Zero Waste Philosophy on the Example of a Selection of International Projects

Olga Dagmara Kania
Faculty of Architecture, Cracow University of Technology, City Rebuilding Laboratory, A-52, Cracow, Poland
E-mail address: olgadkania@gmail.com

ABSTRACT
The article discusses the topic of sustainable design, understood as an answer to the growing amount of concepts of using pro-environmental solutions in the process of creating works of architecture. Due to rising population numbers, as well as the migration of the population to large urban centres, in addition to the development of settlements, there comes the question: are currently used solutions sufficient in order to protect the environment and save its resources in an effective manner? What alternative methods of optimising resource use can we use in order to design in an economical and environmentally friendly way, one which does not waste non-renewable sources of energy? The article includes examples of alternative methods that bring our manner of thinking about environmentally friendly design up to date with modern developments. The article is focused on design methods that incorporate environmentally friendly construction materials that are obtainable from natural sources and that do not require technologically advanced processes in both their manufacturing and use. Thanks to these solutions, these materials can be used in regions where the level of technological advancement does not allow the use of high-end and technologically advanced environmentally friendly materials, or in places where the very transport of these materials would cause a negative impact on the environment because of the consumption of fuel, which is currently largely still based on non-renewable resources. The approaches outlined in the article include those of the zero-waste movement and the cradle-to-cradle design philosophy.

Keywords: sustainable design, zero-waste, ecology, environmentally friendly design, cradle-to-cradle
1. INTRODUCTION

Zero waste is a set of ideas, principles and philosophies based on the premise that the minimisation of the amount of waste in production processes or use, as well as its intelligent management is the key to the preservation of humanity's sustainable functioning in current times. In a world in which consumption increases from year to year and the number of items that individuals surround themselves with rises, it is inevitable that the amount of needless items will keep growing as they are constantly replaced with newer and newer items that take their place. The zero waste philosophy states that the skilful management of excess items, as well as a conscious approach to consumption itself, as well as thoughtful conduct during the purchasing stage is the key to suppress the chaos of the rapidly rising amount of objects that litter our planet, our apartments and our environment. In order to influence the change in perceiving the world solely through the prism of becoming richer with newer and newer items in any meaningful way, we need to return to the basics - to education, to a change in worldview, spreading knowledge from the disciplines of economy, ecology and sustainable planning.

From a historical point of view, the first mentions about zero waste were made in the 1970's, when Paul Palmer, a chemist, founded his own business, the main goal of which was finding a new purpose for waste that was the result of the process of producing chemical reagents for the electronics industry. Over the course of time and the changes in the demand of the market, the scope of the company's activity broadened. It turned out that the amount of waste produced by industry is enormous and Palmer's laboratories became larger and larger, while the company started to process and sell chemical products obtained from seemingly unusable waste from large factories. The pioneering and innovative project by Paul Palmer met with a huge success. The moral of the story of the success of Palmer's company are the principles that told us not only to process the by-products from industry, but to change the general management approach to production processes in a manner that could change them in such a way that would eliminate their production entirely. In order for this to become a reality, we need to introduce a number of changes regarding the global way of thinking, teaching and feeling responsible for the products that have already been made.

Another increase in the popularity of the zero waste movement took place at the break of the XXI century. In 2003 Robin Murray published his book Zero Waste, and the movement gained in popularity and the support of authorities. The Zero Waste International Alliance has defined its philosophy in the following statement: „...a goal that is ethical, economical, efficient and visionary, to guide people in changing their lifestyles and practices to emulate sustainable natural cycles, where all discarded materials are designed to become resources for others to use. ZW means designing and managing products and processes to systematically avoid and eliminate the volume and toxicity of waste and materials, and not burn or bury them” (ZWIA, 2009).  

3http://www.academia.edu/9626570/A_comprehensive_review_of_the_development_of_zero_waste_management_Lessons_learned_and_guidelines (access 10.03.2016)
Thanks to the activity of people associated with the movement, in 2010 the city of San Francisco achieved a diversion rate\textsuperscript{4} of 80\%, which was a groundbreaking moment on the national scale. Adelaide and Vancouver also joined similar initiatives. Many representatives of institutions tied to industry or social commentators did not put much stock in the ideas of the zero waste movement; the fact remains, however, that calls for the minimisation of unneeded products have their critics, which do not believe in a manner of shaping human endeavours that aims to reduce the amount of waste being produced to zero. Furthermore, many world-famous brands have decided to follow the paths outlined by the principles that had been formulated by proponents of the zero waste philosophy, thus confirming the status of hyper-consumption and hyper-production as an enormous, global threat.

