

Towards the reuse of materials in Polish architecture. Working in the post-socialist context

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The article provides a discussion on how socialism, its aesthetics and architecture have influenced contemporary architecture in Poland, especially the choices of materials and aesthetics present in Polish society. The article focuses on current problems grounded in the socialist ideology, which can be seen as: the negations of socialism (e.g. denial of maintaining habits, homogenous aesthetics, temporary solutions), the remnants of the previous system (e.g. denial of natural, local, old materials) or the effects of westernization (e.g. the use of new, 'luxurious' materials). The post-socialist reality is a challenge for a sustainable approach to architecture and materials. This paper aims to analyse a specific, Polish context and to establish guidelines for the future development of sustainable concepts and architectural applications of reused materials in architecture in Poland.

Key words: reuse, reused materials, post-socialist architecture, sustainable architecture

'Learning from the existing landscape is a way of being revolutionary for an architect.'
Robert Venturi, Denise Scott Brown, Steven Izenour [1]

Introduction

Socialism and the times of systemic transformation influenced Polish society and its architecture. Years of unified planning and ascetic design had a significant impact on Poles' material and aesthetic choices. Later, in the post-socialist Poland, the westernization of everyday life was strongly affecting people's architectural preferences, which did not accord with the principles of sustainable consumption and pro-environmental design. Moreover, they do not fit a contemporary, fast changing world [2], [3], where social needs were and are constantly redefined and buildings - redesigned. In such a world mobility and a life cycle approach become necessities. Shrinking natural resources (it has been estimated that with current trends the global raw material consumption is due to triple by 2050, [4]) and an increasing amount of generated waste require a new approach to architecture, its aesthetics and materials. One of questions concerning building materials today, is the way they are sourced and used. Thus, the reuse of construction and demolition waste in architecture seems to be a modern and much-needed concept. However, it requires several changes in architectural design and in the construction process – as well as, in consumption patterns and people's individual choices.

This article tries to understand the specific, Polish context and aims to establish guidelines for introducing sustainable architecture and the reuse of building materials in Poland. Firstly, the principles for the optimal reuse of materials in architecture are presented. Secondly, the main characteristics of socialist architecture are described. Then,

post-socialist aesthetic and material choices of the society are analysed. Finally, the Polish, architectural context and the principles for the pro-environmental reuse of materials are compared to define main problems and opportunities for introducing sustainable concepts in Polish architecture. In conclusion, guidelines for the successful reuse of materials are defined.

Reused materials in architecture. The principles

The discussion about sustainable architecture and shrinking natural resources emerges also in the field of architecture. This subject has been present at various Venice Biennale exhibitions where national pavilions focused on such problems as.: the building's life cycle (Polish Pavilion: Piątek, Trybuś, *The Afterlife of buildings*, 2008), the use of materials (Belgium Pavilion: Rotor, *Usus / Usures. How the things stand*, 2010) or their reuse (German Pavilion: Petzet, *Reduce/Reuse/Recycle*, 2012). Waste is also a frequent theme in urban interventions and temporary installations (Basurama, RUS Project, Latin America, 2009, *Ecosistema Urbano*, Air Trees, Madrid, 2010). Moreover, reclaimed materials have been frequently used in construction processes – especially in adaptation projects (Atelier Zeinstra van der Pol, *Aquartis*, Amsterdam, 2007; Neri and Hu, *Waterfront Hotel*, Shanghai, 2010), where such existing materials are reused as: old bricks, window frames, wooden timber or industrial machines. They are usually used for new functions. Furthermore, there is an alternative architecture movement (Earthship Movement), where nat-



