



Delft University of Technology

Conclusions and recommendations from the research Colour, Form and Space. Rietveld Schröder House Challenging the Future

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Publication date
2018

Document Version
Final published version

Citation (APA)
van Thoor, M.-T. (2018). *Conclusions and recommendations from the research Colour, Form and Space. Rietveld Schröder House Challenging the Future*. Delft University of Technology.

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HERITAGE & ARCHITECTURE

 **TU Delft**

 **CENTRAAL
MUSEUM
UTRECHT**

Marie-Thérèse van Thoor

5 November 2018

Keeping it Modern Grant,
The Getty Foundation

Conclusions and recommendations from the research Colour, Form and Space: Rietveld Schröder House challenging the Future.



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At the end of 2015, the project *Colour, Form and Space: Rietveld Schröder House challenging the Future*, a Keeping it Modern Grant from the Getty Foundation, started. The grant was granted to Centraal Museum Utrecht, the manager of the Rietveld Schröder House, who commissioned the research from Delft University of Technology.

The research consisted of two parts: I Historical Research and II Technical Research.

Mrs Truus Schröder lived in the Rietveld Schröder House for more than sixty years; from 1925 onwards she and her three small children first lived there. After the children had left the house, Schröder lived there alone, with a housekeeper, or sometimes with tenants.

From the late 1950s until his death in 1964, Gerrit Rietveld also lived with Truus Schröder in this extraordinary house designed by him. Over time the house underwent some changes and renovations, as well as regular maintenance. Rietveld himself decided how all this should be done. But in the sixties a more radical restoration became necessary. At the same time, the house had attracted increasing attention.

In 1973 the Rietveld Schröder House came into the possession of the Rietveld Schröder House Foundation, and this foundation was also the client of two major restorations carried out by Bertus Mulder (b. 1929). In 1974 Mulder began the restoration of the exterior, followed by a restoration of the interior in 1985/6, after the death of Truus Schröder. Since 1987 the house has been opened as a museum house, managed by the Centraal Museum Utrecht. When this museum became independent in 2013, the Rietveld Schröder House, being a National Monument, was also included as a collection piece in the museum's Collection. But the house is not just one of many national monuments or collection pieces, it is - more importantly - one of only ten UNESCO World Heritage Sites in the Netherlands today.

The approved application for Getty describes the purpose of the research as follows:

'The research will enable a reflection on Mulder's work and the former, pioneer restorations, combining historical documentation and oral history with technical research on the historical fabric and colours of the house. Research on Mrs Schröder and her ideas on modern living will expand the understanding of her role in the design, building and restoration processes, as well as their meaning in international context. Further technical

research on the building physics and construction will enlighten the technical and physical conditions of the house and its actual and expected building performance. In this way *a future sustainable solution for the building can meet an enhancement of the museological value of the museum house*. The Rietveld Schröder House can function as a testing ground, and the experience can be used as example for other objects of modern architecture’.

The role and meaning of Mrs Schröder has been given a slightly different interpretation in the research, as a result of the change of curator within the museum. But the reflection on the previous restorations - with particular attention to oral history, and (unexpectedly) extensive archive research - and the research into the technical ‘performance’ of the building *as a museum residence* have been central. The historical research, supplemented with part of the technical research, will be published online on the TU Delft’s website at the end of February 2019, and will be presented as a paper book at the annual Rietveld Day on 23 June 2019. The results of Part II have been published in report form (see appendices), and as such will be linked to a digital spatial database book of the Rietveld Schröder House, which will also be available online in February 2019: <http://rsh-ruimteboek.centraalmuseum.nl/>

This document contains the conclusions and recommendations of the study and can be read as an addendum to the management plan of the Rietveld Schröder House.

In 2012, the *Rietveld Schröderhuis Management Plan* was drawn up by Land-id on behalf of Werelderfgoed.nl (Arnhem, 17 January 2012). This fulfils the first obligation associated with the conservation of the World Heritage Site and its Outstanding Universal Values (OUV). The management plan aims to demonstrate 'how the conservation of the universal values of the site and its ensemble has been arranged, among other things through management, implementation programmes, monitoring and resources and how the roles of the parties involved are divided' (p. 4). In successive chapters, the plan describes: the definition and characteristics of the site; the conservation objectives and instruments; the spatial delineation of the site; the management (structures, roles, tasks and powers); sustainable use; and finally the resources.

