REAL CORP 2014

Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI (Eds.)

PLAN IT SMART

CLEVER SOLUTIONS FOR SMART CITIES

PROCEEDINGS

of the 19th International Conference on Urban Planning, Regional Development and Information Society

TAGUNGSBAND

bmvit
Bundesministerium für Verkehr, Innovation und Technologie

CORP
Kompetenzzentrum für Stadtplanung und Regionalentwicklung
Competence Center of Urban and Regional Planning – www.corp.at

tinavienna
urban technologies + strategies

CPE
TU KAISERSLAUTERN

austriatech

SMART CITY WIEN

ISOCARP
Knowledge for better Cities

VIE Vienna International Airport

StaDt Wien

CD-ROM-Edition ISBN: 978-3-9503110-6-8
Print-Edition ISBN: 978-3-9503110-7-5

21-23 MAY 2014
VIENNA, AUSTRIA

www.corp.at

REAL CORP 2014. Plan it Smart.
Clever Solutions for Smart Cities

Proceedings of

19th International Conference on Urban Planning, Regional Development and Information Society

Beiträge zur

19. internationalen Konferenz zu Stadtplanung, Regionalentwicklung und Informationsgesellschaft

Edited by

Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI

Schwechat, 2014

CD-ROM-Edition	ISBN: 978-3-9503110-6-8
Print-Edition	ISBN: 978-3-9503110-7-5

Im Selbstverlag des Vereins

CORP – Competence Center of Urban and Regional Planning

Kompetenzzentrum für Stadtplanung und Regionalentwicklung

Lechergasse 4, A-2320 Schwechat-Rannersdorf

office@corp.at, http://www.corp.at

REAL CORP 2014

TEAM

Manfred SCHRENK
Clemens BEYER
Christian EIZINGER
Linda DÖRRZAPF
Patrick KREJCI
Adela MARCOCI
Michael MÜLLNER
Julia NEUSCHMID
Flora STROHMEIER
Wolfgang W. WASSERBURGER

Editors – Herausgeber:

DI Manfred SCHRENK, President CORP – Competence Center of Urban and Regional Planning, Schwechat, AT

Prof. Dr. Vasily V. POPOVICH, SPIIRAS, St. Petersburg, Russia

Dr.-Ing. Peter ZEILE, TU Kaiserslautern, Kaiserslautern, Germany

Dr.-Ing. Pietro ELISEI, URBASOFIA, Bucharest, Romania

Publisher – Medieninhaber und Verleger:

CORP – Competence Center of Urban and Regional Planning

Kompetenzzentrum für Stadtplanung und Regionalentwicklung

Lechergasse 4, A-2320 Schwechat-Rannersdorf

office@corp.at, http://www.corp.at

CD-ROM Edition: ISBN 978-3-9503110-6-8

Print Edition: ISBN 978-3-9503110-7-5

Table of contents – Inhaltsverzeichnis:

ISBN: 978-3-9503110-6-8 (CD-ROM); ISBN: 978-3-9503110-7-5 (Print)
Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI

ISBN: 978-3-9503110-6-8 (CD-ROM); ISBN: 978-3-9503110-7-5 (Print)
Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI

ISBN: 978-3-9503110-6-8 (CD-ROM); ISBN: 978-3-9503110-7-5 (Print)
Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI

Recycling Architecture: the Redefinition of Recycling Principles in the Context of Sustainable Architectural Design

Milan Šijaković, Ana Perić

(MArch Milan Šijaković, School of Architecture of Barcelona, UPC, Calle Jordi Girona, 31, 08034 Barcelona, milansijakovic@yahoo.com)

(PhD Ana Perić, Faculty of Architecture, University of Belgrade, Department of Urban Planning, Bulevar kralja Aleksandra 73/II, 11000 Belgrade, anaperric@yahoo.com)

