *“streets as arteries”*
- *“general circulation system”*

Revolutionarization of the street system

Figure 4.3.
Biological analogies
in architecture

4.2. The concept of Symbiosis

The origin of the term 'symbiosis' (from Ancient Greek *σύν* "together" and *βίωσις* "living") is accredited to Heinrich Anton de Bary who used the term in 1878 to explain an internal partnership between two organisms. Sapp (1994: 7) explains that "De Bary first used the term symbiosis (*Symbiose*) in an address entitled 'The Phenomena of Symbiosis' delivered at a general meeting of the Association of German Naturalists and Physicians at Cassel in 1878 (...) He defined it as 'the living together of unlike named organisms'". Symbiosis defines a relationship in which one 'symbiont' lives within the tissues of the other (endosymbiont), either within the cells or extracellularly and it also refers to any relationship in which the symbiont lives on the body surface of the host (ectosymbiont), including the inner surface (Ahmadjian & Paracer, 2000). According to de Bary (1879) symbiosis includes: mutualism - both species benefit, the two organisms help each other; parasitism - one species benefits, the other species is harmed; and commensalism - one species benefits, the other species is unaffected. Oxford dictionary defines the term as: interaction between two different organisms living in close physical association, typically to the advantage of both. Organisms living in a symbiotic relationship can have completely different physiognomies. Kurokawa (2000) in 'The Philosophy of Symbiosis: From the Age of Machine to the Age of Life' explains that the philosophy of symbiosis defines the relationship of elements that need each other, while there is constrictions and opposition between them. Douglas (2010) highlights that the term 'symbiosis' refers to any kind of persistent biological interactions. Ahmadjian and Paracer (2000) point out that organisms function only in relation to other organisms and define 'symbiosis' in the following way:

"Symbiosis is an association between two or more different species of organisms. The association may be permanent, the organisms never being separated, or it may be long lasting. This definition excludes populations, which are associations between individuals of the same species. Organisms that are involved in a symbiosis may benefit from, be harmed by, or not be affected by the association. Symbiotic associations are common in nature, from bacteria and fungi that form close alliances with the roots of terrestrial plants to those between giant tube worms and sulphur-oxidizing bacteria that live together in the deepest depths of the ocean. No organism is an island - each one has a relationship to other organism, directly or indirectly. Even humans bear a reminder of an ancient symbiosis - their cells contain mitochondria, organelles which once were symbiotic bacteria (...) It is difficult to imagine life and its evolutionary history without symbioses" (Ahmadjian & Paracer, 2000: 3).

Bradford and Ernest (2013), explain that, after much of confusion that has afflicted the definition of symbiosis for over 130 years, current biology and ecology textbooks use de Bary's definition of symbiosis, i.e. mutualism, commensalism, and parasitism. Ahmadjian & Paracer (2000) also adopted de Bary's classification and in their study 'Symbiosis: An Introduction to Biological Associations' highlight that all forms of life contain symbiotic

associations and explain that these associations played an important role in the evolution of plants and animals and in shaping the earth's physical features. According to Khakhina, the 'syntrophogenesis', "the evolutionary origin of new morphologies and physiologies by symbiosis, has been in the forefront of Russian concept of evolution since the last century" (as cited in Margulis & Fester, 1991: 1). John Maynard Smith highlights that there is a clear connection between the process of symbiosis and the evolutionary progress, and explains that in a transition from prokaryote to eukaryote symbiosis played a crucial role (Margulis & Fester, 1991). According to the same source, symbiosis has been seen as a major source of evolutionary novelty.

Some symbiotic associations can lead to novelty in the host organisms, given that "the incorporation of an entire functioning organism, with all its metabolic pathways, may at once confer a suite of novel traits to the host organism" (Feldhaar, 2011: 533). Feldhaar (2011) explains that the view that the form and function of host organisms is conditioned solely by their own genotype (the genetic makeup of an organism) and phenotype (the composite of an organism's observable characteristics or traits) is changing. According to the same source "hosts are increasingly studied as holobionts, i.e. as an organism whose phenotype is determined by the combined genotype of the host's genome and genome(s) of all symbionts carried by the host" (Feldhaar, 2011: 534). Ferrarini and Vavre (2011) highlight that symbionts have a variety of effects on the host's characteristics such as the costs imposed on the host for maintaining the symbiont population, the fitness advantages provided to the host or the manipulation of the host's reproduction. Thus, the form and function of the host individuals in some symbiotic associations is conditioned by the other symbionts.

Peacock (2011) explains that "symbiosis plays an obvious role in the generation of functional novelty, and it may be an essential part of the explanation both of rapid bursts in evolution, and the very existence of certain types of organisms" (Peacock, 2011: 231). According to the same source, "symbiosis plays a major role in the genesis of both functional and genetic novelty" (Peacock, 2011: 231). Douglas (1994: v) points out that symbiosis "is a route by which organisms gain access to novel metabolic capabilities, such as photosynthesis, nitrogen fixation, and cellulose degradation". Peacock (2011: 232) broadens this viewpoint by adding that through symbiosis not only the metabolic capabilities are gained but "novel symbiotic associations could also allow organisms ways of responding to rapid changes in habitat and climate". According to the same source, symbiosis is as responsible for the novelty as mutation and other mechanisms of direct genetic change.

In this research a direct analogy with terms, studied in the field of biology, which explain the types of symbiotic relationships between two organisms, is drawn. Thus, symbiosis refers to all types of close relations between the two 'symbionts' i.e. a new intervention

and the original building. These relations can be commensal, mutualistic or parasitic depending on the influence symbionts have on each other, i.e. on their structure, material, form and spatial organisation. As stated earlier, in biology, some symbiotic relationships imply a certain degree of change to symbionts genome and phenotype, i.e. its form and function. In architecture, as in biology, symbiotic relationships can alter the host's (original industrial building) genome (its form) depending on the type of the symbiotic association. These associations are formed in nature so that at least one of the symbionts can draw benefit, i.e. nutrition or protection. These benefits can be directly translated to architecture as structural, material, formal or spatial upgrading. Biologists (Peacock, 2011; Douglas, 1994) have agreed on the role of symbiosis in the creation of novelties and adaptations of species to changing natural conditions. Symbiotic relationships in architecture, i.e. interventions on existing architecture – architectural recycling, can also be viewed as a response to rapidly changing conditions in today society.

In the following subchapters the redefined design concepts of 'commensalism', 'mutualism' and 'parasitism' will be explained and a correlation with the original meaning of the adopted term will be drawn. In this way each of the redefined recycling design principles is relabelled according to a proper biological term, depending on the type of the relationship between the two 'symbionts' i.e. original building and new intervention.

4.2.1. Commensalism

Ahmadjian and Paracer (2000: 6) point out that the term 'commensal' (from Latin, '*com*'- and '*mensa*', meaning "sharing a table") was used for the first time by P.J. van Beneden in 1876 "for associations in which one animal shared food caught by another animal ". According to the same source, the term commensalism refers to a relationship where one of the 'symbionts' benefits, i.e. nutritional or protective benefit, and the other is not harmed nor helped. Therefore commensalism is a relationship in which one species benefits while there is a neutral impact on the other. This relationship is often formed between a larger host, which stays unmodified, and a smaller symbiont which may show great structural adaptation. According to Hogan (2012), editor in-chief of the 'Encyclopedia of Earth' commensalism is most often observed between two species of bacteria where one bacterium metabolises a chemical not useful to the second, producing a product waste metabolite that is a useful energy source for the beneficiary second bacterium. Thus, it involves one species of bacteria feeding on the chemicals produced or the waste products that are not used by the other bacteria.

A direct analogy can be drawn to the field of architecture. This type of relationship can occur between an existing, underused industrial building which gets 'nutrition', i.e. structural, material, formal or spatial upgrading, while the newly introduced elements

poses no threat to the formal and spatial integrity of the original building. These new elements, such as structural or installation units, provide 'nutrition', i.e. support, energy and normal functioning of the underused building, without altering its form or interfering with its spatial organization. In terms of the building's material, the exterior of the original building is left unchanged. If any reparation work has to be done to the building's façade (e.g. material replacement, crack repairs, patching, cleaning and painting), they will preserve and reveal original aesthetic, material and historic value. All new interventions to the building's interior will be made using the materials which follow the aesthetic logic of the old – new and old will be interwoven. If new materials are added, which are distinguishable from the original, they are always integrated harmoniously with the whole.

The form of the building stays intact. Its volumetric composition, fenestration rhythm and proportion is preserved in its totality. No additions are executed to the building envelope. If some parts of the building are in state beyond repair, selective demolition can be applied without changing the building's character or appearance. All newly introduced elements will follow the spatial logic of the host building. The division of spaces within the building, i.e. its internal organisation, is preserved and governs the new intervention. New elements are defined by host building's physical characteristics, its dimensions, scale and disposition of spaces. The character of the old building's interior is not changed by the intervention. The original building has the predominance and fully governs the new intervention. Thus, the recycling design principle of 'commensalism' can be defined in the following way:

- Structure:
 - Old structure retained, if new structure is added, it is dependent on the old structure
- Material:
 - Exterior:
 - Old and new materials are completely interwoven
 - Interior:
 - Old and new materials are interwoven, if there is a distinction between the old and new materials they form a harmonious union
- Form:
 - Formal logic of the old building is respected-unchanged, no new elements are added
- Spatial organization:
 - Spatial logic of the interior spaces is preserved and unaltered

4.2.2. Mutualism

According to Ahmadjian and Paracer (2000) mutualism is a type of a symbiotic association where both partners benefit from the relationship. According to the same source, the extent to which each 'symbiont' benefits may vary, but "in many associations there is a reciprocal exchange of nutrients" (Ahmadjian & Paracer, 2000: 6). Further, the close complementarity between two partners increases the success and evolution of the mutualistic association. According to Thompson (2005), mutualism is the driving force which triggered the revolution of much of the biological diversity, such as flower forms for example, and co-evolution between groups of species. Through mutualistic relationship 'symbionts' can trade resources, services or protection. Ollerton (2006) refers to this trade between species as 'biological barter'. The author points out that "physical resources are largely concerned with nutritional gain (e.g. carbohydrates, inorganic nutrients, and water)" and that "services range widely in their scope and include transport of propagules (e.g. seed and spore dispersal), movement of gametes (...), bioluminescence, cleaning, and physical protection" (Ollerton, 2006: 412-13). According to the same source, in the insect-microbial mutualisms, the nutrition is provided by the microbe which in return benefits from the protected environment provided by the host insect's body. In mutualistic symbiosis, the endosymbiont, i.e. symbiont living inside the host, adapts to the host. These adaptations lead to changes, such as drastic reduction in endosymbiont's genome (genetic material) size as well as the changes in its phenotype, i.e. the composite of an organism's observable characteristics or traits (Moran, 1996). Mutualistic relationship is also formed between humans and other species, such as their gut flora, which enables them to digest food efficiently (Sears, 2005). By processing the consumed food the bacteria living in the human digestive system helps the digestive process and the bacteria benefits from the suitable environment and nourishment provided by the host. These bacteria allow us to harvest otherwise inaccessible nutrients and provide us with genetic and metabolic attributes we have not been required to evolve on our own (Bäckhed, Ley, Sonnenburg, Peterson, & Gordon, 2005). Different studies show that gut flora has coevolved with us manipulating and complementing our biology in ways that are mutually beneficial (Bäckhed et.al, 2005). Thus, this mutually beneficial symbiotic relationship implies adaptation of one symbiont, its genome and phenotype, to the host, as well as some adaptations of the host to the other symbiont.

In terms of architecture, mutualistic relationship occurs between two 'symbionts' – the original building and new intervention, which have different physiognomy, i.e. different spatial/formal logic and material expression, but are dependent on and conditioned by each other – physical characteristics of the original building determine properties of new intervention (its scale, rhythm and disposition of spaces). In terms of structure, the new intervention will retain and upgrade, if necessary, the original structure. If new

structural elements are introduced, they can be either dependent or independent on the existing structure, according to the scope of the intervention. If new structural elements are self-sufficient they are certainly conditioned by the pure physical characteristics of a host building, its size and disposition of its structural elements. The positioning, size and rhythm of new structure depends entirely on the old building's organization.

In many cases the building's exterior, i.e. its envelope, façade, is preserved, or if necessary, restored to the original state, saving its appearance and integrity. However, this design principle implies change to the buildings fabric as well. The additions can be made to the host's building volume, and they are always executed in materials clearly distinguishable from the old, yet carefully chosen to create a harmonious relationship with the existing materials. Even though new and old are not interwoven, they form a union. There is a clear distinction between what is new and what was already there. If the new additions are made, the elements added to the buildings envelope follow the formal logic of the old building, its symmetry and relationship between its elements.

Even though new intervention has its own spatial logic, inner-spatial distribution, it is nonetheless influenced by the industrial building's physical characteristics. This influence is limited to new intervention's dimension, not character. Therefore spatial organisation of the industrial building can be changed but newly introduced elements will be conditioned by the scale and physical dimensions of the original building. There is a clear distinction between what belongs to the old and what was newly introduced. Compared to design principle of 'commensalism', 'mutualism' creates a much more dynamic relationship with the old. Additions and alterations of the old building can be executed, yet buildings formal logic, i.e. its symmetry and volumetric composition, will not be jeopardised by this act. In most cases, the alterations are restricted to building's interior. Both symbionts, i.e. original industrial building and new intervention, are dependent on each other. Original industrial building could not be operational without the structural and service support of the new intervention which on the other hand is provided with the 'suitable environment' and 'protection', i.e. physical space to be installed in or attached to. The characteristics of the recycling design principle of 'mutualism' are:

- Structure:
 - New structure is added, which can be both dependent on or independent from the old structure
- Material:
 - Exterior:
 - Clear division between the old and new materials

- Interior:
 - Clear division between the old and new materials
- Form:
 - New elements are added respecting the old building's formal logic
- Spatial organization:
 - Spatial logic of the host building's interior spaces is altered but depends on the host's physical properties

4.2.3. Parasitism

Etimology Dictionary defines the term parasite as “one who lives at another’s expense, who eats at the table of another,” Greek origin, derived from noun use of an adjective meaning “feeding beside”, from *para-* “beside” and *sitos-* “food”. Combes (2001) defines “parasitism” as a type of relationship between species, where one species – the parasite, benefits at the expense of the other – the host. According to the Oxford English Dictionary (2nd ed.), a parasite is an animal or plant which lives in or upon another organism (technically called its host) and draws its nutrients directly from it. Webster’s Third New International Dictionary of the English Language invokes directly the concept of harm as “an organism living in or on another living organism obtaining from it part or all of its organic nutrient, and commonly exhibiting some degree of adaptive structural modification – such an organism that causes some degree of real damage to its host”. According to Ahmadjian and Paracer (2000) ‘parasitism’ is a type of a symbiotic relationship in which one of the symbionts benefits at the expense of the other. According to the same source “as in mutualism, the primary factor in parasitism is nutrition: the parasite obtains its food from the host”, yet in this type of symbiosis, some symbionts that draw the benefit from this relationship can be “so pathogenic that they producing a disease in host shortly after the parasitism begins” (Ahmadjian & Paracer, 2000: 7). Barnard and Behnke (2005) point out that “parasites are exploitative, taking form their host nutrients and energy made available through the latter’s foraging efforts, as well as perhaps benefitting from transport, protection and a thermally-regulated environment provided by the host” (Barnard & Behnke, 2005: 1). In this association, the parasite (its genome - genetic material) manipulates the physiology, behaviour and defence mechanisms of the host (its phenotype - the composite of an organism’s observable characteristics or traits) (Combes, 2001). Combes (2001: 6) argues that “in a parasite-host association, the signals produced by the genome of one of the partners may act on the phenotype of the other, thus crossing the species barrier and inducing morphological, anatomical, physiological, or behavioural changes in the recipient”. Poulin (2010: 151) underlines that “the idea that a parasite can modify the

phenotype of its host, by either taking control of host behaviour or changing the host's appearance" is a well-known concept in the study of animal behaviour. The changes in the hosts behaviour and appearance induced by the parasite can be far from subtle, like those induced by one species of trematode (parasitic flatworms), *Leucochloridium* spp., which "alters the size, shape, and coloration of the tentacles of its snail intermediate host and causes them to pulsate violently in response to light"(Poulin, 2010: 151). Thus, this type of symbiotic relationship implies a drastic change in the host's form and behaviour.

This term, originally used in biology, has been adopted by architects to express dynamic relationships between different architectural entities. According to Marini (2010), the parasitical organism results distinct from the host both in terms of form and space. She explains that the term 'parasite' has been used in a series of cultural, design and artistic investigations since the 1980s. Marini (2010) points out that the text 'Le parasite' by Michel Serres, published in 1980, was the main influence of the work of the same name by Diller+Scofidio exhibited at the Museum of Modern Art in New York in 1989. Since the 1980s onward there have been many studies and projects exploring the parasitism in architecture, as Korteknie and Stuhlmacher's prototype 'Las Palmas parasite', a temporarily occupied roof of a disused warehouse in Rotterdam in 2001, or the exhibition 'Parasite Paradise' which took place in 2003 at Leidsche Rijn, a residential expansion at Utrecht (Marini, 2010).

This design principle, in structural terms, implies introduction of new structural elements independent from the old structure, and in some cases complete replacement of the old structure. The positioning and size of the new structural elements depend entirely on the new intervention and does not follow the structural logic of the old building. Additions and all the alterations to the host building's fabric are executed in materials clearly distinguishable from the old, and even confrontational. Newly introduced materials do not pretend to form a harmonious union with the old, but follow completely separate material aesthetic defined by the new intervention. In the host building's interior the clear separation of old and new materials is also at play. The clash between existing and newly introduced materials produces dynamic and very intense relationship between the old and the new.

The form of the original building is substantially changed by this design principle. The balance of its composition, symmetry, and fenestration is broken and altered by new intervention. New volumes are added following its own formal logic, which is confrontational with the old. The host building can endure substantial subtractions as well, which can change its appearance. New elements belong to a clearly different style, defined by the commissioned architect. This intense relationship extends to the building's interior as well, where new intervention changes the spatial composition of the old building.

The logic of interior spaces is altered and the character of the host building completely changed. Thus, the new intervention is fully governed by its own formal and spatial logic independent from the existing one.

