

Newsletter no. 2

CONSErvation of 20th century concrete

Cultural **Heritage** in urban changing environments

→ 7TH WTA COLLOQUIUM
– MAINTENANCE OF CONCRETE
BUILDINGS - JUNE 10TH, 2022,
DELFT (THE NETHERLANDS)

Strategies for the Conservation of Historic Concrete Structures

Concrete heritage buildings from the 20th century are at risk, due to the absence of recognition of the historic values of these buildings as well as to the lack of knowledge of the specific characteristics of historic concrete structures. Frequently, solutions developed for repair of contemporary structures are applied to historic concrete buildings, resulting in interventions which are neither compatible nor durable. The scope of the lectures ranges from the possibilities of new investigation methods and procedures of condition assessment, from the application of innovative materials to the use of heritage precast concrete elements. In addition, main results from relevant case studies are presented. The Colloquium aims at providing building owners, employees from planning and engineering offices, construction companies, concrete experts, architects and representatives of

authorities, with the latest developments in the field of conservation of concrete historic buildings, as resulting from practice and from international research projects. On behalf of the organizing team, the members of WTA – International (TC5 Concrete) and of the JPI-CH CONSECH20 project, we cordially invite you to the 7th Colloquium WTA – Strategies for the Conservation of Historic Concrete Buildings and Structures.

Please, visit the website for checking the program and the guidelines on how to participate: <https://www.wta-international.org/de/veranstaltungen/7th-wta-colloquium-maintenance-of-concrete-buildings/>

Download the flyer: [Flyer_7thWTA_Colloquium_2022](#)

EDITORIAL ←

In the second newsletter of the [CONSECH20](#) project (CONSErvation of 20th century concrete Cultural Heritage in urban changing environments), you will find the latest news related to the reinforced concrete heritage case studies selected in the Czech Republic, Cyprus, Italy, and The Netherlands.

Focus is given to the 7th WTA Colloquium that will take place on June 10, 2022, and in which many results of the CONSECH20 project will be presented. The colloquium will be devoted to the latest developments in the field of conservation of concrete historic buildings, as resulting from practice and international research projects.

The main results of the research assessment of relevant project case studies are presented and digital storytelling for engaging communities in promoting heritage and fostering partnerships with cultural heritage institutions.

An interactive online platform containing all the data collected from the case studies selected in the project is currently being finalized.

Finally, a selection of articles published during 2021 is showcased.

Due to the constraints related to the Covid-19 pandemic, the project has been extended until mid-2022.

Cristiana Lara Nunes, Project coordinator

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→ CASE STUDIES

Nearly 50 case studies have been selected in Cyprus, Czech Republic, Italy, and The Netherlands. The original selection was based on representative architectural styles, materials, construction systems, decorative techniques, aesthetic quality, and damage mechanisms. At least two buildings from the original list of case studies in each country have been selected for in-depth analysis about their state of conservation and for monitoring during the project duration to aid in the formulation of intervention proposals. The following case studies in need of intervention were selected in each country. The report including the in-depth assessment of all buildings can be downloaded via the following link: [Case_Studies_Report](#)

→ BARRANDOV DIVING TOWER (CZECH REPUBLIC)

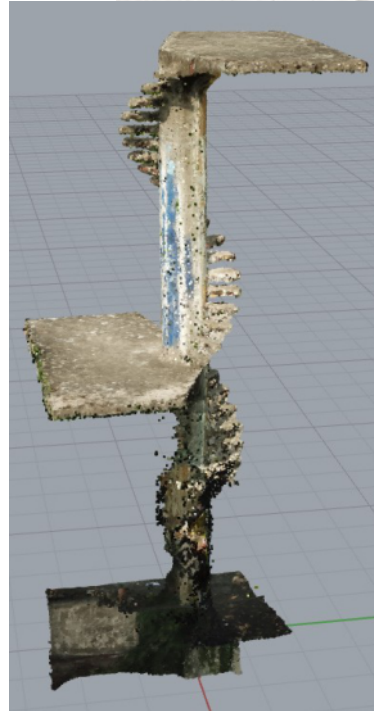
The Barrandov swimming stadium, located in the outskirts of Prague, is an iconic sports modernist construction in the Czech Republic designed by the architect Václav Kolář and built in 1930 on the left bank of the Vltava river. The dominant feature of the stadium is a concrete functionalist diving tower, which became an emblem of water sports in the country. The stadium was in use from its inauguration in 1931 until 1955. In 1993, the complex was declared a cultural monument. The swimming pool and the diving tower are currently in a state of ruin and surrounded by overgrown vegetation. However, it is accessible to the public and, during summer, it has been used as a place for cultural events.

The Barrandov diving tower has been selected as a case study for analysis within the project because of its historical importance, poor conservation condition, and significance to the local community and tourism.