Figure 1. Reused materials in architecture: Belgium Pavilion, Venice; Villa Welpeloo, Enschede; Am Kupfergraben Gallery, Berlin; Freitag Store, Zurich

ural and waste materials (e.g. tires, timber, aluminium cans, bottles) are applied in single-family houses[5]. Recycled materials are also promoted by green building certification systems (e.g. BREAM, LEED), which award the use of 'recycled content materials' [6]. Reused materials and elements are analysed in the context of building functional layers [7], a sustainable building model, design for deconstruction [8] or the waste management hierarchy [9]. There are several related theories, such as: 3R [10], Upcycling [11], Superuse [12], Cradle-to-Cradle [13] and Urban Metabolism [14]. The 3R concept reduces the design and construction process to indispensable activities. It saves energy and raw materials and values smart strategies more than beautiful forms. 3R perceives buildings as resources. This approach to architecture continues in the idea of Upcycling, which can be defined as such new use of an obsolete product or material that creates its new value, improves its properties or provides its more effective use through *'enhancing its inherent qualities, or by radically counter programming their use.'* [11] Similarly, the theory of Superuse aims to recreate the value of degraded objects and to generate their positive value by reducing material flows. It uses specific tools (e.g. Harvest Map, Environmental Impact Calculator) to reduce environmental impacts of the construction process. Superuse opts for the reuse of locally available materials, intended to be moved from one life cycle to another. This idea belongs to the concept of Urban Metabolism, where cities are seen as sums of flows of different substances. Due to a rising material-consumption of urban areas, the current linear metabolism is unable to meet the needs of inhabitants without being to the detriment of the natural environment. Thus, a more sustainable circulation of substances and materials in a city is required – the one based on renewable resources and waste recovery. Circular metabolism, a base of Cradle-to-cradle concept, is a holistic approach to cities, buildings or industry and it depends on low consumption, on the reuse and recycling of various urban flows. Cradle-to-cradle promotes intelligent, healthy and renewable materials, which have positive impact on the environment and human health. It sees building materials as parts of a continuous, technological cycle, where every waste becomes a nutrient.

According to mentioned theories, various frameworks for the optimal reuse of building materials are developed. Construction waste is successfully reused, which is visible in architectural applications of such materials as: recycled concrete (Boltshauser Architekten, Kindergarten, Hirzenbach, 2008), reused concrete structures (A.Brandlhuber, Brunnerstrasse 9, Berlin, 2010), reclaimed bricks (D. Chipperfield, Am Kupfergraben, Berlin, 2007), building rubble (W.Shu, Historic Museum, Ningbo, 2008), prefab panels (Wiewiorra Hopp Architekten, Plattenpalast, Berlin, 2009), aluminium elements (Karo Architekten, Open-Air Library, Magdeburg, 2009), steel sheets (Superuse Studios, Kringloop Zuid, Maastricht, 2014), reclaimed wood (Superuse Studios, Willa Welpeloo, Enschede, 2009), recycled glass (D.Chipperfield, Museum Folkwang, Essen, 2010), window frames (Superuse Studios, EspressoBar, Delft, 2012), shipping containers (Spillman Echsle Architekten, Freitag Store, Zurich, 2006), wind turbines (Superuse Studios, Rewind, Rotterdam), road signs (Gigon Guyer, Transport Museum, Lucerne, 2009) and recycled ceramic tiles, carpets, rubber floors, gypsum, plastics or furniture. Building materials are reused without processing (e.g. prefab panels), with partial transformations (e.g. window frames as façade systems) or can be completely processed (e.g. recycled glass). They can be firmly incorporated into a building (e.g. bricks combined with mortar in Am Kupfergraben Gallery in Berlin) or may be flexibly assembled for future reuse (e.g. bolted steel structure in Villa Welpeloo in Enshede). Reclaimed products can create such building elements as: a building's structure (steel machine as a load-bearing system of Villa Welpeloo in Enschede), a façade (multi-material rubble on the façades of the Historic Museum in Ningbo), windows (frames as openings in the EspressoBar in Delft), stairs and lifts (truck steel sheets as staircase in Dordyart in Dordrecht), finishings or furniture.

