Social perception of concrete in garden architecture

Summary: The paper concerns social perception of concrete in garden architecture. As a result of the analysis a concept of a garden has been proposed, where various concrete elements are present. A questionnaire was used as an auxiliary tool. It was formulated in a way to get information on preferences related to concrete use in garden architecture with an indication of structural elements made of it, their shape, type of concrete as architectural material, combination of concrete with other construction materials and plant types, as well as economical and ecological conditions. Preferences of respondents are different but a social need to respect environment during creation of garden architecture is common.

Key words: concrete, garden architecture, social perception

Introduction

Concrete is a basic construction material, it is continuously perfected, used for various civil engineering purposes and usually perceived as useful due to its technical properties rather than its aesthetic features. It is so because of competition in the artistic quality from other construction materials and a certain tradition in their use, as well as little promotion of knowledge related to concrete properties which enable its application as a material with “an artistic potential”. Concrete as a material used for decorative purposes is still controversial among non-professionals. On the other hand, professionals claim, that “concrete is no longer
only a friend of a structural designer but becomes a helper for an architect” [Kozłowski 2014]. They suggest quantitative methods to assess surface quality of decorative concrete [Klovas and Daukšys 2013], and introduce architectural concrete to various branches of economy, for instance to transport infrastructure [McCarthy et al. 2013]. In this way they approve in a more an more consequent way this material as having significant artistic value.

Development of modern garden architecture, both in private property field and in public space, becomes an expression of wealth [Zasieczna 2008]. Taken in a conscious way, it should represent not only fulfilling of aesthetic expectations of potential users of gardens but also possession of a certain knowledge on the fact, that aesthetic properties of a material depend on its durability, and that production of the material and its properties should meet the principles of sustained development in civil engineering.

This paper concerns social perception of concrete in garden architecture. It reports on an attempt to analyze knowledge and preferences of current and future users in applications related to concrete. As a result of this analysis a concept of a garden has been proposed, where various concrete elements are introduced.

**Development tendencies in contemporary concrete technology**

Directions of development of contemporary concrete technology coincide with a sustained development in civil engineering by tending to fulfill technical, ecological and economical requirements. They result from the knowledge on environment with a provision for human requirements, material science, chemistry, physics, environmental engineering and architecture [Bromberek 2012].

Modern concrete is advanced technically and technologically. Some types of the material are already classified as high-tech ones [Kuniczuk 2011].

A special attention should be paid to self-compacting concrete with a necessary application of highly effective superplasticizers and micro-fillers in their production [Szwabowski and Gołaszewski 2010, Organa et al. 2014] as well as more and more promoted viscosity modifiers [Grabiec 2013, Szwabowski and Gołaszewski 2010]. This type of concrete, due to elimination of compacting through external energy supply, is more user-friendly to workers engaged directly in its production and is also more environment-friendly. Easier placing process of the concrete mix has special importance in cases of fine reinforcement and complex shapes of concrete elements [Szwabowski and Gołaszewski 2010]. Application of appropriate anti-adhesion substances leads to especially smooth
concrete surface, what enhances its aesthetic value [Kuniczuk 2010]. It is doubtless, that there is a promise to apply self-compacting concrete as architectural material, especially that it continually gains an aesthetic identity [Bigaj 2014]. However, its use in garden architecture is still too rare.

Architectural concrete can be formed in various ways [Bigaj 2014, Kuniczuk 2011, Stawiarski 2007]:
- by exposing its surface texture (boarding stamp, concrete from smoothed boarding, structural concrete, stonework treatment, mechanical smoothing, treatment with an abrasive material, rinsed concrete, acid etching),
- use of natural colours of concrete and aggregate,
- use of white cement,
- colouring of concrete mass, surface or layer including enhancement of the effect by addition of blast-furnace slag (in the case of white cement and inorganic pigments) [Hong-seok et al. 2013]).

Quality, durability and also aesthetic durability of concrete is influenced by a careful choice of quality and quantity of its components, including cements compatible with chemical admixtures [Grabiec 2011, Łukowski 2003 and 2007, Szwabowski and Gołaszewski 2010], and also cements with mineral additives, what brings ecological (smaller emission of carbon dioxide, reuse of waste materials), economical (smaller energy consumption in cement clinker production) and technological advantages (improvement of certain properties of concrete, like durability). Choice of aggregate is important, both in its plastic and technical value (little absorbability, frost resistance, high strength, high durability to wear, uniformity of grain-size distribution and possibility to achieve its tightest possible version [Jamroży 2005]). In the case of water-permeable concrete there is a possibility to form an ecological pavement allowing precipitation water to flow to soil – an aggregate free of fraction below 4 mm.