The assessment of the structure within the project began with the investigation of the available archive documentation. The Archive of Architecture of the National Technical Museum (NTM) provided a valuable collection of documents from the constructor of the stadium, including parts of the executive project drawings. However, the documents were often incomplete; in many cases, only fragments were preserved.

The lack of drawing documentation of the Barrandov tower asked for a new survey. Close-range photogrammetry was chosen to overcome accessibility limitations. A drone was used to shoot over 600 photos to document the state of the inaccessible parts of the structure and used for constructing the photogrammetric 3D image.

The executive-project drawings and the photogrammetric survey were the primary sources for reconstructing the original geometry.



Point cloud 3D image of the Barrandov diving tower.



3D reconstruction of the original state of the Barrandov diving tower.

The condition of the structure was first done by visual inspection, and the description of damage types was registered with the aid of the [MDCS](#) tool for concrete damage assessment as well as the [MONDIS](#) mobile tool for onsite inspection.

The entire concrete surface of the diving tower was covered with a finishing coat. Samples of the finishing layers collected from the pillar were investigated with high precision analytical methods (e.g., Scanning electron microscopy, Raman Spectroscopy). The analysis showed that the lower half of the coating stack is made up of lime-based coatings, the upper half contains aluminosilicates (clay minerals) and gypsum.

← THE FENIX (THE NETHERLANDS)

The Fenix, a former warehouse, was built in 1920 in the historic haven of Rotterdam as a storage place for the North America Line. It was selected as a case study for in depth investigations being an example of a building under restoration, to be transformed (into a cultural center). The building has a high social and historic value, in terms of concrete fabrication and building techniques used.

The north side of the Fenix was destroyed by bombing in 1944. Damaged by a fire in 1947, the building was split into two parts in the 1950's and partly reconstructed.

The columns supporting the structure showed local spalling, cracks and corrosion of the reinforcement, especially on the South side. The South façade had been furnished with a render layer in 1980 and a finishing layer of Kristal Cement Granite.

The research mainly concerned the quality of the construction and the state of conservation of the building, and it focused on 16 external and internal columns built in the 1920's and in the 1950's. The aim was to assess the presence of carbonation-induced corrosion. Besides, the risk of damage to the structure due to flooding was calculated and proved not relevant.



Fenix, former storage place for the North America Line, Rotterdam, The Netherlands (Photo M. Olmeda)

NDTs (e.g. profoscop, rebound hammer, etc.) were used in the investigation, next to powder drilling - sampling. The results showed that the cover layer of the exposed 1920's columns was originally too thin; as expected, the carbonation depth found in the old columns was higher than the depth reached in the 1950's columns. The reinforcement used in the two periods is comparable (only the spacing of the ties differs). The compressive strength values of the 1951's columns are only slightly higher than the 1920's.

The moisture content measurements (gravimetric method) showed no significant difference between the exterior columns from 1920 and 1951; the interior columns tend to have a higher MC than those of the 1920s. Chloride was found in small amounts and - although pitting corrosion had been found locally - was not considered a risk factor.

Summarizing, it has been concluded that the quality of the concrete (Portland cement used) exceeded the quality standards of the times. The carbonation induced corrosion on the exposed columns is the main cause of spalling and cracks in the building. The higher carbonation depth of the external South columns is probably due to the old construction techniques (e.g. less compaction). Together with the cover layer being originally too thin, this induced the corrosion of the reinforcement, leading to damage.

THE HENNEBIQUE GRAIN SILOS (ITALY)

The Hennebique grain silos are considered one of the most striking reinforced-concrete buildings of the 20th century. Strategically located on the waterfront of Genoa's Old Port, the structure is facing the sea and the historical centre of the city.

The building of the Silos of Genoa underwent various construction phases in its life that led to its current conformation. The first reinforced-concrete structure, which came into operation in 1901, was built by the Porcheddu Company, the first Italian company concessionaire of the Hennebique system for Northern Italy. At that time the building consisted of only the central body and the first two storeys of the wings. Only after a few years, in 1906, the expansion was carried out to obtain additional capacity. The contractor Ferrobeton, a subsidiary of the German company Wayss & Freytag and concessionaire of the perfected Monier patent, took over to carry out these works. In the period from 1924 to 1929 Ferrobeton was always commissioned to carry out further extensions, the last ones before the post-war makeover.

Operational until the end of the 20th century, the building is now in a state of neglect, even if structurally it does not show any significant signs of fragility. The deterioration of concrete structures can be attributed to two factors: intrinsic



Hennebique grain silos in Genoa, Italy (Foto: L. Pedrazzi, 2018)

characteristics of the material and environmental conditions. At that time construction techniques in reinforced concrete were still underdeveloped; the mixture used contains round and large aggregates that give the material physical characteristics that favour degradation phenomena.

