



Application of High Performance Concrete Surfaces in Landscape Architecture

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Abstract: The exposed concrete is a very high quality unwrapping concrete. Producing qualitative exposed concrete objects is such a complex process, when the process of planning and designing can not be separated. However the concrete seems to be a very rough material for many people, but it is suited for producing pretty smooth surfaces. The formwork, the content of the concrete and the exactitude of the constructor affects most of all the quality of the exposed concrete.

Keywords: exposed concrete, concrete bench, concrete garden furniture, concrete surface

1. Introduction

Hardly could such quality exposed concrete have been seen either in Hungary or in the neighboring countries, or rather they could rarely be seen there, until the beginning of the 21st century which could have inspired the architects and landscape architects to design natural concrete surfaces. Though dozens of cases abroad proved that concrete is not just a structural material, and it could also be a surface of high aesthetic value, only few designers tried to apply visible concrete. The main reason for it, in my opinion, is that the construction industry in Eastern Europe was not, and partly is still not able to build quality concrete surfaces.

Examples of natural concrete surfaces worth mentioning in Hungary could be found since the end of the 1950s [1]. Analysing these artefacts one can immediately notice that their aesthetic value does not originate from the quality of their concrete surface but from their other architectural values. It can be stated that the quality of visible concrete surfaces produced from the 1960s till the years in the 21st century was, as a matter of fact, consistent with the higher quality structural concrete in Hungary.

Since the second half of 19th century garden architecture has been using different concrete, cast stone garden furnishings: neo-baroque statues, raised beds, railings, caps, and benches. Their shared characteristic is their surfaces, which are coarse grained surfaces in order to produce the natural effect of rubblestone. Besides having different forms, this surface quality reappears in the case of the 1970s and 1980s' prefabricated concrete garden furnishings: benches, counterfort walls, raised beds, and concrete pavements. Objects made of concrete in this era could be characterised by exposed aggregate concrete and gravel surfacing.

In recent years, the increased attention towards concrete furniture and pavement for public spaces, and exposed concrete surfaces have resulted in a very different surface quality from the above mentioned examples. Nowadays not the washed or coarse grained surfaces are popular, the implementation of which does not mean any professional challenge, but smooth concrete floors with sharp edges and impeccable corners. The aim is to make the surface of such concrete objects fully homogenous and nonporous, also their colour and texture, their edges, corners, and the different joints exact to the extent of a millimeter. Also, the aim is to make the surface reasonably lasting in the open air: it should be frost-resistant, graffiti resistant, and could be cleanable. There is a demand for such concrete objects and surfaces, the quality of which could compete with high quality rubblestones. The magnificence of concrete is inherent in its being a mineral substance which can be cast, and theoretically any form could be made of it. At the same time it is fit to produce the finest surfaces.

2. Materials and Methods

I examine the opportunities of high quality surface concrete applications in open air architecture through analysing Europe's considerable visible concrete edifices and prefabricated garden furnishings which were built in the last decade [2]. Besides the Western European examples, I have gained really useful practical experience when I examined visible concrete edifices in Hungary in recent years.

I pay special attention to the opportunities of applying high density and high performance concretes in open air architecture, which have been widely available in recent years.

3. Discussion

During the design of exposed concrete surfaces one of the most important tasks is to define exactly the quality of the surface. On the one hand, it is vital because of the execution's building cost calculations and organisation; on the other hand, because of the implemented work's quality control.

When defining quality demands concerning visible concrete surfaces, it is an important aspect how far the object will be seen from, and how close it will be to the users.

On consideration, concrete garden furniture should have the finest quality surface. The basic requirement is to have an entirely nonporous and homogenous surface, and to have the complete colour identity of items manufactured in large amounts. The surface should be smooth; implementations similar to the washed, corroded by acid, artificially coarse grained surfaces, or surfaces similar to concrete pavements do not mean any professional challenge any more.



Photo 1: Pannonhalma, The open air theatre stage, excerpt.

In recent years, just some bigger projects made it possible to implement high quality concrete furniture and garden furnishing. Among others, the Pannonhalma Benedictine Archabbey's tourism development is worth mentioning; nearly 90 concrete benches were made and got built in within its framework (photos 1 and 2) [3].