1 ABSTRACT

The sustainable management of city resources (land, infrastructure, suprastructure) is one of the crucial urban processes to which the 'smart cities' concept should be addressed. In other words, resource conservation is highly important question nowadays. Namely, only a small percentage of the total building stock is made up of new works. This inevitably means that the general refurbishment and adaptive reuse will significantly benefit the sustainability agenda in the next twenty years, which will, further, make our cities smarter. Since most buildings are physically suitable to various uses, flexibility and 'long life – loose fit' should be a guiding principle behind most design briefs. The recycling of existing buildings has several benefits, such as: decreasing the pressure on new land, preserving the embodied energy of building materials, saving new materials form being used, cutting the associated environmental impacts of producing and transporting new materials, and, finally, involvment the lesser generation of residues in relation to a totally new construction. Thus, the subject of this research relates to the definition of recycling principles for sustainable architectural design. According to this, contemporary literature on recycling in architecture has been evaluated, compared and analysed. It is hypothesised that in order to produce least environmental damage the recycling intervention should use as much of the original building's material as possible. Thus, physical characteristics of the original building define which design principle is most adequate for its recycling. Such an literature overview enabled the creation of so-called recycling model, which establishes a 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. This model provides a fresh understanding of how an extensive range of physical characteristics of building can be considered in a systematic way in order to choose the most suitable design principle in the recycling process. Its elaboration is the focus of the research.

2 SUSTAINABLE DEVELOPMENT AND 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 (Bragança & Cuchí, 2007). Out of all resources consumed across the planet fifty per cent are used in construction, 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" (1987) has spawned a series of sub-definitions to meet particular sector needs. Typical of these is that used by the practice of Foster and Partners, which defines the sustainable design as creating buildings which are energy-efficient, healthy, comfortable, flexible in use and designed for long life (Edwards, 2005). The Buildings Service Research and Information Association (BSRIA) has defined sustainable construction as the 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" in which the principles of sustainable development were laid down. 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). The timeline of main environmental agreements is briefly shown in the Figure 1.

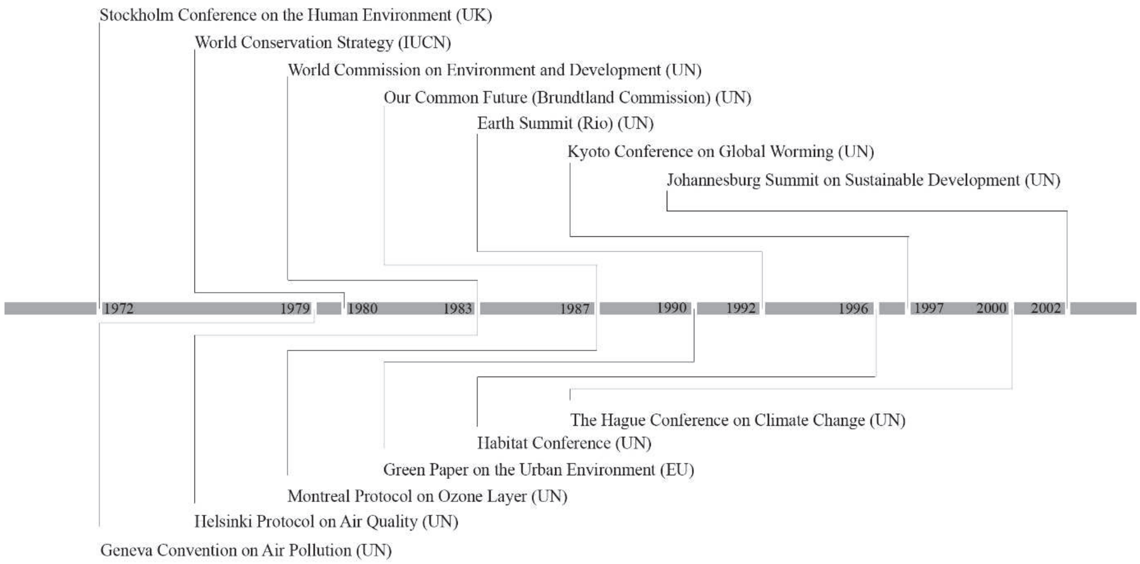

Fig. 1: Major global environmental agreements (Source: Author according to Edwards, 2005).

Unquestionably buildings are big users of raw materials. 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 (Bragança & Cuchí, 2007).

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 as 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). Existing buildings are crutial to any strategy for carbon-emission reduction. Buildings are durable goods which can reach 100 years of useful life or more 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 (Bragança & Cuchí, 2007).

3 RECYCLING DESIGN PRINCIPLES

All major global environmental agreements state that recycling our building stock is one of the most effective strategies in reducing carbon footprint and environmental degradation in general. A number of publications have been written on what is considered 'good practice' of recycling architecture in general and of architectural design of an intervention on existing buildings. These publications are usually in the form of a catalogue, where projects are divided into several categories, usually depending on the intensity of the intervention, or in other words, the relationship between the old and the new. In contemporary literature dealing with reconversion of existing buildings projects are divided into three categories, where the alterations to existing fabric are of low, medium and high intensity.