The survey and analysis of 2018 have made it possible to see the increase in the degradation of the building compared to data dating back to 2013.

The survey of the architectural structure was carried out using topographic instruments, laser scanners and 360 panoramic cameras to capture panoramic images. With the aid of the detailed photographs, a dynamic virtual path was created across the building that provides immersive panoramas.

In 2018 a structural study was carried out to evaluate the building, considering both the minimum necessary and maximum allowed demolition. This study also contains an assessment of the compliance of the building with the currently applicable building regulations regarding seismic requirements.

In disuse since the 1980s, today these silos have received full planning permission for the conversion, preserving the structure's historical and technical features, to integrate the building in the redevelopment of Genoa's old port. The outcomes of the research will be made available to companies who submit an expression of interest in the concession.

MELKONIAN EDUCATIONAL INSTITUTE - HEADMASTER'S MANSION (CYPRUS)

The Melkonian Educational Institute was originally built by the Melkonian brothers to operate as an orphanage/boarding school for Armenian orphans, following the Armenian genocide. The architect was Armenian Garo Balian. The construction of the building took place between 1924 and 1926. The Melkonian Educational Institute has a great social and cultural importance for the Armenian diaspora, whilst it is also architecturally significant. The complex comprises of two identical rectangular buildings, with simple repetitive window openings and arches supported on pilasters at each entrance, and what has come to be known as the Headmaster's Mansion. The three buildings, as well as the 'Forest of Remembrance' in front of them, were listed in 2007. They are believed to be the first reinforced concrete design buildings in Cyprus, and the only ones built using the proprietary Hennebique system.

The overall state of the three buildings, including the Headmaster's Mansion, is rather good, despite the fact that these have been abandoned since 2005. In general, in the Mansion there are no visible cracks on the reinforced concrete elements from either service or seismic loads. The pathology of the building was recorded during several site visits, while for its seismic assessment, the following procedure was adopted:

1. verification of the geometry of the structural elements and reinforcement detailing with regards to the original plans (use of rebar detector),
2. evaluation of the material properties through in situ non-destructive (Schmidt hammer) and laboratory destructive tests (core extraction from masonry and concrete elements for testing the porosity, capillary water absorption, compressive strength of concrete and stone; fractionation and XRD mineralogical analysis of the mortar),
3. simulation of the building,
4. assessment of its capacity with time-history analysis.

The analysis performed showed that the reinforced concrete elements are not properly detailed, as they lack stirrup detailing. This may potentially lead to shear brittle failures in a future seismic event. They therefore need careful retrofitting and strengthening to withstand future seismic actions, while maintaining the original fabric, dimensions, detailing and materials, and serving their loadbearing function according to the original proprietary design.



Melkonian Educational Institute - Headmaster's Mansion, Nicosia, Cyprus

STORYTELLING VIDEOS

Each consortium partner has developed a digital storytelling video for engaging communities in promoting heritage and fostering partnerships with cultural heritage institutions. Following is a short description of the contents of the videos that will be released soon.

Concrete heritage architecture in the Czech Republic

The short popularisation video intends to present the reinforced concrete as a construction material of many valuable historic buildings. The progressive construction technique spread in Czech lands sooner than someone may think, in the first decade of the 20th century. Five different buildings were chosen, from the first reinforced concrete frames to the 1940's shell structures, to show the development of the technique. The selection of the buildings reflects also the variety in typology and architectural expression the reinforced concrete is able to serve. A commentary about the specifics of the restoration of this modern but already historic material is included.

You can watch the video online using the following link:
https://www.youtube.com/watch?v=RRJtn-Ria28&ab_channel=%C3%9ATAMAV%C4%8CR

A plea for reuse of 20th century concrete buildings: Cases from the Netherlands

This short movie underlines how buildings in historic concrete (1890's - 1960's) - factories, warehouses, schools, etc. - are beautiful, sustainable and belong to our heritage.

Interviews with architects, contractors and users of some of the case studies considered in this research show that old concrete buildings can be effectively re-used, keeping their original function or being adapted to a new one. All actors agree that the (adaptive) reuse of these buildings should be technically appropriate and respectful of their aesthetical, historic and social values. Change as little as needed and preserve the original fabric to link the past with the future!

You can watch the video online using the following link:

<https://www.youtube.com/watch?v=gYWmZB5fQps>



Reuse of historic concrete buildings: The case of the Nicosia Old Municipal Market

This digital story explores the importance of the Nicosia Old Municipal Market through both its contribution to the area as a social space, as well as in general architectural terms. It does so by using archival material, as well as interviews carried out with stakeholders from the competent authorities, architects and old users of the space. The documentary ultimately wants to raise questions regarding the role of such spaces and challenge the way decisions are made over their future.