The core chapter of the management plan is chapter 5, in which the site managers responsible - the Municipality of Utrecht/Centraal Museum and the Rietveld Schröder House Foundation - and the Cultural Heritage Agency translated the principles of the plan into strategies, implementation and monitoring thereof, and how their roles, tasks and powers are divided among themselves. In clear tables, specific points of attention of the management are addressed as twelve 'issues'.

Section 5.2.5. *Science and research* recalls the scientific research conducted for and about the Rietveld Schröder House. The research by TU Delft, and the related sub-surveys by TNO Delft and the Foundation Restoration Atelier Limburg (Stichting Restauratie Atelier Limburg / SRAL), are a follow-up to this. We hope, however, that these studies will not only be included in this section, but that they will give rise to a revision of the *Rietveld Schröderhuis Management Plan*, as well as being implemented in the Conservation and Management Plan and the Long-Term Maintenance Plan of the Rietveld Schröder House - and, if necessary, the Centraal Museum's Collection Policy Plan. Above all, we hope that the results and recommendations of the studies will soon find their way into the daily practice of management, monitoring and maintenance of the house.

TU Delft research has no direct relationship with aspects (from the management plan) such as the definition of the site, spatial dynamics, climate change, air pollution, tourist development, security, or communicative or educational tasks of the Centraal Museum.

Therefore, no further attention will be given below to points 1, 2, 3, 4, 5, 7, 8, 9 and 11 of the *Rietveld Schröderhuis Management Plan* (pp 23-27). The issues 6 (supply/numbers of visitors), 10 (corporatisation of Centraal Museum) and 12 (reporting and monitoring), on the other hand, are clearly related to our research, and we will therefore address them. This last point, 12, is particularly important because it relates to the Centraal Museum Collection Policy Plan, the Conservation and Management Plan and the Long-Term Maintenance Plan of the Rietveld Schröder House.

At the start of the research it was known from literature that the restorations of the Rietveld Schröder House by Bertus Mulder - exterior 1970s, interior 1980s - were largely based on reconstructions, which meant that the house had to radiate an image of the early period from the late 1920s. The house was built by Gerrit Rietveld, with an important influence of the commissioner Truus Schröder; but the current house has now also received a considerable 'Bertus Mulder time period' as a result of the extensive restorations. Mulder himself reported on his restorations in the publication *Het Rietveld Schröderhuis* (2009). However, no objective reflections have yet been made on his interventions, or the extent to which the publication from 2009 is complete. The Getty study made this reflection and additions possible. The materialisation of inner and outer walls, in plaster and paintwork, played an important role in Rietveld's design ideas. During the restorations (the problems with) the plasterwork and the choice of the colour palette therefore also turned out to be important points of attention; in hindsight, more than the larger, more constructive interventions, they also gave rise to this reflection.

Extensive archival research was carried out, both in existing archives and in the archives that were gradually made accessible by the research or that were still revealed. Despite Mulder's initial reservations, a good relationship between him and the researchers has been built up in the recent period, and as yet unknown historical and archival sources could be studied, checked or merged, and the researchers could interview Mulder extensively about them. In addition, the digital spatial database - presented in 2015 as an interpretation of the so-called VER funds and as co-financing alongside the Getty Grant - gave an important stimulus to the collection, digitisation and re-interpretation of historical photographs. These photographs have become an indispensable part of both the research on the restoration and the interior of the house, and the research of, for example, the SRAL. Over the past three years Bertus Mulder has gradually come to the conclusion that his choices do not have to be the 'only and real' starting points for the future, at least as far as the ground floor of the house and the museum layout are concerned. Conceptually - and for the approach to the construction or the exterior - he remains very convinced of his own interventions. But Mulder was gradually prepared to dig into his memory once again about certain issues - such as the plaster restorations, for example - and documents suddenly

emerged that were not yet known or had been transferred to (the Bertus Mulder archive in) the Centraal Museum. Although Mulder's 'reconstruction' of his reconstructions provides a consistent picture, additions can be made to the analysis, or by linking various sources - including technical research - new conclusions can be drawn, or new starting points can be formulated for future maintenance and restoration.

