From Deterioration to Revival
Approaches to the Conservation of Plastic Buildings

Tyurkay, Ashal; Pottgiesser, Uta

Publication date
2022

Document Version
Final published version

Published in
DOCOMOMO Journal

Citation (APA)
Tyurkay, A., & Pottgiesser, U. (2022). From Deterioration to Revival: Approaches to the Conservation of Plastic Buildings. *DOCOMOMO Journal*, *2022*(66), 75-83.
https://docomomojournal.com/index.php/journal/article/view/537

FROM DETERIORATION TO REVIVAL

Approaches to the Conservation of Plastic Buildings

Ashal Tyurkay, Uta Pottgiesser

ABSTRACT: The four Futuro case studies *(Futuro No. 000, Corfu-Futuro, Donaldson-Futuro, Munich-Futuro)* presented in this journal document conservation approaches to plastic buildings and elements – in this case, glass-reinforced plastic (GRP) sandwich panels. They contribute to the definition of general conservation approaches, and at the same time reveal the knowledge gaps related to their individual histories and the necessity of a framework for managing interventions that are suited to GRP sandwich panels. The history and physical fabric of the selected Futuros, and the interventions done are compared in this article. The comparative analysis demonstrates how important it is to integrate a framework for adequate research and documentation into the conservation processes, in order to understand each building's significance and plan the interventions accordingly. The arguments deduced from the analyses demonstrate which factors differentiate the conservation solutions of the case studies in order to reframe the Futuros' expected life-span into a managed life-cycle.

KEYWORDS: Futuro, deterioration, Conservation Management Plan (CMP), comparative analysis, plastics

INTRODUCTION: The scarcity of conservation methods and processes for 20th century built heritage compared to built heritage of previous eras manifests itself as a critical issue according to the Madrid-New Delhi Document.[1] Early plastic buildings–represented in this paper by the Futuros–are, in particular, at risk to deteriorate and disappear due to lack of awareness and recognition. The four selected cases from the Netherlands, Greece, the United States and Germany, are significant examples of modern architectural expression and of experimental construction from post-WWII [FIGURES 01 - 04]. They witness an iterative construction process using innovative forms, materials or joints in connection with traditional building methods and techniques.[2]

An informal survey carried out in preparation of this paper showed that out of more than 100 Futuros there are about 60 left worldwide today [Voigt, Pamela, "The Futuro – History, Design and Construction in Finland and the USA" Docomomo Journal 66: 2022/1, p. 40-49]. Some have been relocated and dismantled, but

01 *Futuro No. 000* (prototype) before conservation in 2003 exhibited outside in the Centraal Museum in Utrecht. © K. Vermaas, 2003

02 The *Corfu-Futuro* house installed in Limni, Corfu island. © D. Joannou, 2014

03 The *Donaldson-Futuro* is placed outside and serves as a private guest house. © P. Kozal, 2018

04 The *Munich-Futuro* in Witten (Germany) before transportation to Munich. © BAKU, P. Voigt, 2016.

only few have been restored.[3] All Futuros compared here were designed and produced in the late 1960s and had periods of progressive deterioration, related to relocation and changed ownerships. Most of them were dismantled and reassembled several times, exposed to different environmental conditions and used for different functions. These events explain different types and levels of deterioration to their glass-reinforced plastic (GRP) shells, which required different intervention approaches.

Although the use of GRP sandwich panels as an exterior shell and for structural purposes was already tested, the Futuros are considered to be the first multiple-produced plastic buildings.[4] Neither had the service life of GRP sandwich panels been accurately estimated, nor its behavior under long-term exposure to varying environmental conditions. Due to uncertainties about the production and maintenance processes as well as missing information about the types and causes of deterioration, combined with the unprecedented uses of GRP panels, no conservation procedures for Futuros and plastic buildings in general have been developed and established. The four accompanying case studies of Futuros may offer material to put forward a method for study and evaluation.

CONSERVATION PHILOSOPHY AND INTERVENTION CATEGORIES

Ethics of conservation have been debated over the years and four criteria have been internationally recognized in the Charters: minimal intervention, minimal loss of fabric, reversibility, legibility of new work.[5] The timelines in this article indicate all the conservation activities in each Futuro's lifetime and how these criteria are met. The timelines also aim to inform decisions on the selection of the necessary materials and techniques for future interventions, thus supporting the development of a conservation policy. In order to define the extent of changes and interventions in line with the ethical criteria from the Charters, the following intervention categories are used: restoration, rehabilitation, replacement.[6]

- Restoration: the act of returning an object to a state of particular earlier period by removing features from other periods and reconstructing missing features with minimal introduction of new material.
- Rehabilitation: the act of improving performance or introducing a compatible new use through repair, alterations, and additions while retaining historical and cultural significance.
- Replacement: the act of removing severely deteriorated materials or features and substituting them with in-kind or visually similar materials.