Among concrete modifiers, besides plasticizers and superplasticizers, tightening admixtures are especially useful. Aerating admixtures and those improving frost resistance are important in our climate zone. Among additives, fly ash and granulated blast furnace slag improving concrete tightness and, consequently its durability, are of great value, too [Giergiczny and Synowiec 2014, Jamroży 2005, Łukowski 2003 and 2007].

The question of concrete durability becomes more and more important, because it is the durability, which finally determines an energetic balance of a civil engineering investment [Bromberek 2012]. It also influences aesthetic durability of concrete, which is so important in every aspect of architecture. In the context of sustained development it is more and more
frequently emphasized, that concrete strength results from its durability, not vice versa [Bobrowicz et al. 2014]. Conscience of these interactions accompanies scientific research and is also increasing among designers and contractors. This knowledge is worth publishing among persons not involved professionally in civil engineering to improve ecological consciousness of the society.

**Materials and methods**

The purpose of this paper was to create an optimal concept of a garden with diverse presence of concrete. The concept was based on opinions of respondents regarding social perception of concrete in garden architecture.

The designed garden is localised in Otusz, Buk district, Great Poland region. There is a plot of 1000 m² area located in a flat terrain with a one-storey detached house of 240 m² area with a built-in garage for two cars and a terrace having an under-roof area of 12,2 m² and an open area of 34,6 m². The garden area subjected to the arrangement is of 725 m². Entrance to the plot and to the garage is from north-east side.

The pilot investigation was carried out. A questionnaire was used as a tool for this purpose. It was formulated in a way to gain prognostic information on preferences related to concrete use in garden architecture with an indication of structural elements made of it, their shape, type of concrete as architectural material, combination of concrete with other construction materials and plant types, as well as economical and ecological conditions. The questionnaire took into account division of respondents into groups according to:

- sex,
- age (respondents gave exact age),
- place of residence (large city, town, village),
- employment and education (persons involved professionally in civil engineering and not involved).

There were 104 respondents. The investigation was carried out in two ways:

- traditional (paper forms),
- electronic (in the website interankiety.pl).

The majority of 17 questions in the questionnaire had closed character.

The questionnaire form was given as a supplement at the end of the paper.

Solution to the concept problem in the range of arrangement of the designed garden was preceded by *in-situ* visits including preparation of a photographic documentation. Design
concept of the garden was prepared using a general map of the plot in 1/500 scale from January 11\textsuperscript{th}, 2012, issued by Poznański Starost. In the further preparation of the design computer programs ArchiCAD 16 and Adobe Photoshop CS6 were used.

**Results and discussion**

*Analysis of questionnaire*

There were 73 women and 31 men in the group of 104 respondents. The age mean was 27.6. The youngest respondent was 18 years old, the oldest one – 65. The largest number of respondents were 22 years old with median equal to 23 years. The smallest group – 25 persons, was characterized by age exceeding 30 years. 77 persons lived in large cities, 13 – in towns and 14 – in villages. Students of landscape architecture amounted to 36\% of respondents, 14.4 \% were employees of design offices related to architecture or landscape architecture, 7.7\% – employees of civil engineering companies not involved in architecture, 6.7\% – graduates from architecture or landscape architecture studies. A large 36\% group represented other professions.

It was concluded from an analysis of respondents’ answers, that the main source of knowledge on concrete use in garden architecture is internet (almost 73\% of respondents). It confirms the contemporary tendency to reach for that easiest accessible source, which, as in all branches of knowledge, should not be taken uncritically.

An average assessment of concrete as a material to form composition in garden architecture in a 10-point scale amounts to 5.5 with a standard deviation 2.4 and distribution median equal to 5. Such an intermediate location of concrete indicates a moderate attitude to this material. This can be kept constant among those who are traditionally thinking [Furmanik 2010, Madejski 2008], but after a wide propagation of knowledge on its advantages, can be improved.