Presented theories and case studies differently define optimal ways of working with waste. However, there are several similarities among them, which can be seen as the principles for the sustainable reuse of materials in architecture. Therefore, building materials should be locally sourced, chosen adequately to function, homogenous, safe, non-toxic, healthy, changeable and recyclable. Their content needs to be identified and life cycle – planned (e.g.

planned future reuse). Optimal building forms are often defined as open, mobile, adaptable, light and aesthetic. Buildings should consist of a limited amount of materials, elements and connection types as well as have defined construction and demolition scenarios. Moreover, the design process should be open, flexible and interdisciplinary. The extended, conceptual phase should include more research, consultations and material tests. Therefore, the successful and sustainable reuse of building materials requires an innovative, reasonable, flexible, often modest and collaborative approach to architecture and the construction process. Thus, to introduce new sustainable concepts, such as the reuse of materials, in contemporary Polish architecture it is crucial to understand local conditions, the historic context, which has been influencing Polish society and its architecture until present times.

Polish architecture in socialist times

After World War II, simultaneously with a systemic change Polish architecture was forced to transform. It became the subject of interest for communist politics. Socialist realism was implemented in 1949 and socialist architecture's rules dominated until 1989. Authorities treated architecture as an ideological tool. It was defined as an optimization between space arrangement and ideology [15], often described as national in form and socialist in content [16] with an underlined utilitarian function. Architecture of these times had several characteristics including: formal composition, axiality, hugeness, monumentalism [17], national and historic decorations, over scaled socialist details, formal excess, totality with the goal to design everything from the building to the pavement [18]. Later the ideological layer was limited to economic efficiency, *'the aesthetic was promoted without reference to any socialist principles (bar the compulsory reference to economic prudence)'* [19]. The economic aspect was dominant in the discourse and in the propaganda of such slogans as: *'realism consists in avoiding the excess'*, *'realism means that there is no striving for the impossible'* or *'the buildings are modest and the flats small because we have to build a lot'* [16]. Moreover, starting from 1954 economic efficiency was combined with the mechanization and industrialization of the construction process. Quickly the prefabrication's motto: cheaper, faster, easier [20] became a principal factor. The range of prefabricated elements was vast – from small details to big building parts - from facade elements, window frames to staircase blocks, floor slabs and wallboards. Unfortunately, the quality and assembly of these elements were poor and often imprecise. Moreover, standardization became a design trap because prefabricated elements were produced in small range and in consequence they did not enable interesting design [20]. Repetitiveness among anonymity and hugeness was perceived as one of the most noticeable characteristics of Communist architecture. Aesthetic unification was visible in *'the monotony of flat roofs, blunt window rhythms and identical*

concrete walls' [17]. The quality of work was worsening with time. A lot of buildings remained unfinished and some of them required renovation just after their commission [17].

Furthermore, in the 1970s, material-consumption became a decisive aspect. In consequence architecture was fully dependent on construction and production possibilities. Such materials were commonly used as bricks, cavity bricks, concrete blocks, reinforced concrete, cement mortar, ceramic stones' imitations - and natural stones in more prestigious projects. The need for savings led to the reuse of bricks, reclaimed rubble, Goldwetten floor systems (made out of waste material, incl. resin, pitch, mineral additives, colour pigment) or crushed mirrors, plates and tiles ('Picasso-style' facades in single-family houses). In the countryside, new legal regulations forced the use of fire-resistant, industrialized materials and prefabricated details. This resulted in a disconnection from nature and in a monotonous unification of Polish countryside buildings (cubic house). Natural materials, techniques and traditions were denied and the local character of architecture disappeared. The economic efficiency goal [19] and mass production often led to subversive situations when - for cost saving reasons, a historical building was firstly torn down to be rebuilt later. Economic values were more important than historical, aesthetic and cultural ones. The cost saving goal – highly dominant in every sector of production – was blocking possibilities to create innovative systems or materials. To fulfil social needs it was often decided to use worse, but cheaper solutions instead of applying the modern ones [18]. Finally, the Communism had an influence on the perception of collectivism and sharing. The idea of collective work was destroyed by the so-called 'societal actions', when spontaneous actions were replaced by the organized ones and voluntary work became a discouraging compulsion [17]. Thus, the socialist system, by promoting economic efficiency, mass production and standardisation, created a difficult background for sustainable architecture, which considers innovation, flexibility, collaborative processes and the use of local, old materials as preconditions for the successful, pro-environmental activities.