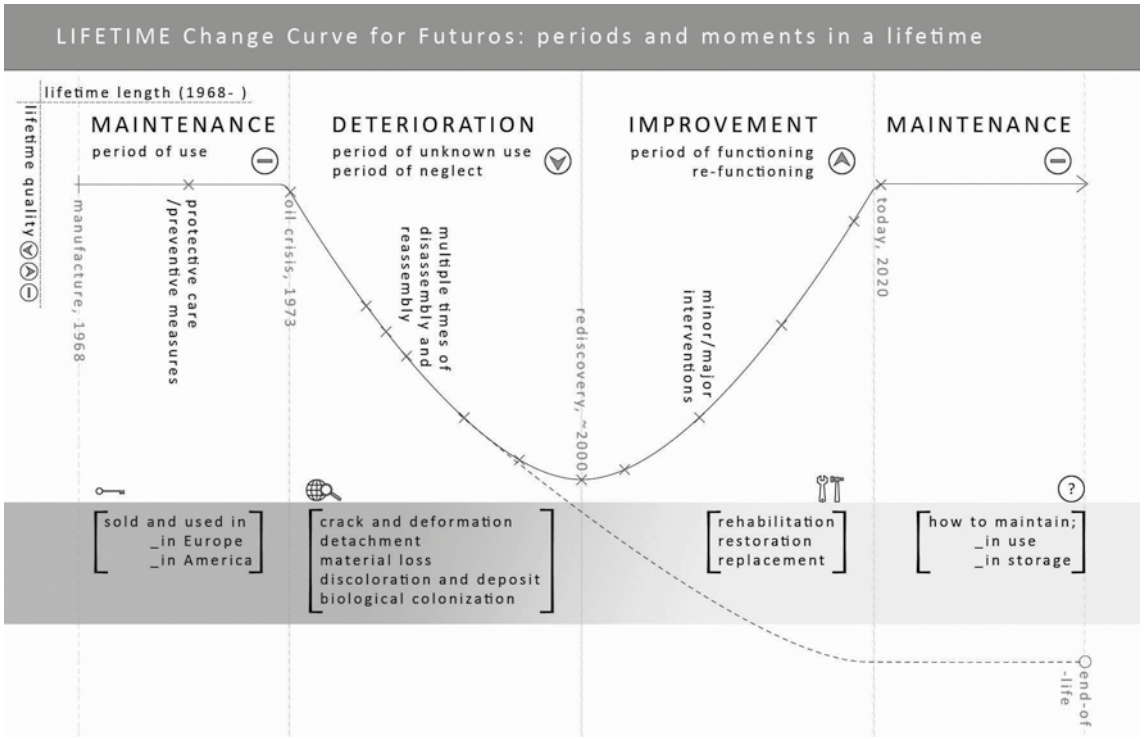
Criteria and processes of conservation could be applied to the lifetime of the Futuros [05]. Taking the manufacture or creation date of the Futuro as the start of its life, the lifetime could be described, including maintenance, deterioration and conservation intervention (improvement).

METHODOLOGY

It is crucial to analyze the presented cases to identify the elements of significance according to the structure of Conservation Management Plans (CMP) which are developed as guidance and evaluation frameworks through a conservation process.[7] All models emphasize that understanding the value of an object by applying a significance assessment provides the basis for developing and implementing conservation and change management strategies to guide future interventions.[8]

This article collates the histories and interventions of the four Futuros described separately elsewhere in the journal. Finding comprehensive documentation of the four Futuros has clearly proved difficult,[9] so a comparative analysis has been established to better understand and visualize the history of the case studies and the evaluation frameworks for their conservation.

Sources of the significance assessment come from historical documentary evidence and from physical evidence in the fabric as-found.[10] Understanding the place and object as a whole enables the creation of a chronological sequence of surviving elements.[11] This article presents two timelines. The comparative history of each case is



05 The Lifetime Change Curve describes the periods and moments of deterioration and intervention. © Authors

presented in a historical timeline [Table 1] with key dates and actors of design/manufacture, use and interventions. The comparative history of construction and materials, with a chronology of damage and intervention is presented in the technical timeline [Table 2].

The data for the two timelines are collected from the case study articles in this journal by extracting, comparing and analyzing them and contacting the authors for additional information. The information on each case study is grouped focusing on deteriorations and interventions. The deterioration data are supported with findings and underlying causes, the intervention data are described within a step-by-step approach, differenciating the treatments concerning the exterior and the interior of the Futuros.