This design principle implies the highest level of change to the original building. Compared to the recycling design principle of ‘commensalism’, where the old building has the predominance, and ‘mutualism’, where both new and old are equally present and powerful, the design principle of ‘parasitism’ implies complete inferiority of the old building to the new intervention which overpowers the old. Thus, the recycling design principle of ‘parasitism’ can be defined in the following way:

- Structure:
 - New structure added, independent from the old structure; the old structure can be completely replaced
- Material:
 - Exterior:
 - Clear division between the old and new materials
 - Interior:
 - Clear division between the old and new materials
- Form:
 - Formal logic of the old building is disrupted
- Spatial organization:
 - Spatial logic of the host building’s interior spaces is completely changed

• • •

The above definitions of the recycling design principles of ‘commensalism’, ‘mutualism’ and ‘parasitism’ are in the close correlation with the physical characteristics of original industrial building. In order for the recycling intervention to be as environmentally sustainable as possible, extensive range of existing building’s physical characteristics has to be taken in consideration. As already explained in the Chapter II, the level of the environmental sustainability of the intervention can be measured by: 1) the amount of the old building’s material used, since the use of the existing material minimizes pollution and energy waste related to excavation, production, and transportation; as well as 2) the level of change imposed to the old building, since the less change cause the less energy and material waste. Therefore, it can be concluded that the most environmentally sustainable

recycling intervention will be the one which fully exploits the host building.

If the host building can be used 'as found' and only a negligible physical change is required, the design principle of 'commensalism' is to be applied, given that this design concept implies the predominance of the old and the maximum use of its material. The original building's structure and materials are preserved and no changes are imposed to the building's formal composition nor spatial organization. All elements of the old building are put to use. In this way, the embodied energy of the building's material will be preserved, and unnecessary demolition avoided, cutting down the associated environmental impact.

When the original industrial building requires minor physical change, upgrading of its structure or replacements of certain parts, the design principle of 'mutualism' is to be applied, given that this concept implies the preservation of the majority of the elements of the old and yet leaves the space for equally powerful new intervention. Original building's structure is preserved but new structure is added as well, which can both support the old one or be independent form it. In terms of materials used, there is a clear distinction between the old materials and newly introduced one. New elements can be added to the original building respecting its formal logic and volumetric composition. The interior of the building can undergo a substantial change but the spatial organisation and physical properties of the new elements (i.e. dimension and position) depend entirely on the physical characteristics of the original building. Hence, the elements of the original building in the state beyond repair are replaced, leaving the space for the new intervention, i.e. structure and materials. All elements in good or fair condition are preserved and upgraded if necessary.

If significant physical change, reconfiguration and reconstruction are required for the host building to be usable once again, the design concept of 'parasitism' is to be applied. Old structure is replaced and new materials clearly distinguishable from the old are introduced. The formal logic and volumetric composition of the original building is disrupted and the spatial composition changed. As the majority of the original industrial building's elements are in unsatisfied condition and cannot be reused, overpowering new intervention, characterized by entirely new structure and materials, and different, confrontational formal and special logic is entirely justified.

4.3. Contemporary practice of recycling the Industrial Architecture

In the following subchapter the conceptual 'recycling model' is tested in the contemporary practice of recycling industrial architecture. As the aim of this subchapter is to determine to what extent are these redefined recycling design principles used in the contemporary architectural practice, three case studies, corresponding to three redefined recycling design concepts, have been chosen and analysed. Through the first case study the 'Fabra i Coats' project in Barcelona, Spain, by Manuel Ruisánchez Capelastegui and Francesc Bacardit Segués, the recycling design concept of 'commensalism' is analysed. The design concept of 'mutualism' is analysed through the second case study, the 'Centro de Monitorização e Interpretação Ambiental – Casa dos Cubos' project, in Tomar, Portugal, by architectural office Embaixada Arquitectura. Consequently through the third case study, the '192 Shoreham Street' project in Sheffield, England, by Project Orange, the recycling design principle of 'parasitism' is evaluated.

Methodological approach

The part of the research dealing with the practice of recycling industrial architecture involves the validation of the 'recycling model' consisting of the redefined recycling design principles. This is done through the analysis of the chosen 'good practice' examples. The main goal of this part of the research is to confirm the incidence of the redefined recycling design principles in contemporary architectural practice. The research also explores to what extent physical characteristics of a particular industrial building inform the intervention, i.e. to what extent these characteristics determine the most environmentally sustainable design solution. Therefore, the research methodology is adapted to the research hypotheses. Firstly, through the selected cases, the process of recycling, as a viable alternative to demolition and replacement, is investigated. Secondly, the focus of the research is on the redefinition of the recycling design principles. And lastly, the relationship between the physical characteristics of an existing industrial building and the most environmentally sustainable design principle for its recycling is determined.

As the goal of this research is the redefinition of recycling design principles and the understanding of the relationship between the physical characteristics of a given industrial building and design principles chosen for its recycling, the case study method has been chosen as the most adequate one. More precisely, as the research does not aspire to present just one single case, but to draw general conclusions by analysing multiple empirical data, the case study is an appropriate research method (Yin, 2009).

It is important to mention that the case study method consists of a variety of other methods. The most important methods within the method of case study used in this research are: 1) content analysis of sources dealing with the topic of recycling architecture,

and 2) interviewing the representatives of chosen architecture offices directly involved in the selected recycling project. The data were collected from different sources: publications on selected individual projects of recycling industrial architecture, as well as from conversations with project leaders of chosen projects (by the technique of direct interview). The above data collection techniques and methods of analysis aim at the evaluation of the 'recycling model' i.e. the redefined recycling design principles, referring to the selected examples of recycling industrial architecture. These techniques and methods also serve to analyse the relationship between physical characteristics of a given industrial building and the design principle chosen for intervention. In this way, it is possible to directly observe the extent to which the physical condition of an industrial building informs the intervention.

Chosen method: Multiple-case study

According to research dealing in-depth with the case study method (Yin, 2009; Harrison, 2002), the process of performing the case study consists of several stages. The first phase relates to the selection of cases to be analysed. This phase includes the overview of the criteria by which the cases were selected. The second phase describes techniques used for collecting the necessary empirical data. The following phase describes ways in which the obtained data are analysed, while the final phase describes possible generalisation of the data, which makes them potentially applicable in future research. Therefore, this subchapter provides a description of the approach applied in this part of the research and explains the reasons for the selection of particular research methods, techniques and procedures for data analysis.

As a particularly appropriate method for the analysis of empirical data in this study, the method of multiple case study was selected, i.e. cases that occur in different places and at different times, but with the same subject of research. Of special importance is the use of the same apparatus allowing the comparison of the information from different cases, which are, chosen according to the same or similar parameters (Swanborn, 2010). In this research, the cases refer to three projects of recycling the industrial architecture. Case study research consists of empirical exploration using familiar research techniques (Yin, 2009), usually involving the generation of data from more than one source within each case. If the research is to explore multiple cases, the data collection is then repeated in each of the cases. Researchers, therefore, need to demonstrate the rigour of their methods within each set of data, within each case as well as across cases (Johnston, Leach & Liu, 1999). The researcher is then faced with the challenge of ensuring that each of the data sets meets not only the quality criteria for that particular method but convincing the reader of the overall contribution of the study (Farquhar, 2012).

The final quality assessment for case study research is generalizability, which relates to the belief that theories must be shown to count for phenomena not only in the setting in which they were studied but elsewhere (Remenyi et al., 1998). One of the most frequent criticisms levelled at case study research is that the findings cannot be generalized to a wider population. Some authors believe that multiple cases provide the bases for generalizability (Leonard & Barton, 1990). Johnston et al. (1999) advocate multiple case study research claiming that generalization can be achieved through replication in multiple settings. One of the most complete definitions of the case study method characteristics refers to its use for the analysis of contemporary phenomena - occurring in the real context and requiring the use of multiple sources and types of data (Feagin, Orum & Sjoberg, 1991). Therefore, the method of case study allows the holistic understanding of the phenomena, i.e. understanding of the context it is placed in, through the thorough analysis involving the use of a large number of data (Perić, 2013).

The method of case study is considered appropriate methodological choice for this research for various reasons. Firstly, the exploration of the design principles of recycling the industrial architecture is achieved through the analysis of the 'good practice' examples, i.e. internationally recognized and awarded projects of recycling industrial architecture. Secondly, research by the method of multiple-case study offers the possibility for the systematization and validation of the data in a broader context, thus developing research approach to be used for other examples (Yin, 2009). This is of a particular importance for the study, given that one of the main goals of this research is to provide guidance for the recycling of industrial architecture in different contexts. In addition to the advantages of the case study method, the shortcomings attributed to this research method should be mentioned as well, but also the ways in which these deficiencies can be overcome. First objection, referring to the case study implementation, concerns the subjectivity and unreliability of information (Perić, 2013). More precisely, the interlocutor's subjectivity while conducting the interview may affect the validity of the data. However, in presented research, this deficiency is reduced to a minimum, as there was no reason for concealing the important information. The selected cases are examples of 'good practice' (that received international recognition), so that most of the information can be verified in publications dealing with the topic of recycling architecture. A problem of credibility of the research is mentioned as another weakness of the case study method, due to preconceptions of the researcher (Flyvbjerg, 2006). However, as the spatial range of this research deals with the foreign context, to which the researcher has no prior preconceptions, it is clear that a completely objective approach to the research is taken. Therefore, the general shortcomings of a case study, as a research method, are not relevant for this particular research. The structure of the analysis of selected case studies and the criteria for their selection are given in the following.

The selected case studies

The practical part of the research consists of the evaluation of the recycling design principles applied in the selected examples of recycling the industrial architecture. Three projects are selected for the analysis of the redefined recycling design principles. Each of the three projects corresponds to one of the redefined principles from the 'recycling model'. The most important part is the determination of the set of criteria for a more restricted selection, as the concept of recycling fades and branches out in a number of different directions (Ciorra, 2012). Therefore, the projects selected for the analysis in this research are chosen according to the following criteria:

1. Spatial scope. The first selection criterion is concerned with the geographical affiliation to the Western Europe. The examples from three Western European countries - Spain, Portugal and Great Britain, were selected for the analysis. According to a number of historians (Hobsbawm, 1977, Southcliffe Ashton, 1997), the Industrial Revolution began in Great Britain and spread to the Western Europe within a few decades. Great Britain dictated the rhythm of progress to the rest of Europe from 1750 onwards, as it enjoyed two important advantages: an extremely productive and wealthy agricultural system, and an astonishing number of creative inventors. Spain and Portugal, together with Great Britain have remarkable industrial legacy, and are countries with an internationally recognized practice of reconvertng the industrial architecture.

2. Location. The second criterion refers to the location of the selected recycling project. In this research, only the cases placed in urban areas are analysed. Industrial buildings were traditionally built in the outskirts but nowadays, due to the expansion of the city, they are situated in the city's central zones. Such buildings were considered especially interesting given that they occupy the potentially most attractive city sites. Thus, each of the three projects chosen for the analysis is located in the urban area.

3. Scale. As already mentioned in the Chapter III, industrial buildings can be found in the form of individual buildings, industrial complexes, or industrial landscape. In this research, the selected cases refer to the transformation of individual buildings. In this way, in-depth analysis of design principles is conducted by focusing on one single building, rather than on a complex of buildings or industrial landscape.

Data collecting methods and techniques

According to Swanborn (2010: 95), the data sources of central importance in case study are field documents, information and observation. In this way, through existing source evidence, as well as the original field data research, a continuous analysis can be performed thus revealing the gaps in data, verifying the hypothesis and suggesting how to reach new

data. The collection of data for the analysis of individual cases is done by the methods of examination, individual, mainly oral examination, while in some cases the combination of oral and written examination was conducted. Since the research aims at the redefinition of recycling design principles and understanding of the relationship between physical characteristic of a given industrial building and design principles to be chosen for its recycling, the interview was used as an examination technique which enables a higher level of knowledge and a greater level of knowledge veracity (Miljević, 2007; Dunn, 2000). Given that the interviews are used with the aim of understanding the design logic behind the selected recycling projects, directed interview was chosen, as a particularly suitable form of interview. The main characteristic of this type of interview is “accurately developed procedure, based on previously studied and categorized situations, and the construction of the model of the expected situations” (Miljević, 2007: 204). The advantage of this type of interview is that, in spite of a clear structure, the examiner has the ability to adapt its examination to each interviewee individually (Dunn, 2000). In this way the quality of information obtained by respondents that, at first glance, seem indifferent to cooperate or do not agree with the traditional way of conducting interview, is increased.

Selection of the respondents was of a particular importance. According to Harrison (2002), in order for the investigation in a new environment to result in a success, it is necessary to choose a respondent who possesses variety of information related to the desired field of research. Therefore, for the purposes of this research the project leaders of chosen interventions were selected as appropriate respondents. The interview was conceived as a directed interview, where every part consists of a series of questions aimed at allowing the communication between the interviewer and interviewees, that is, interviewees were given the opportunity to express their own views on the given topics. The questions were formed with the aim of understanding the design logic behind the project and determining to which extent physical characteristic of the original building informed the recycling intervention. Based on the respondent’s reactions, new interesting subjects of the interview can emerge, and therefore, questions can adapt to newly emerged topics. According to Dunn (2000), a good interview should include a series of questions of different types. According to the same source, there are few basic types of questions classified according to the types of responses that are given to them. Thus, among others, “there are questions to which the answer is: description, narration, structure and thinking” (Dunn, 2000: 56). Above mentioned types of questions are applied in surveys, in order to clarify information regarding the general research aims. Through the inquiries, the answers were given to the general research questions, i.e. initial hypothesis. As the first hypothesis addresses the process of recycling architecture as a viable alternative to demolition and preservation, this set of questions deals with the interviewee’s attitudes towards recycling, i.e. how was this viability achieved in selected projects and what were the benefits and drawbacks of

choosing to recycle existing building instead of building a new one. The second hypothesis refers to the relationship between the physical characteristics of the original industrial building and the design principle chosen for its recycling. Therefore, in the second set of questions the focus is on the chosen recycling design principle and extent to which it was influenced by physical characteristics of the original building. In this way, it is possible to determine the design logic behind the selected projects and which factors were crucial for choosing one design principle over the other.

The structure of the interview consists of three main parts - the introduction, the central part, and the general guidelines as a form of the concluding part. The central part consists of several segments addressing the selected recycling design principle and the relationship between the physical characteristics of the existing building and the design principle chosen for its recycling. In the first part of the interview broad and general questions are being asked, which lead to more specific, substantial questions. With such a strategy comfortable and pleasant atmosphere is achieved, which encourages the interviewees to talk openly about their experiences, which at the same time creates context for thinking and more complex interpretations that will follow (Patton, 1990). In the beginning, easier questions were asked, i.e. questions followed by a descriptive answers, usually questions relating to the role and responsibilities of the interviewee. Later, more abstract questions were being asked, while the most sensitive ones were asked at the very end of the research. Detailed structure of the interview is presented in the following.

1. The introductory part elucidates the respondent's general professional experience, as well as the experience in projects dealing with the topic of recycling the industrial architecture.
2. The central part is dedicated to a detail presentation of the recycling project:
 - 2.1. First part deals with the original building and its physical condition (structure and material).
 - 2.2. Second part refers to the recycling intervention.
3. The final part of the interview provides conclusive answers regarding the design principles applied in the recycling project, overall assessment of the success of the project, and possible recommendations for future recycling projects.

Apart from the ways of conceptualizing questions and forms in which they are asked, to obtain high quality information, interviewer's ability to listen to his respondent is essential (Patton, 1990). In order to maximise the dedication to the respondent all interviews were recorded. In this way the interviewer is able to participate as an active listener and to concentrate on the formulation of additional questions, if they are necessary for better understanding of the interviewee (Dunn, 2000).

Data analysis methods and techniques

The aim of the analysis is the evaluation of design principles used in recycling projects and understanding the factors influencing their election. As Yin (Yin, 2009) states, every research should have a general analytic strategy to define what will be analysed and in what way. The data analysis involves the interpretation of data obtained from interviews with authors of selected projects. Analysis of data obtained from the interviews can be conducted in two ways: through different computer programmes or “manually” (Yin, 2009). Dunn (2000) believes that the use of computers is effective in the case of a superficial content analysis of interviews, such as determining how many times a word is repeated in the interview, or the types of breaks present in the given interview. However, in the case of this research, which seeks to determine whether the redefined recycling design principles are present in the contemporary architectural practice, manual analysis of data is considered as more appropriate. This implies the use of a procedure consisting of multiple repetitions: reading, coding, re-coding, re-reading and comparison of the transcripts (Johnson & Harris, 2002). This method of data processing has proven to be more adequate as it increases the reliability of the analysis. The main goal of the interview is to confirm that one out of three redefined recycling design principles was used in one (out of three) project (i.e. case study). More precisely, the analysis of the case studies provides evaluation of the redefined recycling design principles in contemporary architectural practice. This study also determines the relationship between physical characteristic of the original building and design principle chosen for its recycling. This is achieved through the tectonic and spatial-formal analysis of the recycling intervention. Through such an analysis, the factors determining the use of specific design principle for the elaboration of the specific recycling project are explored. Also, the extent to which physical characteristic of the original industrial building influence the choice of the specific design principle is elucidated.

The analysis of the case studies is divided in two parts. Firstly, the **original industrial building before the recycling intervention** is analysed. Here, the focus is on the physical state of the industrial building. In order to conduct objective analysis on the physical conditions of the industrial building (which easily can turn to personal misinterpretation), there is a strong need for a structured set of criteria. Thus, the analysis strongly relies on the criteria elaborated in the Building Condition Evaluation Manual (Bergeson, 1997). More precisely, the criteria comprise two categories - structure and material, as shown in the Chart 4.1.

Chart 4.1.

Building condition evaluation chart

(Source: Author according to Bergeson & Bigelow, 1997)

		RATING			
		Good	Fair	Poor	Unsatisfied
STRUCTURAL CONDITION	Foundations				
	Vertical load bearing structures				
	Horizontal load bearing structures				
	Roof structure condition				
	Internal partitions				
MATERIAL CONDITION	Façade				
	Internal surfaces				
	Floor coverings				
	Wall and ceiling coverings				

According to the Building Condition Evaluation Manual (Bergeson, 1997), the rating of structural and material condition of the building is conducted in the following way:

- Good:
 - No visible sign of distress or failure in building.
 - Total system in sound condition.
 - No sign of water intrusion or damage.
 - Roof membranes, flashing and entire system sound and complete.
 - Routine maintenance will be adequate.
- Fair:
 - Minor shrinkage in floor.
 - No disruption of service in facility.
 - A minor cracks in walls with no intrusion into building.
 - Minor reparable problems visible such as built up membrane blisters, loose or displaced flashing and broken elements of roof covering.
 - Continuous observation and minor repair required.
- Poor:
 - Settlement cracks in floor creating problems.

- Failure apparent.
- Distinct signs of roof or wall leaks and water penetrating into building.
- Water intrusion obvious.
- Major repairs required.
- Unsatisfied:
 - Foundations, columns, beams or structural walls showing any sign of failure or distress such as settling, subsidence, severe cracks or crushing.
 - Extensive damage to building interior materials/systems obvious.
 - Severe and extensive failure of system apparent, resulting in extensive damage to building, disruption of operation or damage to systems.
 - Reconstruction and replacement required.