Aesthetic and material choices in the post-socialist Poland

Forty years of Communism in Poland had a strong impact on preferences, beliefs and behaviours of Polish society. Moreover, Poles' further material and aesthetic choices rarely harmonized with the principles of sustainable consumption and design. Consumerist attitudes and aesthetic or material preferences of the society were consequences of people's reactions to the previous system, its unified planning and standardised architecture. These reactions can be explained as the rejections of the socialist system, its continuations or as the effects of westernization and new approaches.



Figure 2. Buildings in Warsaw

The rejection of the socialist system

The natural reaction of the society, when Communism ended, was the denial of previous times - their aesthetics, materials and architecture. After the years of monotony and unified architectural forms, when mostly prefabricated, low quality materials were used, people strove for a difference. *'Aesthetic sins of the transformation period stem from psychological mechanisms of suppression and a radical denial of historic circumstances'* [22]. The lack or ambiguity of legal regulations and easy access to building materials enabled people to build whatever they wanted. The years of architectural asceticism were denied [21]. Significant changes can be observed in architectural forms of the 1990s. Huge blocks of flats with flat roofs, monotonous window rhythms and mono-material facades were replaced by diverse and disunited forms, where such eclectic details were used as: columns, turrets, molds and arches [23]. The formal change was followed by a change in colour: *'The most common preconception about the aesthetics of Poland and Central Europe is that it is grey, seriously devoid of colours'* [22]. In case of Poland, the greyness was intensified by concrete and sandstone buildings from the socialist period. The common (and still present) solution was to paint buildings with pastel colours (so-called 'pastelosis' [22], [24]) or to introduce colourful glass and metalwork, which only enhanced the omnipresent formal chaos [24].

Other consequences of the systemic shift were a rejection of prefabricated materials and maintenance practices. Low quality of finishings in socialist buildings, lack of materials, a constant need for fixing, provoked that solidity, novelty and variety became considered as valuable features of building materials. Due to an easy access to new materials, maintaining practices and temporary solutions were denied. Materials and technologies were often chosen without adequate evaluation in the context of function and life cycle [25]. Similarly, the denial of waste, reusing and recycling processes showed that life cycle and pro-environmental aspects were not taken under consideration. The rejection of - present in socialist times - collecting (e.g. metal scraps) and reusing habits (e.g. glass bottles) was justified by the argument of deserved compensation. Concepts driven by economic efficiency goal, but also pro-environmental, socialist aspects of feeding recyclable materials back into the production process [26], became unpopular. Sim-

ilarly, another valuable idea from the socialist times - the concept of collectivism was negated by the society, when the system changed. After the years of forced collaboration and sharing, there was a noticeable shift towards individual thinking and privatisation. It influenced the appearance of cities and public space. But it also affected all kinds of collective actions, the sense of the common good and the level of engagement of Polish society - a non-engaged society [27] with low social capital [28] emerged. Thus, these, often understandable, rejections of previous ideas and practices did not reconcile with the sustainability principles. Excessive forms, gaudy aesthetics, the denial of prefabrication processes and maintaining or reusing practices as well as rejection of collective thinking and sharing became serious constraints for the development of a sustainable approach to architecture and building materials in Poland.

