Why historic concrete buildings need holistic surveys

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ABSTRACT: With the increasing listing of 20th century buildings as monuments, it is necessary to find suitable conservation methods as these monuments differ from the traditional heritage. For concrete, one of the major 20th century building materials, a tailored conservation approach is needed urgently. At present, no specific concrete conservation approach exists, and concrete repair approaches are consulted. Looking at practice, cultural-historical values are often lost due to interventions. One reason is the insufficient awareness of possible values of the original concrete, which are thus not respected in the process. In this paper, the diverging aims of repair and conservation, which are seldom considered, are discussed. A closer look at backgrounds of repair and conservation explains why standard surveys endanger monumental values. To improve concrete conservation, a holistic survey integrating the technical condition and the monumental values is essential in order to obtain a sound basis for the conservation process.

1 INTRODUCTION

Currently, 20th century buildings are increasingly reviewed and re-evaluated, often forced by the threat of demolition, neglect (Fig. 1) or careless interventions. As a result, selected buildings are listed because of specific values, and attempts should be made to preserve them together with those values. To achieve this, a tailored conservation approach is needed as these young monuments do not only differ by their typology, structure or design from traditional heritage, but also by the used materials.

Concrete, for example, became a major building material in the 20th century, and its conservation will be an important task for heritage care in the future, therefore a tailored concrete conservation approach is needed. Currently, a dependence on concrete repair approaches is common for concrete conservation projects as heritage care stakeholders are usually not familiar with the material concrete. Concrete repair experts are entrusted with the technical aspects, and as considerable knowledge exists on concrete durability and repair techniques, it seems suitable.

However, evaluating concrete conservation practice, a loss of cultural-historical values can often be encountered (Fig. 2). The question arises if this is only

Figure 1. Years of neglect often lead to increased deterioration, complicating conservation and endangering values. (Jospeh Lemaire Sanatorium, Belgium, Brunfaut, 1937).

Figure 2. The visual impact and the extent of loss of original material due to repair are often not considered. (Fort Bezuiden Spaarndam, 1901, part of the UNESCO World Heritage Site Defence Line of Amsterdam).
due to technical problems or if there are more fundamental, underlying problems. As the critique is the loss of values, whose preservation is a key issue of heritage care, a closer look is required in order to understand whether or not these values are integrated in the concrete conservation process and if it can be determined where and how they are ‘lost’.

In this research, the phase of the survey of the state of conservation was analysed by means of case studies and literature. As surveys are usually carried out by concrete repair experts, the backgrounds and aims of conservation and repair were studied, too. As a conclusion of this research, standard surveys are not suitable for conservation as their aim differs from conservation aims. Instead, a survey for conservation should integrate the values of the monument and their correlation to the existing fabric and its condition.

In this paper, the backgrounds and aims of the different approaches (repair and conservation) will be explained and shown that an integration of values in a survey is possible with a multidisciplinary approach. Examples for the identification of possible values during a survey illustrate that their integration in the conservation process is feasible.

2 BACKGROUNDS AND AIMS

2.1 Repair

The main motive for repairing concrete, and therefore for research as well, is to maintain or improve a structure or its function. Lately, in connection with sustainability, there is a shift towards integrating maintenance and improving the service life of the structure. Examples for the objectives and options of concrete repair are described in the European Pre-standard ENV 1504-09 General principles for the use of products and systems, where criteria for the choice of a repair approach, beside the structural performance, are the service life, economical issues and the possibilities of maintenance. The repair options go from no intervention to downgrading the structure, repairs, protection to demolishing. It offers principles and methods to treat the defects in concrete, distinguishing between defects in the concrete and defects related to reinforcement corrosion. The aim is to improve or restore mechanical, chemical or physical properties.

2.2 Conservation

Monuments are preserved because of their significance and are important artifacts which connect a society with its history. Their preservation, including the preservation of their values and their authenticity, is one of the key issues of heritage care. International guidelines (e.g. the Charter of Venice, 1964) can be consulted for conservation principles. One important aim is to preserve places of cultural significance with their history and meaning for ‘present and future generations’ (Australia ICOMOS 1999). The variety of authenticity of cultural heritage is understood in the Nara Document on Authenticity (ICOMOS 1994) in ‘artistic, historic, social, and scientific dimensions’.

3 NEED FOR HOLISTIC SURVEYS

As concrete heritage is part of the cultural heritage, the conservation principles are valid for concrete conservation, too, and an integration of these principles is necessary for a transition from concrete repair to tailored concrete conservation. However, awareness that concrete can be a material that needs conservation is still scarce. This is amongst others reflected in the small number of publications addressing concrete conservation (e.g. Macdonald et al. 2007, Macdonald 2003, Müller et al. 2004, IFS 2004).