3.1 The role of stakeholders

An important aspect should not be overlooked here. We cannot fully assess the restorations from the 70s and 80s according to current standards or starting points. Certainly the restoration of the exterior, the first of its kind, is difficult to compare with another example. This was different for the 1980s, when the views on restoration, building history, colour research and the like had already changed. Nevertheless, it was decided not to show the history of the house and its occupation by Mrs Schröder, but to reconstruct the original image.

Through the restorations much of the building substance and original materiality has been lost. This fits in with the consistent ideas of Mulder, who was supported by the wishes of Mrs Schröder and his client, the Rietveld Schröder House Foundation: it was not the materiality, but the spatial concept of the house that had to be preserved and, if necessary, reconstructed. Moreover, Mulder followed Rietveld's line here, for whom experimentation was very important, and who always tried to renew himself in his work and the technical possibilities.

But it is remarkable that the heritage institutions - and in fact also the client - were so easily involved in these views, and did not have their own material research carried out in the decades after the restorations either. During the restorations and maintenance, everyone was completely confident in Mulder's views. A house like the Rietveld Schröder House requires constant maintenance or repairs, and it is painted regularly. But there are no inspection reports, there is no world heritage monitoring programme (from the RCE and the site keepers), there are no reports for monument permits, or other building archaeological or material research available, other than the restoration reports in the Bertus Mulder archive. The 'Rietveld Schröder House dossier' in the municipal and national heritage archives is extremely thin. The only more substantial document is the nomination file for designation as a UNESCO World Heritage Site (1999), which forms the basis of the current management plan, the *Rietveld Schröderhuis Management Plan* (2012). The relevant passages on restoration, authenticity and maintenance were all written by Bertus Mulder.

In consultation with the paint manufacturer Sikkens, Mulder also had the formulation of paints recorded, but only from the early 1990s. Before the restorations by Mulder, and until his death in 1964, Rietveld himself determined the colours for each paint job, and he actively involved the painter with whom he was working at the time. Sikkens always supplied and renewed the paints and recipes. Sikkens has no archive on the Rietveld Schröder House from Rietveld's time; and no report has been made on the precise composition of paint during the restorations. Until recently, the Sikkens reports (from 1992) were available at Mulder's home, the very last recipe was in the drawer of a Sikkens employee. The 'Report on the state of affairs regarding the repair of the plasterwork of the Rietveld Schröder House' (Mulder 1980) did provide some brief information on the composition of the plaster. However, neither the Rietveld Schröder House Foundation nor the Centraal Museum have kept records of this kind of specific information about maintenance and materials themselves. The museum is currently making every effort to ensure that its archives and documentation are fully up to date and complete (and then accessible).

Maintenance plans for the Rietveld Schröder House have been drawn up since the early 2000s by Mulder and his successor Harriën van Dijk, who was appointed by him; but these plans do not contain any information about the composition of plaster or paints. With every paint job, the available Sikkens paint cans are removed from the basement and, if necessary, reordered from Sikkens. Even in April 2018 the house was painted in this way, interior and exterior. On the advice of TU Delft, the study and three walls of the former studio, on the ground floor of the house, were spared and not included in this painting.¹ The painting work, which is periodically applied according to the *Meerjaren Onderhoudsplan Rietveld Schröderhuis* (Long-term Maintenance Plan for Rietveld Schröder House), is painted layer on top of layer, with changes in colour already being made after the restorations of the 70s and 80s. Necessary repairs to the plaster are carried out on site by Van Dijk and the maintenance department of the Centraal Museum.

Repairs have only recently been reported, but very briefly.² The choices are individual choices, following Mulder's example, who worked as his teacher Rietveld during the entire restoration and later maintenance process: gradually, at work and according to his own insight.

¹ During the painting in April 2018, the colour codings were recorded and a short report of maintenance work was made: 'Logboek onderhoudswerkzaamheden Rietveld Schröder huis, tweede kwartaal 2018', without name, without date, attachment mail to N. Dubois dated 22 July 2018.

² 'Logboek onderhoudswerkzaamheden Rietveld Schröder huis, derde kwartaal 2018', without name, without date, attachment mail 30 October 2018.