The comparative analysis of four sources and their categorization of recycling prnciples, Brooker & Stone (Intervention–Insertion–Installation), Feireiss & Klanten (Add-On, Inside-Out, Change Clothes), Jäger (Addition–Transformation–Conversion) and Rogic (Coexistence–Imposition–Fusion), is conducted with the aim of understanding the logic behind the definition of these design principles.

3.1 Intervention, Insertion, Installation

The design concepts of Intervention, Insertion and Installation defined by Brooker & Stone (2004) are determined by the relationship between the existing and the new building, the host and the intruder. Depending on the level of the autonomy of the new elements, the recycling project gethered in their study fall into one of the described categories. This autonomy is represented both in structural terms, as the extent to which the new structure is dependant on the old, and formal-spatial terms, as the level to which the original building's form and spatial organization influenced new design.

Intervention is defined as a process which transforms the host building, but new and old elements become completely dependent upon each other. Through this process the original building may be changed but Brooker & Stone explain that all the changes are informed by the original building, its volume, scale, geometry and in this process old and new become one. Yet in one of the projects selected as the representative of this design principle, Museum Küppersmühle by Herzog and de Meuron, it is clear that the intervention executed on the façade of the building disrups 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. A new element was added in front of the building, staircase, in a form of a prismatic tower which introduces new architectural vocabulary into the scene. 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 character and physical characteristics of the old building. In material terms all new elements are executed in materials clearly distinguishable from the old. 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 rely on the old building for its support, but can also be structurally independent, without touching the existing structure.

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

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 equality 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 Add-On, Inside-Out, Change Clothes

Just like in the Brooker & Stone's "Re-Reading", the relationship between the old and the new was the leading criteria in determining the design principles of recycling in Feireiss & Klanten's study "Build-On converted architecture and transformed buildings".

The design principle of *Add-On* includes all types of additions that can be executed upon the existing structure. This category is very broad as it contains both projects that simply restore the original structure by adding elements that follow the formal logic of the old, and also projects that almost completely change the face of the original building. One of the projects selected as representative of this design concept, CaixaForum in Madrid, shows that completely different architectural vocabulary was used for the new addition, both in material, formal and structural terms. The interior of the old building was also substantially changed. Compared to Brooker & Stone's principle of Intervention, the principle of Add-on allows for a much more aggressive approach to the host building's exterior and interior.

The second category, *Inside-out*, presents projects that change fundamentally old building's interior, but leave its exterior and appearance intact. The original image of the building stays almost unaltered just as in Brooker & Stone's principle of Insertion. However, in one of the selected projects for this category, Haworth Tompkins's Temporary Theatre, it is clear that the new intervention was completely governed by the old buildings 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. Therefore it can be concluded that this design principle implies minimal change to the building's exterior. If any changes are made, they are always informed by the old building itself. Since this design concept follows a change of function of the host building a greater degree of alteration can be executed in buildings interior. New elements can be both structurally independent form 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.

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, as in Brooker & Stone's Installation category. This concept implies change not only to the building's interior but exterior as well, changing it 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, it this project it is clear that the importance of the host building was recognised and its landmark qualities and appearance preserved.

It can be concluded that as in the Brooker & Stone's classification the relationship between the old and the new was the leading criterion for the definition of design principles of intervening with the existing buildings. Yet here, it cannot be said that the dominance of the new elements rises from first to the last principle. New elements are executed in materials clearly distinguishable from the old in all three design concepts. The main difference between the first two concepts is the localization of change. The design principle of Inside-out confines the change within the old building leaving its interior unchanged while the concept of Add-on implies substantial change to the building interior as well. The third design concept, Change Clothes, just like the first one allows the change of the building's formal logic as well, but should imply the higher level of alteration of the building fabric. There is no clear difference in structural dependence of the old and the new between these design principles.

3.3 Addition, Transformation, Conversion

According to Jäger (2010), the main criterion for the classification of selected projects in his study named „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 established, Addition–Transformation–Conversion, each one corresponding to a different level of independency of the new elements.

Jäger's first category *Addition*, just like Feireiss & Klanten's category Add-On, implies a multitude of architectural actions that change the original building, but 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 was preserved and changes were made only in its interior. Structurally 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 vocabulary could be used, forms which follow its own logic, but can also be influenced by the host building. In general it can be said that this category gathers projects where both the old and new have the same presence and importance and are coexisting.