The remnants of the previous system

Even if the dominant reaction of Poles in the times of transformation was to reject everything, that could be linked with the socialist system, its long presence and profound indoctrination of everyday life, had a strong influence on people's subconscious, habits and beliefs. Sometimes, social behaviours, aesthetic and material choices were the remnants of the previous system, its ideology and architecture. Popular preconception in socialist times was the appreciation for industrially produced materials, which were seen as more efficient and durable than natural or low technological ones (despite common defects). Past legal regulations (e.g. concerning fire-resistance safety) removed natural, local materials and techniques even from buildings in the countryside. The trend continues in Poles' contemporary choices: the most commonly used materials in single-family houses are ceramic roof tiles (40%), plaster (72%) and plastic windows, while for example wooden structures have been completely rejected. In public buildings and multi-family housing, it is popular to use aluminium, stainless steel, less frequently - stone. There is also a strong appreciation for composites, laminates and plastics [21] and for industrially produced double façades, mega-blinds, stone ornaments and portholes. Only one in fifty Polish clients opts for a roof with a wooden shingle, 1 in 20 - for a wooden facade and 1 in 22 - for the use of wooden logs. Poles are more interested in pro-environmen-



Figure 3. Building facades in Warsaw

tal high technologies, such as: solar collectors, a grey water system and mini sewage plants [21]. The popularity of industrially produced building materials intensifies the detachment from the nature and from local techniques. Frequently used foreign materials (e.g. exotic wood or stone) are applied without pro-environmental or context analysis. Furthermore, due to the lack of a contextual approach and unified construction a culture of innovation has not been possible to develop. Thus, an unusual approach to materials and experiments are unlike to happen in architecture nowadays [25].

Another problem for sustainable architecture, rooted in the previous system, is Poles' ambiguous relation with the old or historic substance. Sometimes, despite post-socialist nostalgia for pre-communist times, old materials and structures are not considered as attractive or valuable. Eighty percent of Poles prefer to live in new buildings [29]. Single-family houses, even in good technical condition, are frequently demolished and rebuilt. Sometimes, also listed or historic buildings undergo a similar process (e.g. an old market Koszyki or 1960s modernist office building of Metalexport in Warsaw). At times, the lack of respect for buildings' authentic substance leads to the situation whereby the original building is torn down and rebuilt in an almost identical shape with the use of new materials and technologies (Metalexport, Warsaw) [25]. This case shows well that the authenticity of old material is not seen as a value. Moreover, it seems that unification, standardisation and sameness of buildings persists – just in another form. Prefabricated blocks of flats and cubic houses are replaced by omnipresent catalogue houses with a burgundy roof and a porch with arched coping and columns [29]. Poles are conservative in their aesthetic and materials choices [21]. Also architects rarely try to experiment. What is more, they often avoid ideological approach as they did during the socialism [19], which can be observed from the fact that formal and material choices are not thought as the consequences of specific goals [22] – for example pro-environmental ones. Therefore, deeply engrained practices or habits from the times of socialist architecture and planning may become a blocking factor for the development of sustainable architecture in Poland – especially the ones related to mass production, standardisation, detachment from the nature and local or historic context. Also the lack of ideological,

pro-environmental approaches may restrain a possibility to see a bigger picture – e.g. environmental consequences of construction activities.