The key problem, it turns out, is thinking about the future of a product already during its design phase, assuming that: it can be used multiple times, whether it is possible to convert it for use in other sectors, what material is it made of, how does it influence the environment - both in terms of obtaining the resources needed to produce it, as well as its fate after use, etc. Due to rising population numbers\textsuperscript{5} and the migration of said population from poorly urbanised areas to large metropolitan areas, the problem of the increasing amount of waste is only going to become more severe.

In light of what has previously been mentioned, movements that propagate the implementation of the zero waste philosophy have made their calls easier to understand to the average consumer - oscillating around the topic of household upkeep, featuring a mindful and sustainable manner of managing waste that is generated by a household.

In current times we should focus on the basics that could help in stopping the process of the degradation of the ecosystem and the excessive production of waste. The author wants to focus on activities that are tied with the cycle of architectural design. By referencing possible methods of solving problems that are discussed by the zero waste philosophy, three examples of actions that could help the situation associated with waste management have been outlined.

### 2. ZERO WASTE DEVELOPMENT IN DESIGN AND ARCHITECTURE

The zero waste philosophy features a holistic approach to the lifecycle of a product. Beginning at the design phase, through a product's introduction onto the market and eliminating the consequences of its degradation. In the paper, the author focuses on the process that precedes a product's release - on the design, which, when properly thought out, allows a reduction in the amount of unnecessary by-products of the final phase of a product's lifecycle already at its foundations. In the case of works of architecture, it is the design phase, an in-depth analysis of the conceptual design, the materials that are to be used or the shape of a building's massing. However, oftentimes a complete achievement of the principles of the concept of zero waste is not fully possible in the case of architecture, the combining of the ideas of zero waste and sustainable, environmentally friendly design is highly desirable and possible to implement.

- The cradle-to-cradle principle

\textsuperscript{4}https://discardstudies.com/2013/12/06/san-franciscos-famous-80-waste-diversion-rate-anatomy-of-an-exemplar/ (access 10.03.2016)

The term Cradle-to-cradle\textsuperscript{6} appeared in popular use after the publishing of the book Cradle to Cradle: Remaking the Way We Make Things in 2002, authored by American architect William McDonough and German chemist Michael Braungart. It was a publication that clarified how we can achieve a model that features a change in the lifecycle of a product from the cradle-to-grave model (which does not feature a continuation of the lifecycle of a product) to a cradle-to-cradle approach (that uses the product in new lifecycles). Employing the principles associated with Cradle-to-cradle\textsuperscript{7} design has a considerable influence on environmental benefits.

Their implementation in the design process - during the development of methods of establishing the structural solutions of a building, the choice of materials or conceptual solutions related to its form of use - can allow us to reduce the amount of unnecessary waste from each stage of the lifecycle of a building. The aforementioned idea disassembles the process of a building’s construction into its constituent parts and, through analysis, is to lead us to provide a continuity to its lifecycle - in other words, something that traditionally would be considered waste, receives a new purpose during the next lifecycle. It is a counter to the system that the authors call Cradle-to-grave, in which there is no possibility of using a product past the end of its lifecycle. This concept features guidelines for designers, suggesting that only materials that are friendly to the environment, to humans, and their health - bio-friendly, non-toxic, easy to obtain, biodegradable and local\textsuperscript{8} - should be used.

One example of a structure built in accordance with the spirit of Cradle-to-cradle is the design of the Netherlands Institute of Ecology building, which is one of the research facilities of the Royal Netherlands Academy of Arts and Sciences (KNAW)\textsuperscript{9}, erected in 2010 in Wageningen, the Netherlands\textsuperscript{10}.