The second design principle, *Transformation*, implies more aggressive approach, and the change to the old building's structure as well. In the first category there is usually clear distinction between the old and new, and according to Jäger, 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 form 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 old building interior where it is clearly recognizable and can both follow or alter the host building's spatial logic. This design principle implies more invasive approach than the previous one.

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 form 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 somewhat abstract criteria were used to separate these design principles and that there is a rather blurry line which separates one form the other.

3.4 Coexistence, Imposition, Fusion

Rogic (2009) went a step further in her PhD thesis, “Converted Industrial Buildings: Where Past and Present Live in Formal Unity”. She extracts three design principles, Coexistence–Imposition–Fusion, from the six proposals (David Chipperfield, Renzo Piano, OMA, Herzog & de Meuron, Tadao Ando and Jose Rafael Moneo) shortlisted for the second stage of the competition for the reactivation of the Bankside Power Station and analyses them on two levels, building tectonics and spatial-formal composition.

Coexistence is defined as parallel existence of the old and new. And all projects shortlisted for the second phase of the competition clearly distinguish between the old material, brick and steel, and the new introduced materials, usually concrete and glass. However, she explains that the interventions differ in the level of rendering visible the coexistence of old and new materials. By detaching new and old materials one form the other in terms of their structural and environmental behaviour, Chipperfield and Piano, demonstrated transparently the principle of coexistence, whereas in the other four interventions (OMA, Ando, H&dM and Moneo) there is no divided role between old and new materials (Rogic, 2009).

The concept of *Imposition* implies the predominance of the new element introduced to the host building. It also means that the original building’s characteristic were not taken into account while designing the new intervention. OMA’s (Office for Metropolitan Architecture) 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 (Rogic, 2009). 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.

If old and new structure and materials could not be recognised, are dependent on each other and work together then the concept of *Fusion* is at play. The spatial composition of the intervention derives from the physical characteristics of the host building. New and old structure work together.

Rogic analyses these three principles, established by the architects themselves, on two levels. The first level of the analysis is the building tectonics. Here Rogic refers to building material and its structure, and to what extent is the original tectonics changed and new intervention governed by the old building. The second level of the analysis is the spatial-formal composition, which she divides in two categories, building interior and exterior. The extent to which the spatial organisation of the old building influences and governs the new intervention was examined. Based on this analysis Rogic defines four new concepts: *Tectonic fusion* if new and old structure and materials are completely interwoven; *Tectonic coexistence* when new and old structure and materials work separately and are clearly distinguishable; *Spatial composition conservation* if the old spatial organisation was preserved and influenced the new intervention; *Spatial composition transformation* if the old spatial organisation was altered.

4 REDEFINITION OF RECYCLING DESIGN PRINCIPLES – RECYCLING MODEL

It can be concluded that a general criteria for the definition of design principles of recycling in all above mentioned examples, was the relationship between the host building and the new intervention, i.e. the level of independency of newly introduced elements. Thus, in all cases one design principle was presented which implies obedience to the host building and minimal change to its appearance. The original building governs the intervention and decides how it is going to be changed. All characteristic of the new elements derive from the physical characteristics of the host building.

The second design principle implies higher level of autonomy of the new elements. The new intervention is influenced by the host building, their characteristics can derive from the original building itself, but the ‘new’ speaks equality loud as the ‘old’. The substantial change to the original building can be done, but always following the spatial logic of the old building. Its volumetric composition, rhythm and scale are the elements which should be respected and which define the new intervention.

The third design principle implies the highest level of the autonomy of the new elements. New intervention and the host building speak different languages. The physical characteristics of the old building are not factors that define the new intervention. These new elements are dominant and follow their own spatial logic.

Some of the abowe analysed design principles limit the recycling intervention almost exclusively to the host building´s interior, as Inside-Out and Insertion.

Yet due to a rather abstract criteria for the definition of these design principles, there is no clear and direct distinction between them, and example 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 which would define design principles of recycling.

The criteria for the analysis of the chosen design principle were material relationship and structural dependence on one hand, formal disruption and change of spatial organisation on the other. Table 1 confirms that there is a rather blurry line which defines and separates these principles. In order to redefine design principles and make the distinction between them clearer, a clarification and more precise definition of criteria should be established.