The effects of westernisation

In the 1990s, Polish society, apart from a systemic change, had to face another challenge - the country's opening to the world. After the years of limited access to Western culture, Poles were quickly catching up with the world and implementing a capitalist economy. Thus, social change was regulated mostly by financial factors instead of – as it was before – by the political ones [27]. The dominant culture was based on constant accumulation, consumerism and the needs of the market. Poles focused on achieving material and financial success [31]. The effects were visible also in architecture. People's aesthetic choices reflected their strivings for material goods and luxury as well as social status aspirations. Modern materials (e.g. glass, steel, aluminium) have been appearing in multi-family housing and offices during the last twenty years. The new, elitist aesthetics (so-called 'islands of beauty') have been present in the general urban chaos [26]. But as the society is still relatively poor (power purchasing parity in Poland is lower than EU [32]), luxurious materials are often replaced by cheaper, low quality substitutes (e.g. stone-looking claddings and wooden veneers). Moreover, there are also problems rooted in a material/technology mismatch, in the use of unsuitable materials or in following fast-ageing aesthetic trends. '*The pressure of fashion seems to be stronger than ever*' [22]. Thus, Polish consumer decisions are not always reasonable. The environmental awareness of Polish society is low (59% of Poles consider their impact on the environment as unimportant, [33]). Pro-environmental architectural solutions and eco-design are still perceived as less important and '*sustainable and simultaneously aesthetically pleasing design projects for houses are rare*' [22]. The contemporary aesthetic and material choices of Poles are being strongly influenced by status aspirations and Western, mainstream trends and, in consequence, are rarely sustainable.

The new approach

But in Polish architecture, there are also exceptions. There are good quality buildings (JEMS, Agora Building in Warsaw, 2002) with an innovative approach to materials



Figure 4. The new approach: MOCAK, Kraków; Koszyki bar, Warsaw; Przetwory Festival, Warsaw; Młyn Zabierzów, Cracow

(HS99, Silesian University Library in Katowice, 2011). There are other kinds of aesthetics, which include more humble projects (Brzoza, Kwietowicz, Inverted House in Warsaw, 2010) or the contextual ones (MedusaGroup, Bolko Loft in Bytom, 2003), those in harmony with nature (Jojko, Nawrocki, House-detached semi-detached in Rybnik, 2010) and the ones respecting a building's authentic substance (Rauch, Żemojcin, Mill in Zabierzów, 2013). There are designs, that help to save energy (Lipińscy, Passive House in Smolec, 2007), which focus on natural (Beton, Chapel in Tarnów, 2011) and the old or reused materials (Kulczyński Architekt, Fabryka Trzciny, Warsaw, 2003). Also new building typologies are being created (KWK Promes, Typical House – Round near Pszczyna, 2010). Modest forms, raw materials and unorthodox language appear in Polish, contemporary architecture. Moreover, sometimes architects *'overstep the elementary act of denial (denial of socialism/post-socialism/neoliberalism) with a single dialectical move and begin to enjoy manifestations of the Polish landscape.'* [21]

Furthermore, there is an alternative architecture movement (Cohabitat), which uses natural or reused materials and local, DIY techniques (e.g. air collector made out of cans in Młyn Zabierzów, Cracow). Green building certification programs are present (BREEAM and LEED). In adaptation projects such materials are reused as: reclaimed bricks (Sztuka Użytkowa, At Scheibler's apartment complex, Łódź, 2010), steel or concrete structure (Medusa Group, Bolko Loft, Bytom, 2003), wooden beams, columns and slabs (Medusa Group, Lofts in old granary, Gliwice, 2009), sawtooth roof structure (C.Nardi, Mocak, Cracow, 2011), historic decorations (Grupa 5, Main Station, Wrocław, 2012), lift tower (Riegler Riewe Architekten, The Silesian Museum, Katowice, 2013), old factory machines (Studio Ads, Old Brewery Shopping and Cultural Centre, Poznań, 2007) and lights, installations or glass bottles. Sometimes building materials are reused in a sustainable way as they are locally sourced and their processing is limited due to reduced finances. A responsible, preservative approach to old buildings is gaining acceptance among private investors (Kulczyński Architekt, Fabryka Trzciny, Warsaw, 2003). New trends promote an unusual approach (success of a unrenovated Koszyki bar in Warsaw), temporary

structures (summer clubs in transport containers along the Vistula river in Warsaw) or handmade ('Made in Poland' – fairs of DIY products), recycled ('Przetwory' – a recycling festival) and reused products (popular furniture renovation). Sustainable trends (cycling in Warsaw) and collectivism (common co-working spaces) are gaining popularity. These examples change the social perception of waste and sustainability as well as they create space for alternative aesthetic and material choices. They show the potential of reusing in Poland. Thus, a more sustainable approach to architecture and the reuse of building materials may develop in the future.