3.2 The interior of the museum house

The historical research on the museum layout and furnishing of the house shows that Mulder also played a major role in this. Except according to the principle 'back to the end of the 1920s', it appears that no clear-cut plan was made for the interior design and furnishing of the museum house in 1986/7. In the research information about the interior is taken from the conversations with Mulder, supplemented with information from the recently inventoried archive of the Rietveld Schröder House Foundation. Rietveld had photos taken when the house had just been completed and furnished (1925/26). These photographs served as a starting point for the interior, but Mulder also made many choices on the spot or as it came out. A careful study of the first photographs, of later photographs and of the current situation now results in an image of a furnishing concept that is certainly not consistently implemented everywhere. In connection with the results of the technical research, it is possible that new choices can be made for the interior of the museum house in the future.

3.3 An incomplete reconstruction

Based on the information from archives, photographs and conversations with Bertus Mulder, we can now conclude, contrary to what was initially assumed, that the reconstruction of the outer shell and the interior finishing of the house probably was not complete. The documentation seemed to indicate that in 1979 Mulder had - after recurring problems - removed the original plaster layer(s) from the exterior of the house, applied a new layer and had it painted in a colour palette that he had devised himself. The same seemed to have happened in 1985/6 when Mulder, after the death of Mrs Schröder, restored the interior of the house.

In the course of our research we came to other insights and it appeared that Mulder this reconstruction in the interior only and especially on the upper floor has carried out. On the ground floor, the reconstruction was planned, but eventually only partially carried out; in a number of places, the restoration architect limited himself to repairs. There is good reason to assume that only repairs have been carried out, particularly in Rietveld's study and former studio, and that original plasterwork and finishing coats from the Rietveld period are still present in those rooms.

We can now also assume that certain wall parts of the exterior still contain the original rendering with finishing coats. Mulder's memories are not entirely clear in this respect, but probably - at least - the plaster of the parapets under the windows of the studio (south side) and the kitchen (east side) were only repaired and attached during the restoration, but not replaced. With these two wall sections, Mulder's statements correspond to the information we can now read from the historical photographs.

TNO and SRAL have therefore been commissioned to carry out limited research into the composition of the plasterwork and the finishing coats at a number of locations in the house (see Technical research).

4.1 Climate and humidity research

The Rietveld Schröder House is not only an example of World Heritage, it is also a museum house - and even a collection piece - in which several groups of visitors are shown around every day. Although the house has lost much of its original furnishings as a result of extensive restoration work, it still contains the original construction, original parts and valuable furniture. The Rietveld Schröder House is also a vulnerable house, which is why research has been carried out into the indoor climate, humidity (RH) and temperature (T) with a view to its museum future. The results of the research into the indoor climate can be used to identify possible risks to building materials and furniture and to propose necessary measures.

The conclusions from the Report - Interior Climate RSH (Lubelli & Van Hees 2018; see appendix 1) are as follows:

'After monitoring the RSH for one year and in combinations with the inspections that were carried out, the following conclusions can be drawn on the interior climate in the Rietveld-Schröder House:

- *The current interior climate is mainly governed by the variations in the exterior climate; this is most evident on the 1st floor.*
- *The effect of the visitors on the interior climate is negligible. This is most probably due to the small number of visitors (10-12 persons) at each tour of the building and to the high ventilation frequency, due to the fact that the building structure is quite open.*
- *During the heating season, periods with too high temperatures and too low RH values were recorded, mainly due to malfunction of the heating system; this problem has been solved, but care has to be taken of a quicker response in future. During the summer season, very high RH values are recorded.*
- *The indoor climate of the building falls (for 88% and 98% of the time, on the first and ground floor respectively) within the ASHRAE "class of control possible" C, which can be considered the class of control possible for this building (uninsulated masonry, single glazed window). According to ASHRAE risks of mechanical damage are only expected for high vulnerability artefacts, paintings, photographs, some artefacts and books (see table 2).*
- *The risk of mechanical damage and biological growth to the furniture, assessed on the basis of the web-tool available at <http://www.monumenten.bwk.tue.nl/>, is low.*

Based on the results of the measuring campaign, the following suggestions for the conservation plan are given:

- *Avoid as much as possible high T in the heating period. A maximum T of 18°C is suggested. Monitor the T and RH and use an alarm system to promptly intervene in case of malfunctioning of the heating system.*
- *In order to reduce the level of RH in the summer, air dehumidification should be considered. Ventilation will not be sufficient, as the absolute outdoor humidity during summer is high.*
- *There is no reason, when considering the interior climate under the current heating and ventilation regime, to reduce the number of visitors.*
- *No immediate risks of biological growth or mechanical damage have been assessed. The option of replacing the original pieces of furniture with copies, might still be considered if the lifetime needs to be optimized with respect to other risks (e.g. mechanical damage due to visitors).*
- *However, as several severe thermal bridges are present in the construction, the risk of mould growth on the construction is a risk that might become evident when interventions would be performed that could change the indoor climate class (from class II to class III), like sealing of windows without simultaneously introducing RH control.'*

Recommendations

TU Delft recommends that the above conclusions be adopted and implemented in systems of monitoring, management and maintenance: *issue 12*. Since monitoring, management and maintenance are also related to the organizational structure of the Centraal Museum, or may have consequences for the division of tasks and responsibilities between all site holders, and the RCE, this has also followed for *issue 10* of the management plan. More concretely, the conclusions can be translated into the recommendations below.

In the longer term, the Rietveld Schröder House will have to be restored again. Until then, repairs and monitoring of damage and repairs will remain necessary. Special attention should be paid to leakages:

- leaks; the house should be checked regularly for leaks (e.g. in the roof structure, above the toilet, the radiators).
- T should remain at 18 gr day and night; the monitoring and signalling system is important, protocol and responsibilities should be established.
- T should be measured every 15 minutes with wireless sensors that can be read remotely. Outside temperatures can be requested from the KNMI in De Bilt (is close by, so comparable).

- RH should be measured every 15 minutes, using wireless sensors (in places without direct sunlight) that can be read remotely. A control and signal system must also be developed for this, with protocol and responsibilities.
- Ventilation is very important. Current frequency and system of opening and closing windows and sliding walls is fine. This also promotes air circulation. Windows on the ground floor do not need to be opened extra. Installing fans at very high temperatures is always a good idea.
- The darkening of the windows by roller blinds and shutters must be maintained, all year round, at a fixed frequency. It is best to close everything in the evening, and on warm days without visitors close all day long. The protocol for this should be included in the management plan of the house.
- Testing or dehumidification on the ground floor could be carried out, preferably in the autumn, using a non-electric system that is in permanent use (24h).
- Replacing original furniture with replicas is not necessary from an indoor climate point of view, but it would optimise the service life. In the case of the loan of furniture, the museum also applies strict climate requirements.³
- The moisture content of the beams should be checked during major repairs or renovations, or with a view to the next restoration.
- It is urgently recommended to start with a digital, and professional logbook at short notice, in which all technical information and data about the house are brought together (T, RH, maintenance, management, but also visitor numbers, damage, repairs etc). The responsibilities for the management and maintenance of the house are currently divided over various parts and persons inside and outside the Centraal Museum, so that the overview is lacking, data is difficult to retrieve and verify, and in many respects these are and remain incomplete. During the Getty research, such a logbook, which is part of the professional monitoring of World Heritage, was sorely missed.
- It is advisable to have the Rietveld Schröder House regularly checked for damage and maintenance by an external party that is not involved in maintenance or management. This could be the Monumentenwacht.

³ The temperature in the exhibition room must remain between 18-25°C, with a maximum fluctuation of 3°C per 24-hour period; the relative humidity must remain between 50-55%, with a maximum fluctuation of 3% per 24-hour period; the lighting may not exceed 150 Lux for paintings and 50 Lux for works on paper and textile, and the UV content may not exceed 75 microwatt per Lumen.

4.2 Construction research

At the request of the Centraal Museum Utrecht, a number of specific parts of the construction of the Rietveld Schröder House were investigated by TU Delft. The central question was whether the supporting structure is/will be able to withstand the changed use without damage now and in the future, and whether the safety of visitors and users is guaranteed. The conclusions and recommendations from the report *Rietveld Schröderhuis, Utrecht. Constructieve analyse* (Pasterkamp 2018; see appendix 2):

'No structural defects are visible during the visual inspection. The Rietveld Schröderhuis is in good condition.

There is no question of subsidence.