The second step of the case study analysis refers to **the evaluation of the recycling intervention**. This analysis, relying on the criteria elaborated by Rogić (2009), is divided in two parts: 1) tectonic analysis and 2) spatial-formal analysis. Tectonic analysis determines the relationship between the existing structure and the newly introduced one, as well as the relationship between the materials. The criteria for the tectonic analysis are structure and material, which can be rated as in the following:

- Structure:
 - Old structure retained, no new structure added
 - New structure added, independent from the old structure
 - New structure added, dependent from the old structure
 - Old structure completely replaced
- Material:
 - Exterior:
 - Old and new materials are completely interwoven
 - Clear division between the old and new materials (harmonious union)
 - Clear division between the old and new materials (confrontational)
 - Interior:
 - Old and new materials are completely interwoven
 - Clear division between the old and new materials (harmonious union)
 - Clear division between the old and new materials (confrontational)

On the other hand, spatial-formal analysis determines the degree of change induced to formal and spatial characteristics of the original industrial building. Here the analysis deals with the extent to which the original building's volume composition, symmetry and interior space division is changed. The criteria for the spatial-formal analysis are form and spatial organization, rated as in the following:

- Form:
 - Formal logic of the old building is respected-unchanged, no new elements are added
 - New elements are added respecting the old building's formal logic
 - Formal logic of the old building is disrupted
- Spatial organization:
 - Spatial logic of the interior spaces is preserved and unaltered
 - Spatial logic of the host building's interior spaces is altered but depends on the host building
 - Spatial logic of the host building's interior spaces is completely changed

The need to divide the case study analysis at two levels, i.e. 1) the analysis of the original building, and, then 2) the analysis of the recycling intervention, was of crucial importance for the consistency of the entire research. More precisely, in order to avoid general analogies between the principles used both in biology and architecture, but, on the contrary, to form the profound base for the elaboration of the redefined recycling design principles, it was necessary to first develop a consistent set of criteria. The criteria finally serve as a tool for a coherent implementation of the 'recycling model' in the practice of recycling the industrial architecture.

Data generalisation

For the research using the method of a multiple-case study as the main research method, it is of crucial importance to achieve the consistency in data collection and analysis (Harrison, 2002). This is the basic prerequisite for drawing the conclusions based on the analysis of multiple cases. Analytical strategy based on consistency as an essential principle greatly simplifies the process of data generalization, or as Yin (2009) emphasizes - the process of data 'replication'. The mentioned process of 'replication' is often very complex since it tends to rationalize the diversity that each of the examples carries (Harrison, 2002). However, the same source states that these differences are as important as the similarities between cases. Both characteristics strive to ensure the extension of knowledge, which in this investigation refers to the redefinition of recycling design principles and the

understanding of the influence which physical characteristics of an existing industrial building have on the election of the most environmentally sustainable design principle for their recycling. According to Harrison (2002), the main aim of the research based on the multiple cases is to show the following:

- Common elements, which provide insight into what can be considered as ‘universal example of good practice’;
- Uniqueness, which deals with the possibilities of application the specific mechanisms in given situations.

In this research, the identification of similarities among the examples, as well as the uniqueness of each one individually, is achieved through the analysis of the following aspects:

- Structural dependence
- Material relationship
- Formal disruption
- Spatial alteration

The above-mentioned aspects represent criteria for the redefinition of recycling design principles, i.e. the principles embedded within the conceptual model. Generalization of data actually refers to a final validation of the principles of the ‘recycling model’ through the examples from contemporary practice of recycling the industrial architecture.

4.3.1. Case study 1: Fabra i Coats Creation Factory

The project “Fabra i Coats Creation Factory” is a reconversion of the well preserved textile factory building, in Barcelona, Spain, into a multidisciplinary artistic centre. The project was done by Manuel Ruisánchez Capelastegui and Francesc Bacardit Segué. This reconversion was a part of “The Art Factories Programme”, initiated by the Barcelona Institute of Culture, which proposed the reactivation of a number of industrial premises for the cultural activities, such as: Fabra i Coats, Ateneu Popular 9 Barris, Hangar, Graner, La Central del Circ, La Escocesa, La Seca, Nau Ivanow and Sala Beckett / Obrador.

Analysis of the original building

The Fabra i Coats industrial complex (Figure 4.4.) is a 19th-century spinning mill, thread and textile factory that was part of the former municipality of Sant Andreu de Palomar in Barcelona, Spain. The complex is a testimony to the history of Sant Andreu del Palomar before its annexation to Barcelona, to an exceptional moment in the city’s development and to the process of industrialisation of Catalonia. The businessman Ferran Puig i

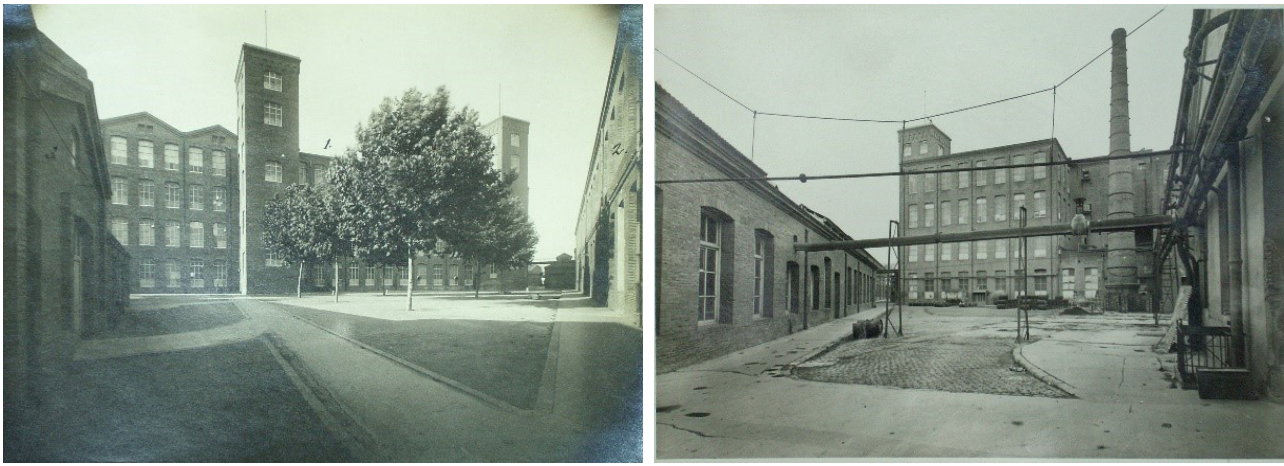


Figure 4.4.
Fabra i Coats before
the intervention

(Source: courtesy of
Manuel Ruisánchez
Arquitectes)

Gibert and his partner Jaume Portabella founded in 1893 a linen spinning factory in Sant Andreu which they called the Vapor de Fil. The factory applied the latest technological breakthroughs in its production processes. In 1884, when Camil Fabra joined the firm, the Sociedad Anónima Fabra y Portabella was constituted, which in 1903 merged with the British firm of J&P Coats. The resulting company was to become one of the chief textile industries in Europe. In the 1970s, though, factories began closing and workers were laid off.

The central structure of the Fabra i Coats complex is a four-storey building which consists of three juxtaposed bodies. A large edifice located to the west and two smaller ones oriented to the east and north. Leaning on the east facade of this great building, a single-storey construction houses the 'boiler room', which used to supply energy to the whole Fabra i Coats compound. The building, built in 1910, has a total of 14,000 m². This factory has an open floor plan, steel column matrix and brick perimeter walls (Figure 4.5.). In order to determine which recycling design principle is most environmentally sustainable for the intervention, the analysis of the original building's physical characteristics has to be firstly conducted. Thus, according to the criteria for the analysis of the existing building, original Fabra i Coats building has been evaluated, as shown in the Chart 4.2.

Figure 4.5.
Interior of the Fabra
i Coats before the
intervention

(Source: courtesy of
Manuel Ruisánchez
Arquitectes)

The analysis of the original building revealed that the industrial building was preserved in an excellent state, both structurally and materially. Foundations, vertical and horizontal load bearing structures, roof structure and internal partitions were in good condition. The industrial building has a very strong façade and, cladding and internal surfaces were well preserved. Thus, both structural and material characteristics of the given building allowed for the change of use without any significant physical change or upgrading. The industrial building can be used with negligible physical change to the building 'as found'. No external fabric replacement, modification of building's structure, or reconfiguration of internal spaces is needed for the building to be operational once again.



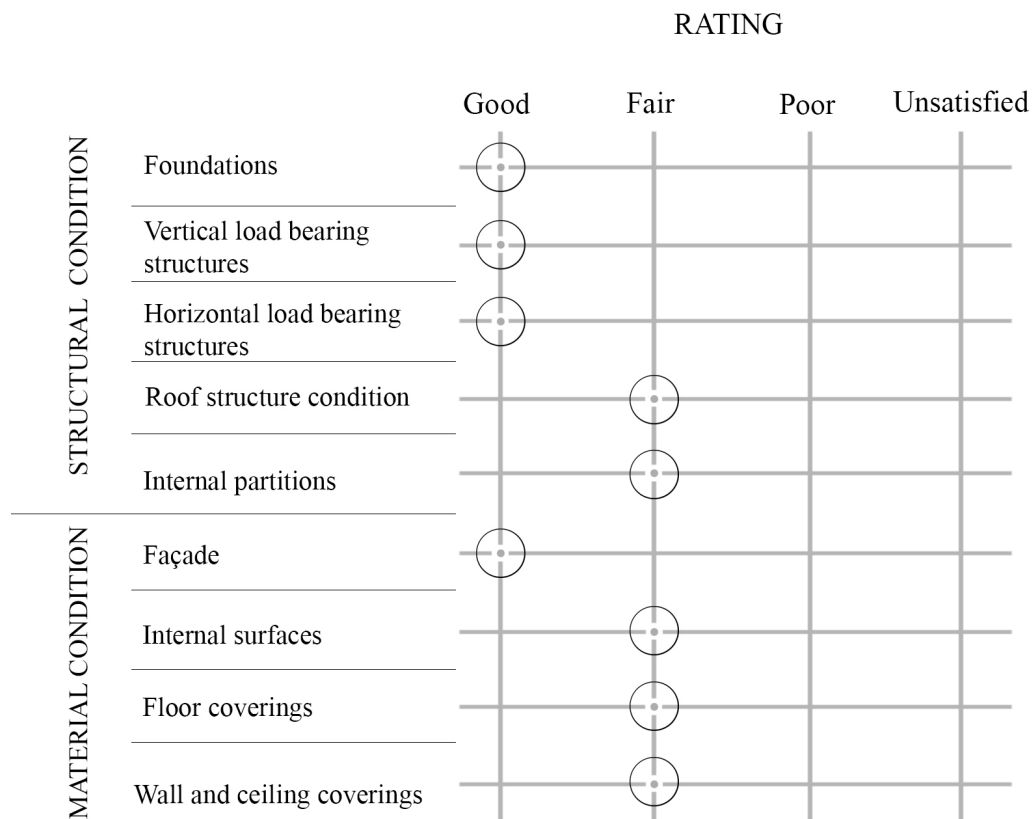


Chart 4.2.

Fabra i Coats,

Rating of the original building's structure and material condition

Analysis of the recycling intervention

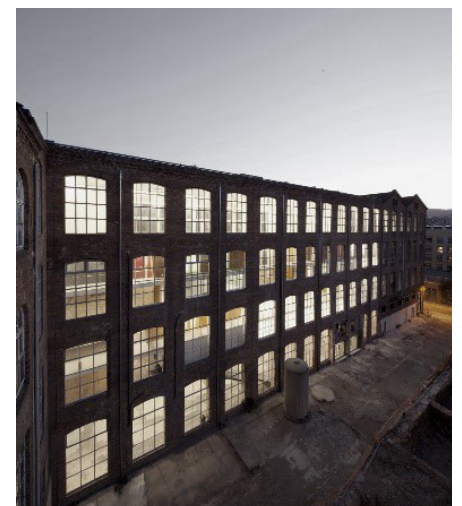
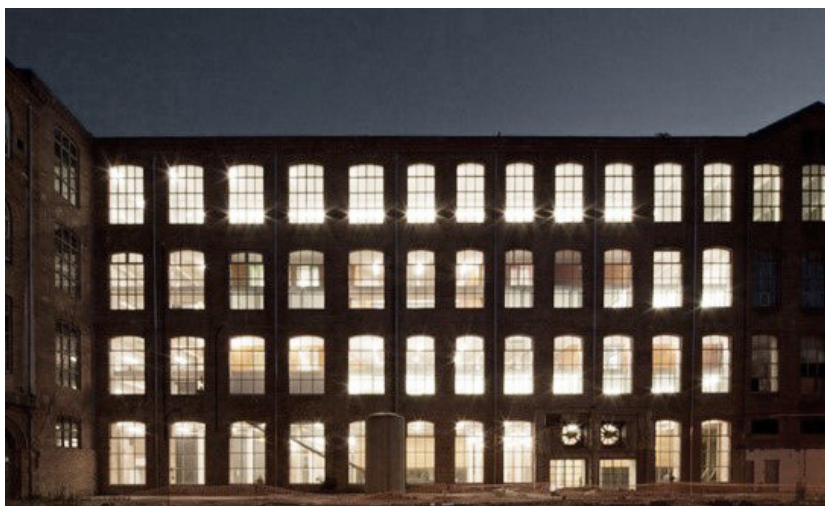
In 2008 it was proposed that the Fabra i Coats industrial complex should be converted into the Artistic Creation Factory as part of the “Art Factories Programme”- incubator for the creative sector, driven by the Barcelona Institute of Culture (Institut de Cultura de Barcelona). The aim of the “Art Factories Programme” was to upgrade disused industrial building in the very centre of the city, by giving them new cultural use, which would serve as a trigger for the regeneration of entire neighbourhoods.

Eight architectural offices were invited to take part in the contest for redevelopment of Fabra i Coats Creation Factory. As a winning proposal, a project by the architects Manuel Ruisánchez Capelastegui and Francesc Bacardit Seguéswas was chosen. The core of the project was the adaptation of the central wing and the boiler room of the Fabra i Coats complex (Figure 4.6.). The building that houses the creation factory was built between 1910 and 1920 and consists of four floors with exposed brickwork and two towers abutting the façade which connect the different spaces vertically.

Figure 4.6.

Fabra i Coats after the intervention

(Source: courtesy of Manuel Ruisánchez Arquitectes)





Tectonic analysis

Figure 4.7. Fabra i Coats, Removal of the later addition

(Source: courtesy of Manuel Ruisánchez Arquitectes)

The design strategy for the reconversion of Fabra i Coats was highly respectful of the original building. More of a transformation, it is a recovery of an industrial space. Not only that no new additions were made during the intervention, but on the contrary, all later additions, made during years, were stripped off. Thus, the building's form was recovered and brought to its original image (Figure 4.7). The volumetric composition of the original building, its fenestration and symmetry were respected and completely preserved.

The above pictures of the industrial building before and after the intervention show the removal of the later additions and returning of the building to its original state (Figure 4.7). Constructive and structural elements were kept, as well as some of the original systems and facilities, despite the complexity of the functional programme ('factory' of artistic creation, school of arts, Heritage Conservation Centre and a 'Museum of labour').

The old structure was retained, the roof structure and foundations were reinforced and upgraded. During the intervention, the original structural matrix was completely unaltered (Figure 4.8). All the existing materials were preserved. Even the windows with single glazing have been left in their original state.

Spatial-formal analysis

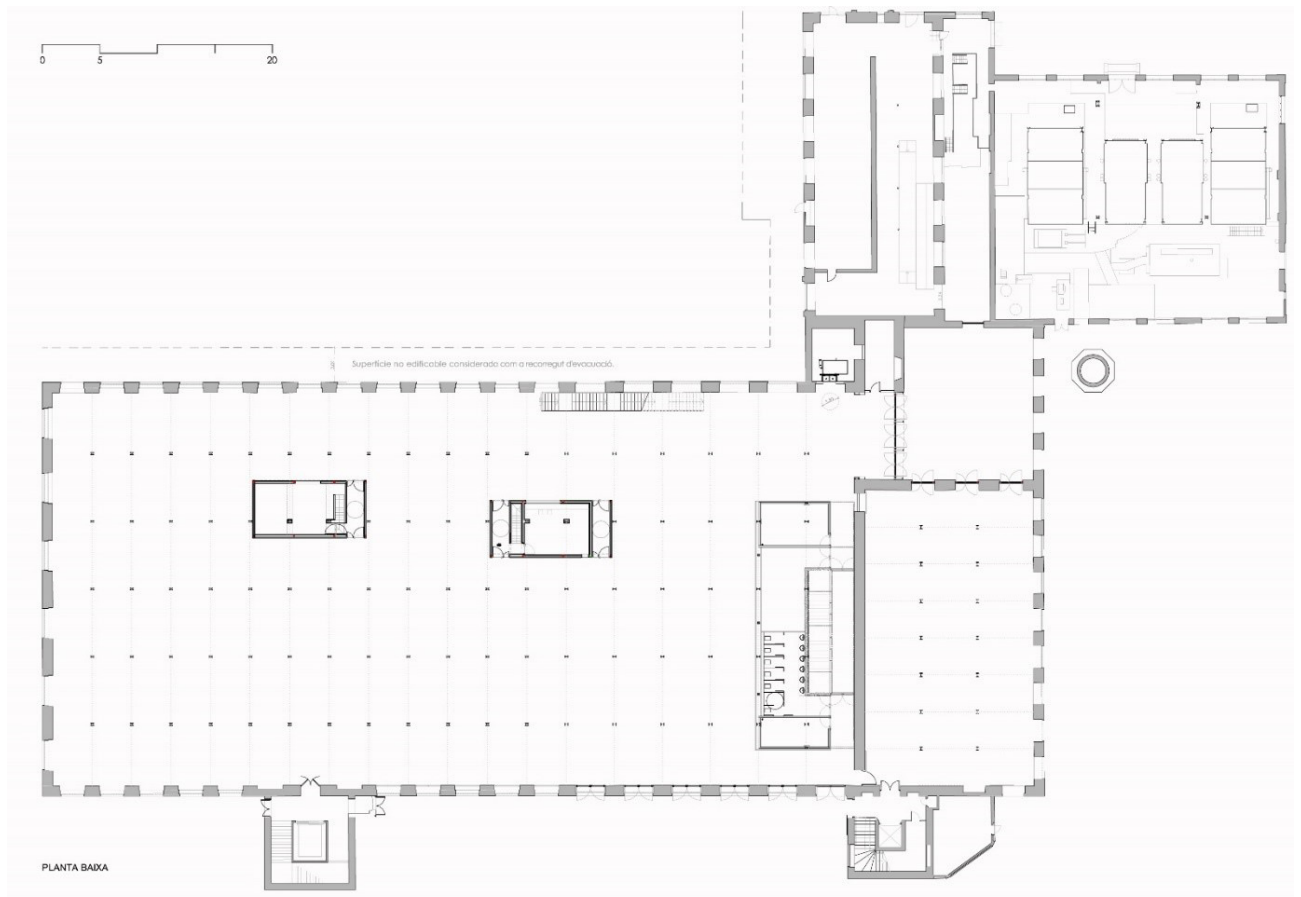
The original spatial organisation of the host building was preserved and unaltered. This spatial division determined the new intervention. The authors of the project explain that the organisation of the access systems and routes on the ground floor allows a clear distribution of the different functional programmes and easy occupation of the spaces, ensuring the proper functioning of the building's busiest parts: the public use areas. The upper floors host creation and training programmes.