Introducing sustainable concepts in Polish architecture: constraints and problems

During the last 25 years Poland's economic growth has been visible. The GDP was rising even in times of financial crisis (1,6% in 2009, 1,9% in 2012, [32]). But the Polish economy is not considered as innovative. Moreover, Poland has the highest domestic material consumption in Europe (798 million tons in 2011) [32] and rising consumption of non-metallic resources (incl. building materials). The country uses more resources than exist on its territory. Furthermore, poor environmental awareness, inefficient information about pro-environmental practices (72% of Poles claim that information about waste management is insufficient [33]), inadequate aesthetic education [34], lack of pro-environmental knowledge among authorities and professionals, low level of social engagement and negative perception of waste and reusing practices are often the remnants of the previous political system, but they affect Poland's current, sustainable development (Table 1).

Furthermore, the negation of simple forms, the need for unnecessary colours and luxury decorations do not correspond with the rather modest and rational requirements of sustainable architecture. Unconsidered consumerism is far from the ideal and a responsible consumption patterns. The unpopularity of natural and local materials and crafts or DIY techniques causes serious constraints for a sustainable building development. Ambiguous attitude towards the old building substance and rejection of collecting and reusing practices are contradictory to the principles of the optimal reuse of materials. Low acceptance of temporary

Table 1. Comparison of principles for the optimal reuse of materials in architecture and post-socialist blocking factors

Building form		Building material	
Optimal	Blocking factor	Optimal	Blocking factor
simple	complex	locally sourced	no attachment to local materials; the use of foreign materials
rational	excessive	adequate to function	unsuitable due to lack of analysis, e.g. temporary solutions
open	solid	with planned life cycle	lack of life cycle approach
mobile	static	homogenous	eclectic
adaptable	standardised	simple	luxurious, high-tech
aesthetic	lack of aesthetic education	changeable	solid
limited amount of materials and connection types	eclectic: different types of materials and joints	recyclable, reused	lack of acceptance for waste and old materials
with defined construction and demolition scenario	lack of life cycle approach	sustainable	low environmental awareness
Design and construction process		Social attitudes	
Optimal	Blocking factor	Optimal	Blocking factor
open	standardised	maintaining, servicing	rejection of maintaining practices
flexible	standardised	collecting, reusing	rejection of collecting, reusing
innovative, experimental	conservative thinking, non-innovative approach	sharing, collectivism	rejection of sharing, collectivism
interdisciplinary, collaborative	lack of collective thinking	pro-environmental behaviour	low environmental awareness, avoiding ideologies
longer introductory phase incl. consultations and tests	standardised process with limited time and finances	respecting old building substance	ambiguous attitude towards the old materials and structures
		responsible consumption	unconsidered consumption

solutions does not fit to the life cycle approach. Conservatism in design practice and lack of innovation block necessary experiments to introduce previously used materials. Moreover, the need for unification, legislative constraints and habits based on commonly available solutions are serious barriers for the reuse of materials, which requires a non-standard approach to the design and construction process. Also the devaluation of the idea of collective thinking and working becomes an obstacle, because sustainable architecture and the reuse of materials are often based on multi-subject, interdisciplinary collaboration and shared processes.

Presented blocking factors, the remnants of previous system or its rejections, create a challenging background for sustainable architecture in Poland. However, rationally designed buildings, pro-environmental solutions, reused materials and reasonable consumption trends have been appearing more frequently in recent years. This new approach to architecture is still rather an exception than a common practice. Nevertheless, the Polish society seem to opt for pro-environmental behaviours as 90% of people state that nature preservation should be a priority in human actions concerning the environment, 47% declare that they can pay more for eco-solutions and 70% feel responsible for their local surroundings [33]. Thus, to introduce the principles of sustainable architecture and to enable the successful reuse of materials, it is necessary to introduce multilevel actions, which should include politics, legislation, education, information, economy, urban planning, architecture

as well as social behaviours and daily practices. It is important that these actions are designed to overcome problems engrained in the previous political system and to fit current Polish conditions.