OWNERSHIP, USE, CONSERVATION APPROACH AND INTERVENTION

In this section the historical and technical timelines are further described. The Futuros are similar in design, form, material use and manufacture date—namely 1968. The evidence for their original production and their current conditions can be documented in most cases, whereas tracing the chronology of ownership, use and change is very difficult. The historical timeline [Table 1]) presents the chronological similarities or differences in ownership and use, the relative histories of the case studies with a "provenance" approach.[12] Use and ownership of Futuros include intangible values and documentary evidence.[13] Based on designation and type of ownership, the statutory system of heritage protection dictates specific legislative and constraints on the owners. Ownership affects also the balance between inherent needs of the place and owners' interests or benefits, including financial policies.

After being used by their first owners for a few years, all Futuros underwent a period of approximately 30 years where they faced the threat of becoming obsolete. Surprisingly, all presented Futuros were saved from complete deterioration or demolition towards the end of 1990s. With this rediscovery the Futuros found new owners and different functions at new locations, followed by different intervention approaches.

The "provenance" approach proved suitable for both, individual-owned and museum-owned Futuros, not only in terms of valuation but also for defining the conservation strategies. In fact, the conservation specialists have developed different solutions for their interventions because each Futuro has a different history of use and ownership. The *Donaldson-Futuro* is owned by a private individual (an architect) and is now used for living purposes. The *Corfu-Futuro* also belongs to a private individual (an art collector) but has a semi-exhibitory use with living purposes, being kept within a group of collected art objects in the owner's residential garden. *Futuro No. 000* and the *Munich-Futuro,* on the contrary, belong to institutions (museums) and are used as collection objects and thus solely for exhibition purposes. Three Futuros are exposed to the outdoor environment, only *Futuro No. 000* is kept indoors.

The record of use and ownership together with the interventions in relevance to time help to understand how and why the changes to Futuros have been managed in the way they were. The 50-year lifetime of the Futuros resulted in severe damage due to material decay and handling of components as well as undergoing several interventions. The collected data on deterioration and interventions are transferred into the technical timeline [Table 2] with a 'system approach' for each Futuro. The 'System approach' does

not only provide analytic understanding of the sub-systems of Futuros, but also illustrates the implementation of interventions recorded in the case studies. All elements other than structural and connecting components—shell, windows, partitions, furniture—are made of plastic and have undergone different treatments. For example, the interior and exterior surfaces of the shell are treated differently due to the shell's function of separating two environments (indoor and outdoor), and newly designated uses for the Futuros. Therefore, these elements are analyzed separately; the focus is laid on the exterior and interior GRP shell surfaces, and the windows.

Table 1 Historical timeline with key data on ownership and use of the Futuros.

FUTURO NO.000 - THE NETHERLANDS	MANUFACTURE	UNKNOWN/NOT DOCUMENTED PERIODS	REDISCOVERY AND PROCUREMENT	INTERVENTION	EXHIBITIONS AND STORAGE
	1968, Finland Matti Suuronen, Oy Polykem Ab ski lodge outdoor	**1968-1996, Finland** more than ten moments of dis-/re-assembling outdoor	**1996-2007, Europe** **1996, Vienna** exhibition **1997, Utrecht** exhibitions **2007, Rotterdam** exhibitions collection object indoor/outdoor	**2010-2011, Netherlands, Rotterdam** Lydia Beerkens, Samy Supply, Nikki van Basten, Poly Products BV collection object indoor	**2011** disassembled **2012** reassembled **2012 - Rotterdam, Netherlands** stored in pieces (disassembled) collection object indoor
CORFU-FUTURO - GREECE	MANUFACTURE AND TRANSLOCATION	PERIOD OF NEGLECT	REDISCOVERY AND AUCTION	INTERVENTIONS	USE AND INSPECTIONS
	1968, Finland Matti Suuronen, Oy Polykem Ab **1969, Belgium** under Belgium/Benelux license outdoor	**1969-1999, Belgium, Tildonk** remained at the same place outdoor	**1999, Belgium** saved from demolition P. Van Langendonck **2007, Luxembourg** exhibition **2007, Paris** auctioned off to Dakis Joannou indoor	**2008, France** Roman Touly at A.C.C.F. Chantier Naval **2009, Greece** Mitakidis-Michailos collection object & leisure space outdoor	**2010/2015/2019, Corfu, Greece** deteriorations; awaiting restoration collection object & leisure space outdoor
DONALDSON-FUTURO - USA	MANUFACTURE AND TRANSLOCATION	PERIOD OF NEGLECT	RESCUE AND PROCUREMENT	INTERVENTIONS	USE
	1968, US-PA Leonard Fruchter, Futuro Corp. Philadelphia **1969, US-CA** Stan Grau outdoor	**1969-2002, US-CA** used for naval training and architecture tours for a short time, then remained unused at a parking lot outdoor	**2002, US-CA** saved from demolition M. Wayne Donaldson transport in assembled state to San Diego Boat Yard (later Idyllwild) outdoor	**2002-2003, San Diego Boat Yard,** exterior intervention: San Diego Boat Movers and Planet Plastics, Corona **2004-2015, Idyllwild** interior interventions. M. Wayne Donaldson outdoor	**2009 - today, Idyllwild, USA** occupancy permit obtained weekend home outdoor
MUNICH-FUTURO - GERMANY	MANUFACTURE AND TRANSLOCATION	PERIOD OF USE	REDISCOVERY, 1ST PROCUREMENT AND INTERVENTION	2ND PROCUREMENT AND INTERVENTIONS	USE AND EXHIBITION
	1968, Finland Matti Suuronen, Oy Polykem Ab **1970s, Germany** ASV Stübbe, Vlotho outdoor	**1970s-2010, Vlotho** ASV Stübbe exhibition object & company boardroom outdoor	**2010, Witten** Charles Wilp Museum transport in assembled state **2010-2013, Witten** Interior interventions collection object outdoor	**2015, Munich** die Neue Sammlung – The Design Museum, Pinakothek der Moderne **2016-2017** Tim Bechthold with Pamela Voigt and SKZ: Das Kunststoffzentrum collection object outdoor	**2017 - today, Munich, Germany** die Neue Sammlung – The Design Museum, Pinakothek der Moderne collection object outdoor