The ground floor plan of the Fabra i Coats factory after the intervention shows that the

Figure 4.8. Fabra i Coats, Factory interior - Structural elements

(Source: courtesy of Manuel Ruisánchez Arquitectes)





original open floor plan was preserved (Figure 4.9). Existing column grid stayed unchanged as well as the perimeter walls. New light volumes introduced by the intervention did not alter the space in any way. These elements followed the original building's spatial logic.

The project was based on the search for a flexible system of distributing the available spaces based on movable divisions. This flexible space division on the first floor has been designed with a cable-and-sails system allowing the change of space according to needs (Figure 4.10.). In this way, the best effect was achieved by the least invasive approach. This system adapts to space requirements and allows for a great variety of spatial schemes to be implemented. Walls made of sturdy cloth with a plastic coating, suspended on steel wires and rails, delineate temporary work units that can be formed independently of the original support structure. The structures created by the sails can be installed in different heights depending on the necessity of privacy and on the type of work to be performed or executed. Thus, the space is transformed according to the different activities housed in Fabra i Coats.

Figure 4.9.

Fabra i Coats, Ground floor plan

(Source: courtesy of Manuel Ruisánchez Arquitectes)

Figure 4.10.

Fabra i Coats, Cable-and-sails system

(Source: courtesy of Manuel Ruisánchez Arquitectes)



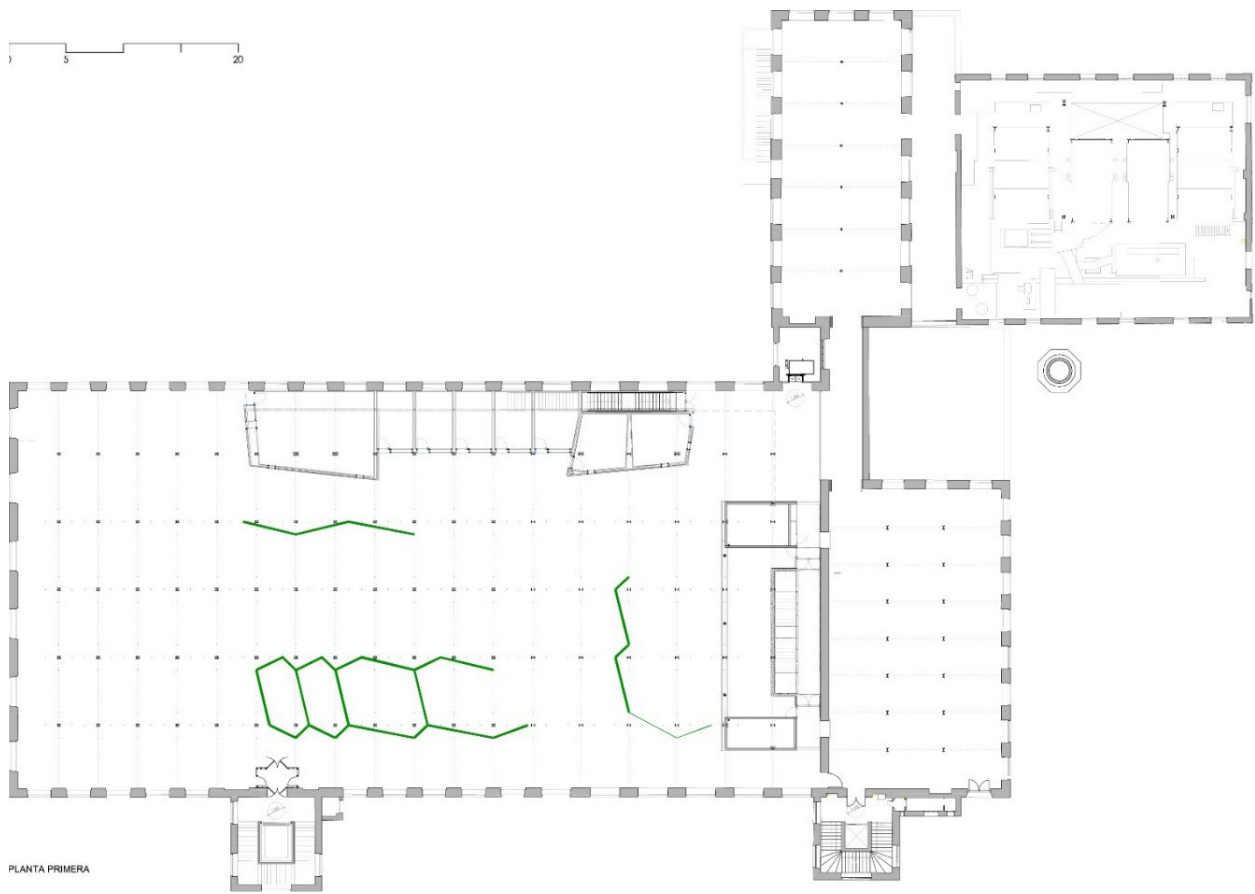


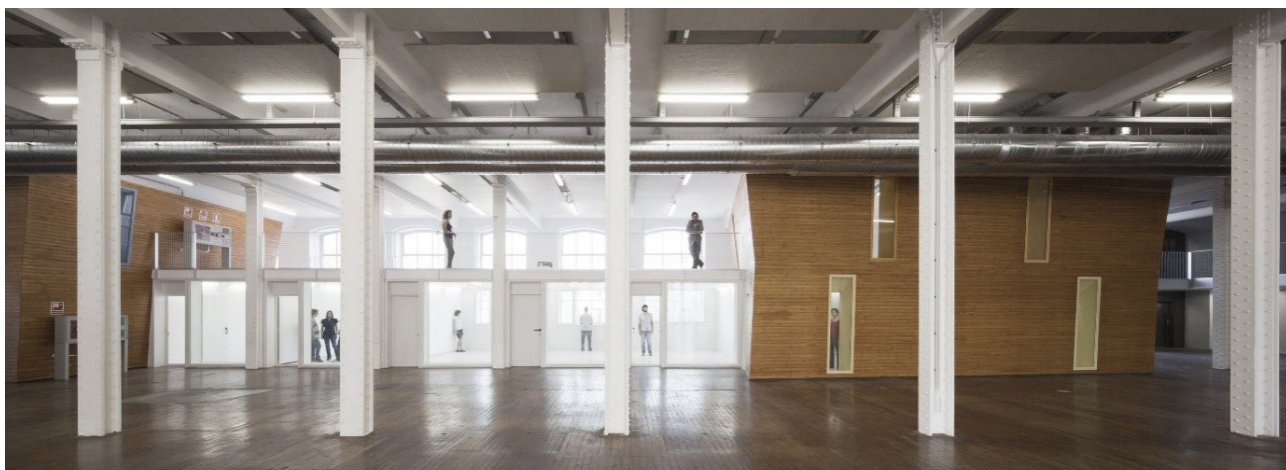
Figure 4.11. Fabra i Coats, First floor plan
(Source: courtesy of Manuel Ruisánchez Arquitectes)

First floor plan of the Fabra i Coats factory after the intervention shows the possible disposition of the cable-and-sale system, which, owing to different possible positions, create semi-private and private spaces, depending on the space requirements (Figure 4.11.).

Two types of new volumes were implemented into the host building, following its spatial logic. Firstly, new vertical communication and systems shaft, known as “Jack” (Figure 4.12.), in the form of a cuboid was placed in the factory building. This module gathers all the installations, services and fire escape, enabling the undisturbed use of space. Secondly, music boxes (i.e. the sound production and recording units) were implemented into the first floor of the industrial building without changing its spatial organization.

Figure 4.12.
Fabra i Coats, “The Jack”
(Source: courtesy of Manuel Ruisánchez Arquitectes)

The original building structure is preserved as a whole and upgraded where necessary. New structural elements are dependent on the old structure and together play the role of building tectonics. No changes are made to the original building form - its appearance stayed unchanged. The symmetry of the host building, its fenestration rhythm and volume composition are not altered. Ruisánchez highlights that the old construction



determined the intervention type which is “as light as possible” (M. Ruisánchez, personal communication, August 15, 2013). In terms of building materialisation, there is a clear separation between the old and new materials. Ruisánchez explains that when certain hardness is required in the separation, the rigid elements appear in the form of recycled wood creating the “music boxes” that are placed, whenever possible, close to the “jack” service. The wooden floors are not refurbished and white pillars are treated only with fireproof paint. The spatial composition of the building interior stayed unchanged as well. The original floor plan and column matrix remained as they were and, thus, influenced the new intervention. All the building interior elements follow the spatial logic of the original industrial building.

Evaluation of the given project according to the criteria for the analysis of the existing building, defined in the ‘recycling model’, is given below.

- Structure:
 - Old structure is retained and upgraded.
 - New structure is added, dependent on the old structure.
- Materials:
 - Exterior: old and new materials are completely interwoven
 - Interior: there is a clear division between the old and new material which form a harmonious union.
- Form:
 - Formal logic of the old building (volumetric composition, symmetry) is respected and unchanged.
 - No new elements are added.
- Spatial organization:
 - Spatial logic of the interior spaces is preserved and unaltered.

According to the above analysis of the recycling intervention, it can be concluded that the recycling design principle of ‘commensalism’ is at play. As defined in the conceptual model, this design principle is characterized as the least invasive one. Original building’s formal and special logic stays unaltered and existing structural elements and materials are preserved. The original building is dominant and new elements are conditioned by its formal and spatial logic. All the characteristics of the recycling design principle of ‘commensalism’ are found in the Fabra i Coats project.

4.3.2. Case study 2: Centro de Monitorização e Interpretação Ambiental (CMIA) – Casa dos Cubos

The project “Centro de Monitorização e Interpretação Ambiental – Casa dos Cubos” is a reconversion of a former rundown storehouse which, despite any particular architectural interest, plays a relevant role in the social and urban context of the city of Tomar, Portugal. The project was created by the Portuguese architectural office Embaixada Arquitectura² as a part of the governmental program – “The Polis”, to revive cities by introducing new facilities, such as the Environmental Monitoring and Interpretation Offices (EMIO). The aim of the “Polis” strategy, active in the period between 2000 and 2008, was to stimulate the rehabilitation of the city based on two key perspectives: 1) urban and 2) environmental issues. Overall, forty Portuguese cities were involved within the framework of the “Polis” strategy, thus providing a unique platform for debate, research and experimentation related to the topic of recycling.

² Embaixada Arquitectura is a Lisbon based office, led by Albuquerque Goinhas, Cristina Mendonça and Nuno Griff.

Analysis of the original building

The original structure was built as a storehouse for cereals belonging to the Knights Templar in the city of Tomar, Portugal, founded in 1161 by the Order of the Knights. The building is located at the edge of the city’s historical centre and has been subjected to several attachments and changes over the years. It has been threatened by decay and has been often found inadequate for its intended use (Figure 4.13.).

The building was adapted into a bank institution, was used as an industrial storage facility, and lastly, it was converted into offices belonging to the city hall. During the last intervention new walls, floors, and technical ceilings were placed. Nevertheless, the building continues to be protected under historic-preservation ordinances.

Above ground floor plan of the buildings before the intervention clearly shows significant subdivision of the inner space (Figure 4.14.). This spatial division was conditioned by the buildings latest office function. The building’s internal partitions, floors and ceilings, were found in a poor state and could not be put to use. The outer walls and foundations were in a good state and needed only minor upgrading.

Figure 4.13.
Casa dos Cubos,
Storehouse before the
intervention
(Source: courtesy
of Embaixada
Arquitectura)



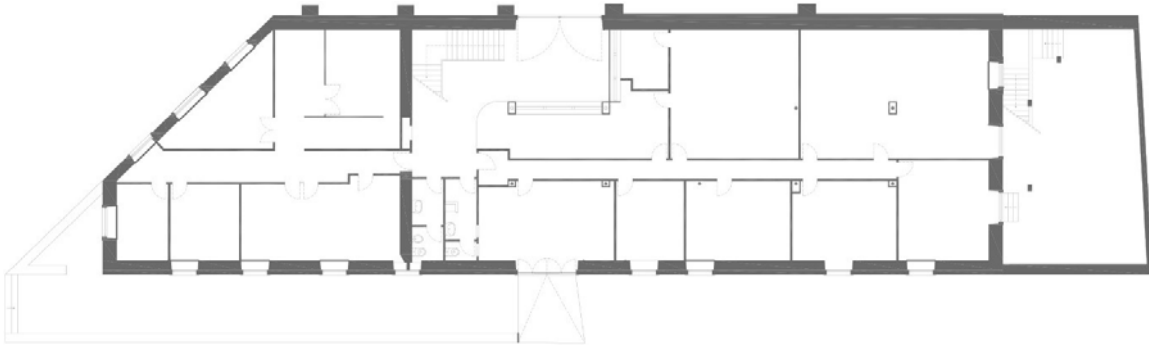


Figure 4.14.
Casa dos Cubos,
Ground floor
(Source: courtesy
of Embaixada
Arquitectura)

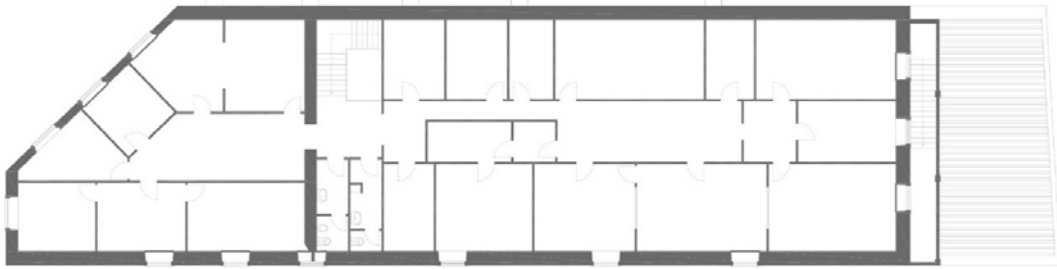


Figure 4.15.
Casa dos Cubos,
Level 1
(Source: courtesy
of Embaixada
Arquitectura)

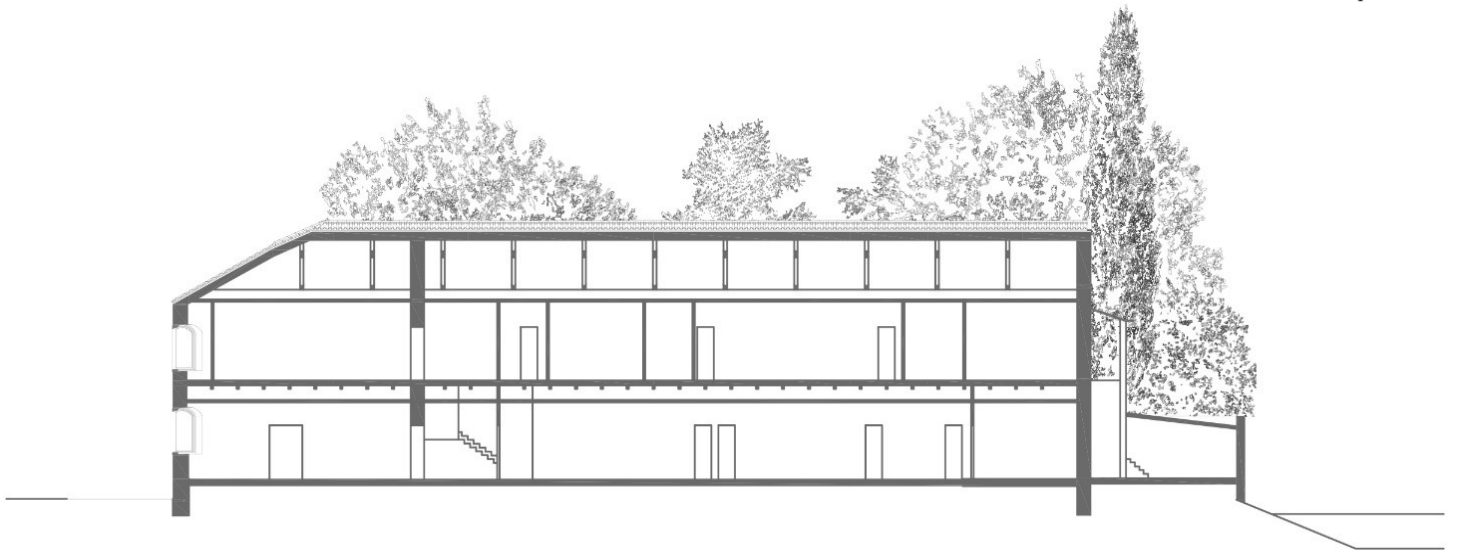


Figure 4.16.
Casa dos Cubos,
Longitudinal section
(Source: courtesy
of Embaixada
Arquitectura)

First floor plan of the building before the intervention (Figure 4.15.) shows that the same strategy was applied to the first floor during the latest change of use. A number of inner walls and corridors subdivided the interior space which was in the state of redundancy. The original building had two levels, connected with one staircase near the entrance (Figure 4.16.). Staircase and interfloor construction were found in a poor state. The evaluation of the original building according to the criteria for the analysis of the existing building, defined in the 'recycling model', is given in the Chart 4.3.

This analysis revealed that the building's main structure needed upgrading and that the internal structural element conditions were poor. The conditions of the perimeter walls were fair, both in terms of structure and materials. On the other hand, interior of the building was rundown, and needed substantial remodelling for the building to be operational once again.