The main idea of the complex designed by Claus en Kaan Architecten was to design a building that would employ the principles of sustainable development, as based on the idea of Cradle-cradle, to the largest degree possible. The building is a complex of research laboratories and facilities dedicated to zoology study. The layout of the building was proposed in such a manner that those rooms that required sunlight would be exposed to it as much as possible. Light wells that would reflect daylight and direct it inside the building to areas where it is needed were also designed. Furthermore, the building features solutions that ensure sustainable energy use, limiting CO\textsubscript{2} emissions. In terms of material solutions, the building incorporates materials that do not contain toxic additives, that are biodegradable and that can be reused. The materials that were used during the production process to make the lining of its horizontal and vertical partitions, the interior decorations and even furniture, were manufactured from elements that allow them to be reused, which at the same time have not been treated with any toxic substances during the production process. The wood which has been used in the building is so-called plato wood\textsuperscript{11}, which has been modified with the use of

\textsuperscript{6}https://books.google.pl/books?hl=pl&lr=&id=KFX5RprPGQ0C&oi=fnd&pg=PP1&dq=cradle-to-cradle&ots=iqLht5piDg&sig=VQULRa5TjBcyQ7K-8biLgLg8e-yk4&redir_esc=y#v=onepage&q=cradle-to-cradle&f=false (Access 10.03.2016)
\textsuperscript{7} ibidem
\textsuperscript{8} ibidem
\textsuperscript{9} http://www.c2c-buildings.org/projects/nioo-knaw/ (access 10.03.2016)
\textsuperscript{10}http://www.archdaily.com/316294/netherlands-institute-for-ecology-nioo-knaw-claus-en-kaan-architecten (access 10.03.2016)
\textsuperscript{11} https://nioo.knaw.nl/en/cooked-wood (access 10.03.2016)
temperature and pressure in a manner that allows a complete reduction of external chemical compounds.

The ventilation of the building was designed to be a hybrid system, where it is simultaneously possible to ventilate it naturally by opening windows and the air is sucked in and used reused in the ventilation system. The structure had been covered with a green roof, which was turned into a space for photovoltaic panels. On two roofs, thermal energy obtained by photovoltaic panels is used to effectively heat the entire building, which is why it is not necessary to use an additional energy sources during winter.\(^{12}\)

- **Passive buildings**

The challenges tied to energy efficient and environmentally-friendly building are being taken on by passive architecture. The concept of the passive house was defined by German scientists - Wolfgang Feist, PhD, and professor Bo Adamson from Lund University.\(^ {13}\) The operation of such a house is based on obtaining heat from internal gains, the passive obtainment of energy from sunlight with the use of glazed vertical barriers, the use of cardinal directions in the design of a building's interior or the reuse of heat from internal infrastructure. Windows used in passive houses are designed to be as airtight as possible, with an appropriately large surface area that allows the obtaining of the desired amount of solar radiation. In particular, windows located on the southern side of a building are the most crucial from this point of view.

One principle associated with passive building is designing buildings in a manner that minimises or entirely rejects the use of non-renewable fuel sources for heating these types of buildings. As a result, these types of solutions feature the use of methods that propose the most effective insulation parameters for the external partitions of a building, eliminating heat loss as much as possible. This allows us to minimise energy loss associated with conventional heating. The structure of such a building should be very airtight, which means the elimination of thermal bridges by using various technologies for layered walls. The energy demand in a passive house should not exceed 15 kWh,\(^ {14}\) which is a very economical value when compared to traditional buildings, which usually have an energy demand of around 120 kWh (Paster, Magiera 2011, p. 167).

It is preferred to use balanced ventilation with recuperation and a ground heat exchanger. Thanks to the use of these solutions, it is possible to attain the highest rate of heat reuse from expelled air.

One Polish example of a passive house is a building located in Smolec, near Wrocław. The structure was designed by architects Miłosz Lipiński and Ludwika Lipińska in 2007. It was the first building in Poland to receive a certificate from the German Passivhaus Institut Darmstadt, while simultaneously being built in cooperation with the Passive Building Institute of the National Energy Conservation Agency in Poland.\(^ {15}\)

The building was designed in accordance with design guidelines for passive houses - with a compact form, with the use of precision insulation. The design process stressed the minimisation of heat loss with the simultaneous obtainment of the highest possible thermal

---

\(^{12}\) ibidem


\(^{14}\) ibidem

gains from heat derived from solar radiation. Large glazed surfaces were used on the southern side to this end. The northern facade only has those glazed surfaces that are absolutely necessary due to low thermal gains associated with the incidence angle in that direction and even the thermal losses that were caused by the placement of glazed surfaces in that area. In order to avoid overheating the building during the summer period, shade-producing elements in the form of wide eaves were used. According to calculations by NAPE, the yearly energy demand for this building is 13.7 kWh\(^{16}\), which fulfils the criteria for the purposes of classifying it as a passive building.