Table 2 Technical timeline with comparison of deterioration and intervention data of Futuros.

		CONSTRUCTION AND VISUAL PROPERTIES OF SUB-SYSTEMS		NATURAL / HUMAN DETERIORATION FACTOR						DETERIORATION LEVEL AND CATEGORY					INTERVENTION MOTIVATION					INTERVENTION CATEGORY AND OUTCOME
		ORIGINIAL	CURRENT CHANGES	Atmospheric factors	Ageing and "time"	No use and/or maintenance	Handling and transport	Previous interventions	Vandalism	Crack and deformation	Detachment	Decay and/or material loss	Discoloration and deposit	Biological colonization	Preservation / Conservation	Materials decay	Safety / security	User comfort	Energy conservation	
FUTURO NO.000 - THE NETHERLANDS	GRP EXTERIOR	top/bottom: 8/8 panels GRP/PUR/GRP: 3/45/2 mm gelcoat: light blue	original							high										**Restoration** (2010-2011)
				•	•	•	•	•	•	•	•	•	•		•	•				Clean/polish gelcoat Repair with resin/fiberglass Inject resin/filler into voids Reinforce steps with plywood/polyester
	GRP INTERIOR	acrylic paint: purple	latex paint: purple							medium/high										**Restoration** (2010-2011)
				•	•	•	•					•	•		•	•	•			Clean/polish the surface Fill lacunas and old drill holes Repaint the entire surface
	WINDOWS	PMMA: double-layered double-curved seals: black silicone rubber	original							high										**Restoration** (2010-2011)
				•	•	•						•			•	•				Clean original rubbers Clean original PMMA panes
CORFU-FUTURO - GREECE	GRP EXTERIOR	top/bottom: 8/8 panels GRP/PUR/GRP: 4/xx/4 mm gelcoat: grey	varnish: transparent							high										**Restoration** (2008)
				•	•	•	•			•	•				•	•				Repair with resin/fiberglass
										medium/high										**Restoration** (2009)
				•			•			•	•	•			•	•				Remove flakes Repair with resin/fiberglass Apply grey primer and paint partially Varnish the entire surface
										high/medium										Based on investigations in 2019
				•	•					•	•	•		•						Awaiting **restoration**
	GRP INTERIOR	primer/paint: purple/grey	original							high										**Restoration** (2010)
				•				•			•		•	•	•			•		Remove flakes and wet carpet
										high/medium										Based on investigations in 2019
				•	•						•		•	•						Awaiting **restoration**
	WINDOWS	PMMA: double-layered double-curved seals: black silicone rubber	new seals							high/medium										**Restoration** (2008)
				•	•	•				•						•			•	Reshape openings Install new seals

Structure and content of the technical timeline allow for comprehension of the constructive and visual features of the initial design and the final condition at the same time, and give insight to specific deterioration states and interventions in between. Thus, all information is provided in a reason-result relationship. The timeline could be used as an inventory of as many case studies as possible which will highlight both, similarities and differences in intervention approaches.