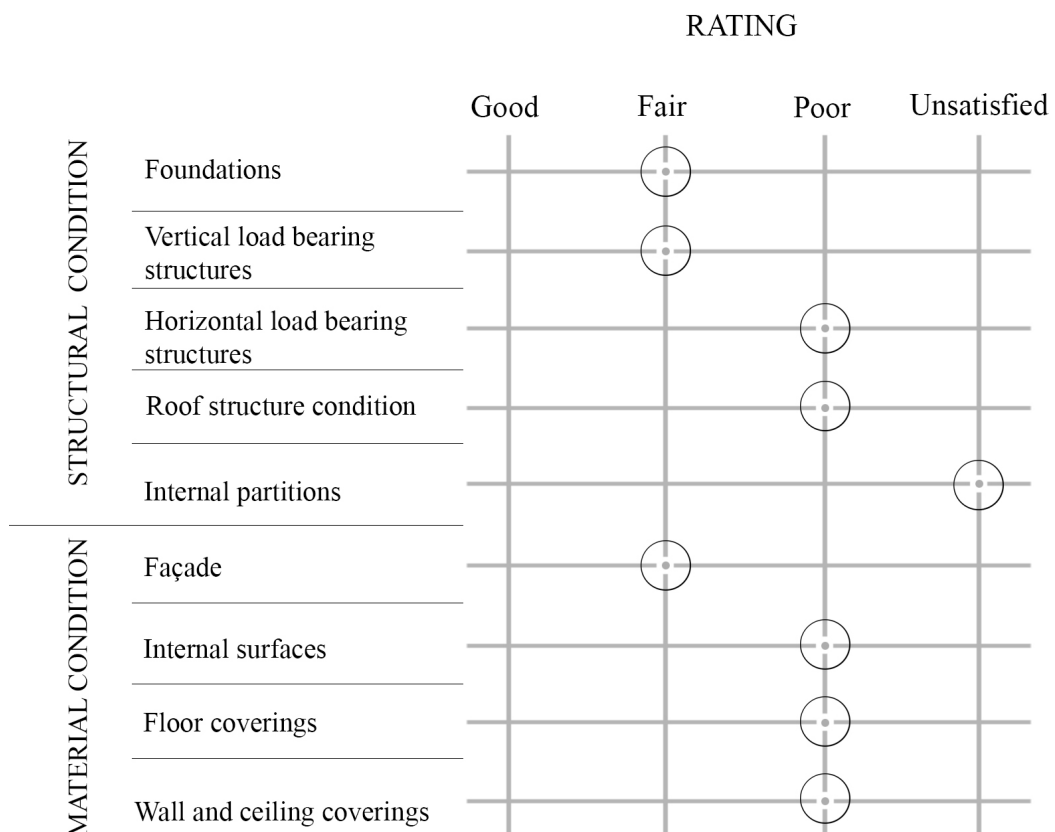


Chart 4.3.
Casa dos Cubos, Rating of the original building's structure and material condition

Analysis of the recycling intervention

The project is a first prize winner of the competition organized by the Portuguese government in 2003. The construction began in 2005, finished in 2006 and the building was open to the public in the spring of 2007. This renewal demanded the implementation of an Environmental Monitoring and Interpretation offices (EMIO). The EMIO are public facilities for exhibitions and other cultural events concerning environmental, educational and regional subjects comprising several functional areas, such as: multipurpose space for events and exhibitions; store; cafeteria; monitoring room; storage room; administrative room; offices rooms; lecture rooms; and an area for artistic residences with bedrooms, kitchen and working areas.

The building also became the new home for the city hall's cultural division and also the embryo for the Senior Citizens' University. According to Griff (2013), founding partner of the *Embaixada Arquitectura*, it was crucial to make a deeper analysis and understand that "to talk about urban regeneration is not only to talk about the emptiness and degradation of the urban fabric, but also to get overview of the potential inner spaces created by the existing empty buildings" (N. Griff, personal communication, September 23, 2013). He explains that the existing building acquired a central role in the development of the project and was transformed in a laboratory, i.e. the space of experimentation that does not imply the simulating of what already exists, but enables the exploration of the latent potential. Thus, the elements that do not bear the meaning and whose structural conditions were poor were demolished (Figure 4.17).

Tectonic analysis

During the intervention, all the external perimeter construction of the original building was kept, while its rundown interior was totally scooped out. The external walls were preserved and upgraded, while new structure, independent from the old one, was built. There is a clear cut in terms of structural behaviour of the old and new elements. Namely, new and old structure have completely divided roles.

Figure 4.17.

Casa dos Cubos,
Reconstruction
process

Source: courtesy of
*Embaixada Arqui-
tectura*



Authors of the project point out that “the new structure establishes itself as the anatomy of the existing building, a new architectural body that runs throughout the available space” (N. Griff, personal communication, September 23, 2013), tectonically dividing the finite interior into a new series of places and programmatic situations (Figure 4.18.). The new programme comprises two distinct areas: 1) public area for exhibitions, meetings and cafeteria, and 2) private area consisting of lecture rooms and accommodation for invited artists. The building was reconfigured and transformed into a unitary and hermetic space with the use of white mate paint and mate epoxy resin coating (Griff, 2013). Defined within the new structure are the private areas, each with its own access, atmosphere, identity, shape, use and dimension. Social life, exhibitions and meetings take place in the interstitial space around the new structure, and are characterized and organized by the programmatic events defined by the enclosed spaces (Griff, 2013). The architects explain that spaces are “born” from a visceral symbiosis and from the tension between this architectonic organism and the physical limits that keep him in captivity. A new interior “reading” was acquired for the existing building. For a newly introduced structure, a skin was created by mixing dark pigment, acrylic resin and reflective glass spheres. This abstract and simultaneously expressionistic skin is a clear contrast to white perimeter walls. Authors explain that “the entrails of this animal were painted with glossy white paint and with glossy epoxy resin coating - a new interior within an interior” (N. Griff, personal communication, September 23, 2013).

Spatial-formal analysis

As stated earlier the entire external perimeter construction was maintained and the new elements added follow the host buildings formal logic. These additions upgraded the rundown perimeter walls and roof structure. No changes were made to the building exterior, - its form and volumetric composition. The symmetry of the host building was not disrupted. Its formal logic and volumetric composition were unchanged (Figure 4.19.)

A completely different approach was adopted for the building’s interior. The rundown interior was totally scooped out, erasing the divisions made by the earlier interventions. By demolishing all the inner partition walls, the original building’s spatial organisation was transformed and a new singular space created. The authors of project explain that despite the fact that the building plays a relevant role in the social and urban context of the city, the original building presented a strong lack of architectural quality, and the preservation of the original spatial matrix would not enhance the development of the new activities. Thus a “new architectural vocabulary” was introduced into the old building interior in the form of volumes that have its own formal and spatial logic, independent from the old one. Authors explain that a “new machine capable of producing space was installed in a shell that was progressively deflated and then insufflated with a new and strange form of life” (N. Griff, personal communication, September 23, 2013).

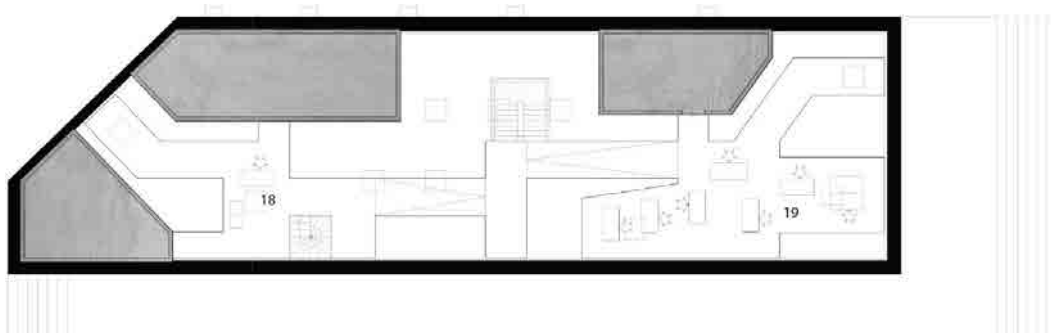
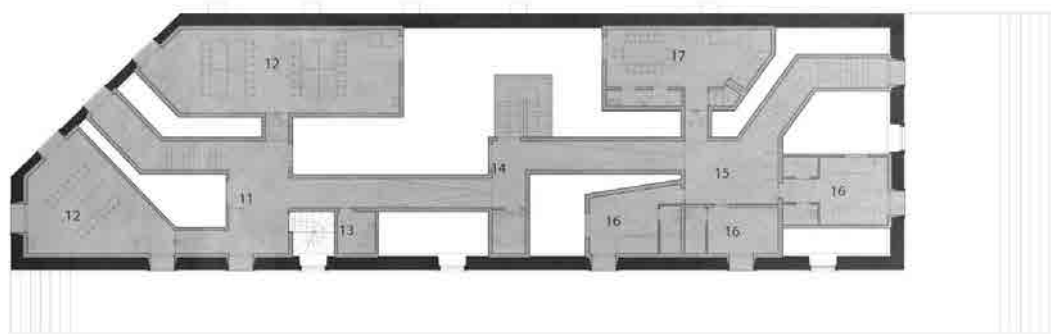
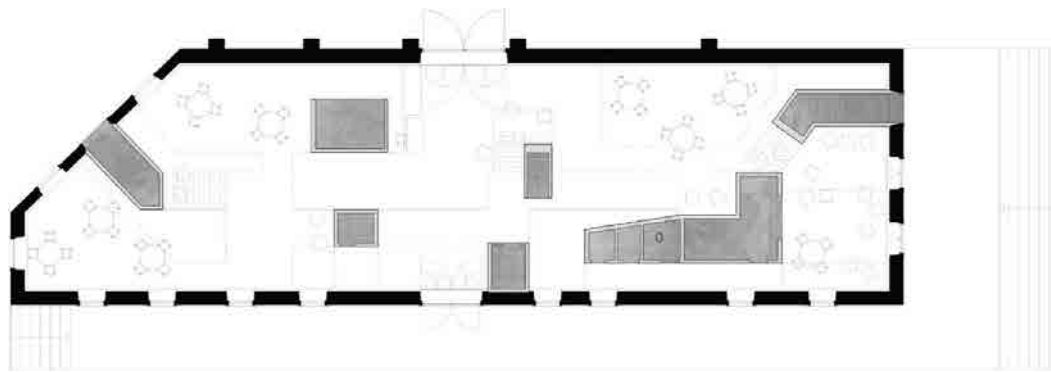


Figure 4.18.
Casa dos Cubos,
Ground floor, Level 1
and Level 2

(Source: courtesy
of Embaixada
Arquitectura)



Figure 4.19.
Casa dos Cubos, View
of the building, after
the intervention, and
its surroundings

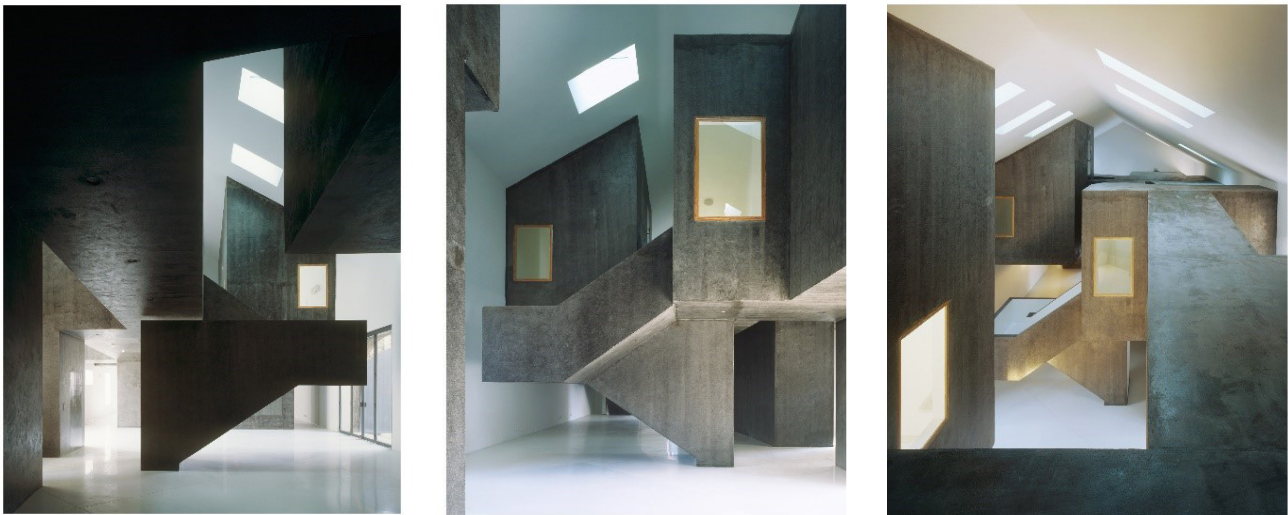
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of Embaixada
Arquitetura)

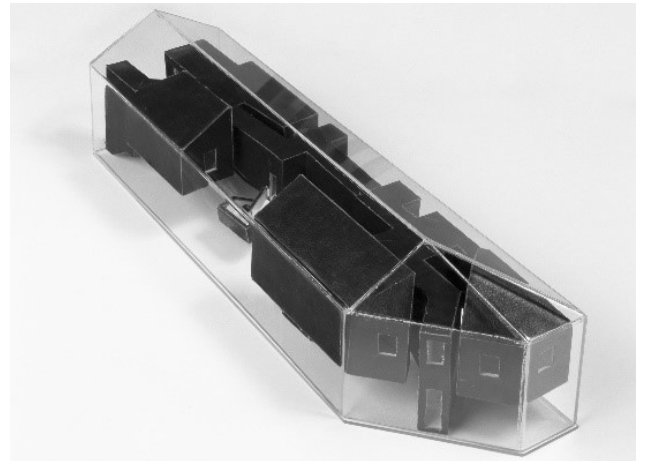
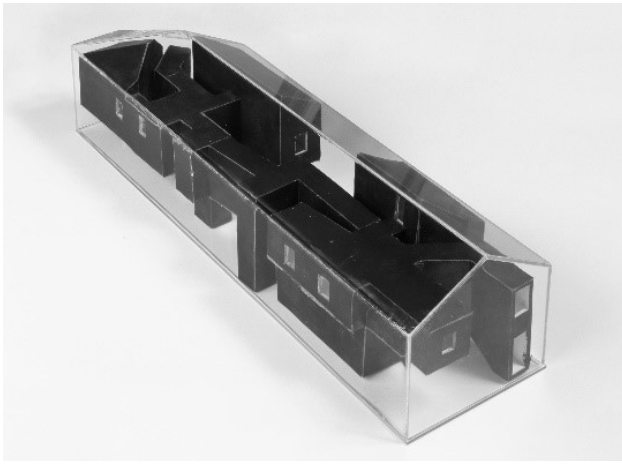
Although new elements completely filled the interior space of the original building, their size and position depend on the physical characteristics of the old building (Figure 4.20.). The new intervention is contained within the host building. Old building and new intervention are of equal importance. The new and the old form a symbiotic relationship in which the characteristics of the new elements directly derive from the old building's physical properties. In other words, the newly introduced elements adapt to host building. Griff (2013) explains that in this intervention as well as in all the interventions with the already existing buildings, the aim should be to ensure the continuity of the building. This continuity is achieved when a space is produced which fulfils perfectly all the new programmatic demands, but which has a potential "to become anything else in few years and still continues to work perfectly. Today, we call this flexibility, but Aldo Rossi called it 'the permanence of form'" (N. Griff, personal communication, September 23, 2013). Griff also highlights that in many cases of intervening with the building stock, the original spatial matrix does not support the new typology and a more radical strategy has to be implemented, as in the case of the "Casa dos Cubos" project.

The original structure which could be reused was preserved and upgraded (foundations, perimeter walls and roof structure) and rundown elements (inner partition walls, staircase and interfloor construction) were demolished. There is a clear cut in structural and material terms between the old and the new, i.e. they have divided roles. The volumetric composition of the original building's masses, its symmetry and fenestration rhythm was preserved and unaltered while the spatial organisation of its rundown interior was changed. Although new elements belong to a different, formal and material, architectural style, their dimensions are conditioned by mere physical characteristics of the host building (Figure 4.21.). Thus the 'new' and the 'old' are not without any relationship but, on the contrary, form a symbiotic one.

Figure 4.20.
Casa dos Cubos,
Interior view of the
building after the
intervention

(Source: courtesy
of Embaixada
Arquitetura)





The evaluation of the “Casa dos Cubos” project according to the criteria for the analysis of the recycling intervention, defined in the ‘recycling model’ is given below.

- Structure:
 - Old structure is partially retained and upgraded.
 - New structure is added, independent from the old structure.
- Materials:
 - Exterior: clear division between the old and new material which form a harmonious union.
 - Interior: clear division between the old and new material which are confrontational.
- Form:
 - Formal logic of the old building (volumetric composition, symmetry) is respected and unchanged.
 - No new elements are added to the building’s volume.
- Spatial organization:
 - Spatial logic of the old building’s interior spaces is altered but depend on the host building physical characteristics.

According to the above analysis of the recycling intervention, it can be concluded that the recycling design principle of ‘mutualism’ is at play. As defined in the conceptual model, this design principle is characterized by the equal importance of the existing building’s elements and the newly introduced ones. Original building’s formal composition stays unaltered, but the logic of its interior spaces changes. New and old structural elements have divided role and there is a clear cut between the original building’s materials and the newly introduced ones. All the characteristics of the recycling design principle of ‘mutualism’ are found in the ‘Casa dos Cubos’ project.

Figure 4.21.
Casa dos Cubos,
Model of the
intervention
(Source: courtesy
of Embaixada
Arquitectura)

4.3.3. Case study 3: 192 Shoreham Street

The “192 Shoreham Street” project is a reconversion of a Victorian industrial brick warehouse located at the edge of the Cultural Industries Quarter (CIQ) Conservation Area of Sheffield, England, into a mix use building, designed by Project Orange. In the early 1980’s, as a part of the city’s economic regeneration strategy, Sheffield City Council developed a policy with the aim of supporting the cultural and media industries. CIQ is one of eleven quarters designed by the “City Centre Strategy” as one of the most cosmopolitan and vibrant areas of the city. The intention of the CIQ was to create a cluster of music, film and science based business in the area, which today includes: Showroom Cinema, Red Tape Music Studios, Leadmill nightclub and venue, Sheffield Hallam University Students’ Union (former National Centre for Popular Music), Sheffield Institute of Art Gallery, Sheffield Live, Site Gallery - art gallery and Spearmint Rhino. The “192 Shoreham Street” project was awarded the ‘Sheffield Building of the year 2012’ award and also won the RIBA Regional Award in 2013.

Analysis of the original building

The Victorian industrial warehouse was not officially listed but considered as locally significant. For a long time this building was vacant and disused. It was once part of the city’s blooming steel and aluminum industry and it finally got a new purpose in 2011, when Sheffield developed into a service oriented city. The building was found in a state of redundancy. Its foundations, vertical and horizontal load bearing structures, roof structure and internal partitions were run down (Figure 4.22.).

Facade, cladding system, internal surfaces, floor, wall and ceiling coverings were in a poor condition and significant physical change was required if the building was to be operational once again. Many of the buildings elements were in the condition beyond repair. Evaluation of the industrial warehouse according to the criteria for the analysis of the existing building, defined in the ‘recycling model’ is given in the Chart 4.4.

The analysis revealed that the original building’s structural and material conditions were poor and that substantial reconfiguration and remodelling was needed for the building to be operational.