The majority of respondents would like to have a garden at their houses (75\%) and 50\% of them would choose an abstract style out of the list of suggested styles. The mostly preferred concrete elements (38\% to 46\%) are: stairs, retaining walls, pavement, terraces and flower pots. The mostly liked concrete types include: natural raw surfaces and ones imitating or lined with natural stone (37\% to 61\%), while among geometric shapes – polyhedral ones are preferred (over 60\%). Hence, from one point of view users tend to prefer natural forms with respect to materials, but on the other hand – more unusual geometrical forms.
The majority of respondents accepted a combination of concrete with wood, glass, metal and natural stone. It proves, that a part of users try to relieve the presence of concrete with traditional elements but another part treat it as modern, simultaneously using metal and glass.

The mostly agreed on plants to coexist with concrete were: grass, creepers and bushes. The majority of respondents had no knowledge on water permeable concrete surfaces but having learned it, the absolute majority of them approved its use in gardens. It indicates a social need to respect environment and purposefulness of skillful propagation of knowledge on this subject.

*Concept of optimal garden design*

The proposed concept is an effect of respondents’ answers, authors’ knowledge in the range of concrete technology and landscape architecture including their taste and creativity, as well as adopted functional assumptions. Thus, the questionnaire results although they had exploratory character, were treated by the authors as a certain hint to create the concept, both in the inspirational sense and in respecting the dominant tendencies in concrete perception by the respondents.

The optimal garden is described below. The concept of a design landscaping is given in Fig. 1. Figs. 2-6 show visualizations of selected concrete elements and their localization in the garden.

The designed landscaping is to fulfill a role of a modern garden by a house combining simplicity with functional space, composed according to geometry rules with a subdivision into six zones: representative – at the entrance, three internal ones with recreation space and two pass-by interiors at the sides of the house.

The zone in front of the house features a water permeable concrete pavement both for a path leading to the house door and to an approach road to the garage (Fig. 2). This pavement, placed on a natural soil, consists of the following layers: water permeable concrete (10 cm), mixture of sand and broken stone (15 cm) and filtering sand layer (15 cm) [Boroński 2013]. Both pavement zones are separated by a green strip with bushes and high natural grass. At the right hand side, beside three decorative trees, benches are located to allow for a rest. Along the paths, passing by the house, made from concrete panels imitating natural stone, strips of decorative grass of varied height were proposed with groups of freely growing bushes. The south border of the plot is framed by a high hedge, and the south house wall is covered with a creeper. The recreational zone includes a concrete terrace imitating natural
stone (Fig. 3) surrounded by a high decorative grass. The terrace allows for a view onto entire garden. The distinguished zones are separated by concrete walls (Fig. 4) with windows allowing for views into adjacent ones. The interior attached to the terrace features the same concrete panels as around the house, with two hummocks flanked by a group of four trees. The subsequent interior can be entered by the same concrete path. The recreation zone designed there is located at a small water reservoir, which separates two wooden terraces. It is a proposal to combine concrete and wooden elements including introduction of water into the landscape (Fig. 5). The passage is also made from concrete panels. The larger terrace features a tree of an “umbrella” shape to protect users from sunshine. The entire interior is surrounded by concrete flower pots with low grass species. There is a modern abstract concrete sculpture made from variously sized cubicoids connected at different heights, located between these two interiors. The sculpture is topped by planks from an exotic wood (Fig. 6), which can form a space for recreation and playing. The last from the arranged interiors, adjacent to the south-west house wall, is composed using concrete flower pots with recumbent bushes (Fig. 4) and a water wall visible from the majority of garden interiors. It is accompanied by a tree of spherical form. The water wall is surrounded by broken glass reflecting water. There are wood and steel benches located at the terrace adjacent to the house, at the wooden platforms and in front of the house, while lamps and trash bins are placed along the paths and nearby each terrace.

Conclusions

1. The questionnaire carried out allowed to learn about social knowledge and preferences concerning concrete use in garden architecture, however the gathered results are valid for the group of rather young users (below 30 years of age) and city dwellers.

2. The gathered information indicates that:
- almost half of respondents would like to arrange a garden near a house in an abstract style, where concrete would be used for: stairs, retaining walls, pavement of paths, approach roads and terraces, as well as flower pots,
- potential garden users mostly accept raw or stone imitating concrete finish, and choose polyhedral geometric forms,
- wood, glass, metal and stone are treated as best composing materials to accompany concrete in garden architecture,
- grass, creepers and bushes are especially preferred plant types to form garden architecture
with concrete.