The technical timeline covers tangible values of Futuros and describes the physical evidence which requires historical research as well as condition assessment of their fabric as-found. Historical research forms the baseline of information on construction and material configuration and how both changed over time. If the physical evidence of these changes was not recorded at the time the change was made, it could be identified and located by several assessment techniques such as stereophotogrammetry, digital recording tools and measurements.[14]

		CONSTRUCTION AND VISUAL PROPERTIES OF SUB-SYSTEMS		NATURAL / HUMAN DETERIORATION FACTOR						DETERIORATION LEVEL AND CATEGORY					INTERVENTION MOTIVATION					INTERVENTION CATEGORY AND OUTCOME
		ORIGINIAL	CURRENT CHANGES	Atmospheric factors	Ageing and "time"	No use and/or maintenance	Handling and transport	Previous interventions	Vandalism	Crack and deformation	Detachment	Decay and/or material loss	Discoloration and deposit	Biological colonization	Preservation / Conservation	Materials decay	Safety / security	User comfort	Energy conservation	
DONALDSON-FUTURO - USA	GRP EXTERIOR	top/bottom: 2/2 panels GRP/PUR/GRP: x/x/x mm gelcoat: Harvest Gold	panel sealing: permanent							-none-										**Rehabilitation** (1969-1972)
				•	•											•				Paint with green latex
			paint: yellow							high										**Restoration** (2002)
				•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	Remove green latex Repair and repaint the entire surface Seal the top halves with fiberglass
	GRP INTERIOR	finishing material	color							high										**Restoration** (2004-2015)
				•	•	•					•	•	•	•	•	•		•		
	WINDOWS	PMMA: double-layered double-curved seals: black silicone rubber	windows PMMA skylight PMMA							high										**Rehabilitation** (2007)
				•	•	•			•			•			•	•		•	•	Install new seals Install new PMMA window panes
			zipper gaskets: H-shaped, neoprene							high										**Rehabilitation** (2007)
				•	•	•				•	•	•	•					•		Remove a section (ø=2.5 m) from top Install a skylight
MUNICH-FUTURO - GERMANY	GRP EXTERIOR	top/bottom: 8/8 panels GRP/PUR/GRP: 2.5/40/3.5 mm gelcoat: signal white (RAL 9003)	PUR foam: partial GRP laminate: partial panel sealing: silicone paint: signal white (RAL 9003)							low										**Restoration** (2010-2013)
				•	•										•	•				Paint entire surface, seal joints with silicone
										medium/high										**Restoration** (2016-2017)
				•	•	•		•	•	•	•	•	•	•	•	•				Replace PUR and GRP where necessary Remove coatings down to gelcoat Repair with resin/fiberglass Repaint the entire surface
	GRP INTERIOR	GRP finishing: orange (RAL 2011) or signal white (RAL 9003)	paint: orange (RAL 2011)							medium/low										**Replacement** (2010-2013)
																		•		Plaster and paint (white) entire surface
										medium/high										**Restoration** (2016-2017)
				•	•			•		•	•	•	•	•	•	•	•			Clean the entire surface Remove all added coatings Repair with resin/fiberglass Repaint the visible surfaces
	WINDOWS/SKYLIGHT	PMMA: double-layered double-curved seals: black silicone rubber	windows PMMA skylight PMMA seals							high										**Replacement** (2010-2013)
									•			•			•		•			Install flat PMMA panes
										high										**Restoration/replacement** (2016-2017)
								•	•			•			•					Install new window- and skylight-panes Install new seals

Deterioration data include categories, factors and levels. This information is obtained generally with condition assessment techniques before an intervention is made, so with each timely different intervention new data are obtained regarding deterioration and intervention. The recorded deterioration types in the case studies are grouped into five deterioration categories as described in the *Illustrated glossary on stone deterioration patterns* prepared by ICOMOS-ISCS: crack and deformation, detachment, features induced by material loss, discoloration and deposit, biological colonization.[15] The causes for deterioration are collected as explained in the articles and classified with sub-factors of natural and man-made deterioration factors: atmospheric factors, ageing and "time", no use and/or maintenance, handling and transport, previous interventions, vandalism. The deterioration level is ascribed to a sub-system with the help of the in-text information and pictures from the articles and authors in this journal.

Natural deterioration (atmospheric factors, ageing and "time") is an inevitable phenomenon and common to all buildings and objects in an outdoor environment, and which work particularly effectively against the integrity of GRP shell elements. Directly linked with these factors is the maintenance and inclusion of maintenance planning with periodic cleaning and repairs within conservation management plans to slow down deterioration and prolong the lifetime of plastic buildings. The absence of use or maintenance is, however, a recurrent cause of damage to the Futuros. Handling and transport may lead to cracks and deformation, which was often the case of Futuros with multiple dismantling and re-assembling and changing locations. This weakened connections and overall structural stability. Drill-, pin- and service-holes created weak points in the construction due to material loss and and increased susceptibility to atmospheric factors and biological growth.