The reuse of materials in Polish architecture – directions

The development of sustainable architecture in Poland and implementation of such pro-environmental concepts as the reuse of materials in post-socialist reality is challenging. However, the concept of nature preservation and pro-environmental behaviour lies in line with the society declarations. Moreover, good practices, inspiring examples and alternative trends have been recently appearing. Thus, there is a starting point for a new and reasonable architecture. But to make any sustainable concept popular, it is necessary to introduce policies, strategies and legal regulations, which would promote pro-environmental design and construction processes. It could be done on different levels – through national or regional material efficiency strategies or through adequate waste management plans, which prefer waste prevention and reusing practices over its incineration and landfilling. The new Polish legal act on waste has already introduced this waste management hierarchy but additional regulations should define optimal waste treatment of specific waste streams (e.g. minimum standards). Pro-environmental architectural solutions can be stimulated

through sustainable procurement, green investments, related taxes or other economic incentives. Moreover, it is important to create a society, which is conscious of the environmental impacts of their routines and consumer choices – also the ones concerning building materials. Responsible consumption, high environmental awareness and well-informed decisions are the consequences of adequate education and information practice. Efficient, interdisciplinary, pro-environmental and aesthetic education should be provided on different levels (from elementary school to the university) and should involve multiple stakeholders (consumers, producers, professionals, authorities). Formal education needs to be enhanced by dedicated research institutes and programs, which enable experimental approaches to design and construction practice. Information about innovative buildings, products and business patterns should be accessible through social campaigns, trainings for diverse stakeholders, open access platforms and online databases. Also such tools as eco-certification and voluntary agreements for frontrunners in sustainability are valuable in the development of sustainable practices. Furthermore, informal (e.g. social games) and bottom-up actions (urban interventions, art installations) may have a positive impact on the dissemination of pro-environmental information.

What is more, education and dissemination of the information is also crucial to introduce sustainable concepts and to promote the reuse of materials among Polish architects. Basic, updated and practical pro-environmental courses should be provided at the university level as well as for practicing professionals. Such sustainable concepts as Design for deconstruction, 3R, Upcycling, Superuse or Cradle-to-cradle should be recommended as inspiring guidelines. Buildings should be designed rationally. Open, adaptable and flexible forms are preferred. Materials should be chosen adequately to function and sourced locally. Simple, homogenous, healthy and non-toxic elements should be used. Moreover, building forms and materials need to be analysed in relation to their life cycles. Thus, all materials have to be chosen adequately to their life spans and the building design needs to enable its easy maintenance, replacement and disassembly. The amount of types of materials and connections should be limited. Mechanical joints and reversible structures are preferred. Construction and demolition scenarios should be provided as well as detailed specifications of all materials and elements. In case of old structures and materials, their technical and chemical properties should be evaluated and tested to preserve as much as possible from the existing building substance and to reuse economically and environmentally feasible elements. Moreover, reused and unusual materials need to be used in a precise, aesthetic and innovative way to change the social perception of waste materials and to create valuable examples for the further development of sustainable architecture in Poland. Also Polish design and construction process should be directed towards interdisciplinary collaboration,

which includes multiple tests and consultations. The research should be introduced early – during the conceptual stage and developed throughout the design and construction processes. Therefore, the successful reuse of materials in Polish architecture requires several modifications in the design and construction process, in the way buildings are designed and materials are being used as well as a change in people's architectural preferences. It is necessary to create a synergetic relation between the environment, the client-citizen and the architect.

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