3. It is purposeful to provide a basic knowledge on possibilities to apply concrete in landscape
architecture to users, who are not professionally involved in civil engineering. Such an
approach may allow them to see garden architecture in a more conscious way and their
possible choices will coincide with sustained development of civil engineering,
simultaneously coinciding with their particular taste. It seems to be confirmed by answers to
questions in questionnaire about water permeable concrete surfaces. They are not familiar to
society but they are acceptable for use in gardens after providing information about them.

4. Analysis of social perception of concrete in garden architecture done with fulfillment of
statistic significance requirements would undoubtedly give a wider picture concerning the
problem. However, some knowledge obtained by the authors on the base of questionnaire
used could be systematized in some way and seems to be a contribution to further studies.
Evidence in support of the conducted research is a part of material which allowed to create the
concept of the garden meeting the expectations of potential users.

5. Analysis of social perception of concrete may be useful and should be taken into account
by landscape architects and concrete producers, who expect to offer this material for
interested clients to be used in gardens.

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References

**Questionnaire form**

**Sex**
- Female
- Male

**Age**

**Place of residence**
- large city
- town
- village

**Employment / Education**
- employer of design office / contracting unit involved in architecture / landscape architecture
- employer of civil engineering company not involved in architecture / landscape architecture
- student of architecture / landscape architecture
- graduate from architecture / landscape architecture
- other profession

1. **Have you ever planned / are you going to start the garden? If ‘yes’, of what type?**
   - utility
   - at the house
   - recreation
   - other

2. **Do you like concrete elements in garden?**
   - Yes
   - No
   - It is difficult to say

3. **What is the main source of your knowledge on concrete use in garden architecture?**
   - professional literature
   - internet
   - leaflets, brochures
   - friends
   - other sources

4. **What style of the garden do you like the best?**
   - English
   - French
   - Japanese
   - abstract
   - no opinion

5. **How much attention do you pay to aesthetics of concrete elements in garden architecture?**
6. **What concrete elements would you like to have in your garden?**
   - retaining walls
   - stairs
   - fountain
   - terrace
   - bench
   - pavement
   - fence
   - flower pots
   - sculptures
   - other

7. **How many points would you give to concrete elements for creation of garden architecture?**
   - 0 pkt
   - 1 pkt
   - 2 pkt
   - 3 pkt
   - 4 pkt
   - 5 pkt
   - 6 pkt
   - 7 pkt
   - 8 pkt
   - 9 pkt
   - 10 pkt

8. **What concrete types do you like the best in garden architecture?**
   - natural and raw
   - coloured
   - imitating natural stone
   - lined with gravel
   - lined with natural stone
   - lined with other material

9. **What geometric shapes of concrete do you prefer in garden architecture?**
   - spherical
   - polyhedral
   - cylindrical
   - other

10. **What materials do match concrete elements in the garden?**
    - wood
    - ceramics
    - glass
    - metal
    - natural stone
    - plastics
    - other

11. **What plants do coexist the best with concrete?**
• trees
• bushes
• flowers
• grass
• creepers
• other

12. What is the greatest advantage of concrete in garden architecture?
• possible creation of various utility forms
• possible creation of various decorative forms
• durability
• competitive price
• other properties

13. Specify disadvantages of concrete in garden architecture.

14. To what extent do you pay attention to costs connected with use of concrete in garden architecture?

0%  10%  20%  30%  40%  50%  60%  70%  80%  90%  100%

15. How many points would you give to concrete as a modern building material?

0pkt  1pkt  2pkt  3pkt  4pkt  5pkt  6pkt  7pkt  8pkt  9pkt  10pkt

16. Have you ever heard about water permeable concrete surfaces?

Yes  No

17. Water permeable surfaces is an ecological solution in architecture. They allow to drain precipitation water to the ground and in this way sewage system is burdened. They improve climate conditions and located close to plants ensure permanent access of water and air to them (INTERNET 7).

Would you like to use such surface in your garden?

Yes  No
Fig. 1. Design concept of a garden

Fig. 2. Water permeable concrete pavement as an approach road

Fig. 3. Terrace and path from concrete imitating natural stone
Fig. 4. Concrete retaining walls and flower pots with creepers

Fig. 5. Combination of concrete, wood and water

Fig. 6. Abstract concrete sculpture with wooden lining