	Materials		Structure		Form		Inner special organization	
	Clear distinction	Interwoven	Dependent	Independent	Changed	Preserved	Changed	Preserved
Intervention	x		x			x		x
Insertion	x		x	x		x		x
Installation	x			x		x		x
Add-On	x		x	x	x		x	
Inside-Out	x			x		x	x	
Change Clothes	x		x	x	x		x	
Addition	x		x	x	x	x		x
Transformation	x		x			x		x
Conversion	x			x	x		x	
Coexistence	x			x		x		x
Imposition	x			x	x		x	
Fusion		x	x		x	x	x	x

Table 1: Analysis of all four groups of design principles

Criteria for the analysis of the intervention:

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

- Old and new materials are completely interwoven.
- Clear division between the old and new material which form a harmonious union.
- Clear division between the old and new material which are confrontational.

Interior

- Old and new materials are completely interwoven.
- Clear division between the old and new material which form a harmonious union.
- 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.
- 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 the size and the position of the new elements depend on the physical characteristics of the host building (its size, volume, organisation).
- Spatial logic of the host building's interior spaces is altered.

On the other hand, in order for the recycling intervention to be as environmentally sustainable as possible, a range of existing building’s physical characteristics has to be taken in consideration. The level of the environmental sustainability of the intervention can be measured by the amount of the old building materials used (the use of existing material minimizes pollution and energy waste related to excavation, production, transportation), and the level of change imposed to the old building (the less change, the less energy and material waste). Thus it can be concluded that the most environmentally sustainable recycling intervention will be one which fully exploits the host building, inducing as minimal change as possible, given that the condition of the host building allow it.

Hence, the first step in planning the recycling intervention and deciding which design principle is most adequate/environmentally sustainable for a given building the following set of its physical characteristics has to be taken into account.

Criteria for the analysis of the existing building:

Structural characteristics:

- Foundations condition
- Vertical load bearing structures condition
- Horizontal load bearing structures condition
- Roof structure condition
- Internal partitions condition

Material characteristics:

- Façade condition
- Cladding system and fenestration
- Internal surfaces condition
- Floor coverings condition
- Wall and ceiling coverings condition

Therefore, according to the above described criteria for the analysis of both existing building and the intervention a recycling model, which implies a new set of redefined design principles of recycling (3S classification: Subjection–Symbiosis–Subversion), can be proposed. This model links the physical state of the host building and the most environmentally sustainable design approach for its recycling. Which of these design principles should be used depend entirely on the state in which the host building is found, i.e. its physical characteristics.

4.1 Subjection

Longman dictionary of English language and culture defines the term as: the act of bringing under firm control; not allow to have free expression; contingent or dependent. This design principle implies the subjection of the new intervention to the old buildings. In structural terms, the new intervention will retain the existing structure and upgrade it if necessary. If new structure is added it is dependent on the old one, relies on it for its support, they work together. Material-wise the exterior of the 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 it's aesthetic and historic value and will be based on respect for original material. All new interventions to the building's interior will be executed in materials which follow the aesthetic logic of the old, thus the new and old will be interwoven, or in materials which are distinguishable from the original but integrated harmoniously with the whole.

The form of the building stays untacked. Its volumetric composition, fenestration rhythm and proportion are 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 but this process will not change the building's character and appearance. All newly introduced elements will follow the host building's spatial logic. The division of spaces within the building, its 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 will not be changed by the intervention.The original building is dominant, fully governs the new intervention, and decides how it is going to be recycled.

If the host building is found in an excelent state, both structuraly and materialy, and can be used 'as found' and only a negligible physical change is required the design principle of Subjection should be applied, given that this design concept implies the predominance of the old and the maximum use of its material.

4.2 Symbiosis

Heinrich Anton de Bary coined the term symbiosis (from Ancient Greek σύν – together, and βίωσις – living) in 1879 to explain an internal, mutually beneficial partnership between two organisms. This term defines a relationship in which one symbiont lives within the tissues of the other, 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, including the inner surface (Paracer & Ahmadjian, 2000). 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 have different physiognomy, jet together they form a harmonious, mutually beneficial, union.

The new intervention will retain and upgrade, if necessary, the existing structure. If new structural elements are introduced, they can both be 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, its envelope, façade will be preserved, or if necessary, restored to the original state, preserving its appearance and integrity. Yet this design principle implies greater degree of change to the buildings fabric than the previous one. Additions, can be made to the host's building volume, and they will always be executed in materials clearly distinguishable form 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. All the changes done in the old building's interior are executed in materials different form the old. There is a clear distinction between what is new and what was already there. The form of the old building, the balance of its composition, is not altered by new intervention. Elements which are added to the buildings envelope follow the formal logic of the old building, its symmetry and relationship between its parts. New follows the old but is equally present and dominant.