- **Natural building**

Natural building constitutes a branch of sustainable design based on using local, renewable and environmentally friendly materials. The key here is the notion of local materials - this is a deciding factor in minimising costs associated with their obtaining and transport. The impact of such building systems on the environment is not seen as negative. The materials used in the building of natural houses are mostly eco-friendly, biodegradable and harmless to human health. Most commonly, the notion of natural building refers to techniques that have already been known to man in the past, and used in a given area for a long time, only to be abandoned after being replaced by new technologies and materials that were industrially perfected.

The most widely known material solutions used in natural building are:

- Straw bale
- Clay blocks
- Rammed earth
- Wood
- Stones

Straw bale technology, which has been used to built the Straw Bale Cafe at the Herefordshire College of Technology in the UK, is an example of the use of pressed straw blocks plastered with clay. Straw blocks require appropriate drying and pressing. These types of solutions allow us to build low buildings, like residential, low commercial buildings or farm buildings. Walls made from straw blocks feature a large thickness, while having very good thermal properties, eliminating the need to use additional thermal insulation. The materials used in the production process are ecological and environmentally friendly, in addition to being economic and cheap to maintain\(^ {17}\). The aforementioned cafe was designed by Hewitt Studios with the use of this technology, which makes use of a material - straw - that is locally available, obtained on the campus grounds. The cafe has all the qualities that are typical of these types of buildings, while at the same time being a representative example of the use of environmentally friendly solutions in design\(^ {18}\).

\(^{16}\) *ibidem*

\(^{17}\) http://www.kluszewski.com.pl/64/domy-ze-slomy (access 10.03.2016)

3. SUMMARY. IS ZERO WASTE A VIABLE SOLUTION IN ARCHITECTURE AND BUILDING CONSTRUCTION?

The program of the Zero Waste philosophy is broad and defines numerous planes related to processes associated with human activity. It can constitute an inspiration for many minor movements - drawing on the most important principles associated with a sustainable approach to the topic of using the environment's resources. In the case of the aforementioned concepts associated with building construction, we can find many common criteria for a future-oriented approach to the topics associated with design in architecture, building construction and material design. In order to reduce waste to a minimum and, along with the process of perfecting the applied methods, eliminate it entirely during the design process, and, as a result, in production, we should develop the aforementioned ideas on a wider scale. Materials used as the base should be friendly to the environment and, if possible, easy to transform into other, ecological, environmentally friendly materials, made without the use of toxic chemical industrial reagents. In order to achieve satisfying results, it is important to widely propagate environmentally friendly construction, convincing observers that these are not radical and complicated solutions - on the contrary, they are easy to achieve with a minimum of effort and openness. Starting from our own backyard, we can do our part to improve the quality of life and the environment of the entire world. The examples mentioned in the article indicate samples of paths in the design process - from planning in accordance with the cradle-to-cradle principle, to searching for design solutions associated with natural, local and bio-available resources. Because the process of the development of cities and human settlements is becoming faster, which is the result of a rising amount of population around the world and the migration of that population to large urban centres, the introduction of the principles of sustainable design, based even partially on the tenets of the zero waste philosophy, seems unavoidable. Excessive consumption - not only applying to people's everyday lives, as well as the excess of items in their surroundings - also applies to the wasting of and an unwise use of natural resources, construction materials, the unnecessary and inconsiderate intensification of the built environment. In order to achieve concrete benefits, it is necessary to undertake joint action on behalf of designers and higher authorities - governments, business owners and industry. We should, however, begin with small steps, like changes in thinking and education from our youngest years and the propagation of the notion of sustainable development in mainstream media. The paper presented the possible paths that can be taken by designers implementing a programme based on the zero waste philosophy. However, while some solutions seem complicated at first glance, it is important that these ideas reach the largest amount of people that work in design. On the basis of the three examples that were mentioned, the author pointed out what alternative action can be taken in order to minimise losses to the ecosystem associated with construction, the amount of by-products in the form of production and construction waste, as well as the use of local, naturally bio-available resources for construction purposes.

Bibliography


(Received 04 April 2017; accepted 24 April 2017)