As guidelines for an actual concrete conservation task do not exist, it seems logical that concrete repair standards are followed, which do not integrate conservation aims. Yet to improve the quality of concrete conservation, the common approach has to be subsequently adapted to the demands of conservation principles. As a start, the values of the concrete heritage have to be identified and integrated. However, it is not as simple to assess objectively the cultural-historical value of a material/building as it is to determine its technical condition; here lies one of the pitfalls of (concrete) conservation. Nevertheless, the values must be determined and understood by the involved parties for a sound decision-making in the conservation process.

Furthermore, the correlation of values, the existing fabric, and the state of conservation has to be determined and integrated in the choice of a repair technique. Only with a sufficient understanding of this correlation, the conservation aims (preservation of values) and the properties of possible conservation techniques can be formulated. Otherwise, a chosen approach might be technically sound and fulfil the demands of repair standards, yet be risky for values, whose perseverance was the initial point of the conservation process.

A universal answer to which values of the concrete heritage are at risk cannot be given due to the fact that values differ from building to building and from culture to culture. Also the meaning of the concrete for each building differs, and therefore the characteristics of the values (Heinemann 2007). Yet what often can be encountered is the loss of values which are connected to the original concrete or its appearance, as the authenticity of the material or aesthetical properties of concrete are not part of standard surveys.

The survey of the state of conservation is of utter importance for the preservation of values, as here,
the values are brought for the first time in direct connection with the existing fabric. Only if the correlation between value, original fabric, state of conservation and impact of the conservation technique is fully understood, a sound decision can be made. Therefore, a survey should be understood as a fundamental requirement for a conservation process. Potential conservation techniques can only be reviewed critically on their impact on the values, when the correlation between values and with the building and material is fully understood. To achieve this, a survey needs to integrate both technical aspects and cultural-historical aspects and to evaluate their dependency. Otherwise, there is the risk that preservation of values is, intentionally or unintentionally disregarded in the remaining intervention process.

4 REQUIREMENTS FOR A HOLISTIC SURVEY

A survey in line with the aims of concrete repair focuses on defects and structural and economic aspects dominate. According to ENV 1504-9, an assessment of concrete requires as a minimum following data: the present condition, the original design approach, the environment the structure is exposed to, the conditions during construction, the history of the structure, the use, and the requirements for future use. These aspects are of relevance for historic concrete buildings, too. However, a survey for historic concrete buildings has to go further and integrate the cultural-historical significance of the concrete/building. This is needed for a sound basis for the following steps of the conservation: the formulation of the conservation aims and the choice of an appropriate approach, balancing the preservation of values and technical possibilities. Depending on the extent of the conservation project, the depth of a survey of a historic concrete structure must be determined by concrete conservation experts. Yet as part of a preliminary investigation, the possible of values attached to the original concrete should be investigated. As a minimal requirement the surface, the construction method, historical background, and if possible the composition, should be investigated from a holistic, conservation point of view.

4.1 Surface

The surface influences the appearance of a building and the feeling of a location. It is usually the result of the interaction of design, materials, construction, location, and history of the building (Fig. 3). A sound documentation of the surface is not needed for a repair, as the appearance of the surface does not influence the structural performance. In case of a standard repair of a surface (e.g. patching), the physical compatibility of the repair material and the surrounding concrete is of importance, whereas the visual impact of a repair technique is secondary. As it is likely that the surface of a monument influences the values or the authenticity of a building, a survey for conservation should describe and document the surface, including at least following properties: surface finish (e.g. raw, smooth, structured, washed-out, coated), color (more precise than ‘concrete grey’), properties of visible aggregates and indications of former interventions.

4.2 Composition

An analysis of the composition of the concrete is helpful to gain information on historical and scientific values of the original concrete as the composition of concrete changed since the invention of synthetic concrete in the 19th century, reflecting the increasing knowledge and experience. The historic concrete can
Figure 4. Standard patching does not consider an adaptation of color, texture or use of coarse aggregates and can cause a loss of the details of the exposed concrete. (Sculpture in Delft, the Netherlands by Carel Visser, 1966).

have a value as an artifact, representing a certain period in the development of concrete and its authenticity can be evaluated, for example with a petrographic analysis (Fig. 5). Additionally, such analysis can also give better insight into damage causes, which is valuable for the choice of an appropriate repair technique, helping to preserve a monument for future generations.

As taking of samples is destructive, the need and location of samples must be well considered. In a cultural-historical context not only the visual impact of the core-taking should be considered, but also the value of the material, balancing possible information and the loss of original material.