New intervention is governed by the old building's inner space distribution. Building's interior organization influences the design of the new intervention. This influence is limited to new intervention's dimension, not character. There is a clear distinction between what belongs to the old and what was newly introduced, both in material and formal terms. Compared to design principle of Subjection, Symbiosis creates more dynamic relationship with the old. Additions and alterations of the old building can be executed, jet buildings spatial and formal logic will not be jeopardised by this act. In most cases the alterations are restricted to building's interior. Whereas in Subjection old dominates and fully conditions the new, in Symbiosis old and new are equally present but speak different languages.

When a host building is found in a relatively good state, structurally and materially, and requires only minor physical change, upgrading of its structure or replacements of certain parts, the design principle of Symbiosis should be applied, given that this concept implies preservation of all usable elements of the old and yet leaves space for equally powerful new intervention.

4.3 Subversion

Subversion (lat. *subvertere* – overthrow) refers to a process by which the values and principles of a system in place, are contradicted or reversed (Blackstock, 1964). Through this act the established system is changed or damaged. This concept involves infiltrating, penetrating and manipulating existing system.

This design principle, is structural terms, implies introduction of new structure independent form the old, 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 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 different material logic, defined by the new intervention entirely. 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 old and new.

The form of the existing building is substantially changed by this design principle. The balance of its composition, symmetry, and fenestration are broken and altered by new intervention. New volumes will be added following its own formal logic, confrontational with the old. Host building can endure substantial subtractions as well, which can change its appearance. New elements belong to a clearly different style, the style which is 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 in altered and the character of the host building completely changed. 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 Subjection, where the old building has the predominance, and Symbiosis, where both new and old are equally present and powerful, the design principle of Subversion implies complete obedience of the old building to the new intervention, new overpowers the old. If significant physical change, reconfiguration and reconstruction are required for the host building to be usable once again the design concept of *Subversion* can be applied. As only small part of the original building can be used, overpowering new intervention, composed of entirely new stricture, materials and space logic is entirely justified.

5 CONCLUSION

The global concept of sustainable development is imposed as a general context for all urban questions in the last few decades. This concept implies the integration of various aspects of urban development, which affects the modification of the contemporary design principles.

Adaptation of the design principles to the demands of sustainable development concept has great potentials, reflected in increasing quality of land as a non-renewable resource. During this and the past decade, sustainability in construction industry, represented a central theme of the most important international conferences. Further, our existing building stock plays a fundamental role in our society. It contains large quantities of embodied energy, materials and resources and contributes to the streetscape, character and embodied memory of our communities. When buildings no longer meet expectations, demolition is frequently employed, contributing to the building industry as the single largest consumer of resources and the single largest contributor to the waste stream.

Thus, recycling architecture has many historic, environmental, social and economic benefits, all of which make it an essential component of sustainable development. By analysing recommendation in most important international documents regarding sustainable development and by analysing design concepts used in contemporary practice of recycling architecture a recycling model has been created. It fully exploits the host building, by analysing its structural and material state and characteristic and assigning the most environmentally sustainable design principle for its recycling accordingly. In this way the embodied energy of host building's materials is preserved and energy necessary for excavation, manufacturing and transportation saved.

6 REFERENCES

BLACKSTOCK, Paul: The Strategy of Subversion. Chicago, 1964.
BRAGANÇA, Luis & CUCHI, Albert: Portugal SB07. Sustainable construction, materials and practices. Lisboa, 2007.
BROOKER, Graeme & STONE, Sally: Re-Reading. London, 2004.
EDWARDS, Brian: Rough guide to sustainability. London, 2005.
FEIREISS, Lucas & KLANTEN, Robert: Build-On converted architecture and transformed buildings. Berlin, 2009.
JÄGER, Frank Peter: Old & New-Design manual for revitalizing existing buildings. Basel, 2010.
LEEL, Bruno, TRCKA, Marija & HENSEN, Jan: Embodied energy of building materials and green building rating systems - a case study for industrial halls. In: Sustainable Cities and Society, Vol.1, Issue 2, pp 67-71.
PARACER, Surindar & AHMADJIAN, Vernon: Symbiosis-An Introduction to Biological Associations. Oxford, 2000.
ROGIC, Tamara: Converted Industrial Buildings. Delft, 2009.
SZOKOLAY, Steven: Introduction to Architectural Science-the basis of sustainable design. London, 2004.