The condition of the concrete foundation is unknown. It is recommended to dig an inspection well next to the east facade. The aim is to gain insight into the quality of the stony parts of the foundation below ground level: the masonry work, the foundation beams and the concrete pillar. A particular point of attention here is possible weapon corrosion.

The cellar probably consists of masonry, but based on the archive research there is a small chance that it consists of concrete (Brown 1958). A simple visual inspection can probably provide a decisive answer.

The wooden joists of the ground floor and the first floor can be used for a museum function if the load remains up to 3.00 kN/m². This is already under normal use no practical objections.

The reinforcement of the concrete of the balconies is undetermined, but will probably be insufficient for a load that exceeds the use as a balcony of a house. The balustrades of the balconies are certainly not strong enough.

The balconies should be closed to visitors.

The wooden and steel beams of the roof have arithmetically sufficient strength to absorb the snow load prescribed in the Eurocode with sufficient safety. The roof does not have enough slope. The roof has not been damaged by wind or snow since it was built. However, there is regular leakage. It is important that the roof and rainwater drainage are regularly inspected and maintained.'

Recommendations

The above conclusions relate to the longer term and the short term. TU Delft recommends that they all be implemented in the system of maintenance and management, and that long-term recommendations be implemented as soon as major maintenance is involved or during the next restoration.

For the long term this means:

- inspection of the building and cellar.

For the short term can be stated:

- the building is 'at rest', the balance has been restored, there are no visible structural problems
- the floor load can handle the current use; the tours are not problematic, provided the load does not exceed 3.00 kN/m² (no more than 3 people per m² over the entire surface): *issue 6*.

The most critical parts of the house are the kitchen and the floor above it (at the table in the corner).

- The balconies are a risk for use by visitors, both in terms of load and because of the insufficiently strong balustrades. They should be immediately closed to visitors.
- The roof and rainwater drains must be checked and maintained regularly to prevent leakages.

4.3 The plaster research (TNO)

In October 2016, a piece of plaster from the top of the south wall of the study on the ground floor of the Rietveld Schröder House partially came loose. TU Delft carried out research into the causes for the release of the plasterwork and, in collaboration with TNO, the composition and properties of the plaster were investigated. The results are presented in *Petrografisch onderzoek pleisterwerk Rietveld-Schröderhuis Utrecht* (Nijland 2017; see appendix 3) and *Onderzoek naar het pleisterwerk van het Rietveld Schröder Huis* (Lubelli & Van Hees 2017; see appendix 4).

Since the historical research gave reason to assume that there are still plasterwork and finishing coats from the Rietveld period both on the exterior and interior of the Rietveld Schröder House, TNO conducted a limited follow-up study in 2018 into the composition of the plaster.

The conclusions from this report, *Petrographic investigation of plasters & renders from the Rietveld-Schröderhuis*, Utrecht (Nijland 2018; see appendix 5), are as follows:

'Samples RSH 18/1 [studeerkamer begane grond] and 18/3 [kamer meisjes 1e verdieping] possibly represent the same stratigraphy with a coating covering an outer finishing plaster and an inner plaster made up by two layers. The outer finishing plaster based on lime and gypsum present in sample RSH 18/3 is not present in the thin section of sample RSH 18/1, but macroscopically visible (Fig. 3). Additional SEM investigations (§ 5) show the presence of lime and gypsum here. The hydraulic lime based inner mortar is present in both samples. If RSH 18/1 and 18/3 are the same indeed, this would imply that RSH 18/1 is not an original plaster, but, likewise

RSH 18/3, a renovation plaster. This is unexpected, as the sample investigated in 2017 (Nijland 2017) came from the same wall as RSH 18/1. In this sample, a lime-gypsum based mortar is also present. However, the stratigraphy in the 2017 sample is much more complex than current RSH 18/1 (RSH 18/3): it contains more finishing layers (one lime based one on top of the lime-gypsum mortar and two below), whereas the base (inner) mortar is made up by two layers. Taking the lime-gypsum mortar as starting point, differences between current RSH 18/1, RSH 18/3 and the 2017 sample are illustrated [in figure p.19 report TNO]

Both outside renders (samples RSH 18/4 and 18/5) have compositions different from the indoor plasters in terms of binders, the former being a cement-lime mixture, the latter a very belite rich hydraulic lime (or perhaps an early Portland cement).'