Figure 4.22.
192 Shoreham Street
Industrial
warehouse before the
intervention

(Source: Photograph
of a warehouse before
the intervention,
2014)



		RATING			
		Good	Fair	Poor	Unsatisfied
STRUCTURAL CONDITION	Foundations			⊙	
	Vertical load bearing structures			⊙	
	Horizontal load bearing structures			⊙	
	Roof structure condition				⊙
	Internal partitions				⊙
MATERIAL CONDITION	Façade			⊙	
	Internal surfaces				⊙
	Floor coverings				⊙
	Wall and ceiling coverings				⊙

Chart 4.4.

192 Shoreham Street, Rating of the original building's structure and material condition

Analysis of the recycling intervention

The intervention designed by the London based architectural office, Project Orange, seeks to provide a new meaning for the derelict industrial building and create a striking new landmark for the city. The brief was to transform a rundown warehouse into a mixed use building, combining desirable double height restaurant/bar within the original shell, with duplex studio and office units above (Figure 4.23). This new restaurant/café bar unit with separately accessed penthouse offices above comprises approximately 4,500 sq. ft. with a ground floor restaurant/bar area and provision for additional dining/seating at mezzanine level, which is fully serviced by a lift. The project was completed in 2011.

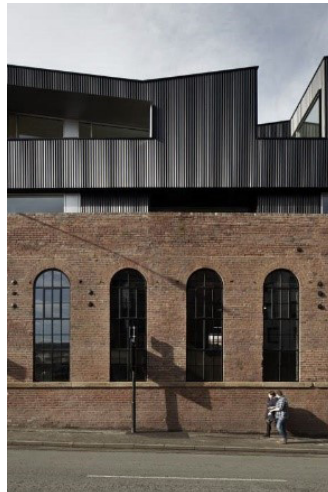
Tectonic analysis

The new construction consists of a lightweight steel frame with composite concrete/steel 'Ambideck' floor decks. This steel frame supports both the extension and restrains of the original brick walls (Figure 4.24). The original double pitch roof was replaced with a modern, box-like level structure.

Figure 4.23.

192 Shoreham Street, Original building after the intervention

(Source: Hobhouse, 2012a)



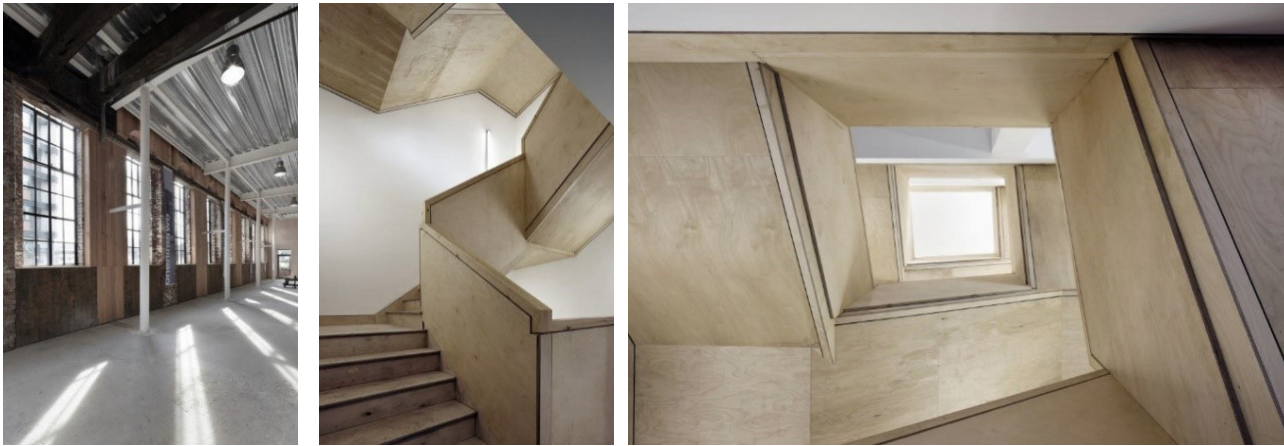


Figure 4.24.
192 Shoreham Street,
Interior view
(Source: Hobhouse,
2012b)

In terms of building materialization, all the newly introduced materials are in contrast to the existing ones. Kingspan Benchmark ‘Karrier’ insulated panels clad with sinusoidal powder coated aluminium profiled sheets are used for the cladding of the extension. The extension roof is finished with an extensive ‘Bauder’ sedum roof (Figure 4.25.). The black façade of the new elements of corrugated sheet metal stands in tension-filled contrast to the reddish brick façade of the original building. There is a clear separation between old and new in terms of materials used.

Spatial-formal analysis

New volumes were added to the original building. The authors of the project describe this vertical building expansion as “parasitic”. The very term used by the architects themselves suggests a confrontational and dynamic relationship between the old and the new. The new “parasitic” elements break the formal logic of the old Victorian building. The symmetry, fenestration and formal composition of the host building are altered by this intervention. This is also achieved by the windows of the modern structure, protruding into the original building (Figure 4.26.). Hence, new intervention brings completely new architectural style to the scene. The new addition replaces a pitched roof, creating three duplex studio offices, within a powder-coated steel volume, that both overlap and bite through the original brick structure. These volumes are an abstract evocation of the industrial roofscapes that used to dominate the city. These two new stories, added to the roof of a redundant brick warehouse, seem like another building stacked on top of the existing one. Even though the new addition looks cubic from the building’s front, it is loosened up by the gaps and inclined roof lines at its long side (Figure 4.27.). Newly introduced volumes push themselves through the dip line of the host building’s façade, thus, conquering space of its own within the structure. There is a clear dividing line between the old and the new.

Figure 4.25.
192 Shoreham Street,
Clash between
materials
(Source: Hobhouse,
2012c)





Figure 4.26.
192 Shoreham Street,
Tense relationship
between the old and
the new
(Source: Hobhouse,
2012d)

Compared with the previously analyzed project – ‘Casa dos Cubos’, where new elements fill the interior space of the original building, but their size and the position depend on the physical characteristics of the old building, here the intervention was not contained within the existing structure. New elements are not conditioned by the formal and spatial characteristics of the host building. New is dominant and is imposed on the old and the spatial and formal logic of the original building is changed.

The spatial organisation of the host building interior is changed and altered by the intervention as well (Figure 4.28.). New elements follow their own spatial logic in order to create spaces determined by the brief. Inside the old industrial building core there is the restaurant with a guest room on the intermediate level while inside the new volume, placed on top of the old building, three double-story studios are placed.

Internal features such as the dynamic sculptural plywood stair represent the new architectural style of the architects of the Project Orange (Figure 4.29.). Thus the design logic for the building’s exterior was also applied to the interior. In this example, as in the previous one, there is a clear cut in structural and material terms between the old and the new, i.e. they have divided roles. However, in the ‘192 Shoreham Street’ project volumetric composition of the original buildings masses, its symmetry and fenestration rhythm was changed, as well as the spatial organisation of its rundown interior. Newly introduced elements belong to a different formal and material architectural style, and their dimensions are not conditions by physical characteristics of the host building. Thus the relationship between the new and the old is dynamic and confrontational. Evaluation of the ‘192 Shoreham Street’ project according to criteria for the analysis of the recycling intervention, determined by the ‘recycling model’ is given below.

Figure 4.27.
192 Shoreham Street,
North and west
elevation
(Source: Project
Orange, 2012)



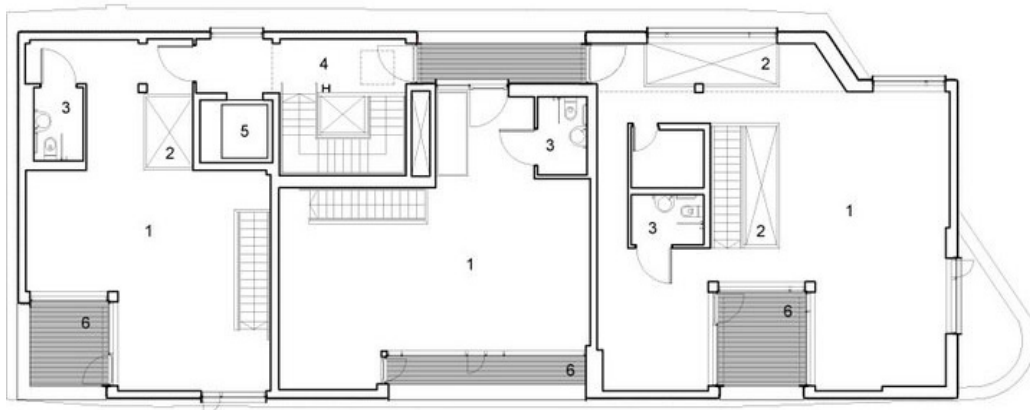
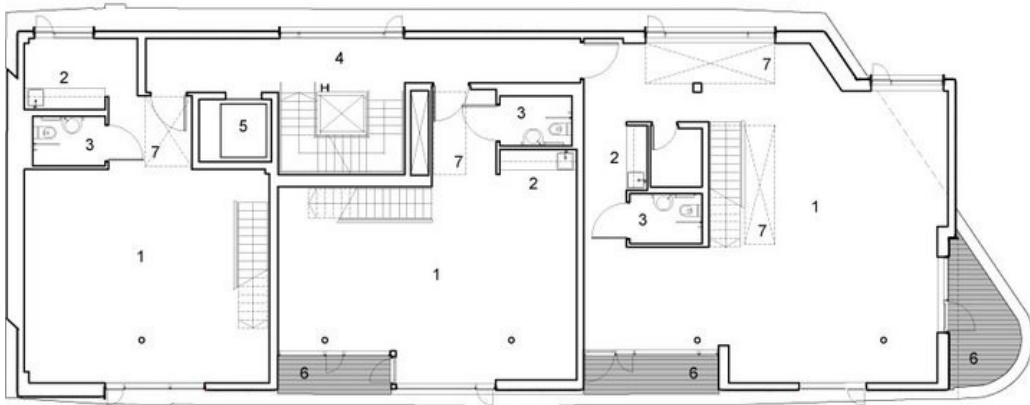
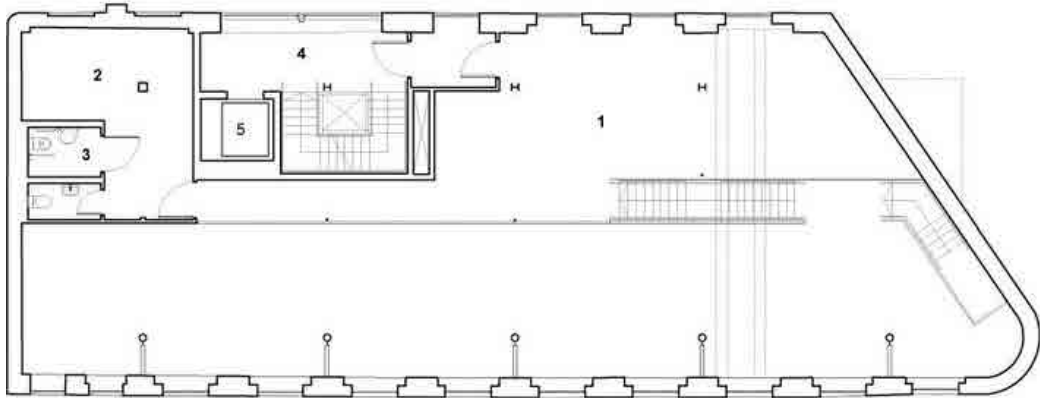
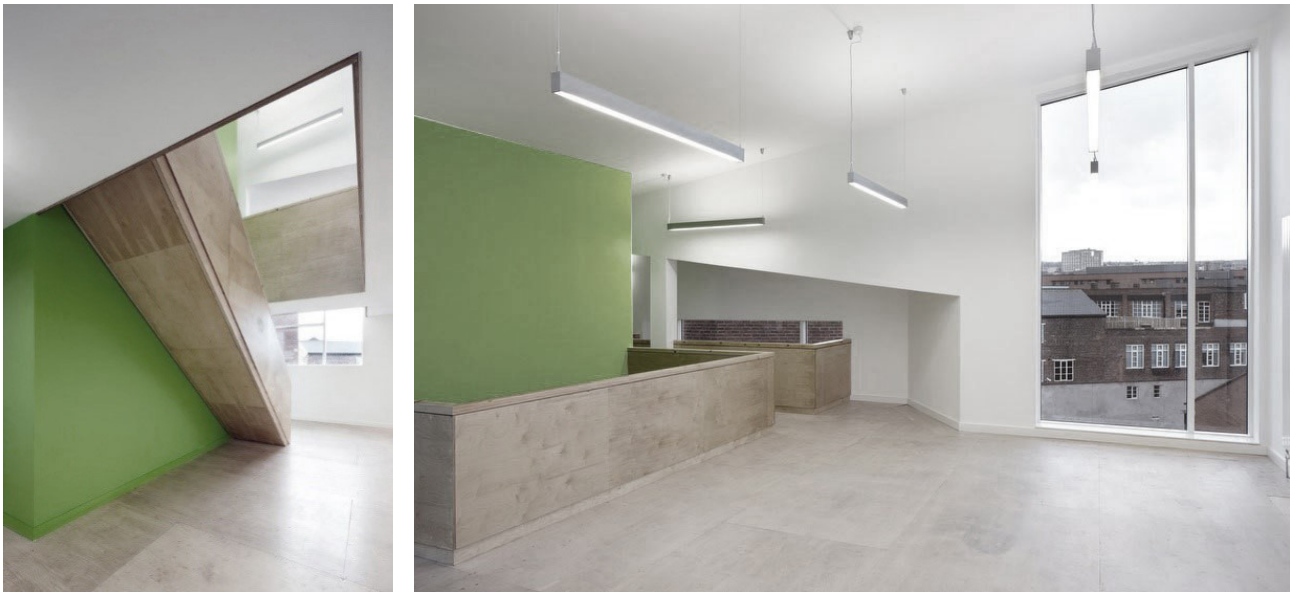


Figure 4.28.
 192 Shoreham Street,
 First, Second and
 Third floor plan
 (Source: Project
 Orange, 2012)



- Structure:
 - Old structure is mainly replaced.
 - New structure is added, independent from the old structure.
- Materials:
 - Exterior: clear division between the old and new material which are confrontational.
 - Interior: clear division between the old and new material which are confrontational.
- Form:
 - Formal logic of the old building is disrupted.
- Spatial organization:
 - Spatial logic of the host building's interior spaces is completely changed.

Figure 4.29.
192 Shoreham Street,
Interior view
(Source: Hobhouse,
2012e)

According to the analysis of the recycling intervention, it can be concluded that the recycling design principle of 'parasitism' is at play. As defined in the conceptual model, this design principle is characterized by the dominance of the new elements. Original building's formal composition as well as the logic of its interior spaces is changed. New and old structural elements have divided role and there is a clear cut between original building's materials and newly introduced ones. New elements are dominant and overpower the old features. All the characteristics of the recycling design principle of 'parasitism' are found in the '192 Shoreham Street' project.

• • •

In this chapter, through the analysis of the case studies, the recycling design principles (as defined in the 'recycling model') have been tested and verified. It has been verified that these redefined design principles are present in the contemporary architectural practise. The analysis of the selected cases also confirmed the existence of the close correlation between physical characteristics of an underused industrial building and the most environmentally sustainable design principle for its recycling.

In the case of 'Fabra i Coats', the analysis of the original building revealed that the industrial building was preserved in an excellent state, both structurally and materially. According to the 'recycling model', the most environmentally sustainable recycling design principle for an industrial building which is, in structural and material terms, in excellent condition is the design principle of 'commensalism'. By applying the design principle of 'commensalism' in the 'Fabra i Coats' project, all the available original building's material was saved, the embodied energy of these materials preserved and unnecessary demolition avoided, cutting down the associated environmental impact. Thus, it can be concluded that the most environmentally sustainable approach was selected for the intervention.

In the case of 'Casa dos Cubos' project the analysis of the original building revealed that the building's perimeter walls, façade, and foundation needed upgrading but its interior elements needed remodelling. The 'recycling model' recommends the recycling design principle of 'mutualism' as the most environmentally sustainable recycling design principle for an industrial building demanding only minor physical change and upgrading. For the 'Casa dos Cubos' project this design principle is the most environmentally sustainable one, given that all the available elements of the original building were put to use and unnecessary demolition was avoided. By preserving and upgrading all the structure and materials that could be used again, authors of this intervention have saved the embodied energy of the original building's material and have cut down the associated environmental impact of production and transportation of new materials. Having in mind that the interior of the host building was in a state beyond repair, authors had the liberty to use new contemporary elements with their own formal, spatial and material logic. These elements are conditioned by the host building, i.e. they enhance it and provide a new 'reading' of existing space.

In the final case, '192 Shoreham Street' project, the analysis of the original building indicated that the industrial building was in a very poor state, both structurally and materially. Many of its elements were in a state beyond repair, and had to be demolished for the building to be operational once again. As defined in the 'recycling model', the most environmentally sustainable recycling design principle for an industrial building which requires significant physical change, reconfiguration and reconstruction is the

design principle of 'parasitism'. For the '192 Shoreham Street' project, the recycling design principle of 'parasitism' is the most environmentally sustainable one, as all the elements of the original building that could be reused are put to use, thus saving the embodied energy of its material and cutting down the associated environmental impact of production and transportation of new materials. However, much of the original building was heavily deteriorated and practically beyond repair. Hence, the authors of the project introduced significant change by designing new contemporary elements with their own formal, spatial and material logic. These elements are not conditioned by the host building. On the contrary, they are dominant and overpower the old structure.

The case studies show that the selection of the recycling design principle greatly depends on the structure and material conditions of the original industrial building. It is also demonstrated that architects create their strategies and choose design principles according to the physical characteristics of the given industrial building. Thus, by exploiting the original building to a high degree, the architect opted for the intervention which is as environmentally sustainable as possible, confirming the hypothesis that in the process of recycling, physical characteristics of an underused industrial building determine which design principle is the most environmentally sustainable one for its recycling. The analysis of case studies confirms the validity of the 'recycling model' and provides an understanding of how a range of physical characteristics of existent industrial building can be considered in a systematic way with the aim of choosing the most environmentally sustainable design principle in the recycling process.

Redefinition of the architectural recycling practice: Symbiotic approach

Comparative analysis of four selected sources (each one elaborating three design principles through selected projects of architectural recycling), conducted in the Chapter III, revealed the absence of a clear criteria for the formulation of the recycling design principles resulting in inconsistencies in their definitions. This analysis served as a base for the redefinition of the recycling design principles. The analogy between the field of biology and architecture was drawn as a framework for the redefinition. From the biological concept of symbiosis, three design principles of recycling were defined, namely: commensalism, mutualism, and parasitism, and later evaluated through three case studies. The re-evaluation of the contemporary practice of recycling the industrial architecture, i.e. the classification of the selected projects according to newly defined recycling design principles, can be observed in the Figure 4.30.