Previous interventions also induced deterioration, when the quality of the workmanship was low, or due to wrong material selection and faulty planning in application decisions. Correcting the previous treatments often led to a more invasive intervention due to the more extensive damage triggered by the initial misguided intervention.

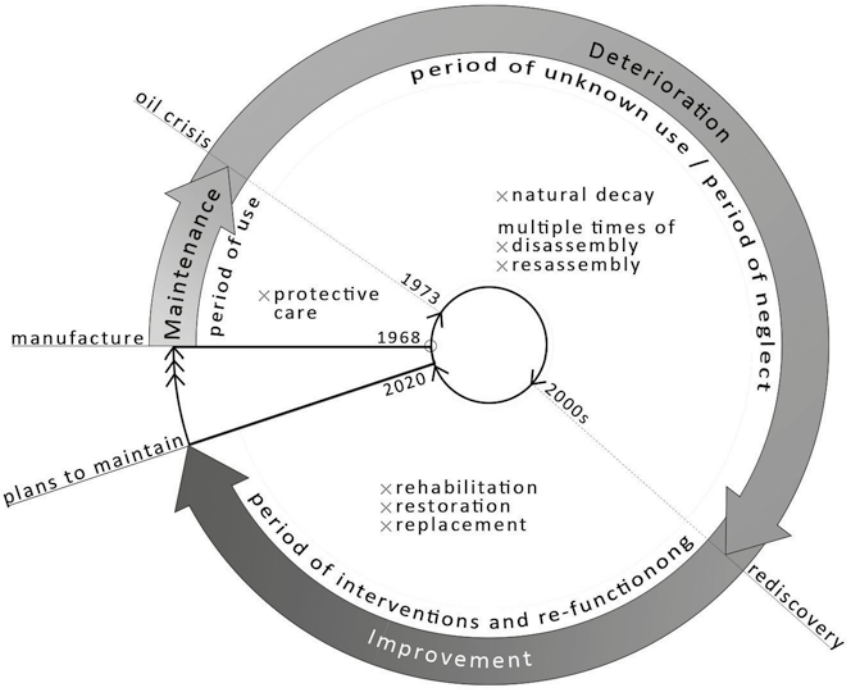
The intervention information is recorded under descriptive outcomes, categories and intentions. Intervention outcome is a step-by-step narrative of the applied procedures. Based on this description together with the prior state of conservation of an element, the category for the intervention is identified: restoration, rehabilitation or replacement. This motivation is classified under one or more of the five main drivers for interventions[16]: historic preservation/heritage conservation, materials decay, safety/security, user comfort, energy conservation.

Despite the high level of deterioration to the exterior of the GRP shell in *Futuro No. 000* the restoration was less invasive than that of the shell's interior. It was not intended to bring back its new and polished look as in 1968, but to re-establish the structural stability of the shell structure as a result of deciding to exhibit and store the Futuro inside. The same strategy was followed for the restoration of windows, no longer exposed to atmospheric factors. The interior location delays the progress of material decay and the Futuro's historical and cultural values were preserved by maintaining the exterior's latest appearance. However, the Futuro was restored to its original state inside, to allow visitors experience its unique atmosphere when they step in.

Unlike the *Futuro No. 000,* the *Corfu-Futuro* is kept outside, so the elimination of the adverse effects of atmospheric factors was of great importance. The restoration in 2008 aimed to repair the exterior surfaces of the Futuro without altering its appearance. Consequently, the old-worn window seals were replaced and a transparent varnish was applied to its exterior shell surface to protect the shell structure and the indoor environment against atmospheric factors. However, only one year later, the interior surfaces developed new moisture-related damage due to condensation. Because both restorations in 2008 and 2009 have caused further damage after 10 years, a conservation management plan for the *Corfu-Futuro* should be developed.

Different from other Futuros, the *Donaldson-Futuro* is used as a living space. Making the construction conform to building legislation and obtaining building permits had caused significant delays and a long intervention period. User comfort and energy conservation have gained importance in the GRP shell's interior restoration and in the rehabilitation of windows together with the addition of a skylight. The *Donaldson-Futuro* is an example of the necessity of regular maintenance. Although it was painted once for protection against environmental factors, the absence of further maintenance and care in the following 30 years resulted in serious damage. To bring it back to a usable condition as a living space to be kept in a suburban area, *Donaldson-Futuro* had to be almost recreated again. The permanent connection of the two halves during the interventions on the exterior precluded disassembly for transportation which turned out to be an advantage for the shell's long-term structural stability.