In 2017 TNO concluded the following about the plaster that had come loose in the study room:

The interior plaster of the Rietveld-Schröderhuis in Utrecht is from the wall surface made up of two lime-bound mortar layers and four lime-bound finishing coats, with two coatings on top. The composition does not correspond to that expected by TU Delft. It is possible that the sample is a remnant of the original plaster.'

Bertus Mulder's 'Report on the state of affairs regarding the repair of the plasterwork of the Rietveld Schröder House' (1980) contains an appendix from the company STS (7 May 1979) in which the following was advised about the new stucco:

Wet masonry work. Cracks in the masonry that have been sealed with plastic mortar must be pre-treated with a cement paste. Approximately 15-30 minutes later apply a plaster mortar on the walls, including cracks.

Composition:

8 volume parts sand

1 volume part lime

1 volume part Portland cement

Next day apply a thin cement sanding layer and very fine sanding. Composition. 3 volume parts silver sand:

3 volume parts silver sand

1 volume part lime

Add 1 litre Portland cement to 10 litres of abrasive mortar and $\frac{1}{4}$ [?] litre of subdued plastic dispersion, e.g.

Plextol, Murafan od.

Although this sanding specials layer is suitable for every type of paint, we recommend using a breathable mineral paint'.

The publication *Het Rietveld Schröderhuis* (2009) contains 'Cutlery and conditions of the house' (by A. de Koff, 9 July 2014), in which the following is included about the composition of plaster:

Strong Portland mortar: 1 Portland 3 sand 1 lime milk

Basterdportlsand specie: ½ portland 4 sand 1 lime milk

Slack portland mortar: ½ portland 5 sand 1 lime milk'.

Recommendations

The piece of stucco that came loose in October 2016 is probably the oldest layer with the oldest, possibly original composition. It does not contain cement, and it is not recommended to repair the clearing with cement or very dense or water-repellent treated plaster.

- A plaster with a composition used on the bottom of the same wall may very well be used for the repair. The plaster used on the first floor has the same composition (RSH 18/1 and RSH 18/3). Also there, and elsewhere in the interior (such as in the workshop) can best be repaired with this plaster.

However, the ratio of hydraulic lime to sand mortars could possibly be determined even more precisely by TNO. A usual ratio of 1:3 (lime: sand) - with a layer of lime gypsum sand on top and then the coating - could also be the the starting point, in consultation with a plasterer from a certified company that works according to ERM guidelines (such as Van de Kant, the company that was also involved in the restoration in the 1980s). If necessary, the plasterers can also determine a more precise composition.

The repair in the study room can be done in two ways:

Either the plaster is removed from the wall and replaced; or only the loose parts are replaced; or the loose parts are 'glued' again with a grout, followed by a turnip layer and a thin finishing layer.

- The exterior plaster can best be put together during repair or restoration according to the formula of the repair plaster used for the balcony (RSH 18/4): a cement-lime-sand plaster in which a so-called air bubble former is used.

4.4 Limited colour-historical research by the SRAL

At the same time as TNO's research into the composition of the plasterwork, SRAL investigated the finishing coats of the rooms and wall sections where we still expected (more) original layers based on the historical research in 2018. The results of the historical research have been made available for this purpose. The report of the SRAL then again gave rise to the search for missing data and to complete our research. The results of the SRAL study have been incorporated in the *Beperkt kleurhistorisch onderzoek Rietveld-Schröderhuis* (Friedrichs, Junge & Van der Woude 2018; see appendix 6 A/B). The results are summarised:

On the ground floor there are remnants of the original paint layers from 1925 found. These are matt finishes with a clearly visible brushstroke in which mainly calcium is present (analysis with SEM/EDX). The grey layers contain not only black but also ochre; this has already been established by Bertus Mulder. In the course of the study of the cross-sections of the paint under the microscope, the layers are semi-transparent because the sanded surface is saturated with a slowly evaporating solvent; the refractive index of the lime is close to the refractive index of the liquid, so that the layer becomes translucent. This property indicates an aqueous binder - most probably lime, but glue may also be present as a binder (no binder analysis was performed).

The second finish found in various paint cross-sections dates from before restoration by Mulder (1987). Further interpretation of these layers within the time frame was of the present investigation is not yet possible. After all, it is possible that these layers may also have been removed from the date the construction time and are early adjustments of Rietveld.