COMMENSALISM

MUTUALISM

PARASITISM



• Fabra i Coats



• Casa dos Cubos



• 192 Shoreham Street



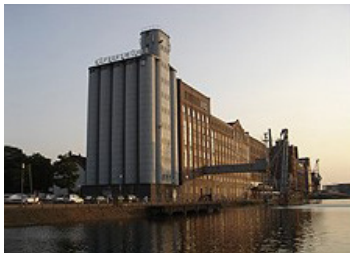
• Almeida Temporary Theatre



• German Design Centre



• Caixaforum Madrid



• Museum Küppersmühle



• Morton Duplex



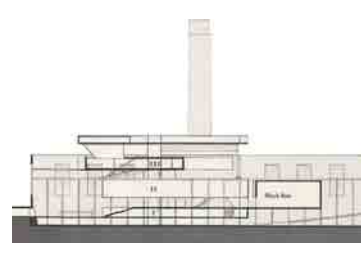
• Jægersborg Water Tower



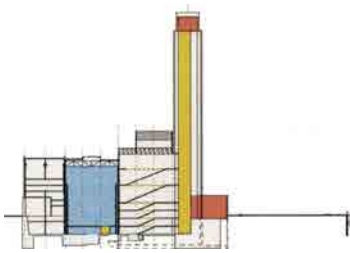
• Punta della Dogana



• Cafeteria in the Zeughouse ruin



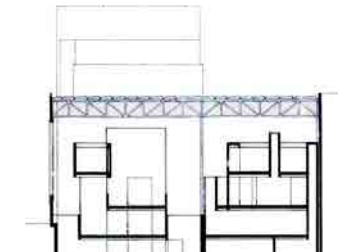
• Tate Modern - OMA



• Tate Modern - Herzog & de Meuron



• Fahle Building



• Tate Modern - David Chipperfield

Figure 4.30.
Re-evaluation of
the architectural
recycling practice

Commensalism. The projects that fall into this category are: Fabra i Coats, Almeida Temporary Theatre, Museum Küppersmühle, Punta della Dogana, and the Herzog & de Meuron's design for the Tate Modern. These projects respect the original building's formal composition and spatial organisation in its totality. The division of spaces within the building, i.e. its internal organisation, is preserved and governs the new intervention. In terms of material, new materials are integrated harmoniously with the whole and follow the aesthetic logic of the old. The original building has the predominance and fully governs the new intervention.

Mutualism. Projects gathered under this category are: Casa dos Cubos, German Design Centre, Morton Duplex, Cafeteria in the Zeughouse ruin, Fahle Building and David Chipperfield's design for the Tate Modern. These projects may add new elements to the building's volume which follow the formal logic of the old building, its symmetry and relationship between its elements. The additions are executed in materials clearly distinguishable from the old and there is a clear distinction between what is new and what was already there. These projects follow their own spatial organisation, inner-spatial distribution, which is influenced by the industrial building's physical characteristics, i.e. newly introduced elements are conditioned by the scale and physical dimensions of the original building. In these projects original industrial building and new intervention are equally present and dominant.

Parasitism. Projects which belong to this category are: 192 Shoreham Street, Caixaforum Madrid, Jægersborg Water Tower and OMA's proposal for the Tate Modern. These projects change fundamentally the image of the original industrial building, i.e. its formal composition and spatial organisation. The balance of the industrial building's composition, symmetry, and fenestration is broken and altered in these projects. New elements follow their own formal logic, which is confrontational with the old, and belong to a clearly different style, defined by the commissioned architect. The spatial organisation, i.e. the logic of the interior spaces, of the original building is altered and the character of the host building is completely changed. Thus, the new intervention is overpowering and fully governed by its own formal, spatial and material logic, independent from the original one.

V CONCLUDING REMARKS

In the introductory part of the research the research subject, - architectural recycling, as the most environmentally sustainable method of dealing with the existing building stock, was discussed and explained. The research starts with the premise that if sustainability agendas are to be reached it is not enough to develop strategies and principles for a sustainable design only for the new projects, but for the existing buildings as well. Therefore, the concept of architectural recycling has been viewed in the context of a sustainable architectural design, given that the global concept of sustainable development is imposed as a general context for all building related questions in the last few decades.

The aim of the first part of the research was to elucidate the concept of architectural recycling as a viable alternative to both demolition and preservation. The evolution of the architectural thought regarding the treatment of the existing buildings was investigated through the analysis of the concepts of preservation, restoration, destruction and sustainable design. In the first place, a systematic review of the concepts of preservation, restoration and destruction was presented based on the sources by John Ruskin, William Morris, Eugène Viollet-le-Duc and Rem Koolhaas. Ruskin believed that buildings are a living memory that should be preserved without any alterations. He equates the term restoration with destruction explaining that any change executed upon the existing building destroys it and produces a lie. Morris adopted Ruskin's teachings and also opposed restoration which he considered destructive. However, Ruskin's and Morris' passive model of preservation embalms the buildings as a monument, a museum piece, and prevents a wide range of conversion schemes (which could respond to the market needs by incorporating new functions) to be implemented. On the other hand, Viollet-le-Duc embraced the concept of restoration as a logical step in the evolution of the treatment of the original building. According to Viollet-le-Duc, restoration improves and completes original building with the introduction of new, better and stronger materials, thus, bringing a building in a state which never existed before. While Ruskin and Morris advocated passive preservation, Viollet-le-Duc promoted preservation of building through change of use, enabling in this way the continuity of the building occupancy. On the other end of the scale, the concept

of architectural destruction was praised by Koolhaas as a method for liberating space from outdated and useless architecture. Destruction has been seen as a countermeasure to preservation. A countermeasure which should be applied continuously. However, this action simply contributes to the endless circle of production, consumption and waste. Even though Koolhaas promotes destruction as a response to over preservation, in his projects, such as renovation and redefinition of the *Fondaco dei Tedeschi* in Venice or general staff building extension for the *Hermitage* Museum in St. Petersburg, Koolhaas preserves and reuses building elements on various levels, thus, choosing less radical approaches as a design strategy. In the former project original building's profile, galleries as well as the 75% of the building's structure were left unchanged, and in the later one, even the dilapidated spaces were left in the state in which they were found. Lastly, the concept of the sustainable architectural design was reviewed. Through the analysis of the sustainable design principles, defined by Edwards, Szokolay, Kibert and De Garrido, it was concluded that only through the optimization of natural and artificial resources, reuse of the existing structures and materials and reduction of energy consumption and waste, truly sustainable architecture can be reached. Through the analysis of the sustainable design principles the importance of the repurposing of the existing building stock, as one of the most effective methods for reaching the sustainable architectural design, and thus reaching general sustainability agendas, was confirmed.

The analysis of the above mentioned concepts enabled the elucidation of the concept of architectural recycling and its positioning between two polar and radical methods of dealing with the existing building, preservation as radical stasis and destruction as radical change. Architectural recycling – a 'preservation through change', is a process which, contrary to passive preservation (which persists in maintaining status quo) or total replacement, through the right amount of change responds to the changing conditions while exploiting the original building to a high degree. Through this process the balance is created between the preservation and destruction, i.e. stasis and change, in order to allow the building to alter its original function and adapt to the new requirements. In this way the continuity of the building occupancy is ensured through the transformation, necessary for the accommodation of new function.

The concept of recycling has also been analysed through its implication with architecture movements, namely Archigram and Metabolism. These avant-garde movements recognised the potential of the reuse and transformation of the already existing and used it both for the formulation of their ideologies and creation of the practical body of work. It was demonstrated that architecture itself can be considered as recyclable material, which has been recycled and repurposed throughout centuries, from temples and citadels to entire cities. Both Archigram and Metabolism movements revolved around the idea of flexibility, change and constant repurposing. The idea that the city is a living entity which can evolve and adapt to rapidly changing conditions was central to both movements, and

their designs were the embodiments of this idea. Even though they drew inspiration from different fields, Archigram from a mechanical progress and Metabolists from a biomorphic model of transformation, these movements promoted architectural recycling as a method of responding to constant social and economic change. Thus, the concept of architectural recycling, i.e. 'preservation through change', embodies the principles of sustainable architectural design (preservation of the embodied energy of building materials, cutting pollution and waste, and lowering impact on new land) and allows the building to evolve and adapt to market needs, while producing minimal environmental impact.

Once the importance of architectural recycling has been elucidated, both as a method for reaching sustainable architectural design and for providing the continuity of the building occupancy through transformation and adaptation, the research focused on industrial architecture. Industrial architecture was understood as a field for the exploration of the topic of architectural recycling. This building type is the most appropriate for the research on architectural recycling, due to its physical characteristics, i.e. large flexible spaces with great adaptability potential. In the first place, both architectural and social importance of industrial buildings was assessed as well as their role in the urban regeneration of cities and their influence on the emergence of new art and architecture movements. Due to strict building regulations, structural and material innovations were first tested in industrial buildings, as they were not subjected to these building laws. Therefore, these buildings were responsible for the progress in the field of architecture, given that they were the testing field for experimentation. Industrial buildings were also responsible for the creation of new and impressive urban identity and they determined the character of neighbourhoods and towns. Simply by the virtue of their size, but also due to their active role in the shaping of communities these buildings are considered valuable and important local landmarks. Industrial buildings also have deep-seated associations for the local residents, and they give character and distinctiveness to a neighbourhood. Precisely because of the part industrial buildings played in the shaping of the Modern World, i.e. profound changes induced by the industrial revolution, and their social importance as collectors of the embodied memory of our communities, these buildings have an important role in the urban regeneration of towns and cities. Through the recycling - 'preservation through change', of industrial buildings, a sense of community can be reinforced and the important contribution to the local economy can be made. The recycling of these buildings acts as a catalyst for the improvement and regeneration of districts and wider urban areas as well. In this way new jobs are created, local economy is boosted, local cultures reinforced and better use of natural resources is achieved. The form and aesthetics of industrial buildings, praised by Le Corbusier and Banham, influenced greatly the direction of the early modern movement and inspired the imagination of artists and architects. The particular aesthetics of these buildings has been analysed through its connection to broader concepts of nostalgia, decay and *terrain vague*. The promise of the unexpected,

contained in the industrial ruin, allows imaginative interpretations and escape from the ordered and controlled space. Industrial ruins produce stark contrast to these ordered spaces and offer alternative to common space use. Through the retrospective of Gordon Matta-Clark's work, it was demonstrated how architectural ruin can be seen as a canvas, a medium for the expression of ideas and beliefs. Through his interventions on abandoned, derelict buildings, Matta-Clark questioned the logic of mass production and consumerism. Industrial aesthetics inspired artists and architects alike, and influenced the creation of new trends and styles, such as industrial chic, and new types of living, i.e. loft living. Secondly, physical characteristics of the industrial buildings, which make them especially adequate for recycling, were elucidated and the conversion possibilities emphasised. Due to their size and spatial composition, i.e. multi-storey buildings with large spans and open spaces internally, structurally robust, made of strong materials, built to last, large window openings, etc., these buildings are extremely adaptable and suitable for most uses. Given that adaptation is a key aspect of sustainable construction, industrial buildings can, through conversion and repurposing, significantly benefit sustainability agendas. Laid on an open plan, these buildings adapt to radical remodelling and can be subdivided and upgraded for a wide range of uses, from cultural, office to residential.

Once the importance of industrial architecture was elucidated the research focus was shifted to the identification of existing recycling design principles in architectural practice. Based on a thorough overview of the body of literature in the field of recycling the industrial architecture, four sources (Brooker & Stone (2004), Feireiss & Klanten (2009), Jäger (2010) and Rogić (2009)), dealing with the design of the recycling intervention, were critically analysed. The analysis was conducted both on the micro, i.e. analysis of the design principles within one source, and macro level, i.e. comparative analysis of all four sources. The criteria for the analysis on both levels were structural dependence, relationship between new and old materials, formal disruption and spatial alteration. The aim of this part of the research was to shed light on deficiencies in definitions of the design principles due to the use of rather vague and abstract criteria. The analysis revealed that the relationship between the host building and the new intervention, i.e. the level of independency of the newly introduced elements, was a common criterion for the definition of the design principles. Due to the lack of a strict differentiation between design principles many of them, which should be confrontational, poses similar characteristics. This analysis served as a basis for the later redefinition of the recycling design principles.

Based on the comparative analysis, on both micro and macro level, of the selected sources, the conceptual 'recycling model', consisting of three new redefined recycling design principles, was created. The focus in this phase of the research was on examination of the possibility of implementing the biological concepts into architectural field. More precisely, the focus was on the identification of the extent to which the analogy between the fields of biology and architecture can be drawn. In the first place, a review of the

biological analogies made to the field of architecture by well-established architects and urban planners, namely those by Georges-Eugène Haussmann, Ildefons Cerdà, Frank Lloyd Wright, John Frazer and Manuel de Solà-Morales, was presented. The analysis revealed that concepts as 'evolution', 'adaptation', 'organic', 'circulation', 'genetics', 'skin', 'epidermis', 'nerves', 'arteries', 'acupuncture', and 'prosthesis' have been extensively used in architecture to explain urban and architectural phenomena and processes. For the purpose of this research a direct analogy with the concept of symbiosis and terms related to symbiotic associations, i.e. close and often long-term interaction between two or more different biological species, has been drawn. The analogy was made between the symbiotic association and possible relationships between the original industrial building and the new intervention. A parallel has drawn between two organisms which form a symbiotic association, i.e. 'symbionts', and the existing building and new intervention. The change that one symbiont can induce to the other one's genome (genetic material) and phenotype (the composite of an organism's observable characteristics or traits) was translated directly to change of the original building's form and function. The sole purpose of the symbiotic associations in nature is to allow at least one symbiont to draw benefits, nutrition or protection, from this relationship. In architectural terms, these benefits refer to structural, material, formal or spatial upgrading. Hence, three new redefined design principles of recycling, stemming directly from the biological concept of symbiosis, i.e. commensalism, mutualism and parasitism, have been presented, forming in that way the 'recycling model'. The translation of the biologically derived principles into architectural domain was possible through the formulation of characteristics that each redefined recycling design principle possesses, based on the clear set of criteria such as: structure, material, form and spatial organisation, i.e. structural, material, formal and spatial relationship between the original industrial building and the new intervention.

Commensalism is a type of symbiotic relationship in which one of the symbionts benefits (nutritional or protective benefit) from the association and the other is not harmed nor helped. This association is usually formed between a larger host, which stays unmodified, and a smaller symbiont which may show great structural adaptation. Therefore, the term commensalism is used to explain the relationship between the existing, underused industrial building and new intervention in which the existing building receives 'nutrition', i.e. structural, material, formal or spatial upgrading, while the newly introduced elements poses no threat to the formal and spatial integrity of the original building. Without altering the original building's form or spatial organisation these new elements, such as structural or installation units, provide normal functioning of the underused, existing building. Therefore, newly introduced elements are completely defined by the host building's physical characteristics, its dimensions, scale and disposition of spaces. Old structure is retained, if new structure is added, it is dependent on the old structure. Old and new materials are interwoven, and if there is a distinction between the old and new materials they form a

harmonious union. Formal logic of the old building is unchanged, no new elements are added and the spatial logic of the interior spaces is preserved and unaltered.

On the other hand, mutualism is a type of symbiotic association characterised by mutual benefit between two symbionts. There is a reciprocal exchange of nutrients, resources, services or protection. This type of symbiosis implies adaptation of one symbiont, its genome and phenotype, to the host, as well as some adaptations of the host to the other symbiont. This term has been used to explain the mutually beneficial relationship between the original industrial building and the new intervention. Even though they have different spatial organisation and material expression, original building and new intervention are dependent on, and conditioned by each other. Hence, physical characteristics of the original industrial building determine properties of new intervention, such as scale, rhythm and spatial disposition. New structural elements can be introduced to the original building, but their positioning, size and rhythm depends entirely on the old building's physical characteristics and spatial organization. Original building's envelope can be preserved but additions can also be made, following the formal logic of the old building, its symmetry and relationship between its elements. There is a clear distinction between what is new and what was already there in material terms. New intervention introduces its own spatial logic, which is nonetheless influenced by the industrial building's physical characteristics. Therefore, original spatial organisation of the industrial building can be altered, but newly introduced elements are always conditioned by the scale and physical dimensions of the original building. Unlike the design principle of commensalism, mutualism allows additions and alteration to be executed on the original industrial building, without jeopardising its formal logic, i.e. its symmetry and volumetric composition. Thus, both original industrial building and new intervention, are dependent on each other, i.e. original industrial building relies on the structural and service support of the new intervention which on the other hand is provided with the suitable environment in the form of a physical space to be installed in or attached to.

Lastly, parasitism refers to symbiotic association in which one of the symbionts, the parasite, benefits at the expense of the other, the host, which is harmed by this association. The parasite manipulates the host by either taking control of host behaviour or changing the host's appearance. Therefore, this type of symbiotic relationship implies a drastic change in the host's physiology and behaviour. In this research the term parasitism is used to explain the most dynamic and tense relationship between the original industrial building and the new intervention. New structural elements, independent from the old structure are placed and in some cases a complete replacement of the old structure is executed. In terms of building's material, new intervention is executed in materials clearly distinguishable from the old, and even confrontational. Additions and alteration introduced by the new intervention drastically change the formal logic of the original industrial building, i.e. the balance of its composition, symmetry, and fenestration. The

spatial composition and the character of the original building is altered as well, thus the new intervention is fully governed by its own formal and spatial logic independent from the existing one. Compared to the design principles of commensalism, and mutualism, parasitism implies the total inferiority of the old building to the new intervention and a tense clash between the two, both in spatial-formal, and structural-material terms.

Finally, the research focuses on the evaluation of the redefined recycling design principles in the contemporary practice of recycling the industrial architecture through the selection of three case studies, where each case corresponds to one of the redefined recycling design principles as constituents of the 'recycling model'. Hence, the recycling design principle of 'commensalism' has been analysed through the project of 'Fabra i Coats' in Barcelona, Spain, by Manuel Ruisánchez Capelastegui and Francesc Bacardit Segués; the recycling design principle of 'mutualism' through the Centro de 'Monitorização e Interpretação Ambiental – Casa dos Cubos' project, in Tomar, Portugal, by architectural office Embaixada Arquitectura; and lastly, the recycling design principle of 'parasitism' through the '192 Shoreham Street' project in Sheffield, England, by London based architectural office Project Orange. Through the case study analysis the relationship between the physical characteristics of the given industrial building and the most environmentally sustainable design principle for its recycling was determined. Lastly, the re-evaluation of the contemporary practice of recycling the industrial architecture, i.e. the classification of the previously analyzed projects according to newly defined recycling design principles, was presented.

In the following paragraphs the fulfilment of the general research hypotheses is verified and the main contributions of the research as well as directions for further research are summarized.

Verification of the research hypothesis

In the following paragraphs the final review of the research results is given through the verification of the research hypotheses. In the first place, the focus was on the exploration of the concept of architectural recycling as environmentally sustainable alternative to demolition and replacement. Secondly, the research focused on the identification of existing recycling design principles in architectural practice. Furthermore, the research focus shifted on the examination of the possibility of implementing the biological concepts into architectural field and consequently on the translation of the biologically derived principles into architectural domain. Finally, the research focused on the evaluation of the redefined recycling design principles in the practice of recycling the industrial architecture.