In contrast to *Futuro No. 000,* the *Munich-Futuro* was restored for exterior exhibition to present its original surfaces and original configuration. Previous interventions to the GRP panels had altered its appearance with the change of color and had led to the reduction of its structural performance. The restoration of the surfaces back to their original appearance and construction had become the only viable



06 The Life-time Change Curve can be transformed into a life-cycle concept through conservation. © Authors

option. Replacement of the old window seals and completion of missing PMMA panes were necessary to create a safe and secure indoor space and prevent leaking.

FROM LIFE-SPAN TO LIFE-CYCLE

Periodical maintenance works and timely repairs are the prerequisites to conserve plastic buildings and to bring them into a life-cycle, i.e. not opting for "replacement", but prolonging their life-span, initially considered to be less than 50 years, but for which research indicates may be up to 100 years [Loader, Robert, "Deterioration, Harm and Conservation of Building Plastics Heritage" Docomomo Journal 66: 2022/1, p. 84-93] [FIGURE 06].

CONCLUSION

The use of plastics in architecture is an innovation belonging to the 20th century. The study of four Futuros has shown that design and construction, use and maintenance of a building belong to different areas of expertise. The applied historical and technical research builds up a holistic approach based on understanding the significance to develop strategies for conservation works and finally a Conservation Management Plan. Due to its technical and historical complexity it is crucial to find experts to build up an interdisciplinary team, and to plan the conservation works keeping in mind the use of the plastic building.

Guidelines to approach the conservation of plastic buildings need to be developed. The Conservation Management Plan should also include a maintenance plan for the future and recommendations for carrying out monitoring and controls.

BIBLIOGRAPHY

AYÓN, Angel, POTTGIESSER, Uta, RICHARDS, Nathaniel, *Reglazing Modernism: Intervention Strategies for 20th-century Icons*, Basel: Birkhäuser, 2019.

AUSTRALIA ICOMOS, *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance 2013*. Burwood, Victoria: Australia ICOMOS. Ret.: 2020 May, 15. https://australia.icomos.org/wp-content/uploads/The-Burra-Charter-2013-Adopted-31.10.2013.pdf

BELL, Dorothy, *The Historic Scotland Guide to International Conservation Charters*, Edinburgh, Historic Scotland, 1997.

BURKE, Sheridan, SOMERVILLE, Jyoti, OSTERGREN, Gail, MATARESE, Laura, MCCOY, Chandler, *Eames House Conservation Management Plan*. Los Angeles: Getty Conservation Institute, 2018. Ret.: 2021 December, 29. https://hdl.handle.net/10020/gci_pubs/eames_cmp.

HISTORIC ENGLAND, *Conservation Principles, Policies and Guidance for the Sustainable Management of the Historic Environment*, Published 23 April 2018.

HISTORIC SCOTLAND, *A Guide to the Preparation of Conservation Plans*, 2000. Ret.: 2020 May, 11. https://www.historicenvironment.scot/media/2786/conservation-plans.pdf

ICOMOS International Scientific Committee on Twentieth-Century Heritage (ISC20C), *Approaches for the Conservation of Twentieth-Century Architectural Heritage, Madrid-New Delhi Document*, 2017. Ret.: 2020 May, 11. http://www.icomos-isc20c.org/pdf/madrid-new-delhi-document-2017.pdf

KERR, J.S., *Conservation Plan: A Guide to the Preparation of Conservation Plans for Places of European Cultural Significance*. 7th ed., Australia ICOMOS, 2013. Ret.: 2020 May, 11. https://australia.icomos.org/wp-content/uploads/The-Conservation-Plan-7th-Edition.pdf

LETELLIER, Robin, SCHMID, Werner, LEBLANC, François, *Recording, Documentation, and Information Management for the Conservation of Heritage Places: Guiding Principles*. Los Angeles, CA: Getty Conservation Institute, 2007. Ret.: 2020 May, 11. http://hdl.handle.net/10020/gci_pubs/recordim

VOIGT, Pamela. *Die Pionierphase des Bauens mit glasfaserverstärktem Kunststoff - 1942 bis 1980*. Dissertation. Bauhaus-Universität, Weimar, 2007.

ENDNOTES

1 ICOMOS ISC20C, 2017

2 Wilp-Futuro (Munich) uses wood to stabilize the plastic shell and the San Diego-Futuro has wood counters and wooden built-ins covered with a plastic laminated top, indicating that the plastic was not trusted.

3 To prepare this article and issue an internal overview of the Futuros was created based on several websites and publications to identify suitable objects and cases to be presented in this comparison: Lola Kleindouwel and Uta Pottgiesser, Internal Research and Documentation, TU Delft, Section Heritage & Architecture, 2019.

4 See VOIGT, 2007. In the appendix of her dissertation Voigt has provided a comprehensive catalogue of plastic prototypes and projects.