Since 1987 the interior has been repainted three times with synthetic wall paint. When the last two paintings took place is not yet clear. In several places it was possible to found that the current shades differ from both the original shade and the shade used by Mulder in 1987 with great care was chosen. Probes at a lavender colored (ceiling hall) and yellow finish (space next to kitchen) also makes it clear that these colors in 1925 considerably more sparkled. The texture of the current paint layers differs from the original ones: the surface looks bumpy but smooth due to the roller with which it is applied while the original layers have a distinctly streaky and matt texture.

A limited inspection of the finishes on a number of wooden components in the interior shows the same picture: the oldest paint layers have more intense colours, a ribbed texture through the brush and are matte.

During the examination of the exterior it became clear that in several places it is very likely that remains of the coloured plaster layers - which are also described in the Specifications (1924) - have been found: it concerns two shades of grey. The visual properties of the layers and their chemical composition seem to point in this direction.³ In the small narrow window opening in the vertical wall next to the front door, white lime layers have been found in a sample that are described in the cutlery. It is not yet clear whether the layers that are present date

from before or after the restoration of Bertus Mulder that took place in 1974 and 1987.

The finishes that have been applied since the restorations of Mulder have not been mapped. However, it is worthwhile to pay attention to this in the future to get a better grip on the whole. We see that the shades have subtly changed since the Mulder phase. But how they looked exactly in 1974 and 1987 and with which type of paint they were made is not entirely clear. After all, Mulder has chosen them with care and a lot of research and test surfaces; this knowledge should not be lost! There is also talk about colour samples that are still in possession of Mulder; it goes without saying that these too play an important role in this story.

The results of the historical and the colour-historical research do not currently lead to specific recommendations in the handling and choices for certain colours and paints. There is too little documentation and reference material available about and at the entire house. There are important considerations and recommendations to give.

- Based on the historical and colour-historical research, it is not possible to draw up a recommendation for the entire house with regard to 'original' or 'more original' colours, because too much reference material is missing. The results of the colour-historical research support the assumption that the Mulder phase has destroyed too much for this.
- On the basis of both investigations, it can reasonably be assumed that the study and the studio on the ground floor of the Rietveld Schröder House still contain original(er) layers. Possibly this original(er) materiality could be taken as a starting point for future repairs or for a future restoration of these spaces. This would require much more extensive colour-historical research to collect reference material from all the walls of these spaces.

If this principle were to be used in the future repair or restoration of these two rooms, the references for them can only be found in these rooms - possibly related to limited remains on the exterior - because the reference material elsewhere in the house has been lost. In that case, this different approach to these spaces would also be separated from the 'balanced colour composition' desired by Mulder and his client at the time.

- The layers that Mulder has applied since the end of the 1970s, both to the exterior and the interior, can be regarded as historical layers, which have become part of the history of the house. Where there are obvious interventions by Mulder, it could be decided to take that situation as the starting point for repairs and restorations - in accordance with the above advice for the composition of the stucco (see point C). However, the historical and colour-historical research also shows that in the period Mulder, from the first major restorations in the 70s and 80s, there have also been various changes in the composition of paint and colours. In that case it is important to

determine exactly which layer or layers Mulder will be used as a starting point.

- Even if one chooses to use one of the layers of Mulder as a starting point, one could still look for a way of painting that [does] more justice to the (more) original image from the periods Rietveld [than Mulder already aspired to], i.e. for a more spotty, less shiny, and more artisanal appearance. Another type of paint may also be required.

As indicated in the introduction, this document contains conclusions and recommendations that can be read as an addendum to or a revision of the *Rietveld Schröderhuis Management Plan* (2012). In addition, it is strongly recommended that a number of necessary - more technical and practical - measures be included immediately, in the short term, in the practice of monitoring, management and maintenance of the house.

The latter advice is of a more general nature. This study has revealed a lot of new and old information about the house. As shown above, this information comes from different sources, from different people, from monitoring and inspection, and several archives have been updated for this purpose. In addition, a digital spatial database has been created. We recommend that all available information about the Rietveld Schröder House be brought together in one place, in one system, and linked to the digital spatial database as a first step for the future challenge of this World Heritage Site.

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5 November 2018



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