First hypothesis: *Recycling the industrial architecture is environmentally sustainable alternative to demolition, on the one hand, and preservation, on the other.*

The negative effects of the construction industry on our environment have been demonstrated in this research through the analysis of the impact of the building sector on the natural virgin material, agricultural land, energy consumption, and waste production. Fifty percent of all resources consumed across the planet are used in construction processes. Eighty per cent of agriculture land loss, fifty per cent of energy and water consumption and coral reef destruction is directly related to building sector. Given that fifty per cent of the global warming gasses and forty per cent of the water pollution are building related, the building sector constitutes one of the biggest waste streams produced in Europe, and is unquestionably the biggest polluter. Thus, it is beyond any doubt that the construction industry is one of the least sustainable industries in the world.

The analysis of two polar and radical methods of dealing with the building stock, preservation and destruction, led to the following conclusions. Architectural preservation persists in preserving status quo and prevents the building to adapt to changing condition through alterations and change of use. On the other hand, destruction and demolition processes require additional energy to break the building into smaller, less useful pieces. The stored material and energy are essentially dissipated and lost given that high proportion of the demolished building becomes waste. Replacing a building has enormous environmental impact as it entails additional energy, extraction, processing, transport, and use of virgin materials.

Buildings are durable goods that can reach more than 50 years of useful life and only a small percentage of the total building stock is made up of new works, which inevitably means that existing buildings play a key role in reaching sustainability agendas. These buildings usually came to their end of life due to the changing needs of its occupant, and not because of the structural or material deterioration. As a result of the decline in the manufacturing sector, rapid development of the new technologies, and the increase in the service economy, industrial buildings have lost their previous function and have been brought to the state of redundancy. However, given that industrial buildings are usually extremely well-constructed, they can tolerate long periods of disuse and neglect with minimal maintenance. It has been demonstrated that due to their physical properties (large, open, uninterrupted spaces, built to last, solid load bearing walls) industrial building are extremely flexible, adaptable and suitable for the majority of new uses. Through the architectural recycling, i.e. 'preservation through change', the original industrial building is allowed to evolve and adapt to market needs through transformation and change of function, while producing least possible environmental impact. By recycling what already exists the embodied energy of building materials is saved, pollution associated with excavation, production and transportation of new materials is cut down and the impact on new land diminished.

Second hypothesis: *Design principles of recycling the industrial architecture stem from the analogy between the fields of biology and architecture.*

A profound critical overview of embeddedness of urban and architectural practice in a broader context of social and natural sciences lead to choosing the field of biology as a proper domain for its analogy with the field of architecture. Through the biological analogies made by Georges-Eugène Haussmann, Ildefons Cerdà, Frank Lloyd Wright, John Frazer and Manuel de Solà-Morales, the connection between biological and architecture related processes was elaborated. The biological concept of symbiosis was selected as the main concept which truly represents the analogy between biology and architecture (particularly recycling the architecture). This concepts accentuates the importance of both 'symbionts', i.e. original industrial building and new intervention, which is of crucial importance for the research in the field of recycling the industrial architecture.

From this concept stem three redefined design principles of recycling, which constitute the 'recycling model', namely: commensalism, mutualism, and parasitism. The translation of the principles used in biology into the field of architecture was possible due to the clear criteria for examination of the redefined recycling design principles, namely: structure, material, form and spatial organisation, i.e. their relationship between both existing building and new intervention. Therefore, each of the three new redefined recycling design principles was determined by the structural, material, formal and spatial relationship between the original industrial building and the new intervention. Even though this relationship may be destructive to original building the concept of symbiosis in architecture (which stems directly from the domain of biology) accentuates the importance and the value of the original building. Determining the relationship between the original building and environmental sustainability lead to the following hypothesis.

Third hypothesis: Physical characteristics of the original building determine which design principle is the most environmentally sustainable one for its recycling.

The level of the environmental sustainability of the recycling intervention is directly related to the degree of exploitation of the original building (given that the use of the existing material minimizes pollution and energy waste related to excavation, production, and transportation) and the level of change imposed (since less change causes less energy and material waste). Therefore, it can be concluded that the most environmentally sustainable recycling intervention will be the one which fully exploits the existing building. In this way the embodied energy of building materials is reused and the environmental impact associated with excavation, production and transport of new materials is avoided.

On the other hand the amount of the usable material depends on the state in which the original industrial building is found, i.e. the condition of its foundations, horizontal and vertical load bearing structures, roof structure as well as façade, cladding system and fenestration, internal surfaces, floor, wall and ceiling coverings. Therefore, physical characteristics of the underused industrial building determine how much of its original material can be considered for the new intervention.

Recycling design principles of commensalism, mutualism and parasitism, which constitute the 'recycling model', differ in their treatment of the existing industrial building's structure, material, formal composition and spatial organisation. If least environmental damage is to be induced, each of the redefined recycling design principles should be used according to the physical characteristics of the given industrial building. Therefore, if the existing building requires only a negligible physical change, in the form of small reparations and upgrading, the design principle of 'commensalism' is to be applied, given that this principle implies the predominance of the old building and the maximum use of its material. No changes are imposed to the existing building's formal composition or spatial organization, and its structure and materials are preserved. By putting all elements of the existing building to use, the embodied energy of the building's material is preserved and unnecessary demolition avoided, cutting down the associated environmental impact.

On the other hand, if the original industrial building requires minor physical change, upgrading of its structure or replacements of certain parts, the design principle of 'mutualism' is to be applied, given that this principle implies the preservation of all reusable building elements and yet leaves space for the introduction of equally powerful new intervention. New structural elements, which can both support the old one or be independent from it, are introduced and there is a clear distinction between the old materials and newly introduced one. Original building's formal logic and volumetric composition are respected in the process of adding new elements. However, the interior of the building can undergo a substantial change. Nevertheless, the spatial organisation and physical properties of the new elements, i.e. dimension and position, depend entirely on the physical characteristics of the original building. Therefore, by applying the design principle of mutualism, the elements of the original building which can be reused are put to use once again and those in the state beyond repair are replaced, leaving the space for the new intervention.

Lastly, if significant physical change, reconfiguration and reconstruction are required for the existing industrial building to be usable once again, the design concept of 'parasitism' is to be applied. Given that the existing building is in the state of dilapidation, old structure is replaced and new materials clearly distinguishable from the old are introduced. In this process the formal logic and volumetric composition of the original building is disrupted and the spatial composition changed. Considering the state in which the original industrial building was found, i.e. very poor condition of its structural elements and material, the application of the design principle of parasitism, i.e. overpowering new intervention, characterized by entirely new structure and materials, is entirely justified.

Through the analysis of the case studies it was evaluated whether and to what extent the selection of the recycling design principles was influenced by the state in which the existing industrial building was found. The analysis was conducted on two levels. In the first place

the physical state of the original industrial building before the recycling intervention was analysed by assessing the condition of its structure and materials. Secondly, the evaluation of the recycling project was conducted according to the criteria used for the definition of the recycling principles (structural dependence, material relationship, formal disruption and spatial alteration). In this way it was possible to determine the influence of the physical characteristics of the existing industrial building on the election of the recycling design principle.

The analysis of the first case study, 'Fabra i Coats' project in Barcelona, Spain, by Manuel Ruisánchez Capelastegui and Francesc Bacardit Segués, revealed that the original industrial building was preserved in an excellent state, both structurally and materially. The architects used all available original building's material and structural elements, and in that way preserved the embodied energy of these materials, preventing unnecessary demolition and replacement, and avoided the environmental impact associated with new construction. Formal composition and spatial organisation of the original industrial building were not altered in any way. Therefore, the most environmentally sustainable recycling design principle, i.e. the design principle of commensalism, was applied, given that the industrial building was, in structural and material terms, in excellent condition.

Through the analysis of the second case study, the Centro de 'Monitorização e Interpretação Ambiental – Casa dos Cubos' project, in Tomar, Portugal, by architectural office Embaixada Arquitectura, it was revealed that the building's main structure needed upgrading, the condition of the internal structural element was poor and that building's interior was rundown and needed substantial remodelling for the building to be operational once again. The authors of the intervention preserved and upgraded the structural elements and materials that could be used again and in that way saved the embodied energy of the original building's material and lowered the environmental impact associated with excavation, production and transportation of new materials. Given that the interior spaces of the original industrial building were in poor state, architects introduced new, contemporary elements with their own formal, spatial and material logic. Nonetheless, these newly introduced elements were conditioned by the mere physical properties of the existing building. Therefore, recycling design principle of mutualism was applied, which was the most environmentally sustainable solution for this intervention, given that the original building demanded only minor physical change and remodelling.

The analysis of the third case study, the '192 Shoreham Street' project in Sheffield, England, by London based architectural office Project Orange, revealed that the original industrial building was in a very poor state, both structurally and materially, and that substantial reconfiguration and remodelling was needed to put the building back to use. The architects of the intervention saved all the elements of the original building that could be reused, and in that way preserved the embodied energy of its materials. However, given that the

large part of the industrial building was in a heavy state of deterioration and practically beyond repair, the authors introduced substantial change through new elements with their own formal, spatial and material logic, independent from the existing building. In that way, the formal logic and the spatial organisation of the original industrial building were altered. Hence, the recycling design principle of parasitism was applied, given that the original industrial building required significant physical change, reconfiguration and reconstruction.

Therefore, in practical terms, the 'recycling model' serves for providing the link between the physical characteristics of underused buildings, on the one hand, and the design principle most environmentally sustainable for its recycling, on the other. More precisely, the model provides a fresh understanding of how an extensive range of physical characteristics of an existing building can be considered in a systematic way in order to provide the guidance for choosing the most environmentally sustainable recycling design principle. The analysis of the case studies confirmed that the election of the most environmentally sustainable recycling design principle is determined by the physical characteristics of the given underused industrial building.

Contributions and directions for further research

In the end, it is important to explain the specific contributions of the research. Apart from the general contribution to the topic of architectural recycling, it is important to demonstrate the contribution of this research both to the conceptual and practical domain. It is also important to emphasize the basic limitations of this research, as well as possible directions for further research.

The relocation of the industry in most developed cities in the world has become a common theme in the global society, especially in Europe, where it has generated an excess of obsolete industrial architecture. The new urban complexity requires a new treatment of this great architectural potential that exceeds the dialectic simplicity practiced from the middle of the twentieth century within this topic, thus overcoming both the model of generic preservation of the existing building stock and the model of its massive destruction. Recycling architecture, i.e. 'preservation through change', overcomes this sterile dialectics, by providing preservation through a programmatic and morphological improvement of the original architecture. The practice of recycling is the practice of transformation. Through this practise, based on the physical condition of the existing building, a balance is searched for between the preservation and change, with the aim of affiliating new viable use to the existing building.

Firstly, the main contribution of the research relates to the confirmation of the view that the recycling of the industrial architecture is environmentally sustainable alternative to both demolition and preservation, as opposed concepts. Secondly, from the point of view

of architectural practice in the domain of recycling the industrial architecture, the research provides the systematic overview of the contemporary approaches to existing building stock. More precisely, the critical analysis of the existing recycling design principles enabled the understanding of the possible relationships between the original building and the new intervention observed through the criteria of structure, material, form and spatial organisation. The main contribution of the research relate to the redefinition of the design principles of recycling in the context of the sustainable architectural design. More precisely, the research demonstrated that in order for the recycling intervention to be as environmentally sustainable as possible, the selection of the adequate design principle should be done according to the physical characteristic of the original building. This research intends to acknowledge a new conceptual standpoint as a preliminary action to a design strategy for the obsolete, underused building. In this sense, it can be considered as the emergence of a new objective analytical methodology, which should be considered as a necessary knowledge which informs the project.

Potential disadvantages of the methodological strategy, such as subjectivity and unreliability of the information, were overcome in this research as only the internationally recognised examples of 'good practice' were chosen, and, therefore, respondents did not have the need for the manipulation of their statements. Another potential lack of the methodological strategy refers to the subjective interpretation of the research results. However, all the data was obtained by analysing the foreign context of which the researcher holds no preconception.

Adaptation is the key to evolution. In time of accelerated economic, social and environmental change, architecture has to be in a constant state of transformation. Flexibility is the key feature which should be nurtured as it allows the existing building to adapt to newly emerging conditions. Through the repurposing of the existing building stock the continuity of the building occupancy is provided and the impact on the environment reduced. Given that the construction industry is one of the least sustainable industries in the world the theme of recycling, i.e. 'preservation through change', becomes crucial.

Cities with their buildings and infrastructure are one of the greatest untapped resources available. One of the possible directions for further research concerns the possibility of the application of the conceptual 'recycling model' beyond the building scale, to urban infrastructure. The adaptation of the conceptual model (which determines a link between the physical characteristics of the given underused building and the most environmentally sustainable design principle for its recycling) to this change of scale would enable the election of the adequate, sustainable design principle for the repurposing of the elements of urban infrastructure, based on their physical characteristics and condition. This would allow the reprogramming of the large structures which provide a framework supporting an entire structure of development.

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ANEX – INTERVIEW

INTERVIEW

1. Experiences of the interview partner

What is your position in the office?

What was your role or function in the given project?

Did you earlier have experiences with projects concerning reuse?

Are you today involved in similar projects?

Do you treat projects concerning reuse the same way as other projects?

2. About the intervention

What was the role of the existing building in the given project?

Which of the following design strategies was selected?

Structure

- Old structure retained, no new structure added.
- Old structure retained and upgraded.
- New structure added, independent from the old structure.
- New structure added, dependent from the old structure.
- Old structure completely replaced.

Materials

Exterior

- Clear division between the old and new material.
- Old and new materials are completely interwoven.

Interior

- Clear division between the old and new material.
- Old and new materials are completely interwoven.

Spatial composition:

Exterior

- Formal logic of the old building (volumetric composition, symmetry) is respected and unchanged, no new elements are added.
- New elements are added respecting the old building's formal logic.
- Formal logic of the old building is disrupted.

Interior

- Spatial logic of the old building's interior spaces is preserved and unaltered.
- Spatial logic of the old building's interior spaces is altered but the size and the position of the new elements depend on the physical characteristics of the old building (its size, volume, organisation).
- Spatial logic of the host building's interior spaces is completely altered and new elements are not restricted by the physical characteristics of the old building (its size, volume, organisation).

How would you define the relationship between the old and the new in this project?

- Old has the predominance and is more important than the new.
- Old and new are of equal importance.
- New overpowers the old.

Which are the factors that lead to the election of this particular design strategy?

To what extent did the technological analysis of the building (materials, structure) influence the election of a design strategy?

If the existing building was in a better or worst physical state would another design strategy be chosen?

Do you think that recycling (using again in a different way) existing obsolete architecture is a logical step towards reaching a more sustainable environment?

Would you agree that the most sustainable approach to dealing with the already existing buildings is to use as much of its material as possible, and thus avoid unnecessary

demolition and/or replacement?

If yes, would this mean that the physical condition of the building (the extent to which its structure and materials are reusable) to a large extent influence the election of a particular design strategy and thus defines the project?

What is your attitude towards recycling architecture?

Do you think that the concept of recycling architecture could be logical step forward in evolution of the architectural thought?

3 Assessment of success

Are you personally satisfied with the result? Why / Why not?

What could have been improved? What would you do in a different way in the next cases of recycling architecture?

ENTREVISTA

1. Las experiencias de la persona entrevistada

¿Cuál es su función dentro de la oficina?

¿Cuáles fueron sus funciones y labores dentro del proyecto?

¿Usted tiene una experiencia anterior con proyectos de reciclaje de arquitectura?

¿Actualmente está involucrado en proyectos similares?

¿Usted aborda la concepción de un proyecto de reciclaje de arquitectura igual que otros proyectos?

2. Sobre la intervención

¿Cuáles son las consideraciones respecto al edificio preexistente a la hora de plantear un proyecto de reciclaje?

¿Cuáles de los siguientes criterios de diseño utilizó y por qué?

Estructura

- Mantuvo la estructura antigua, no se añadió nueva estructura.
- Conservo y mejoro la antigua estructura
- Añadió una nueva estructura, independiente de la antigua estructura.
- Añadió una nueva estructura, dependiente de la antigua estructura.
- Sustituyó completamente la antigua estructura

Materiales

Exterior

- Define una división clara entre los materiales viejos y nuevos.
- Los materiales viejos y nuevos están completamente entretejidos.

Interior

- Define una división clara entre los materiales viejos y nuevos.
- Los materiales viejos y nuevos están completamente entretnejidos.

Composición espacial:

Exterior

- La lógica formal del antiguo edificio (composición volumétrica) fue respetada y sin cambios, no se añadieron nuevos elementos.
- Se han añadido nuevos elementos respetando la lógica formal del viejo edificio.
- La lógica formal del antiguo edificio fue cambiada.

Interior

- La lógica espacial de los espacios interiores del antiguo edificio se conservó sin alteraciones.
- La lógica espacial de los espacios interiores del antiguo edificio fue alterada, pero el tamaño y la posición de los nuevos elementos dependen de las características físicas del antiguo edificio (su tamaño, volumen, organización espacial).
- La lógica espacial de los espacios interiores del antiguo edificio fue alterada.

¿Cómo definiría la relación entre lo viejo y lo nuevo en este proyecto?

- Lo 'viejo' tiene el predominio y es más importante que lo 'nuevo'.
- Lo 'viejo' y lo 'nuevo' tiene la misma importancia.
- Lo 'nuevo' domina lo 'viejo'.

¿Cuáles son los factores que influyen en la elección de esta particular manera (estrategia) de diseñar?

¿Hasta qué punto el análisis tecnológico del edificio (materiales, estructura) influyó en la elección de la estrategia de diseño?

¿Si el edificio se encontraba en un estado físico mejor o peor, se elegiría otra estrategia de diseño?

¿Cree usted que el reciclaje de la arquitectura obsoleta existente, es un paso lógico hacia la construcción de un medio ambiente más sostenible?

¿Está de acuerdo de que el mejor método para tratar los edificios existentes es utilizar la mayor cantidad de su material existente, y así evitar la demolición innecesaria y/o reemplazo?

En caso afirmativo, ¿significaría que la condición física del edificio influye en gran medida en la elección de una estrategia de diseño particular, y por lo tanto define el proyecto?

¿Cuál es su opinión sobre el reciclaje de la arquitectura?

¿Cree que el concepto de reciclaje de arquitectura podría ser un paso lógico en la evolución del pensamiento arquitectónico?

3 Evaluación de éxito

¿Está personalmente satisfecho con el resultado? ¿Por qué / por qué no?

¿Qué pudo haberse mejorado? ¿Qué haría de manera diferente en los próximos casos de reciclaje de arquitectura?