4.3 Construction methods

Contrary to traditional materials, concrete is not associated with the value of traditional craftsmanship. Nonetheless, looking at the development of construction methods, concrete underwent changes, from labour intensive manual work to industrial mass-production. This reflects changes of production and society in the 20th century and the construction method is often connected to the social background of the construction time. The needs of society influenced the choice of construction materials, as for example in times of housing shortage, where mass-produced concrete prefab elements offered solutions. Therefore, the original concrete can be an artifact with social-historical value.

An understanding of the construction method can explain properties of the concrete, too. For example, the quality of manually compacted concrete can be poorer, as voids and a higher porosity are more likely, making the concrete more vulnerable to ingress of harmful agents (Fig. 6). How far characteristics of a construction method are part of the authenticity of the material should be evaluated as part of the survey of the concrete building.
The new (structural) possibilities of concrete influenced Modern architecture; here the Van Nelle factory in Rotterdam (van der Vlugt & Brinkman together with the civil engineer Wiebenga 1925–31).

4.4 Historical context of the design rules

The history and theory of design rules can still be traced in countless original publications, yet the existing concrete buildings are the tangible artifacts, representing former ideas and possibilities of design (Fig. 7). One has to remember that the possibilities of structural design and the calculation developed during time. Initially, concrete structures imitated traditional structures with main and secondary beams. The potential of reinforced concrete, such as wider spans, beamless floor constructions or shell structures, had to be discovered first. In this context, the initial variety of patents for reinforced concrete structures and the related design rules (Newby 2001) are part of the technical history of concrete and should be respected during conservation.

4.5 History of the building

In technical surveys, the history of the concrete structure is included, yet understood in the form of known overloads or former structural interventions (e.g. ENV 1504-9). For conservation, the history of construction, use, and interventions are important sources to determine the value of the building or of its elements, and as “valid contributions of all periods to the building of a monument must be respected” (ICOMOS 1964), historical information is required to formulate the conservation aims. Therefore, the definition of the history of a building has to be broadened.

A survey also provides the opportunity to evaluate the performance of former interventions and repairs. Hereby, insight into their long-time behaviour and their impact on the original concrete in situ can be gained which can help to find an appropriate approach. As it is usually intended to preserve a monument for an increased lifetime, information such as the durability of the former repair technique or its compatibility with the original concrete can be used to improve future repair cycles.

4.6 Documentation

A good documentation and long-time accessibility of a survey, including documents, drawings, photos, test results, and samples taken are seldom done. The conservation process, including research, can be facilitated and improved, when documents of former conservation processes (e.g. used materials, encountered obstacles, and reasons for decisions) can be consulted. A good documentation of the applied repair techniques is important, too, as they become a part of the building and a repair of the repair is to be expected.

In a non-historical context the increasing loss of original material with each repair cycle might be acceptable, but for historic concrete a high loss of original material can mean a high loss of values. By knowing the applied techniques, information on their properties can be gained easier. The data can be helpful to understand if damage occurred due to a failure or incompatibility of the repair technique, or to integrate the properties of the prior repair material during the next repair cycle.

Furthermore, the documentation itself is valuable as an evidence of the state of conservation of a building before intervention. In cases, when the original building/material is destroyed or destructive interventions are inevitable, the related values can still be consulted.

5 CONCLUSIONS

Cultural-historical values of concrete monuments are often lost because there is not enough awareness of them and because of an approach where they are neither identified nor integrated. Due to the recentness of the field, suitable guidelines and knowledge for a conservation approach do not exist yet, and there is a dependence on a repair approach, which differs in its aims. To achieve a shift from repair to conservation, possibilities to integrate the additional demands of heritage care must be found.

Holistic surveys, which include and connect technical and cultural-historic aspects, offer a chance to integrate values from the earliest phase on and can provide a sound basis for decision-making. For conservation, standard concrete surveys are not sufficient as they only focus on structural and economical aspects. A holistic survey, however, can help to determine values of the monument and their correlation to the material, creating a sound basis for the conservation process.

The determination of the properties and values of the historic concrete such as its composition might not have an influence on the performance of a possible
repair technique, but the value of the material should have an influence on the conservation aims and how far material loss during a repair is acceptable. To achieve this, it is necessary to gain knowledge on the properties, history and values of concrete. Values can neither be determined if a building/material and its context are not comprehended nor can they be preserved if the material and repair techniques are not understood.

In practice, concrete conservation experts are rare, as heritage care stakeholders are trained for traditional materials and buildings from earlier periods, and concrete repair experts are trained for structural/material aspects. A collaboration of both fields is needed, using their strengths and experience, to develop guidelines and reference works for concrete conservation.

With sufficient knowledge, possible repair techniques can be reviewed critically if they are not only technically compatible but also on their impact on values. With sound reasons why certain techniques are not advisable for conservation projects, an impulse for the development of appropriate conservation techniques can be given. On the long-term, a tailored concrete approach should be possible, helping to preserve the youngest part of our built heritage.

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REFERENCES