5 See BELL, Dorothy, *The Historic Scotland Guide to International Conservation Charters*, Edinburgh, Historic Scotland, 1997, p. 1.

6 See AYON, Angel, POTTGIESSER, Uta, RICHARDS, Nathaniel, *Reglazing Modernism: Intervention Strategies for 20th-century Icons*, Basel: Birkhäuser, 2019, pp. 29-31. In their publication the authors use this categorization based on the definitions of the *US Secretary of the Interior's Standards for the Treatment of Historic Properties* with the accompanying *Guidelines for Preserving, Rehabilitating, Restoring and Reconstructing Historic Buildings*.

7 Today the Burra Charter (AUSTRALIA ICOMOS, 2013) and the Madrid-New Delhi Document (ICOMOS ISC20C, 2017) are frequently used as a source to follow in developing CMP especially for Modern Movement heritage, for instance, Eames House Conservation Management Plan (BURKE et al., 2018). The Burra Charter takes the understanding of cultural significance of a place as basis to decision-making on conservation policies and implementations of the policies. Nevertheless, the courses of action for conservation activities had been mapped out earlier in Technical Advice Note, No 8 (TAN 8) - The Historic Scotland Guide to International Conservation Charters (BELL, 1997) by synthesizing from international Charters of UNESCO, ICOMOS and Council of Europe in the 20th century which can be taken as a compact summary of previous developments in CMP methods.

8 The framework could be used before making an intervention but also during and after an intervention as the Madrid-New Delhi Document 2017 suggests.

9 Therefore, doing historical research is crucial and in a comparative manner can become even more essential as the knowledge of comparable places gains value in interpreting and reconstructing the missing information of a specific place (KERR, 2013, pp. 7-8).

10 See BELL, Dorothy, *The Historic Scotland Guide to International Conservation Charters*, Edinburgh, Historic Scotland, 1997, p. 34. A more recent guide of Historic Scotland lists them explicitly as history and contents of the place, its construction and materials, previous interventions and repairs, earlier and current uses, and any gaps in the knowledge of the place (HISTORIC SCOTLAND, 2000, pp. 5-6).

11 See HISTORIC ENGLAND, *Conservation Principles, Policies and Guidance for the Sustainable Management of the Historic Environment*, 2018. p. 37.

12 Provenance research is a documented history used for works of art which enables transparency in setting the value of an object and shows its authenticity. See Collecting and Provenance Research www.getty.edu.

13 History of ownership is not only relevant to heritage values, but also to the current state of the place. See HISTORIC ENGLAND, *Conservation Principles, Policies and Guidance for the Sustainable Management of the Historic Environment*, 2018. p. 35.

14 LETELLIER, Robin, SCHMID, Werner, LEBLANC, François, *Recording, Documentation, and Information Management for the Conservation of Heritage Places: Guiding Principles*. Los Angeles, CA: Getty Conservation Institute, 2007, pp. 38-39.

15 Veronique Vergès-Belmin (Ed.), *Illustrated glossary on stone deterioration patterns,* ICOMOS-ISCS, September 2008

16 AYÓN, Angel, POTTGIESSER, Uta, RICHARDS, Nathaniel, *Reglazing Modernism: Intervention Strategies for 20th-century Icons*, Basel: Birkhäuser, 2019, pp. 32-33.

Ashal Tyurkay *Stockholm-based architect, part-time lecturer at Marmara University, Turkey. After obtaining her Diploma in Architecture (2014) at Istanbul Technical University (ITU), she became Archiprix Turkey finalist with her graduation project. She earned her MSc degree in Environmental Control and Construction Technologies (2017) with her thesis 'An Analysis Tool for Performance Evaluation in Architectural Details'. As a Research and Teaching Assistant at ITU (2015-2018) and Visiting Researcher at University of Antwerp (2018), she participated in research projects in the field of facade systems design and performance, organization of international conferences and seminars, teaching activities in building technology and consultancy work for companies. She has worked in prominent architecture firms and construction and facade design companies in Turkey, Belgium and Germany where she gained practical experience at architectural design, building construction and project management.*

Uta Pottgiesser *Dr.-Ing. (PhD), licenced architect, studied Architecture at TU Berlin and finished her dissertation at TU Dresden with the title: Multi-layered Glass Constructions. Energy and Construction—both in Germany. She is Professor of Heritage & Technology at TU Delft in the Netherlands and Professor of Building Construction and Materials at Detmold School of Architecture and Interior Architecture (TH OWL), Germany. As a practicing architect and academic she is concerned with the protection, reuse and improvement of the built heritage and environment. She is board member of docomomo Germany and served as chair of the Docomomo International Specialist Committee on Technology (ISC/T) from 2016-2021. Since 2022 she is chair Docomomo International.*