Photo 2: The surface of a slightly airholed concrete bench after being chamfered

The colour of the benches is natural looking grey, the material of the benches is high density plastic fibre reinforced concrete, the edges are subsequently chamfered 4-5 millimeters [4]. The benches have a hollow structure, their mass is cc. 250 kilograms. Their surface has been made slightly porous and they are dispersed uniformly, but the quantity of pores is still acceptable. The designers judged the benches to be of outstanding quality, even when taking the international standards into consideration; however, they expressed their opinion that the edge forming and the nonporousness of the surface could have been much better. The bigger part of concrete benches in Pannonhalma were placed on the territory of the open air theatre built in the orchard next to the archabbey. The smaller part of the benches were placed on the territory of the Botanic Gardens and Levendulás (Lavender Garden). These latter ones were provided with wooden seating surfaces.

Other important premises where concrete garden furnishing made in Hungary could be seen are in Tettye-park and its vicinity in Pécs (photos 3 and 4) [5]. The surface of the diversely formed irregular prism objects is structured, occasionally ornamented with glass mosaic. Their measuring and size were chosen to make them usable also as benches, and at the same time make them elements for space composition offering independent aesthetic quality. Having had a closer look at their quality one can realise that they were made adopting a process technology for large-scale production unlike the craftsman quality of the benches in Pannonhalma. Their edges are chamfered, the surface has airholes in some places, and there are some flaws in manufacture at the corners. Generally speaking, their surface quality is slightly poorer than of the benches in Pannonhalma.



Photo 3: Pécs, Tettye-park, concrete garden furnishings



Photo 4: The Tettye-park furnishings' roughly chamfered edges

Generally speaking, it can be stated about the above introduced concrete garden furnishings in the two places that the quality of their surfaces is good but not excellent. To improve the quality a lot can and will be done if high density UHPC concretes gain ground. The self compacting concretes of 15-20 N/mm² flexural, and 80-100 N/mm² compressive strength make it possible to produce much thinner structures compared to forms we have got used to before (Photos 5 and 6). With self compacting concrete even sophisticated three-dimensional forms can be cast, and with a suitable formwork self compacting concretes provide a perfectly smooth and nonporous surface. The other advantage of UHPC concretes is that they absolutely block water sorption so their frost-resistance could match high quality stones, and could also last as much as the above mentioned stones.



Photo 5: A UHPC bench, its manufacturer is Escofet



Photo 6: A UHPC bench's edge after being put in formwork, before being chamfered.

In the case of cast-in-place monolithic structures' surface quality, e.g. counterfort walls, one can expect at least one category markdown compared to the surface quality of prefabricated concrete garden furniture and furnishings. It is partly the result of inaccuracies in constructing the formwork in place, and partly the result of the quality of fresh concrete taken to the building site. To produce a high quality surface one have to apply self compacting concrete which could be produced just by highly experienced concrete suppliers.

To categorise visible concrete surfaces the "Merkblatt Sichtbeton", the technical guidelines elaborated by the German Concrete Association, seems to be the best standard to choose [6]. The guideline distinguishes four different quality categories: S1-lowest, and S4-highest, which can be characterised by well-measured or precisely defined parameters. When categorising one should take into account the following parameters: texture, porousness, color identity, precision of work and formwork joint, and uniformity.

In open air architecture countefort walls, blade walls, plinth courses in the most frequented places should be at least of S2 quality, in places of high priority they should be of S3 quality. The supposed quality of prefabricated garden furnishings should be at least S3 quality, in an ideal case it should be S4. The above benches in Pannonhalma meet the quality requirements of S3, the quality of the furniture in Tettye-park alternates between the qualities of S2 and S3.

4. Conclusion

Quality concrete fabrication, and within it fabricating visible concrete is a leading technology these days, which means the first class in building industry. Quality concrete, which is a high quality building material, can be safely applied almost at any scope of both architectural and landscape architectural planning. The period between 1960 and 1990 badly deteriorated concrete's significance in its aesthetic sense. My intention has been to make all the designers and future clients acquainted with the opportunities hidden in advanced concrete architecture.

References

- [1] The most important exposed concrete edifices in Hungary:
<http://kek.org.hu/beton/category/magyar-klasszikus>
- [2] The most important exposed concrete edifices in Europe:
<http://kek.org.hu/beton/category/europai-peldak/>
- [3] Manufacturer: Ivánka Kft., Budapest
- [4] According to the manufacturer's declaration its compressive strength is cc. 50 N/mm²
- [5] Manufacturer: Ornamentika Kft., Győr
- [6] DBV/BDZ-Merkblatt Sichtbeton, Ausgabe 2004, Deutscher Beton und Bautechnik-Verein e.V. Berlin, und Bundesverband der Deutschen Zementindustrie, Köln.