You can watch the video online using the following link:

<https://youtu.be/nxKoT5WH4mo>

INTERACTIVE ONLINE PLATFORM

The project online platform is organised in three linked applications:

1. web display and search front end;
2. web proposal app;
3. database frontend for engaged and identified users.

The public web display has several search panels that become filters after the first level choice: map display, building types/usages, time based search, author/builder, geographic search and map.

The form shows a fairly usual display with author, place, chronology, building features, structures and decay specifications. If the record corresponds to a proposal only, it will show an essential profile, while the presence of in-depth survey will give access to the extensive report.

The web proposal form asks for a contextual registration and only collects some basic information on the proposed database entries. It is publicly accessible and is a way to invite new users/institutions to join the platform. The idea is to stimulate institutions so to have peer reviewed contributions and more in-depth reports on the added buildings.

A complete database frontend completes this toolset. This will be accessible on another server and domain to registered and approved users to deal with the complete dataset. It's a relational database which is extensible on further domains. A simple API lets other sites include research data exposed on a secure interface.

All documents from ConsecH20 working packages will be served on web as static files.

SELECTION OF PUBLICATIONS IN 2021

Following is a short description of articles published during 2021. The open-access publications can be downloaded via the provided links:

Pardo Redondo G., Franco G., Georgiou A., Ioannou I., Lubelli B., Musso S.F., Naldini S., Nunes C., Vecchiattini R. (2021) *State of Conservation of Concrete Heritage Buildings: A European Screening*, in 'Infrastructure' as part of the 'Special Issue Durability and Degradability of Construction Materials' Aug. 2021, available online:

<https://www.mdpi.com/2412-3811/6/8/109>

The state of conservation of historic concrete buildings in Italy, the Netherlands, Cyprus, and the Czech Republic was assessed using a clear terminology of damage types and measurable parameters. The most recurrent types of damage showed to be connected to corrosion and moisture-related processes. Interventions to hinder the

development of damage often include the application of renders to the concrete. Proper maintenance and continuous use of the buildings are beneficial. It would be interesting to carry out a similar research, based on the developed methodology, but broader and involving buildings located in other countries.

Franco, G. and Musso, S.F. (2021) *The fate of the 20th Century Heritage. Research and Actions*. ANUARI d'Arquitectura i Societat, (1), pp.240–261. available online: <http://dx.doi.org/10.4995/anuari.2021.16227>.

20th Century Architecture is an Heritage at risk, mostly caused by abandonment, degradation, underestimation. Nevertheless, the increase of interest and expansion of Heritage leads us to question the values that even the most recent architecture acquires, and therefore, its eventual need of protection. There is a need of a process of understanding and of selection, based on criteria shared by the largest community. This was the main goal of national and international researches here presented concerning the architectural production of the 20th Century. The observation of single constructions and urban complexes, that are very close to us in time, leads to reflect on their meanings.

Pardo Redondo G., Naldini S., Lubelli B. (2021) *Decay Patterns and Damaging Processes of historic Concrete: A Survey in the Netherlands*, Proceedings of the (online) XII Intern. Conference on Structural Analysis, Barcelona (SAHC), 29 Sept. - 1 Oct. 2021, P. Roca, L. Pelà and C. Molins Eds., pp. 105-116

The experimental character of historic concrete buildings demands a correct approach to their conservation. A survey in the Netherlands showed that although old, some buildings are in a good state conservation and resilient while others of comparable age are in need of restoration. The research is based on an initial screening leading to the selection of 15 cases (criteria: age, state of conservation and type of ownership). History and materials were studied. Templates were produced to identify types of damage, and their extent and severity. The data were analysed and discussed to provide further clarification of the degradation of historic concrete. available online:

<https://research.tudelft.nl/en/publications/decay-patterns-and-damage-processes-of-historic-concrete-a-survey>

Georgiou, A., Georgiou, M., Ioannou, I. (2021) *Seismic Assessment of Historic Concrete Structures: The case of Pedieos Post Office in Nicosia, Cyprus*, Transdisciplinary Multispectral Modelling and Cooperation for the Preservation of Cultural Heritage, TMM-CH2021, Athens, 12-15 Dec.

Historic reinforced concrete structures built in the 20th

century are rarely listed as monuments, despite reflecting the past and usually displaying a multitude of values. The main problem with historic concrete structures is their lack of seismic detailing and design, which renders them dangerous for public use, and prone to collapse and permanent loss, especially in countries located in seismic zones. This paper examines one of the culturally significant historic concrete structures of Cyprus, the Pedieos Post Office, located in Nicosia. The building is not currently listed; yet, it continues to serve the community since its construction in 1964. The paper assesses the seismic capacity of the structure by means of comparing various assessment analysis methods.



Municipal Market, Athienou (Cyprus)

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The partners' contacts can be found in the following link:
<https://consech20.eu/contacts/>